JHARKHAND UNIVERSITY OF TECHNOLOGY

(Established by State Act No. ……. of 2017)
Ranchi, Jharkhand, India

ACADEMIC REGULATIONS FOR B.TECH.

<u>REGULAR STUDENTS</u>

With effect from

ACADEMIC YEAR 2018-19

Contents

1. INTRODUCTION

The provisions contained in these regulations govern the conditions for imparting courses of instruction, conducting examinations and evaluation of students' performance leading to the Degree of Bachelor of Technology (B. Tech.). These are applicable to the new batches with approval of the JHARKHAND UNIVERSITY OF TECHNOLOGY from time to time.

1.1. Disciplines: The disciplines in which the courses of study are available and Degrees will be offered are:

1. Civil Engineering (CE)
2. Electrical Engineering (EE)
3. Mechanical Engineering (ME)
4. Electronics and Communication Engineering (ECE)
5. Electrical and Electronics Engineering (EEE)
6. Computer Science and Engineering (CSE)
7. Information Technology (IT)
8. Metallurgical Engineering
9. Production Engineering
10. Chemical Engineering
11. Mining Engineering
12. App. Electr. & Instr. Engg.

New disciplines may be added in future with approval of Jharkhand University of Technology, Ranchi and the Department of Higher, Technical Education & Skill Development, Government of Jharkhand.

1.2. The provisions of these regulations shall also be applicable to any new disciplines that will be introduced from time to time and added to the list in Section 1.1.

1.3. Any regulation, as and when required, may be changed on the recommendation of the Academic council of the University.

2. ACADEMIC CALENDAR

2.1. The academic session is divided into two semesters each of approximately 90 days duration: having a Monsoon semester and a Spring Semester.

2.2. The Jharkhand University of Technology, Ranchi will approve the academic calendar consisting of schedule of activities for a session inclusive of dates for registration, Mid-Semester and End-Semester Examinations; inter-semester breaks. It will be announced at the beginning of the semester. The academic calendar shall usually provide for at least 90 working days (including examination dates) in each semester, excluding holidays and days when classes are suspended.

2.3. All subjects/ courses are to be registered by the student in a semester to earn credits which shall be assigned to each subject/ course in an L: T: P: C (lecture periods: tutorial periods: practical periods: credits) structure based on the following general pattern.

- One credit for one hour/ week/ semester for theory/ lecture (L) courses.

- One credit for one hour/ week/ semester for theory/ Tutorial (T) courses.
- One credit for two hours/ week/ semester for laboratory/ practical (P) courses

Courses like Environmental Science, Professional Ethics, Gender Sensitization lab and other student activities like NCC/NSO and NSS are identified as mandatory non -credit courses.

3. ADMISSION

3.1. Admission to all courses will be made in the Monsoon Semester of each session at the First Year 1st semester/ Second year 3rd semester (lateral entry) level through the entrance examination conducted by JCECEB. However, private Engineering Colleges will follow the AICTE/Government policy for the admission. Basic qualification for entry in both levels will be as per AICTE norms.

3.1. i. Basic qualification for admission to all B. Tech. Courses in First year –

I. Sc. /10+ 2 or equivalent exam passed with Physics, Mathematics as compulsory subjects along with Chemistry and he/she has minimum of 45% marks (40% for reserved category) in above subjects taken together. Norms of AICTE will always be applicable.

ii. Basic Qualification for admission to all B. Tech. Courses in second year through lateral entry-

(a) Three years diploma course passed with 40% marks (reserved category) and 45% marks (general category). Norms of AICTE will always be applicable.

(b) Passed B.Sc. with Math. Norms of AICTE will always be applicable.

3.2. There is no provision of Inter-College transfer of students.

3.3. The Institute reserves the right to cancel the admission of any student at any stage of his career on grounds of unsatisfactory academic performance, irregular attendance in classes or indiscipline (Annexure I).

3.4. At the time of admission, the student is required to provide the following documents:
(a) A certificate for proof of age (Birth certificate or Board certificate).
(b) Pass certificate of the qualifying examination.
(c) College/ School leaving certificate.[CLC/SLC]
(d) Migration certificate (If applicable)
(e) 02 recent passport size colour photographs.
(f) Allotment letter of seat from JCECEB, Board, Ranchi
(g) Other relevant category certificate, if any.

3.5. The student is also required to fill up prescribed forms for semester registration in the Jharkhand University of Technology, Ranchi.

3.6. A provisional admission may be permitted if any of the certificates is not produced, except CLC/SLC and the rest has to be submitted on any other date to be fixed by institute.

4. **ATTENDANCE**

4.1. Every student is required to attend all the lectures, tutorials, practical/ sessional & other prescribed curricular & co-curricular activities. A student having at least 75% attendance (excluding attendance in mandatory non-credit courses Environmental Science, Professional Ethics, Gender Sensitization Lab, NCC/NSO and NSS for that semester) will be allowed to appear in end semester examination.

4.2. The attendance shall be counted from the date of admission in the college or start of academic session, whichever is later.

4.3. Attendance sheet will be provided to each and every Teacher for maintaining the monthly attendance of the students and same will be documented in centralized manner by the Academic office of the respective Institute. The Principal of the concerned Engineering Institute will look after the whole process. Failing which admission will be cancelled and all fees deposited will be forfeited.

The credit for the attendance will be calculated as follows:

$$\%\ \text{attendance} = \frac{\text{Number of classes attended in a course}}{\text{Total number of classes taken in that course}} \times 100$$

and the weightage of attendance would be as:

Attendance %	75 – 79 %	80 – 85 %	86 – 90 %	91 – 95 %	96-100%
Weightage	01	02	03	04	05

5. COURSE STRUCTURE

5.1. The curricula for the different degree programmes as proposed by the respective departments and recommended by the Under-graduate Programme and Evaluation Committee (UGPEC) shall have the approval of the Academic Council of JUT. The departments will also prepare the syllabus of each subject containing the scope of studies and instructions to be imparted which must have the approval of the JUT.

5.2.

i. All subjects will have Lecture- Tutorial-Laboratory/ Design components (L-T-P) to indicate the contact hours. Theory courses will have 3-0-0 (3 credits) or 3-1-0 (4 credits) structure. Design or laboratory courses will be offered as distinct (0-0-P) courses without being mixed with lecture components.

ii. Normally, subjects based on engineering or scientific principles or on thought-provoking information, where it is possible to conduct a closed book examination, will be taught as theory courses, whereas those based on applications and practice (conceptual, computational or experimental) will be covered under Design or Practical Courses/ Sessional Courses.

iii. All subjects will have credit count. Teaching will be reckoned in terms of credits.

5.3. The prescribed coursework shall be grouped under heads –Humanities courses, Basic Science courses, Professional core courses, Elective courses & Mandatory courses.

5.4. The curricula to be followed in the first two semesters by the students of all disciplines.

5.5. The curricula for B. Tech. course will include a programme of "Short term Industrial or Research Experience (SIRE)" of 08 weeks duration after the 6^{th} semester. The experience may be obtained in any reputed industry, research organization, and any other organization of comparable repute. The place of work has to get prior approval of the Department/Training & Placement. On completion of the programme, the student shall submit a report to the department, which will earn 2 credits after evaluation and viva-voce examination in the 7th semester. Detailed procedure for administration of SIRE is given in Annexure-II.

5.6. In addition to regular course work, a B. Tech. student must carry out a major project in final year under the guidance of one or two supervisors. The project work (Annexure-III) will carry a total of 12 credits between 7th and 8^{th} Semesters, the distribution being 4 and 8 credits respectively.

5.7. Every programme shall provide a "Seminar and Technical Writing" course during the 8th semesters where the students shall learn and practice The Training and Placement cell of the respective College will coordinate with the reputed organization/industry for Short term Industrial training of the students. Each student will also do 1 or 2 seminars and/or poster presentations before the class. Evaluation will be based on attendance in departmental and Institute seminars, presentation in seminars, poster presentations and technical writing supervised by the course teacher.

6. REGISTRATION

6.1. Every student in undergraduate programme is required to be present and register for each semester on the date fixed and notified in the Academic Calendar.

The registration process will have 3 components:
(a) Physical presence of the student on the campus on the first day of semester,
(b) Payment of semester fees including any unpaid dues of past semesters and
(c) Selection of courses/subjects papers to be studied during the semester.

6.2. Registration of students in each semester will be organized by the Academic Section. The subject details will be verified by the faculty members of respective Institute. Payment of dues will be verified by the Academic Section and Account Section. An appropriate semester registration form will be used for the purpose.

6.3. A student who does not register on the day announced for the purpose may be permitted by Principals, in consideration of any compelling reason, late registration within next 5 working days on payment of an additional fee as prescribed by the Institute. Normally no late registration shall be permitted after the fifth working day from the scheduled date, except in special cases, a serious medical problem, a family calamity, etc. to be approved by the Principals. However, under no circumstances late registration after 15 calendar days from the scheduled date of registration is allowed.

6.4. Only those students will be permitted to register who have
(i) Cleared all Institute and Hostel dues of the previous semesters,
(ii) Paid all required prescribed fees for the current semester,
(iii) Not been debarred from registering for a specified period on disciplinary or any other ground
(iv) Satisfied the academic requirements and not been struck off from the rolls of the Institute.

6.5. To be able to register in the semester a student must
(i) Secure 'P' [Pass grade point].
(ii)To pass a subject a student must obtain minimum 21 marks (30%) out of 70 in End Semester Examination and a total of 35% marks with addition of internal marks.
(iii) Pass marks in practical examinations and projects - 50% of the total marks.
(iv) Obtain a Cumulative Grade Point Average (CGPA) of not lower than 5 (considering all courses including those in which the student has secured an F (Fail) grade. The method for calculating SGPA and CGPA is illustrated in Clause 9. If the CGPA at the end of the 2nd semester class is less than 5, the student will not be allowed to register in 3rd semester and resume it in the following year along with the next batch of students. In the repeat year, he must attend classes and be treated at par with fresh students. The B. Tech. programme must be completed within 7 years (i.e. 14 semesters) while for students admitted through lateral entry it is 5 years (i.e. 10 semesters).
(v) A candidate may be awarded grace marks upto a maximum of total 10 marks, in maximum four subjects **but not more than three marks in any subject** including theory papers, practicals, project, seminar, industrial training and/ or aggregate marks in each academic year provided he/she can be declared to have passed the academic year by the award of these marks. The grace marks shall not be added to the aggregate marks.

6.6. While registering for 3rd, 5th or 7th semester, a student may register for backlog papers of 1st, 3rd or 5th semester respectively and while registering for 4th, 6th, or 8th semester, he/she may register for backlog papers of 2nd, 4th or 6th semester respectively. A student need not attend classes in papers registered as "backlog papers". He has to sit for end-semester examinations only and the grade will be awarded based on the scores of the latest examinations and previous mid semester Examination. The registration for backlog papers must be done at the time of semester registration. In all such cases of "backlog paper", the grade awarded will be one step lower than what the student actually obtained, provided CGPA should not be less than 5 except for the grade 'P' which remains unchanged. If a student has completed 8 semesters of study but has a few F grades in 7th semester he/she must clear backlog papers of 7th semester within maximum stipulated time to complete the course.

6.7. For registration in 4th, 5th, 6th, 7th and 8th semester, a student must obtain CGPA not less than 5 in 3rd, 4th, 5th, 6th and 7th semester respectively.

6.8. The classes of all semesters will start from the day following the registration, or any other date decided by the Principals.

6.9. A student who has been debarred from appearing at an examination either

(i) As a measure of disciplinary action or

(ii) For adopting malpractice at an examination, may register for the subject (s) as backlog papers in the following semester. Those who have been awarded grade X ("debarred") because of poor attendance or for any other reason need to register for the course and attend classes as per rules. (Expect for 1st semester as per 6.3). Grade at the end of First Year (2nd Semester) CGPA >= 5 to register in 3rd semester with full suite of courses. To register in higher semester with full suite of course CGPA should also not be less than 5.

6.10. For appearing at any semester examination a student must attain minimum 75% of lecture delivered in each theory and in each sessional/ practical paper. Condonation of 10% of attendance on serious medical ground may be allowed by college authority.

7. **EXAMINATIONS:**

End Semester Examination	70 Marks
Internal	30 Marks

7.1. The examination office of the Jharkhand University of Technology will conduct the End Semester Examinations (ESE).

- The end semester examinations will be of 70 marks. It will comprise of seven questions (answer any five) and carry 14 marks each. Questions will be set from the entire syllabus, at least one question from each module (wherever possible).

7.2. Two mid semester examination of 20 marks each (out of total internal marks 30) will be conducted by respective institute. The first mid-term examination shall be conducted on 50% of the syllabus and the second mid-term examination shall be conducted on the remaining 50% of the syllabus.

- The mid semester examinations will comprise of seven questions (answer any five) and carry 4 marks each. Questions will be set from the syllabus as mention in clause 7.2, at least one question from each module (wherever possible).

Internal	Marks
Two Mid Semester Exam each of 20 marks (Consider Best of two)	20
Teacher assessment (through tutorials, Assignment, Quizzes etc)	05
Attendance	05
Total	30

7.3. Practical / Viva – Voce examination marks (Total 50 marks)

- External examiner viva-voce examination marks 20 Marks
- Practical performed during lab period 20 Marks
- Attendance 05 Marks
- Lab record / lab file maintenance up to the mark 05 Marks

7.5. Marks for Seminar

- **Minor project** in 7th semester 50 marks (distribution of marks as in clause 7.3)
- **Major Project** in 8th semester 100 Marks
  - External examiner evaluation 30 Marks
  - Internal evaluation by project incharge 70 Marks

All necessary Charts, Tables, Codes and Data book, drawing board will be provided by JUT/ respective Institute as per requirement.

8. GRADING OF PERFORMANCE IN EXAMINATIONS

As a measure of student's performance, an 8-scale grading system using the following letter grades and corresponding grade points per credit shall be followed:

8.1. **Performance Letter grade Grade point per credit**

Excellent	A+	10
Very good	A	9
Good	B+	8
Fair	B	7
Average	C+	6
Pass	C	5
Fail	F	0

8.2. Method of Converting percentage marks to grades. The absolute grading system will be used as under.

% of marks obtained with Letter Grade

90% and above	A+
80% to 89%	A
70% to 79%	B+
60% to 69%	B
50% to 59 %	C+
35% to 49%	C
≤ 35 %	F

To earn academic credit in a subject, a student should get a grading of "C" or above. Where prerequisite is specified for a course, a grading of C, or above shall be deemed as satisfying the prerequisite requirement.

9. RECORDS OF ACADEMIC PROGRESS

9.1. Semester Grade Point Average (SGPA) shall be calculated as under:

$$\text{SGPA} = \frac{\sum \text{Semester (Course credits x Grade point) for all courses}}{\sum \text{Semester (Course credits)}}$$

9.2. The academic progress of the students in each semester shall be maintained in a grade card or transcript, wherein the grades awarded to students as well as the points secured by the students in the examinations, shall be entered. The transcript given to the students at the end of their complete undergraduate program shall indicate the Cumulative Grade Point Average (CGPA) which shall be calculated as follows:

$$\text{CGPA} = \frac{\sum \text{All Semester (Course credits x Grade point) for all courses}}{\sum \text{All Semester (Course credits) i.e. } \sum \text{ (All subjects credits)}}$$

The CGPA shall be rounded off to one place of decimal. While calculating CGPA, the 'F' shall be replaced by the better grade earned in these course in the subsequent semester/ Summer Examination.

9.3. Credit Adjustment for Lateral Entry Programme

For the students entering from 3rd semester through Lateral Entry Scheme from Diploma institutions will be awarded proportionate and equivalent credits and the calculation of SGPA and CGPA will be made from 3^{rd} and 4^{th} semester respectively.

9.4. The university shall follow the following conversion between CGPA and % marks.

% marks = (CGPA -0.5) x 10.0

9.5. The summer programme will be scheduled during the long Institute vacations after completion of regular semester. A student is permitted to register only for three theory papers for course scheduled in the summer programme, only if, he/she had registered for these courses earlier in the semester and wishes to repeat them because of failure in the courses.

10. GRADUATION REQUIREMENT

In order to qualify for a B. Tech. degree covered under these Regulations, a student must:

(a) Complete all the credit requirements for the degree, as laid down in the prescribed curriculum of the discipline, with a minimum grade 'C' scored in every subject.

(b) Obtain a CGPA of 5 or higher at the end of the semester in which he/she completes all the requirements for the degree.

11. AWARD OF DEGREE

Mode of Examination:

The theory and the internal/practical/project components have been bifurcated as follows:

- **Theory component**

1. TA (Internal Evaluation) – 30 marks

(a) Attendance –	5 marks
(b) Assignment/Class Test-	5 marks
(c) Mid semester examination-	20 marks (One half hours duration)

2. End semester examination- 70 marks (3 Hours duration)

- **Sessional/ Practical/ Minor Project Component: 50 marks**

(a) TA(Progressive Evaluation)-	30 marks
(b) End semester external (viva-voce) -	20 marks

- **Project (Total marks 100)**

(a) TA (Progressive Evaluation) –	70 marks
(b) Viva-voce examination –	30 marks

Cases of adoption of unfair means in an examination shall be dealt with by the Examination Disciplinary Committee of Jharkhand University of Technology. If adoption of unfair means is proved, the punishment may be, depending on the quantum of the offence and prior record, reduction of grade, de-registration of a course, expulsion for one or more semesters or outright expulsion from the Institute.

12. GRADES AFTER COMPLETION OF COURSE

70% and above	First class with distinction
60% to 69%	First class
40% to 59%	Second class (But CGPA not < 5)

13. GUIDELINES FOR ASSIGNMENT

A specific assignment shall be given to each student in every theory course immediately after registration. This may comprise new problems in emerging areas in the subjects/ design methodology/ modelling/ software development/ collection of new results and discussion /analysis etc. The main objective of the assignment is to improve self learning process and exposure to current literature on the subject. The assignment should be an extension of the prescribed syllabus and **in no case the repetition of the class work or problems.** The assignment should be submitted by the students' in hand written form after 50% completion of syllabus in the concerned semester. The grade/marks may be awarded as per the following norms.

Grade/Marks	Explanation
5	upto maximum of 30 % of the total number of students
4	upto maximum of 40 % of the total number of students
3	upto maximum of 30 % of the total number of students

14. CHANGE OF BRANCH

14.1. Change of branch may be allowed against the vacant seats in the following two stages, provided criteria at following sub clauses are satisfied:

- In the second year, on the basis of merit in the B. Tech. first year examination for those who have passed with more than 8.0 CGPI without any carry over paper and

14.2. After change of the branch, number of students in branch (es) shall neither increase over the intake approved by AICTE nor it will decrease below 75% of intake approved by AICTE

14.3. Change of branch is not applicable to following:

- Students admitted in second year of B.Tech. programs as per clauses of Lateral entry.

14.4. Further change of branch shall not be permitted.

15. RE-ADMISSION IN THE INSTITUTION/ COLLEGE

A student may be allowed for re-admission provided he/she satisfies one of the following conditions:

- A student is declared fail.
- A student did not appear in a semester examination or he/she was not granted permission to appear at the examination.
- A student has been detained by the institute and subsequently has been permitted to take re-admission.
- A student as an ex-student passed the examination of the academic year or qualified for carryover system.
- A student promoted with carry over subjects and he/she opted for readmission.

ANNEXURE – I

Rules Regarding Conduct And Discipline

Following rules shall be in force to govern the conduct and discipline of all students:

1. Students shall show due respect to the teachers of the Institute, the Wardens and Hostel Superintendent of the Hostels, the Sports Officers and the Officers of the National Cadet Crops; proper courtesy should also be extended to the employees of the Institute and of the Hostels . They shall also pay due attention and courtesy to visitors.

2. Students are required to develop a friendly relationship with fellow students. In particular, they are expected to show kindness and consideration to the new students admitted to the Institute every year. Law bans ragging in any form to anybody. Any act of physical or mental pressurization of junior students, individually or in group, will be considered as an act of ragging. Ragging also includes forcing junior students to meet seniors outside institute premises, or in places where a student has no valid reason to be present, asking irrelevant questions or using abusive language. Ragging will be considered as gross indiscipline and will be severely dealt with, which may include expulsion from the institute. Any incident of ragging inside or outside the campus must be reported to a Hostel Superintendent, the chief warden or a faculty member designated to look after ragging issues by any student, senior or fresher, who has witnessed an incident. Failure to report a ragging incident will be considered a serious offence, even if one is not personally involved in it. If a junior student yields to any form of ragging by senior students and does not inform the Institute or Hostel Superintendents, or willfully withholds the information in an enquiry of ragging incident, the matter will be treated as indiscipline on the part of the junior student and invite punishment comparable to those against ragging itself. Willful withholding of complaint by a junior student does not automatically exempt a senior from punishment.

3. The following acts of omission and/or commission and comparable offences shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures:
Furnishing false statement of any kind in the form of application for admission or for award of scholarship or prizes etc. Furnishing false statement to the Disciplinary Committee, or willfully withholding information relevant to an enquiry. Organizing or participating in any activity that has potential for driving fellow students along lines of religion, caste, home state, and batch of admission or any other unhealthy criterion.

- Physical or mental harassment of fresher’s through physical contact or oral abuse.
- Getting involved in a brawl or fight with persons outside the Institute, either alone or in a group, irrespective of whom initiated the conflict.
- Will fully damaging or stealthily removing any property belongings of the Institute, Hostels or fellow students.
- Adoption of unfair means in the examinations.
- Possession, consumption or distribution of alcoholic drinks or any kind of hallucinogenic drugs.
- Organizing or participating in any group activity except purely academic and scientific programmes in company with others in or outside the campus without prior permission of the Principal of the Institute.
- Mutilation or unauthorized possession of library books.
- Not cooperating with faculty, officers investigating a potential disciplinary issue.
- Resorting to noisy and unseemly behaviour, disturbing studies of fellow students.

- Disturbing in drunken state or otherwise an incident an academic or student function or any other public event.
- Not obeying traffic rules on campus, not following safety practices or causing potential danger to oneself or other persons in any way.
- Displaying lack of courtesy and decorum, resorting to indecent behaviour anywhere within or outside the campus.
- Not intimating his/her absence to the Hostel Superintendent before leaving campus.
- Getting involved in an activity that violates state or national laws.

4. Commensurate with the gravity of the offence, the punishment for indiscipline may be

- Reprimand, impose fine or take any other suitable measure.
- Debarment from medals and prizes.
- For economic offences (either misappropriation of money or damage to Institute property), the cost to the damage done will be recovered along with a penalty which may be up to ten times of the cost recovered.
- Partial (one month or one semester) or complete debarment from campus placement,
- Reduction in grade in one or more courses.
- Expulsion from the Hostel.
- Rustication for a specified period, or outright expulsion from the Institute.

5. All major acts of indiscipline, which may have serious repercussion on the students in general and/or which may warrant a uniform and more formalized nature of investigation, shall be handled by the Institute Disciplinary Committee appointed by Principal of the Colleges. The Disciplinary Committee shall investigate complaints; examine available evidence and award punishment. Recommendation of the committee, which will include the suggested punishment in case of guilt proven, will be forwarded to the Chairman of the Governing Body of the Colleges for necessary action.

6. Proof of guilt need not necessarily be at the same level as necessary in a court of law. The committee, in order to protect the academic rights of a greater body of students, may award disciplinary measures if it is reasonably satisfied that such measures are in the greater interest of the students.

7. The Principal of the Colleges, at his discretion may take additional measures keeping in mind long term issues and impact on other aspects of Institute management. The Principal make minor changes in the nature of punishment awarded or reduce the level and/or quantum of punishment if he feels appropriate.

8. Acts which may be classed as ‘crimes’ rather than acts of indiscipline will be reported to the state authorities; they include such acts as causing serious injury to fellow students or others, causing major damage to Institute property, being involved in activities prejudicial to national security or to that maintaining communal harmony etc.

9. Cases of adoption of unfair means in an examination shall be dealt with by the Examination Disciplinary Committee of Jharkhand University of Technology. If adoption of unfair means is proved, the punishment may be, depending on the quantum of the offence and prior record, reduction of grade, de-registration of a course, expulsion for one or more semesters or outright expulsion from the Institute.

ANNEXURE-II

<u>Procedure for Administration of Short Term Industrial or Research Experience (SIRE Programme)</u>

1. The SIRE programme shall be of at least 8 weeks duration after 6th semester of B. Tech. The experience should preferably be earned in an industry of repute, major R & D laboratory, an IIT, NIT or IISc. The key word is “repute”.

2. While summer work after 6th semester of B.Tech is compulsory, a student may, at his discretion, acquire experience at the end of the 4th semester of the B. Tech. in addition to the programme after the 6th semester.

3. The Training and Placement department shall arrange places of work for all students of 6th semester of B. Tech. It may also assist students of 4th semester of B. Tech. to find work opportunities at mutual convenience.

4. The work may be carried out either in India or abroad. The Institute shall not bear the cost of travel or accommodation in any place. Some organizations offer work experience to engineering students against a fee. The Institute will examine such programmes for their content and spirit and approve deserving cases. The student shall bear the expenses.

5. Students are encouraged to receive financial support from the organizations where they are placed or from other sources. Such financial offers will not count as alternative scholarships.

6. Students will not be permitted to enroll in regular, periodic or a periodic courses (e.g. CAD/CAM course, Oracle course) offered by companies, even if the subject is of interest to the academic programme. If a subject is of relevance to the Institute’s academic programme, it should be included in the curriculum instead of requiring the students to study it outside the institute by paying additional fees.

7. Considering difficulties of accommodation and travel, the Institute shall work out places of work taking into account the convenience of students. For this to happen, the T & P Centre shall put up a notice seeking suggestions from students for possible work sites.

8. Sometime around February-March of the year, the T & P department shall finalise the list of work sites for the students and announce it on the notice boards. The students will then make railway reservation and take other necessary steps. Students will have no freedom to choose their own places of work beyond giving suggestions to the T & P Centre. In case a student faces difficulty with the assigned place, he should bring it to the attention of the Professor T & P so that he can be given a fresh allotment. Any change of place of work after starting of the summer vacation must be approved by the Professor T & P on the merit of the case. Any work at a place not approved in advance will not count towards credit requirement.

9. The T & P Centre shall have the responsibility to inspect the places of work to ensure that the students are sincere in their assigned responsibility. If it is found that a student is not attending his work place on full time basis, the student shall get ‘F’ grade and the SIRE programme is to be repeated at the end of the 8th semester with consequent delay in completion of the students’ academic programme.

10. The SIRE report will be evaluated by the department at the beginning of the 7th semester, preferably within one month of the starting of the semester. The department will assign one or two faculty members to coordinate presentation by the students and evaluation of the reports. The grades must be sent to the examination office before the mid semester examination of the autumn semester.

11. The T & P Centre shall be the nodal agency for arranging places of industrial experience. But departments also need to play a strong role. Many faculty members are well known in industry and the industry honours the requests of faculty members and Heads of Departments.

12. There will be a Training & Placement Advisory Committee headed by the Professor of Training & placement. Every department shall nominate one faculty member having strong connection with industry and a strong perception of all aspects of the department's academic programmes.

13. SIRE will also include credit for the industrial tours and visits arranged by the Institute during the first seven semesters of a student's career. The relative assignment of marks between the two components shall be: 75% for summer work and 25% for the industrial tours.

ANNEXURE -III

Guidelines for Use of Project Record Book

1. The Project Record Book constitutes the bona fide record of project work carried out by undergraduate, postgraduate and research students of JUT Ranchi.

2. The book contains day to day record of all conceptual, analytical, Laboratory and computational activities carried out by a student as a part of his/her project.

3. It is a permanent record of academic activity and contains intellectual property created by the student and his supervisor.

4. The book should be treated with respect and maintained with care. Pages must not be torn or used for rough work.

5. The student should record all his thoughts, observations, flow charts, computational steps etc., directly on this notebook. Use of second rough book and final copying to this record book is discouraged.

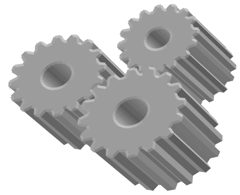
6. All information recorded here must start with a date on the left margin. The work of the day must be organized into sections such as objective, experimental or computational methods, observations, program flow charts, pseudo-codes, conclusion, discussion etc., as relevant to the problem at hand. Short computer prints, photographs, charts and graphs may be pasted neatly wherever necessary.

7. The supervisor should examine the progress of the student and record his observations, comments and suggestions in a regular manner, typically once every week.

8. The student must produce this record book before all Examination Boards for evaluation and grading of his day to day performance, and for award of medals and prizes. The first evaluation of the project will be made basing on the record book only.

9. On completion of the project, the student must surrender this book to his supervisor for archiving. If the same problem is continued by students of the following batch, the supervisor may choose to give it to those students for the sake of continuity. Projects with supervisor intellectual material may be sent to Departmental Library for permanent archival.

10. The students who do work worth publishing and/or patenting are advised to proceed with those activities. The Institute will organize the patenting process.



CURRICULUM

FOR

FIRST YEAR
UNDERGRADUATE DEGREE COURSES

IN

ENGINEERING & TECHNOLOGY

Jharkhand University of Technology

Ranchi, India

2018

Contents

COURSE STRUCTURE

SEMESTER I (FIRST YEAR]

Table 1: Branch/Course Common to all branches of UG Engineering & Technology

Sl. No.	Category	Course Code	Course Title	Hours Per Week			Credit	Marks		
				L	T	P		**IA**	ESE	Total
					Theory					
1	Basic Science Course	BSC101	Physics I	3	1	0	4	30	70	100
2	Basic Science Course	BSC103	Mathematics – I	3	1	0	4	30	70	100
3	Engineering Science Courses/ Basic Science Course	ESC101/ BSC102	Basic Electrical Engineering/ Chemistry I	3	1	0	4	30	70	100
						Total(A)	**12**	90	210	300
					Practical/Drawing/Design					
4	Engineering Science Courses	ESC102	Engineering Graphics & Design	1	0	4	3	25	25	50
5	Basic Science Course	BSC101P	Physics Lab	0	0	3	1.5	25	25	50
6	Engineering Science Courses/ Basic Science Course	ESC101P/ BSC102P	Basic Electrical Engineering Lab / Chemistry Lab	0	0	2	1	25	25	50
						Total(B)	**5.5**	**75**	**75**	**150**
						Grand Total(A+B)	**17.5**	**165**	**285**	**450**

L-Lecture, T-Tutorial, P-Practical

IA- Internal Assessment, ESE-End Semester Examination

SEMESTER II (FIRST YEAR]

Table 2: Branch/Course: Common to all branches of UG Engineering & Technology

Sl. No.	Category	Course Code	Course Title	Hours Per Week			Credit	Marks		
				L	T	P		**IA**	ESE	Total
Theory										
1	Basic Science Course	BSC105	Physics II	3	1	0	4	30	70	100
2	Engineering Science Courses/ Basic Science Course	ESC101/ BSC102	Basic Electrical Engineering/ Chemistry I	3	1	0	4	30	70	100
3	Basic Science Course	BSC104	Mathematics – II	3	1	0	4	30	70	100
4	Engineering Science Courses	ESC103	Programming for Problem Solving	3	1	0	4	30	70	100
5	Humanities and Social Sciences including Management Courses	HSMC101	English	2	0	2	3	30	70	100
						Total(A)	**19**	150	350	500
Practical/Drawing/Design										
6	Engineering Science Courses	ESC104	Workshop/ Manufacturing Practices	1	0	4	3	25	25	50
7	Engineering Science Courses/ Basic Science Course	ESC101P/ BSC102P	Basic Electrical Engg. Lab / Chemistry Lab	0	0	2	1	25	25	50
8	Engineering Science Courses	ESC103P	Programming for Problem Solving	0	0	2	1	25	25	50
						Total(B)	**5**	**75**	**75**	**150**
						Grand Total(A+B)	**24**	**225**	**425**	**650**

L-Lecture, T-Tutorial, P-Practical,
IA- Internal Assessment, ESE-End Semester Examination

COMMON BASIC SCIENCES COURSES

Table 3: Physics, Chemistry & Mathematics

Sl. No.	Courses	Papers	Remark
1.	**Mathematics**	**Mathematics(Option 1)** Mathematics 1 Mathematics 2	For all branches of Engineering except CSE
		Mathematics (Option 2) Mathematics 1 Mathematics 2	For CSE only
2.	**Physics** (Theory & Lab.)	**Physics I** (i) Introduction to Electromagnetic Theory (ii) Introduction to Mechanics (iii) Oscillation, Waves and Optics (iv) Semiconductor Physics (v) Basics of Electricity Magnetism & Quantum Physics	For all branches of Engineering with the combination as suggested in the table 5
		Physics II (i) Semiconductor Optoelectronics (ii) Mechanics of Solid (iii) Introduction to Quantum Mechanics for Engineers (iv) Optics & Fiber Optics	
3.	**Chemistry** (Theory & Lab.)	**Chemistry – I (**Concepts in chemistry for engineering)	For all branches of Engineering

ENGINEERING SCIENCE COURSES &
HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES

Table 4**:** Engineering Science Courses & Humanities and Social Sciences Including Management Courses

Sl. No.	Course	Paper
1.	**ENGINEERING SCIENCE COURSES**	Programming for Problem Solving
		Engineering Graphics & Design
		Basic Electrical Engineering
		Workshop/ Manufacturing Practices
2.	**HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES**	English

Table 5: Physics Papers for different Engineering Discipline

Branch	**PHYSICS PAPER**	**Preferred Semester**
Civil Engineering (CE)	Introduction to Mechanics	Semester I
	Mechanics of Solid	Semester II
Electrical & Electronics Engineering (EEE)/ Electrical Engineering (EE)	Oscillation, Waves and Optics	Semester I
	Introduction to Quantum Mechanics for Engineers	Semester II
Electronics & Communication Engineering (ECE)/ App. Electr. & Instr. Engg.	Semiconductor Physics	Semester I
	Semiconductor Optoelectronics	Semester II
Mechanical Engineering(ME)/ Production Engineering(PE)/ Mining Engineering	Introduction to Electromagnetic Theory	Semester I
	Mechanics of Solid	Semester II
Computer Science Engineering (CSE)/ Information Technology(IT)	Semiconductor Physics	Semester I
	Introduction to Quantum Mechanics for Engineers	Semester II
Chemical Engineering	Basics of Electricity Magnetism and Quantum Physics	Semester I
	Optics & Fiber Optics	Semester II
Metallurgical Engineering & Materials Science (MEMS)	Introduction to Mechanics	Semester I
	Mechanics of Solid	Semester II

SEMESTER I

COURSE CONTENTS

<table>
<tr><td>Course Code</td><td colspan="5">BSC 103</td></tr>
<tr><td>Category</td><td colspan="5">Basic Science Course</td></tr>
<tr><td>Course Title</td><td colspan="5">Mathematics - I
Calculus and Linear Algebra (Option 1) for All Branch excluding CSE
Calculus and Linear Algebra (Option 2) for CSE</td></tr>
<tr><td rowspan="2">Scheme & Credits</td><td>L</td><td>T</td><td>P</td><td>Credit</td><td rowspan="2">Semester I</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Pre-requisites: High-school education</td></tr>
</table>

MATHEMATICS 1

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CALCULUS AND LINEAR ALGEBRA **40 Lectures**

Option 1 (For all branches) excluding CSE

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Module 1: Calculus-I **6 Lectures**

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: Calculus-II **6 Lectures**

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Module 3: Sequences and series **10 Lectures**

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Module 4: Multivariable Calculus (Differentiation) **8 Lectures**

Limit continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Module 5: Matrices **10 Lectures**

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew symmetric and orthogonal matrices; Determinants; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Textbooks/References:

- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
- Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
- Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2010.
- D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
- N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

COURSE OUTCOMES

To introduce the idea of applying differential and integral calculus to notions of curvature and to improper integrals.

To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.

To develop the tool of power series and Fourier series for learning advanced Engineering Mathematics.

To familiarize the student with functions of several variables that is essential in most branches of engineering.

To develop the essential tool of matrices and linear algebra in a comprehensive manner.

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CALCULUS AND LINEAR ALGEBRA **Option 2 (for CSE)** **40Lectures**

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Module 1: Calculus-I **6 Lectures**

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: Calculus-II **6 Lectures**

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L' Hospital's rule; Maxima and minima.

Module 3: Matrices **8 Lectures**

Matrices, vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.

Module 4: Vector spaces-I **10 Lectures**

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank nullity Theorem, composition of linear maps, Matrix associated with a linear map.

Module 5: Vector spaces-II **10 Lectures**

Eigen values, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, Eigen bases. Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.

Textbooks/References:

- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
- Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
- D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
- Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
- N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
- V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

COURSE OUTCOMES

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

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Course Code	BSC 101				
Category	**Basic Science Course**				
Course Title	**Physics-I** (i) Introduction to Electromagnetic Theory – For ME (ii) Introduction to Mechanics – For Civil, MEMS (iii) Oscillation, Waves and Optics - For EEE (iv) Semiconductor Physics – For ECE, CSE (v) Basics of Electricity, Magnetism & Quantum Mechanics- For Chemical Engg.				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester I**
	3	**1**	**0**	**4**	
Pre-requisites	Mathematics course with vector calculus, High-school education Mathematics course on differential equations and linear algebra				

PHYSICS- I

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INTRODUCTION TO ELECTROMAGNETIC THEORY **For ME**

38 Lectures

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Module 1: Electrostatics in vacuum **8 Lectures**

Electric field and electrostatic potential for a charge distribution; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution. Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

Module 2: Electrostatics in a linear dielectric medium **4 Lectures**

Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

Module 3: Magneto statics **6 Lectures**

Bio-Savart law, Static magnetic field; vector potential and calculating it for a given magnetic field; the equation for the vector potential and its solution for given current densities.

Module 4: Magneto statics in a linear magnetic medium **4 Lectures**

Magnetization and associated bound currents; auxiliary magnetic field; Boundary conditions on **B** and **H**. Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Module 5: Faraday's law and Maxwell's equations 8 Lectures

Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time dependent electric field; calculating magnetic field due to changing electric fields in quasistatic approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting.

Module 6: Electromagnetic waves 8 Lectures

The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non conducting medium-vacuum interface for normal incidence.

Text Book:

- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn, 1998, Benjamin Cummings.

Reference books:

- Fundamentals of Physics Electricity and Magnetism, Halliday and Resnick, tenth edition (published 2013).
- W. Saslow, Electricity, magnetism and light, 1st edition
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.

COURSE OUTCOMES

To make student understand the basic of electrostatics in vacuum and in material medium.

To make student understand the basic of magneto statics in vacuum and in magnetic material medium.

Students to get familiarized with the Faraday's Law and Maxwell's equation leading to the application of EMW in vacuum and in media.

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INTRODUCTION TO MECHANICS for Civil, MEMS

38 Lectures

Module 1: Particle motion and Newton's law 8 Lectures

Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law;

Module 2: Central potential and Kepler's laws 7 Lectures

Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Kepler problem;

Module 3: Rotating coordinate system 5 Lectures

Non-inertial frames of reference; rotating coordinate system: Five-term acceleration formula-Centripetal and Coriolis accelerations; Foucault pendulum;

Module 4: Harmonic Oscillations 6 Lectures

Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance.

Module 5: Planar rigid body mechanics 5 Lectures

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion;

Module 6: Three-dimensional rigid body motion 7 Lectures

Introduction to three-dimensional rigid body motion - in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body: Rod executing conical motion with center of mass fixed - show that this motion looks two-dimensional but is three-dimensional.

Reference books:

- Engineering Mechanics, 2nd ed. Publisher: Cengage Learning; 2 edition (January 22, 2013) - MK Harbola
- Introduction to Mechanics, CRC Press - MK Verma

- An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill
- Principles of Mechanics. by Synge, John. L; Griffith, Byron. A. Publication date Publisher McGraw-Hill
- Mechanics - JP Den Hartog
- Engineering Mechanics - Dynamics, 7th ed. - JL Meriam
- Mechanical Vibrations - JP Den Hartog
- Theory of Vibrations with Applications - WT Thomson

COURSE OUTCOMES

Students to learn basics of particle dynamics including the rotational motion in central potential field following Kepler's laws.

To learn the rotating co-ordinate system and harmonic motion with the effect of damping and forced oscillation.

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OSCILLATIONS, WAVES AND OPTICS **For EEE**

38 Lectures

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Module 1: Harmonic Oscillation **07 Lectures**

Simple harmonic motion, damped and forced simple harmonic oscillator Mechanical and electrical simple harmonic oscillators, phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator.

Module 2: Waves **07 Lectures**

Transverse and longitudinal waves in one dimension. Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves. Waves with dispersion, water waves, superposition of waves, wave groups and group velocity.

Module 3: Geometric Optics **10 Lectures**

Fermat's principle of stationary time and its applications. Laws of reflection and refraction, Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them.

Module 4: Wave Optics **06 Lectures**

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer,. Farunhoffer diffraction from a single slit, the Rayleigh criterion for limit of resolution; Diffraction gratings and their resolving power

Module 5: Lasers **08 Lectures**

Einstein's theory of matter radiation interaction, A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne), solid-state lasers (ruby); Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers.

Reference books:

- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- Optics, A. Ghatak, 2008, Tata McGraw Hill
- The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

COURSE OUTCOME

Students to learn harmonic oscillations, physical and wave optics.

Students to get familiarize with the knowledge of waves and Lasers.

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SEMICONDUCTOR PHYSICS **For ECE, CSE**
38 Lectures

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Module 1: Electronic materials **8 Lectures**

Free electron theory, Density of states and energy band diagrams, Kronig-Penny model, Energy bands in solids, E-k diagram, Direct and indirect band gaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Fermi level, Effective mass.

Module 2: Semiconductors **10 Lectures**

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature, Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky).

Module 3: Light-semiconductor interaction **7 Lectures**

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Joint density of states, Density of states for photons, Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect.

Module 4: Measurements **7 Lectures**

Four-point probe and vander Pauw measurements for carrier density, resistivity, and hall mobility; Hot-point probe measurement, capacitance-voltage measurements, parameter extraction from diode I-V characteristics.

Module 5: Engineered semiconductor materials **6 Lectures**

Density of states in 2D, 1D and 0D (qualitatively). quantum wells, wires, and dots: design, fabrication, and characterization techniques. Hetero junctions and associated band-diagrams

References:

- J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
- B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
- S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
- Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).
- P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
- Online course: “Semiconductor Optoelectronics” by M R Shenoy on NPTEL
- Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL

COURSE OUTCOMES

Students will be exposed to the understanding of semiconductor materials and their importance in Computer, Electronics and Communication Engineering.
To learn the interaction of light and semiconductor.
To get familiarized with the measurement techniques on semiconductor devices and circuits.

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BASICS OF ELECTRICITY, MAGNETISM AND QUANTUM PHYSICS
For Chemical Engg. 38 Lectures

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Module 1: Electromagnetism 8 Lectures
Laws of electrostatics: Coulomb's and Gauss's Law, electric current and the continuity equation, laws of magnetism. Ampere's Law, Faraday's laws of electromagnetic induction: Self and mutual induction, motional and changing field emf, Displacement current, Maxwell's equations.

Module 2: Dielectrics 6 Lectures
Dielectric, Polar and non-polar dielectrics, Electric Polarisation, Polarizability, Types of polarization, Permittivity and dielectric constant, internal fields in a solid, Clausius-Mossotti equation.

Module 3: Magnetic Substances 7 Lectures
Magnetic moment and Magnetisation, permeability and susceptibility, classification of magnetic materials, diamagnetic, paramagnetic and ferromagnetic, magnetic domains and hysteresis, hysteresis loss, applications.

Module 4: Basic Quantum Mechanics 7 Lectures
Inadequacy of Classical Mechanics, Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect: Stopping Potential, Work Function, Compton Effect: Compton Shift.

Module 5: Wave particle duality and bound states **10 Lectures**

de Broglie hypothesis, Bragg's Law, wave-particle duality, Born's interpretation of the wave function, verification of matter waves, uncertainty principle, Schrodinger wave equation: time dependent and independent form, eigen value and eigen function, normalization of wave function, particle in a box, quantum harmonic oscillator, hydrogen atom.

Text Book:

- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.

Reference books:

- Introduction to Quantum mechanics, Nikhil Ranjan Roy, 2016, Vikash Publishing House Pvt. Ltd.
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
- Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
- Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.

COURSE OUTCOMES

Students to get basic knowledge of Electromagnetism, dielectrics, magnetic materials etc.

Familiarization with the basics of Quantum Mechanics and its application to few bound states.

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PHYSICS LABORATORY **Code: BSC101P**

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Choice of 08-10 experiments from the following:

- Experiments on electromagnetic induction and electromagnetic breaking;
- LC circuit and LCR circuit
- Resonance phenomena in LCR circuits
- Magnetic field from Helmholtz coil
- Measurement of Lorentz force in a vacuum tube
- Coupled oscillators
- Experiments on an air-track
- Experiment on moment of inertia measurement
- Experiments with gyroscope
- Resonance phenomena in mechanical oscillators
- Frank-Hertz experiment
- Photoelectric effect experiment
- Recording hydrogen atom Spectrum
- Diffraction and interference experiments (from ordinary light or laser pointers)
- measurement of speed of light on a table top using modulation
- minimum deviation from a prism

LABROTARY OUTCOMES

Students to have hands on experiences with experiments on the basics laws and principles of Physics in the field of Mechanics, Optics, Electricity, Magnetism, Modern Physics, etc.

Course Code	**ESC 101**				
Category	**Engineering Science Course**				
Course Title	**Basic Electrical Engineering**				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester I**
	3	**1**	**0**	**4**	
Pre-requisites	**Intermediate level Electricity**				

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BASIC ELECTRICAL ENGINEERING 40 Lectures

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Module 1 : DC Circuits 7 Lectures

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Module 2: AC Circuits 7 Lectures

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Module 3: Transformers 6 Lectures

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module 4: Electrical Machines 8 Lectures

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Module 5: Power Converters 6 Lectures

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Module 6: Electrical Installations **6 Lectures**

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Suggested Text / Reference Books

- D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
- D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
- L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
- E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
- V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

Course Outcomes

- To understand and analyze basic electric and magnetic circuits.
- To study the working principles of electrical machines and power converters.
- To introduce the components of low voltage electrical installations.

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BASIC ELECTRICAL ENGINEERING LABORATORY Code: ESC101P

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List of experiments/demonstrations:

- Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
- Transformers: Observation of the no-load current waveform on an oscilloscope (non sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents).Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
- Torque Speed Characteristic of separately excited dc motor.
- Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super synchronous speed.
- Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
- Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LABORATORY OUTCOMES

Get an exposure to common electrical components and their ratings.

Make electrical connections by wires of appropriate ratings.

Understand the usage of common electrical measuring instruments.

Understand the basic characteristics of transformers and electrical machines.

Get an exposure to the working of power electronic converters.

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Course Code	**ESC 102**				
Category	**Engineering Science Course**				
Course Title	**Engineering Graphics & Design (Theory & Lab)**				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester I**
	1	**0**	**4**	**3**	
Pre-requisites	**Basic knowledge of Computer and Solid Geometry**				

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ENGINEERING GRAPHICS & DESIGN

Lecture - 10 hours & Lab - 60 hours

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Traditional Engineering and Computer Graphics: **10 Lectures**

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling; Introduction to Building Information Modeling (BIM)

(Lab modules also include concurrent teaching)

Lab Module 1: Introduction to Engineering Drawing **5 Lectures**

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Lab Module 2: Orthographic Projections **5 Lectures**

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Lab Module 3: Projections of Regular Solids **5 Lectures**

those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Lab Module 4: and Sectional Views of Right Angular Solids **5 Lectures**

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

Lab Module 5: Isometric Projections **6 Lectures**

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Lab Module 6: Overview of Computer Graphics **8 Lectures**

listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Lab Module 7: Customization & CAD Drawing **8 Lectures**

consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Lab Module 8: Annotations, layering & other functions **9 Lectures**

applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print ommand; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

Lab Module 9: Demonstration of a simple team design project **9 Lectures**

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Suggested Text/Reference Books:

- Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engg Drawing, Charotar Pub House
- Shah, M.B. & Rana B.C. (2008), Engg Drawing & Comp. Graphics, Pearson Education
- Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
- Narayana, K.L. & P Kannaiah (2008), Text book on Engg Drawing, Scitech Publishers
- Corresponding set of CAD Software Theory and User Manuals

COURSE OUTCOMES

All phases of manufacturing or construction require the conversion of new ideas and design concepts into the basic line language of graphics. Therefore, there are many areas (civil, mechanical, electrical, architectural and industrial) in which the skills of the CAD technicians play major roles in the design and development of new products or construction. Students prepare for actual work situations through practical training in a new state-of-the-art computer designed CAD laboratory using engineering software. This course is designed to address:

- To prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- To prepare you to communicate effectively
- To prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice The student will learn :
- Introduction to engineering design and its place in society
- Exposure to the visual aspects of engineering design
- Exposure to engineering graphics standards
- Exposure to solid modeling
- Exposure to computer-aided geometric design
- Exposure to creating working drawings
- Exposure to engineering communication

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SEMESTER II COURSE CONTENTS

<table>
<tr><td>Course Code</td><td colspan="5">BSC 104</td></tr>
<tr><td>Category</td><td colspan="5">Basic Science Course</td></tr>
<tr><td>Course Title</td><td colspan="5">Mathematics – II
Contents
Calculus, Ordinary Differential Equations and Complex Variable (Option 1) for All branches excluding CSE
Probability and Statistics (Option I1) for CSE</td></tr>
<tr><td rowspan="2">Scheme & Credits</td><td>L</td><td>T</td><td>P</td><td>Credit</td><td rowspan="2">Semester
II</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Elementary Knowledge of calculus, Probability and Statistics</td></tr>
</table>

MATHEMATICS - II

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CALCULUS, ORDINARY DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLE (OPTION 1) for All branches excluding CSE 40 Lectures

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Module 1: **Multivariable Calculus (Integration): 10 Lectures**

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities);Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Module 2: First order ordinary differential equations: 06 Lectures

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 3: Ordinary differential equations of higher orders: 08 Lectures

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module 4: Complex Variable - Differentiation: 08 Lectures

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Module 5: Complex Variable - Integration: 08 Lectures

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Textbooks/References:

- G.B. Thomas & R.L. Finney, Calculus & Analytic geometry, Pearson, Reprint, 2002.
- Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
- W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
- S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
- E. A. Coddington, An Introduction to Ordinary Differential Equations, PHI, 1995.
- E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
- J. W. Brown & R. V. Churchill, Complex Variables & Appln, Mc-Graw Hill, 2004.
- N.P. Bali and Manish Goyal, Engineering Mathematics, Laxmi Pub, Reprint, 2008.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

COURSE OUTCOME

To familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables.
To equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

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PROBABILITY AND STATISTICS (OPTION 2) FOR CSE ONLY 40 Lectures

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Module 1: Basic Probability: 12 Lectures

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Module 2: Continuous Probability Distributions: 04 Lectures

Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Module 3: Bivariate Distributions: 04 Lectures

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module 4: Basic Statistics: 08 Lectures

Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation

Module 5: Applied Statistics: 08 Lectures

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Module 6: Small samples: 04 Lectures

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Textbooks/References:

- Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
- P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
- S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
- W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
- N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
- Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

COURSE OUTCOME

- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
- To introduce effective mathematical tools for the solutions of differential equations that model physical processes.
- To introduce the tools of differentiation and integration of functions of complex variable that is used in various techniques dealing engineering problems.

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Course Code	**BSC 105**				
Category	**Basic Science Course**				
Course Title	**Course contents in Physics** (i) Introduction to Quantum Mechanics for Engineers – For EEE, CSE (ii) Semiconductor Optoelectronics – For ECE (iii) Mechanics of Solid – For Civil, ME, MEMS (iv) Optics & Fiber Optics – For Chemical Engineering				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester II**
	2	**1**	**0**	**3**	
Pre-requisites	Mathematics course on differential equations and linear algebra Introduction to Electromagnetic Theory Semiconductor Physics				

Physics-II

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INTRODUCTION TO QUANTUM MECHANICS FOR ENGINEERS For EEE, CSE
38 Lectures

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Module 1: Wave nature of particles and the Schrodinger equation 8 Lectures
Introduction to Quantum mechanics, Wave nature of Particles, Time-dependent and time independent Schrodinger equation for wave function, Born interpretation, probability current, Expectation values, Free-particle wave function and wave-packets, Uncertainty principle

Module 2: Mathematical Preliminaries for quantum mechanics 5 Lectures
Complex numbers, Linear vector spaces, inner product, operators, eigenvalue problems, Hermitian operators.

Module 3: Applying the Schrodinger equation 7 Lectures
Solution of stationary-state Schrodinger equation for one dimensional problems– particle in a box, square-well potential, linear harmonic oscillator.

Module 4: Bound Quantum States **10 Lectures**

Numerical solution of stationary-state Schrodinger equation for one dimensional problems for different potentials Scattering from a potential barrier and tunneling. Three-dimensional problems: particle in three dimensional box, Angular momentum operator, Rigid Rotor, Hydrogen atom ground-state, orbitals, interaction with magnetic field.

Module 5: Introduction to solids **8 Lectures**

Free electron theory of metals, Fermi level, density of states, Application to white dwarfs and neutron stars, Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands.

Text book:

- Eisberg and Resnick, Introduction to Quantum Physics Publisher New York: Wiley. Collection printdisabled

Reference Books:

- Introduction to Quantum mechanics, Nikhil Ranjan Roy, 2016, Vikash Publishing House Pvt. Ltd.
- Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
- Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan

COURSE OUTCOMES

Students to learn the basics of Quantum mechanics and its application to bound states.
To understand the wave particle duality.
To familiarize with the molecular bonding, free electron theory and periodic potentials in solids.

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SEMICONDUCTOR OPTOELECTRONICS **For ECE**
36 Lectures

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Module 1: Review of semiconductor physics **10 Lectures**
E-k diagram, Density of states, Occupation probability, Fermi level; p-n junction, Metal-semiconductor junction (Ohmic and Schottky); Carrier transport, generation, and recombination; Semiconductor materials of interest for optoelectronic devices, band gap modification, hetero structures; Light semiconductor interaction: Rates of optical transitions, joint density of states, condition for optical amplification.

Module 2: Semiconductor light emitting diodes (LEDs) **06 Lectures**
Rate equations for carrier density, Radiative and non-radiative recombination mechanisms in semiconductors, LED: device structure, materials, characteristics, and figures of merit.

Module 3: Semiconductor lasers **08 Lectures**
Rate equations for carrier- and photon-density, and their steady state solutions, Laser dynamics, Relaxation oscillations, Input-output characteristics of lasers. Semiconductor laser: structure, materials, device characteristics, and figures of merit.

Module 4: Photo-detectors **06 Lectures**
Types of semiconductor photodetectors -p-n junction, PIN, and Avalanche -- and their structure, materials, working principle, and characteristics, Solar cells.

Module 5: **Low-dimensional optoelectronic devices** **06 Lectures**
Quantum-well, -wire, and -dot based LEDs, lasers, and photo-detectors.

References:

- J. Singh, Semiconductor Optoelectronics: Physics and Tech., McGraw-Hill Inc. (1995).
- B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons,
- S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
- Yariv and P. Yeh, Photonics: Optical Electronics in Mod. Comm, OUP, NY (2007).
- P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
- Online course: “Semiconductor Optoelectronics” by M R Shenoy on NPTEL
- Online course: "Optoelectronic Materials & Devices" by Monica Katiyar & Deepak Gupta on NPTEL

COURSE OUTCOME

Students to review the concepts of semiconductor physics.
To learn about the semiconductor LEDs and semiconductor Lasers.
To have the understanding of photo detectors and low dimensional optoelectronic devices.

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MECHANICS OF SOLIDS **For Civil, ME, MEMS**
40 Lectures

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Module 1: Statics **10 Lectures**

Free body diagrams on modelling of typical supports and joints; Condition for equilibrium in three- and two- dimensions; Friction: limiting and non-limiting cases; Force displacement relationship; Geometric compatibility for small deformations.

Module 2: Stress and Strain at a point **6 Lectures**

Concept of stress at a point; Planet stress: transformation of stresses at a point, principal stresses and Mohr's circle; Displacement *field; Concept of strain at a point; Planet strain:* transformation of strain at a point, principal strains and Mohr's circle.

Module 3: Material behavior **7 Lectures**

One- dimensional material behaviour; Concepts of elasticity, plasticity, strain hardening, failure (fracture / yielding); Idealization of one dimensional stress-strain curve; Generalized Hooke's law with and without thermal strains for isotropic materials.

Module 4: Force analysis **8 Lectures**

Force analysis — axial force, shear force, bending moment and twisting moment diagrams of slender members (without using singularity functions);; Moment curvature relationship for pure bending of beams with symmetric cross-section; Bending stress; Shear stress; Cases of combined stresses;

Module 5: Strain energy **9 Lectures**

Concept of strain energy; Yield criteria; De*flection due to bending; Integration of* the moment-curvature relationship for simple boundary conditions; Method of superposition (without using singularity functions); Strain energy and complementary strain energy for simple structural elements (i.e. those under axial load, shear force, bending moment and torsion).

Reference books:

- An Introduction to the Mechanics of Solids, 2nd ed. with SI Units - SH Crandall, NC
- Dahl & TJ Lardner

- Engineering Mechanics: Statics, 7th ed. — JL Meriam
- Engineering Mechanics of Solids — EP Popov

COURSE OUTCOME

To familiarize students of civil and mechanical engineering with the understanding of the elastic and plastic behavior of solids.
To understand the importance of stress and strain at a point on solid.
To be able to do force analysis and understand strain energy of solid.

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OPTICS AND FIBER OPTICS **For Chemical Engineering**
36 Lectures

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Module 1: Interference **07 Lectures**

Introduction to interference and example, Theory of fringes, Analytical treatment of interference, Displacement of fringes, Thin film, Newton's Ring, Wedge shaped film.

Module 2: Diffraction **06 Lectures**

concept of diffraction, Fraunhoffer and Fresnel diffraction, Fraunhoffer diffraction at single slit, double slit, and multiple slits; diffraction grating, characteristics of diffraction grating and its applications, Limit of Resolution, Resolving power of grating.

Module 3: Polarisation **06 Lectures**

Introduction, plane of polarization, plane of vibration, polarisation by reflection: Brewester's Law, polarisation by refraction: Malus' Law, polarisation by double refraction, scattering of light, circular and elliptical polarisation, optical activity.

Module 4: Fibre Optics **07 Lectures**

Introduction, optical fibre as a dielectric wave guide: total internal reflection, numerical aperture and various fibre parameters, losses associated with optical fibres, step and graded index fibres, application of optical fibres.

Module 5: **Lasers** **10 Lectures**

Introduction to interaction of radiation with matter, Stimulated and spontaneous emission, Einstein's coefficient, principles and working of laser: population inversion, pumping, various modes, threshold population inversion, three level and four level laser, types of laser: solid state, semiconductor, gas; application of lasers.

Reference Books

- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill

COURSE OUTCOMES

To understand the optical phenomenon of interference, diffraction and polarization,

To get familiarize with fiber optics and laser, their basic concept and application in engineering.

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<table>
<tr><td>Course Code</td><td colspan="5">BSC 102</td></tr>
<tr><td>Category</td><td colspan="5">Basic Science Course</td></tr>
<tr><td>Course Title</td><td colspan="5">Chemistry-I
Contents
(i) Chemistry-I (Concepts in chemistry for engineering)
(ii) Chemistry Laboratory</td></tr>
<tr><td rowspan="2">Scheme & Credits</td><td>L</td><td>T</td><td>P</td><td>Credit</td><td rowspan="2">Semester I</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Knowledge of intermediate level chemistry</td></tr>
</table>

CHEMISTRY-I

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CONCEPTS IN CHEMISTRY FOR ENGINEERING 42 Lectures

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Module 1: Atomic and molecular structure 12 lectures

Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Module 2: Spectroscopic techniques and applications 8 lectures

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

Module 3: Intermolecular forces and potential energy surfaces 4 lectures

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.

Module 4: Use of free energy in chemical equilibria 6 lectures

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Waterchemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Module 5: Periodic properties and Stereochemistry **8 Lectures**

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

Module 6: Organic reactions and synthesis of a drug molecule **4 lectures**

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Books:

- University chemistry, by B. H. Mahan
- Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
- Fundamentals of Molecular Spectroscopy, by C. N. Banwell
- Engg Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
- Physical Chemistry, by P. W. Atkins
- Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

COURSE OUTCOMES

The concepts developed in this course will aid in quantification of several concepts in chemistry hat have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalise bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- List major chemical reactions that are used in the synthesis of molecules.

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CHEMISTRY LABORATORY **Code: BSC 102P**

Choice of 08-10 experiments from the following:

- Determination of surface tension and viscosity
- Thin layer chromatography
- Ion exchange column for removal of hardness of water
- Determination of chloride content of water
- Colligative properties using freezing point depression
- Determination of the rate constant of a reaction
- Determination of cell constant and conductance of solutions
- Potentiometry - determination of redox potentials and emfs
- Synthesis of a polymer/drug
- Saponification/acid value of an oil
- Chemical analysis of a salt
- Lattice structures and packing of spheres
- Models of potential energy surfaces
- Chemical oscillations- Iodine clock reaction
- Determination of the partition coefficient of a substance between two immiscible liquids
- Adsorption of acetic acid by charcoal
- Use of the capillary visco meters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

LABORATORY OUTCOMES

- The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:
- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Synthesize a small drug molecule and analyse a salt sample

<table>
<tr><td>Course Code</td><td colspan="5">ESC 103</td></tr>
<tr><td>Category</td><td colspan="5">Engineering Science Course</td></tr>
<tr><td>Course Title</td><td colspan="5">Programming for Problem Solving</td></tr>
<tr><td rowspan="2">Scheme & Credits</td><td>L</td><td>T</td><td>P</td><td>Credit</td><td rowspan="2">Semester II</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Basic Knowledge of Computer and Mathematics</td></tr>
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PROGRAMMING FOR PROBLEM SOLVING 40 Lectures

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Module 1: Introduction to Programming **6 lectures**

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Module 2: Arithmetic expressions and precedence **12 lectures**

Conditional Branching and Loops Writing and evaluation of conditionals and consequent branching**,** Iteration and loops

Module 3: Arrays **3 Lectures**

Arrays (1-D, 2-D), Character arrays and Strings

Module 4: Basic Algorithms, Searching, Basic Sorting Algorithms **4 lectures**

(Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Module 5: Function and Pointers **6 lectures**

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference

Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation).

Module 6: Recursion and Structure **9 lectures**

Recursion, as a different way of solving problems. Example programs, such as Finding, Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Structures, Defining structures and Array of Structures

Suggested Text Books

- Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
- E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Suggested Reference Books

- Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

COURSE OUTCOMES

The student will learn

To formulate simple algorithms for arithmetic and logical problems.

To translate the algorithms to programs (in C language).

To test and execute the programs and correct syntax and logical errors.

To implement conditional branching, iteration and recursion.

To decompose a problem into functions and synthesize a complete program using divide and conquer approach.

To use arrays, pointers and structures to formulate algorithms and programs.

To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.

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LABORATORY - PROGRAMMING FOR PROBLEM SOLVING Code: ESC103P

[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.]

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:
Lab 7: Simple functions

Tutorial 8 & 9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures

Tutorial 12: File handling:
Lab 12: File operations

LABORATORY OUTCOMES

To formulate the algorithms for simple problems.

To translate given algorithms to a working and correct program.

To be able to correct syntax errors as reported by the compilers.

To be able to identify and correct logical errors encountered at run time.

To be able to write iterative as well as recursive programs.

To be able to represent data in arrays, strings and structures and manipulate them through a program.

To be able to declare pointers of different types and use them in defining self referential structures.

To be able to create, read and write to and from simple text files.

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Course Code	**ESC 104**				
Category	**Engineering Science Course**				
Course Title	**Workshop/Manufacturing Practices** **(Theory & Lab)**				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester II**
	1	**0**	**4**	**3**	
Pre-requisites	Basic Knowledge of Physics, Chemistry and Mathematics				

WORKSHOP/MANUFACTURING PRACTICES 10 Lectures

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lectures)**
2. CNC machining, Additive manufacturing **(1 lecture)**
3. Fitting operations & power tools **(1 lecture)**
4. Electrical & Electronics **(1 lecture)**
5. Carpentry **(1 lecture)**
6. Plastic Moulding, glass cutting **(1 lecture)**
7. Metal casting **(1 lecture)**
8. Welding (arc welding & gas welding), brazing **(1 lecture)**

Suggested Text/Reference Books:

- Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “Elements of Workshop Technology”, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
- Kalpakjian S. And Steven S. Schmid, “Manufacturing Engineering and Technology”, 4th edition, Pearson Education India Edition, 2002.
- Gowri P. Hariharan & A. Suresh Babu, “Mfg. Tech- I” Pearson Education, 2008.
- Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, PHl, 1998.
- Rao P.N., “Manufacturing Technology”, Vol. I & Vol. II, Tata McGrawHill House, 2017.

COURSE OUTCOMES

Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

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WORKSHOP PRACTICE **60 Lectures**

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1. Machine shop **(10 hours)**
2. Fitting shop **(8 hours)**
3. Carpentry **(6 hours)**
4. Electrical & Electronics **(8 hours)**
5. Welding shop **(8 hours (Arc welding 4 hrs + gas welding 4 hrs))**
6. Casting **(8 hours)**
7. Smithy **(6 hours)**
8. Plastic Moulding & Glass Cutting **(6 hours)**

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

LABORATORY OUTCOMES

- Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- By assembling different components, they will be able to produce small devices of their interest.

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Course Code	HSMC 101				
Category	Humanities and Social Sciences including Management Courses				
Course Title	English				
Scheme & Credits	L	T	P	Credit	Semester II
	2	0	2	3	
Pre-requisites	Basic Knowledge of English grammar and composition				

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ENGLISH 38 Lectures

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Module 1: Vocabulary Building 6 lecture

The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms and standard abbreviations.

Module 2: Basic Writing Skills 6 lectures

Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely.

Module 3: Identifying Common Errors in Writing 7 lectures

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés.

Module 4: Nature and Style of sensible Writing 6 lectures

Describing, Defining, Classifying, Providing examples or evidence, Writing introduction and conclusion

Module 5: Writing Practices 6 lectures

Comprehension, Précis Writing, Essay Writing,

Module 6: Oral Communication 7 lectures

(This unit involves interactive practice sessions in Language Lab)

Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday, Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations.

Suggested Readings:

- Practical English Usage. Michael Swan. OUP. 1995.
- Remedial English Grammar. F.T. Wood. Macmillan.2007
- On Writing Well. William Zinsser. Harper Resource Book. 2001
- Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
- Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
- Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

COURSE OUTCOMES

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

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A Guide to Induction Program

Mandatory Induction Program

3 weeks duration
• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

1 Introduction

(Induction Program was discussed and approved for all colleges by AICTE in March 2017.It was discussed and accepted by the Council of IITs for all IITs in August 2016. It was originally proposed by a Committee of IIT Directors and accepted at the meeting of all IIT Directors in March 2016. This guide has been prepared based on the Report of the Committee of IIT Directors and the experience gained through its pilot implementation in July 2016 as accepted by the Council of IITs. Purpose of this document is to help institutions in understanding the spirit of the accepted Induction Program and implementing it.)

Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond.

The graduating student must have knowledge and skills in the area of his study. However, he must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he would understand and fulfill his responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.

There is a mad rush for engineering today, without the student determining for himself his interests and his goals. This is a major factor in the current state of demotivation towards studies that exists among UG students.

The success of gaining admission into a desired institution but failure in getting the desired branch, with peer pressure generating its own problems, leads to a peer environment that is demotivating and corrosive. Start of hostel life without close parental supervision at the same time, further worsens it with also a poor daily routine.

To come out of this situation, a multi-pronged approach is needed. One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character.

2 Induction Program

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Precious little is done by most of the institutions, except for an orientation program lasting a couple of days.

We propose a 3-week long induction program for the UG students entering the institution, right at the start. Normal classes start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

2.1 Physical Activity

This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 6 am for light physical exercise or yoga. There would also be games in the evening or at other suitable times according to the local climate. These would help develop team work. Each student should pick one game and learn it for three weeks. There could also be gardening or other suitably designed activity where labour yields fruits from nature.

2.2 Creative Arts

Every student would chose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

2.3 Universal Human Values

It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base.

Methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values.

The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Experiments in this direction at IIT (BHU) are noteworthy and one can learn from them.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program.

Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

2.4 Literary

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

2.5 Proficiency Modules

This period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

2.6 Lectures by Eminent People

This period can be utilized for lectures by eminent people, say, once a week. It would give the students exposure to people who are socially active or in public life.

2.7 Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

2.8 Familiarization to Dept./Branch & Innovations

The students should be told about different method of study compared to coaching that is needed at IITs. They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

3 Schedules

The activities during the Induction Program would have an Initial Phase, a Regular Phase and a Closing Phase. The Initial and Closing Phases would be two days each.

3.1 Initial Phase

Time	*Activity*
Day 0	
Whole day	*Students arrive - Hostel allotment. (Preferably do pre-allotment)*
Day 1	
09:00 am - 03:00 pm	*Academic registration*
04:30 pm - 06:00 pm	Orientation
Day 2	
09:00 am - 10:00 am	Diagnostic test (for English etc.)
10:15 am - 12:25 pm	Visit to respective depts.
12:30 pm - 01:55 pm	*Lunch*
02:00 pm - 02:55 pm	Director's address
03:00 pm - 05:00 pm	Interaction with parents
03:30 pm - 05:00 pm	Mentor-mentee groups - Introduction within group. (Same as Universal Human Values groups)

3.2 Regular Phase

After two days is the start of the Regular Phase of induction. With this phase there would be regular program to be followed every day.

3.2.1 Daily Schedule

Some of the activities are on a daily basis, while some others are at specified periods within the Induction Program. We first show a typical daily timetable.

Sessn.	*Time*	*Activity*	*Remarks*
	Day 3 onwards		
	06:00 am	*Wake up call*	
I	06:30 am - 07:10 am	Physical activity (mild exercise/yoga)	
	07:15 am - 08:55 am	*Bath, Breakfast, etc.*	
II	09:00 am - 10:55 am	Creative Arts / Universal Human Values	Half the groups do Creative Arts
III	11:00 am - 12:55 pm	Universal Human Values / Creative Arts	Complementary alternate
	01:00 pm - 02:25 pm	*Lunch*	
IV	02:30 pm - 03:55 pm	Afternoon Session	See below.
V	04:00 pm - 05:00 pm	Afternoon Session	See below.
	05:00 pm - 05:25 pm	*Break / light tea*	
VI	05:30 pm - 06:45 pm	Games / Special Lectures	
	06:50 pm - 08:25 pm	*Rest and Dinner*	
VII	08:30 pm - 09:25 pm	Informal interactions (in hostels)	

Sundays are off. Saturdays have the same schedule as above or have outings.

3.2.2 Afternoon Activities (Non-Daily)

The following five activities are scheduled at different times of the Induction Program, and are not held daily for everyone:

1. Familiarization to Dept./Branch & Innovations
2. Visits to Local Area
3. Lectures by Eminent People
4. Literary
5. Proficiency Modules

Here is the approximate activity schedule for the afternoons (may be changed to suit local needs):

Activity	*Session*	*Remarks*
Familiarization with Dept/Branch & Innovations	IV	For 3 days (Day 3 to 5)
Visits to Local Area	IV, V and VI	For 3 days - interspersed (e.g., 3 Saturdays)
Lectures by Eminent People	IV	As scheduled - 3-5 lectures
Literary (Play / Book Reading / Lecture)	IV	For 3-5 days
Proficiency Modules	V	Daily, but only for those who need it

3.3 Closing Phase

Time	*Activity*
Last But One Day	
08:30 am - 12 noon	Discussions and finalization of presentation within each group
02:00 am - 05:00 pm	Presentation by each group in front of 4 other groups besides their own (about 100 students)
Last Day	
Whole day	Examinations (if any). May be expanded to last 2 days, in case needed.

3.4 Follow Up after Closure

A question comes up as to what would be the follow up program after the formal 3-week Induction Program is over? The groups which are formed should function as mentor mentee network. A student should feel free to approach his faculty mentor or the student guide, when facing any kind of problem, whether academic or financial or psychological etc. (For every 10 undergraduate first year students, there would be a senior student as a *student guide*, and for every 20 students, there would be a *faculty mentor*.) Such a group should remain for the entire 4-5 year duration of the stay of the student. Therefore, it would be good to have groups with the students as well as teachers from the same department/discipline. Here we list some important suggestions which have come up and which have been experimented with.

3.4.1 Follow Up after Closure – Same Semester

It is suggested that the groups meet with their faculty mentors once a month, within the semester after the 3-week Induction Program is over. This should be a scheduled meeting shown in the timetable. (The groups are of course free to meet together on their own more often, for the student groups to be invited to their faculty mentor's home for dinner or tea, nature walk, etc.)

3.4.2 Follow Up – Subsequent Semesters

It is extremely important that continuity be maintained in subsequent semesters. It is suggested that at the start of the subsequent semesters (up to fourth semester), three days be set aside for three full days of activities related to follow up to Induction Program. The students be shown inspiring films, do collective art work, and group discussions be conducted. Subsequently, the groups should meet at least once a month.

4 Summary

Engineering institutions were set up to generate well trained manpower in engineering with a feeling of responsibility towards oneself, one's family, and society. The incoming undergraduate students are driven by their parents and society to join engineering without understanding their own interests and talents. As a result, most students fail to link up with the goals of their own institution. The graduating student must have values as a human being, and knowledge and met skills related to his/her profession as an engineer and as a citizen. Most students, who get demotivated to study engineering or their branch, also lose interest in learning. The *Induction Program* is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing competition and making them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and building of character. The *Universal Human Values* component, which acts as an anchor, develops awareness and sensitivity, feeling of equality, compassion and oneness, draw attention to society and nature, and character to follow through. It also makes them reflect on their relationship with their families and extended family in the college (with hostel staff and others). It also connects students with each other and with teachers so that they can share any difficulty they might be facing and seek help.

Course Code	**BSC102**				
Category	**Basic Science Course**				
Course Title	**Chemistry-I** **Contents** **(i)Chemistry-I (Concepts in Chemistry for Engineering)** **(ii)Chemistry Laboratory**				
Scheme& Credits	**L**	**T**	**P**	**Credit**	**Semester I**
	3	**1**	**0**	**4**	
Pre-requisites	**Knowledge of Intermediate Level Chemistry**				

CHEMISTRY-I

CONCEPTS IN CHEMISTRY FOR ENGINEERING **42 Lectures**

Module-1: Atomic and molecular structure [10Lectures]

Schrodinger equation. Particle in box solutions and their applications for conjugated molecules. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Module-2 : Spectroscopic techniques and applications [6 Lectures]

Principles and Applications of Electronic spectroscopy and Nuclear magnetic resonance. Vibrational and rotational spectroscopy of diatomic molecules and its applications. Fluorescence and its applications in Medicine. Surface Characterisation Techniques (Scanning Electron Microscopy and Transmission Electron Microscopy)

Module-3: Intermolecular forces [4 lectures]

Ionic, dipolar and van Der Waals interactions. Measurement of non-covalent interaction, Hydrogen bond, Equations of state of real gases and critical phenomena.

Module: 4: Use of free energy in chemical equilibria [8 Lectures]

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Corrosion: Introduction, Causes, consequences, Mechanism, Laws of Dry Corrosion, Wet Corrosion , Factors Influencing Corrosion, Protective measures against corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Module-5: Periodic properties and Stereochemistry [8 Lectures]

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases.

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Module-6: Polymer [6 lectures]

Classification of polymers, Mechanism of Polymerisation, structure-property relationship, conductive polymers.

Books

- University Chemistry, by B.H.Mahan
- Chemistry, Second Edition, By Prasanta Ratha and S. Chakroborty –Cengage pub
- Engineering Chemistry by Jaya Shree Anireddy, Wiley publication
- Text book of Engineering Chemistry , First Ed.2019, By Sashi Chawala, Dhanpat Rai, publication
- Chemistry: Principles and Applications, by M.J.Sienko and R.A.Plane
- Fundamentals of molecular Spectroscopy, by C.N.Banwell
- Engg Chemistry(NPTEL Web Book),by B.L.Tembe, Kamaluddin and M.S.Krishnan
- Physical Chemistry, by P.W.Atkins
- Organic Chemistry: Structure and Function by K.P.C. Volhardt and N.E. Schore, 5th Edition http://bcs.whfreeman.com/volhardtschore5e/default.asp

COURSE OUTCOMES

The concepts develops in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasing based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometer levels; one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

- Analyse microscope chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalise bulk properties and processes using thermodynamics considerations.
- Distinguish the range of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscope techniques
- Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- Apply the concept and mechanism of polymerization

CHEMISTRY LABORATORY Code: BSC 102P

Choice of 06-08 experiments from the following

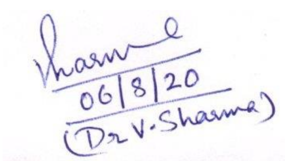
1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Preparation of a metal complex
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Synthesis of a polymer/drug
10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Lattice structures and packing of spheres
13. Redox-titration (Estimation of Iron using permanganometry)
14. Chemical oscillations- Iodine clock reaction

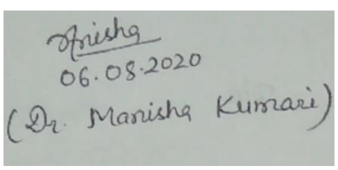
15. Determination of the partition coefficient of a substance between two immiscible liquids
16. Adsorption of acetic acid by charcoal
17. Use of the capillary viscometers to demonstrate the isoelectric point as the pH of minimum viscosity for gelatin sols and/ or coagulation of the white part of egg.

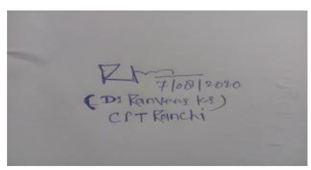
LABORATORY OUTCOMES

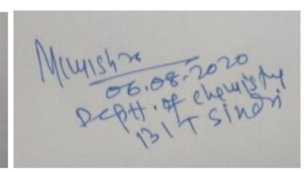
The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:

- Estimate rate constants of reactions from concentration of reactants/ products as a function of time.
- Measure molecular/ system properties such a surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
- Synthesize a small drug molecule and analyse a salt sample









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<tr><td>Category</td><td colspan="5">Basic Science Course</td></tr>
<tr><td>Course Title</td><td colspan="5">Mathematics-I</td></tr>
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Mathematics I: New Syllabus JUT for All Branches except CSE and IT

Module1: Function of one variable: Successive Differentiation, Leibnitz Theorem, Expansion of a function into Taylors and Maclaurin's Series. Function of two or more variables: Partial derivatives; Euler's Theorem; Taylor's Expansion. Maxima & Minima of a function of two variables, Lagrange's method of undetermined multipliers. **(10 L/ 2.5Q)**

Module 2: Reduction formula for integrals. Improper integrals and its convergence; Beta and Gamma functions and their properties. Differentiation under integral sign. Applications of integrals as length, area, volume and surface area of revolution. **(8 L/ 1.5Q)**

Module 3: Matrices- Rank of a matrix (Echelon form and Normal form), System of linear equations; consistency and inconsistency, Eigen values and eigenvectors; Diagonalization of square matrices; Cayley-Hamilton Theorem. **(8L/ 1Q)**

Module 4: First order ordinary Differential Equations: Exact, Linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. **(8 L/ 1Q)**

Module 5: Infinite Series: Convergence of series; Comparison test, P Test, Cauchy's nth Root test, D Alembert's Ratio Test, Rabies Test, Logarithmic test. **(6 L/ 1Q)**

Note:- Question no. 1 will be objective type and compulsory comprising of the whole syllabus with seven sub-parts.

Mathematics I: New Syllabus JUT for CSE and IT Students

Module 1: Functions of one variable: Successive Differentiation, Leibnitz Theorem, Expansion of function into Taylors and Maclaurin's Series. Functions of two or more variable: Partial derivatives; Euler's Theorem; Taylor's Expansion. Maxima, minima of function of two variables. Lagrange method of undetermined multipliers. **(10 L/ 2Q)**

Module 2: Reduction formula for integrals. Improper integrals and its convergence; Beta and Gamma functions and their properties. Differentiation under integral sign. Applications of integrals as length, area, volume and surface area of revolution. **(8 L/ 1Q)**

Module 3: Vector Space: Vector addition and scalar multiplication, linear dependence and independence of vectors, basis, dimension; Linear transformations , range and kernel of a linear mapping, rank and nullity, Inverse of a linear transformation, rank nullity theorem, composition of linear maps, Matrix associated with a linear mapping. **(10 L/ 2Q)**

Module 4: Matrices: Rank of a matrix, solution of system of linear equations, consistency and inconsistency, Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem. Inner product spaces, Gram-Schmidt orthogonalization. **(8 L/ 1Q)**

Module 5: First order ordinary Differential Equations: Exact, Linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. **(6 L/ 1Q)**

Note:- Question no. 1 will be objective type and compulsory comprising of the whole syllabus with seven sub-parts.

Course Code	**BSC 202**				
Category	**Basic Science Course**				
Course Title	**Mathematics-II**				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester II**
	3	**1**	**0**	**4**	

Mathematics II: New Syllabus JUT for All Branches except CSE & IT

Module 1: Multivariable Integral Calculus: Double and Triple integrals, Evaluation of double integrals, change of order of integration, change of variables, Evaluation of Triple integrals, Simple applications involving areas, volumes. **(8 L/ 1Q)**

Module 2: Vector Calculus: Scalar and Vector point functions. Directional derivative, Gradient, divergence and curl. Line integrals, Surface integrals, Volume integrals, Green's theorem, Stokes theorem and Gauss divergence theorem (without proofs). **(10 L/ 2Q)**

Module 3: Higher order linear differential equations with constant and variable coefficients, Method of variation of parameters, Cauchy's and Legendre's linear equations, Simultaneous linear equations, Series solutions of differential equations, Bessel and Legendre's equations and its solution(without proof). Elementary properties of Bessel function and Legendre's polynomial. **(10 L/ 2Q)**

Module 4: Complex Variable - Differentiation:

Differentiation, Cauchy-Riemann equations, Analytic functions, Harmonic functions, finding harmonic conjugate; Conformal mappings, Mobius transformations and their properties.

(6 L/ 1Q)

Module 5: Complex Variable - Integration:

Contour integrals, Cauchy Integral Theorem, Cauchy Integral formula (without proof)and for derivatives also, zeros of analytic functions, singularities, Taylor's series, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine. **(8 L/ 1Q)**

Note :- Question no. 1 will be objective type and compulsory comprising of the whole syllabus with seven sub-parts.

Mathematics II: New Syllabus JUT for CSE and IT Students

Module 1: Multivariable Integral Calculus: Double and Triple integrals, Evaluation of double integrals, change of order of integration, change of variables, Evaluation of Triple integrals, Simple applications involving areas, volumes. **(8 L/ 1Q)**

Module 2: Vector Calculus: Scalar and Vector point functions. Directional derivative, Gradient, divergence and curl. Line integrals, Surface integrals, Volume integrals, Green's theorem, Stokes theorem and Gauss divergence theorem (without proofs). **(10 L/ 2Q)**

Module 3: Ordinary differential equations of higher orders: Higher order linear differential equations with constant and variable coefficients, Cauchy's and Legendre's linear equations. Method of variation of parameters. Simultaneous linear equations. **(6 L/ 1Q)**

Module 4: Probability and Statistics: Random variables: Discrete and continuous random variables, probability mass function, probability density function and commutative distribution functions. Mathematical expectation, variance, moment and moment generating function. Binomial, Poisson, Normal and Exponential distributions.

(8 L/ 1.5Q)

Module 5: Complex Variable - Differentiation: Differentiation, Cauchy-Riemann equations, Analytic functions, Harmonic functions, finding harmonic conjugate;

Complex Variable - Integration: Contour integrals, Cauchy Integral Theorem, Cauchy Integral formula(without proof) and for derivatives also, zeros of analytic functions, singularities, Taylor's series, Laurent's series; Residues, Cauchy Residue theorem (without proof). **(6 L/ 1.5Q)**

Note :- Question no. 1 will be objective type and compulsory comprising of the whole syllabus with seven sub-parts.

CURRICULUM

FOR

FIRST YEAR

UNDERGRADUATE DEGREE COURSES

IN

ENGINEERING & TECHNOLOGY

Jharkhand University of Technology

Ranchi, India

2020-21 Onwards

Course Code	**BSC 101**				
Category	**Basic Science Course**				
Course Title	**Physics-I**				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester I**
	3	**1**	**0**	**4**	
Pre-requisites	Mathematics course with vector calculus, differential equations and linear algebra; Physics course up to 10+2 level				

Module 1:Harmonic Oscillation **6 Lectures**

Simple harmonic motion, damped and forced simple harmonic oscillator with examples, damped harmonic oscillator – heavy, critical and light damping, Amplitude and energy decay in a damped harmonic oscillator. Forced oscillation and resonance condition.

Module 2: Wave optics **8 Lectures**

Superposition of waves, Interference, thin film interference and Newton's ring, Diffraction of light, Diffraction due to single slit, double slits, Unpolarized& Polarized light, Polarization of wave, Production of polarized wave: Brewster's law, Malus' law, Double refraction, Retardation plate, Analysis of polarization.

Module 3: Vector Calculus **6 Lectures**

Scalar & Vector field, Gradient of scalar field, Divergence & Curl of Vector field, Gauss' Divergence theorem, Stokes' theorem.

Module 4: Electrostatics **7 Lectures**

Laplace's and Poisson's equations for electrostatic potential, Uniqueness theorem. Electric polarization; Relation between **D**, **E** and **P** Electric displacement and boundary conditions; Dielectric sphere in uniform electric field.

Module 5: Magnetostatics **7 Lectures**

Biot-Savart's law and applications, Three magnetic vector **B**, **H** and **M** andrelation between them; Boundary conditions on **B** and **H**. magnetic susceptibility, diamagnetic, paramagnetic and ferromagnetic materials. Hysteresis loop Hysteresis loss and its application.

Module 6: Maxwell's equations & EMW **8 Lectures**

Continuity equation for current densities; Ampere's law and its modification, Differential and integral forms of Maxwell's equation, Maxwell's equation in vacuum and non-conducting medium; The wave equation; Plane electromagnetic waves in vacuum, transverse character, relation between electric and magnetic fields of an electromagnetic wave; Energy in an electromagnetic field and Poynting theorem.

Text Book:

- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.

Reference books:

- Fundamentals of Physics Electricity and Magnetism, Halliday and Resnick, tenth edition (published 2013).
- Electricity, magnetism and light, W. Saslow, 1st edition
- Electromagnetic Theory, Singh and Prasad, I. K. International Publication, 1/e
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- Optics, AjoyGhatak, 2008, Tata McGraw Hill
- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Engineering physics, Gaur and Gupta, DhanpatRai Publications
- Modern engineering physics, A. S. Vasudeva, S Chand & Company Ltd

COURSE OUTCOMES

Students to get familiarize with the knowledge of harmonic oscillation and wave optics.

To make student understand the basic of electrostatics and magneto statics in vacuum and in material medium.

Students to get familiarized with the vector calculus and Maxwell's equation leading to the application of EMW in vacuum and in media...
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PHYSICS LABORATORY **Code: BSC101P**

Course Code	**BSC 101P**				
Category	**Basic Science Course**				
Course Title	**Physics Lab**				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester I**
	0	**0**	**3**	**1.5**	

Choice of 08-10 experiments from the following:

- Experiments on electromagnetic induction and electromagnetic breaking;
- Study of LCR circuits
- Magnetic field from Helmholtz coil
- Coupled oscillators
- Experiment on moment of inertia measurement
- Experiments with gyroscope
- Resonance phenomena in mechanical oscillators
- Frank-Hertz experiment
- Photoelectric effect experiment
- Diffraction (from ordinary light or laser pointers)
- interference experiment (from ordinary light or laser pointers)
- Minimum deviation, refractive index and dispersive power of material of a prism
- Study of variation of resistance due to heating effect
- Study of variation of magnetic field along the axis of current carrying coil.
- Use of Carey-Foster bridge
- Measurement of numerical aperture of optical fibre

Text Book:

- Text Book of Practical Physics, Dr. S. K. Ghosh, New Central Book Agency (P.) Ltd., 2000.

Reference books:

- Laboratory Manual in Applied Physics, Hannah Sathyaseelam, New Age International Pvt. Ltd.
- B.Sc. Practical Physics, C.L. Arora, S. Chand Publication.
- Practical optics, NattalyMenn, Elsevier Publication

LABROTARY OUTCOMES

Students to have hands on experience with experiments on the basic laws and principles of Physics in the field of Mechanics, Optics, Electricity, Magnetism, Modern Physics, etc.

Course Code	BSC 201				
Category	Basic Science Course				
Course Title	Physics II				
Scheme & Credits	L	T	P	Credit	Semester II
	3	1	0	4	
Pre-requisites	Mathematics course on differential equations and linear algebra; Introduction to Modern Physics				

Physics-II

Module 1: Basic Quantum Mechanics 08 Lectures

Inadequacy of Classical Mechanics, Introduction to quantum physics, black body radiation; explanation using the photon concept; photoelectric effect: Stopping Potential, Work Function, Einstein's photo electric equation, Compton Effect: Compton Shift.

Module 2:Wave particle duality and bound states 10 Lectures

de Broglie hypothesis, wave-particle duality, Bragg's Law, Davision and Germer's experiment; Phase velocity, group velocity and relation between phase, group and particle velocity, uncertainty principle- mathematical Illustration, Determination of minimum energy of harmonic oscillator, Non existence of electron within a nucleus.

Wave function and Born's interpretation of the wave function, Schrodinger wave equation: time dependent and independent form, eigen value and eigen function, normalization of wave function, particle in a box- one and three dimensional box, Linear harmonic oscillator.

Module 3: Theory of relativity 08 Lectures

Frame of reference, inertial and non-inertial frames, postulates of special theory of relativity, Galilean Transformation, Michelson Morley experiment, Lorentz transformation, length contraction, time dilation, relativistic variation of mass, addition of velocity, mass-energy equivalence

Module 4: Fibre Optics 08 Lectures

Introduction of optical fibre as a dielectric wave guide: total internal reflection, numerical aperture and various fibre parameters, losses associated with optical fibres, step and graded index fibres, application of optical fibres.

Module 5: Lasers 08 Lectures

Introduction to interaction of radiation with matter, Stimulated and spontaneous emission, Einstein's coefficient, principles and working of laser: population inversion, pumping, various modes, threshold population inversion, three levels and four level laser, types of laser: Ruby laser and He- Ne laser; application of lasers.

Text book:

- Eisberg and Resnick, Introduction to Quantum PhysicsPublisher New York: Wiley. Collection

Reference Books:

- Introduction to Quantum mechanics, Nikhil Ranjan Roy, 2016, Vikash Publishing House Pvt. Ltd.
- Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
- Quantum Mechanics: Theory & Applications, A.K.Ghatak&S.Lokanathan, 2004, Macmillan
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
- Introduction to Special theory of Relativity, Robert Resnick, John Wiley & Sons
- Concept of Modern Physics, Arthur Beiser,2002, McGraw-Hill
- Engineering Physics, Gaur and Gupta, DhanpatRai Publications
- Modern Engineering Physics, A. S. Vasudeva, S Chand & Company Ltd

COURSE OUTCOMES

Students to learn the basics of Quantum mechanics and its application to bound states.

To understand the wave particle duality.

To be able to understand Special theory of relativity and its consequences.

To get familiarize with fiber optics and laser, their basic concept and application in engineering.

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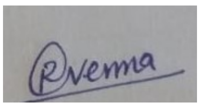
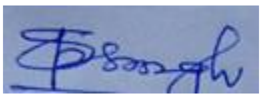
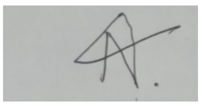


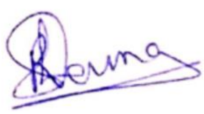
Prof.(Dr.) R.K.Verma
Deptt.of Physics
B.I.T. Sindri



Dr. S. P. Singh
Deptt. of Physics
R.V.S.C.E.T.
Jamshedpur



N.K.Sinha
H. O. D.
Deptt. of Physics
C.I.T. Ranchi



Dr. R. Sharma
Deptt. of Physics
R.T.C.I.T. Ormanjhi

Jharkhand University of Technology
Jharkhand, Ranchi

Proposed Syllabus for B.Tech 3rd Semester

Mechanical Engineering

&

Production Engineering

Mechanical Engineering

3rd semester course structure

Sl. No.	Course Code	Subject	L	T	P	Credit
01	ME301	Thermodynamics	3	1	0	3
02	ME302	Fluid Mechanics	3	1	0	3
03	ME303	Strength Of Materials	3	1	0	3
04	MT301	Materials Engineering	3	1	0	3
05	BSC301	Mathematics-III	3	1	0	4
06	BSC302	Environmental Science	2	0	0	0
01	ME301P	Thermodynamics Lab	0	0	3	1
02	ME302P	Fluid Mechanics Lab	0	0	3	1
03	ME303P	Strength Of Materials Lab	0	0	3	1
04	EX301	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
05	HS301	Communication Skill Lab	0	0	2	1
		Total credit				21

Production Engineering

3rd semester course structure

Sl. No.	Course Code	Subject	L	T	P	Credit
01	ME301	Thermodynamics	3	1	0	3
02	ME302	Fluid Mechanics	3	1	0	3
03	ME303	Strength Of Material	3	1	0	3
04	MT301	Materials Engineering	3	1	0	3
05	BSC301	Mathematics-III	3	1	0	4
06	BSC302	Environmental Science	2	0	0	0
01	ME302P	Fluid Mechanics Lab	0	0	3	1
02	ME303P	Strength Of Material Lab	0	0	3	1
03	MT301P	Materials Engineering Lab	0	0	3	1
04	EX301	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
05	HS301	Communication Skill Lab	0	0	2	1
Total credit						**21**

Mathematics III

(COMMON FOR ALL BRANCH)

Course code –BSC- 301

L	T	P	CR.
3	1	0	4

Module I

Laplace Transformation: Laplace Transformation and its applications, Inverse Laplace Transformation, Convolution Theorem, Solution of ODE by Laplace Transformation.

Module II

Fourier Transform: Complex form of Fourier series, Fourier Transformation and inverse Fourier Transformation, sine, cosine Transformation, Inverse Transformations -simple illustration.

Module III

Z-Transform: Inverse Z-Transform- Properties – Initial and final value theorems- convolution theorem- Difference equations, Solution of Difference equations using Z-Transformation.

Module IV

Partial Differential Equations: Solution of Wave equation, Heat equation, Laplace's equation by the method of separation of variables and its applications. Solution of PDE by Laplace Transformation.

Module V

Numerical Method: Finite difference, Symbolic relations, Interpolation and Extrapolation, Newton – Gregory forward and backward formula, Gauss forward and backward formula, Lagrange's formula , Inverse Interpolation by Lagrange's formula , Numerical Differentiation and **N**umerical Integration : Trapezoidal rule , Simpson's $1/3^{rd}$ rule , Simpson's $3/8^{th}$ rule ,Weddle quadrature formula.

Text Books

- Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.
- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,2010.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition.

Reference Books

- R. J. Beerends ,H. G. Ter Morsche ,J. C. Van Den Berg, E. M. Van De Vrie, Fourier and Laplace Transforms, Cambridge University Press.
- Sastry S.S, Introductory Methods of Numerical Analysis, PHI.

THERMODYNAMICS

(ME , PROD)

Course code -ME 301

Objectives:

- To learn about work and heat interactions, and balance of energy between system and its surroundings.
- To learn about application of I law of various energy conversion devices.
- To evaluate the changes in properties of substances in various processes.
- To understand the difference between high grade and low grade energies and II law limitations on energy conversion.

Contents:

Module -I

Fundaments- system and control volume; property; state and process; Exact & inexact differentials; Work-thermodynamic definition of work; examples; displacement work; path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. **(5hrs)**

Module – II

Temperature , definition of thermal equilibrium and zeroth law; Temperature scales; various thermometers-definition of heat; examples of heat/work interaction in systems-first law for cycle & non-cyclic processes; concept of total energy E; Demonstration that E is a property; Various modes of energy; internal energy and enthalpy**.(5hrs)**

Module – III

Definition of pure substance, ideal gases and ideal gas mixture, real gases and real gas mixtures, compressibility charts-Properties of tow phase system-const. temperature and const. pressure heating of water; Definitions of standard states; P-V-T surface; use of steam tables and R134a tables; saturation tables; superheated tables; identification of states and determination of properties, Mollier's chart.(8hrs)

Module – IV

First law of flow processes-Derivation of general energy equation for a control volume; Steady state flow processes including throttling; Examples of steady flow devices; unsteady processes; Examples of steady and unsteady I law applications for system and control volume. **(5hrs)**

Module -V

Second law- Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-plank and Clausius statements; Definition of reversible process; internal and external irreversibility; Carnot cycle; Absolute Temperature Scale. **(5hrs)**

Module-VI

Clausius inequality; Definition of energy S; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of S from steam tables-Principle of increase of entropy; Illustration of processes in T-S co-ordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and availability, availability function for systems and control volume undergoing different processes, Lost work. Second law analysis for a control volume. Energy balance equation and Energy analysis. **(8hrs)**

Module -VII

Thermodynamic cycles- Basic Rankine cycle; Basic Brayton cycle; Basic vapour compression cycle and comparison with Carton cycle. **(4hrs)**

Course Outcomes:

1. After completing this course, the students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions.
2. Students can evaluate changes in thermodynamic properties of substances.
3. The student will be able to evaluate the performance of energy conversion devices.
4. The students will be able to differentiate between high grade and low grade energies.

Text Books:

1. Sonntag R.E., Borgnakke C. and Van wylen G. J., 2003- 6th edition, *Fundamentals of thermodynamics*, John Wiley and sons.
2. Jones, J.B. and Duggan R.E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India.

3. Morgan, M.J and Shapiro, H.N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.
4. Nag P.K.,1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co. Ltd.

FLUID MECHANICS

Course Code-ME302

Module I

Fluids and Their Properties: Introduction of fluid, fluid classifications, hypothesis of continuum, Shear stress in a moving fluid, molecular structure of material, fluid density, viscosity, causes of viscosity in gases and liquids, surface tension, capillary effect, vapor pressure, cavitation, compressibility and the bulk modulus

Module II

Pressures and Head: Types of Pressure, Pascal's law of pressure at a point, variation of pressure vertically in a fluid under gravity, equality of pressure at the same level in a static fluid, general equation for the variation of pressure due to gravity from a point to point in a static fluid, pressure and head, the hydrostatic paradox, pressure measurements using Elastic Pressure Transducers, Force Balance Pressure gauge, Electrical Pressure Transducers

Module III

Static Forces on Surface and Buoyancy: Fluid static, action of fluid pressure on surface, resultant force and center of pressure on a plane surface under uniform pressure, resultant force and center of pressure on a plane surface immersed in a liquid, pressure diagrams, forces on a curved surface due to hydrostatic pressure, buoyancy, equilibrium of floating bodies, stability of a submerged body, stability of floating bodies, determination of the metacentric height, etermination of the position of the metacentre relative to the center of buoyancy

Module IV

The Energy Equation and its Application: Momentum and fluid flow, Momentum equation for 2-D and 3-D flow along a stream line, momentum correction factor, Euler's equation of motion along a stream line, Mechanical energy of a flowing fluid – Bernoulli's theorem, kinetic energy correction factor, pitot tube, determination of volumetric flow rate via pitot tube, changes of pressure in tapering pipe, principle of venturimeter, pipe orifices, theory of small orifices discharging to atmosphere, theory of large orifices, Rotameter, elementary theory of notches and weirs, flow in a curved path

Module V

Dimensional Analysis And Similarities: Dimension reasoning, dimensional homogeneity, dimensional analysis using Rayleigh's method, Buckingham π-theorem, significance of dimensionless, use of dimensionless numbers in experimental investigation, geometric similarity, dynamic similarity, Kinematic similarity, model testing-Model laws, Undistorted and Distorted models.

Module VI

Viscous Flow: Reynolds number and Reynolds experiment, flow of viscous fluid through circular pipe- Hagen Poiseuille formula, Flow of viscous fluid between two parallel fixed plates, power absorbed in viscous flow through - journal, foot step and collar bearing , movement of piston in dash pot, methods of measurement of viscosity Turbulent Flow: Expression for coefficient of friction -Darchy Weishbach Equation, Moody diagram resistance of smooth and rough pipes shear stress and velocity distribution in turbulent flow through pipes.

Module VII

Flow through pipes: Major energy losses, Minor energy losses, Hydraulic gradient and total energy lines, Pipes in series and parallel, Equivalent pipes, Siphon, power transmission through pipe, Flow through nozzle at end of pipe, Water hammer in pipes

Compressible Flow: Basic equations for one dimensional compression, Pressure wave propagation, sound velocity in fluid, Mach number, Stagnation properties

Reference Books:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S.K.Kataria & Sons
2. Fluid Mechanics and Hydraulic Machines by R.K. Bansal, Laxmi Publications
3. Fluid Mechanics and Hydraulic Machines by R.K. Rajput, S.Chand & Co.
4. Fluid Mechanics by Frank .M. White, McGraw Hill Publishing Company Ltd.
5. Fundamentals of Fluid Mechanics by Munson, Wiley India Pvt. Ltd
6. Fluid Mechanics by A. K. Mohanty, PHI Learning Pvt. Ltd.
7. Laboratory Manual Hydraulics and Hydraulic Machines by R V Raikar

Course Outcome: After learning the course the students should be able to: Understand the basic concept of fluid mechanics.

- Understand statics, dynamics and various approaches to fluid mechanics.
- Understand fundamentals of flow through pipes
- Understand basics of compressible flow
- Correlate fundamentals of fluid mechanics with various mechanical systems

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STRENGTH OF MATERIALS

(ME , PROD,CE)

Course code -ME 303

Objectives:

- To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams,shafts cylinders and spheres for various types of simple loads.
- To calculate the elastic deformation occurring in various simple geometries for different types of loading.

Contents:

Module-1

Deformation in solids-Hooks law, stress and strain-tension, compression and shear stresses –elastic constants and their relations-volumetric, linear and shear strains-principal stresses and principal planes-mohr’s circle**(8hrs)**

Module-II

Beams and types transverse loading on beams-shear force and bending moment diagrams-Types of beam supports, simply supported and over hanging beams, cantilevers. Theory of bending of beam, bending stresses distribution and neutral axis, shear stress distribution, point and distributed loads**.(8hrs)**

Module-III

Moment of inertia about the axis and polar moment of inertia, deflection of beam using double integration method, computation of slopes and deflection in beams, Maxwell’s reciprocal theorem**.(8hrs)**

Module-IV

Torsion, stresses and deformation in circular and hollow shafts,stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical spring**.(8hrs)**

Module -V

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure**.(8hrs)**

Course Outcomes:

- After completing this course, the students should able to recoginize various type of load applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components.
- The students will be able to evaluate the strains and deformation that will results due to the elastic stresses develop within the material for simple type of loading.

Test Books:

1. Egor P. Popov,Engineering Mechanics of solids,Prentice Hall of india,New Delhi,2001.
2. R.Subramanian, Strength of Materials,Oxford University Press,2007.

Ferdinand P.Been, Russel Johnson Jr and Jhon J.Dewole, Mechanism of materials, Tata McGrawHill Publication Co. Ltd., New Delhi 2005.

MATERIAL ENGINEERING

(ME , PROD)

Course code -MT 301

Course Objectives:

To increasing demand of the available materials, coupled with new applications and requirements has brought about many changes in the style of their uses.
To develop the basic knowledge of metals, polymers composites and ceramics other than conventional metals and alloys to apply them to advance engineering applications.

Module - I

Introduction – Crystalline and Non crystalline solids, Classification of Engineering materials and their selections, Bonding in solids: Ionic, Covalent and Metallic bonding. (5hrs)

Module – II

Crystal Structure- Space lattices, Bravais lattices, Crystal system, Unit Cell, Metallic crystal structures : SC, BCC, FCC, HCP structures, Miller notations of planes and directions, Imperfections in crystal: Point defects, Line surface defects. Dislocations: Edge and Screw dislocation, Burgers vectors. (12 hrs)

Module – III

Metallic Materials – Metals and alloys, ferrous materials- introduction to Iron carbon Diagram, steel and their Heat treatment , Properties and applications. Different types of heat treatment processes. Non-ferrous alloys:- Copper based alloys. Al based alloys, other important non ferrous alloys, properties and applications. (10hrs)

Module – IV

Polymers- Basic concepts of Polymers Science, polymer classifications. Crystallinity of polymers, Copolymers, Thermoplastic and Thermosetting polymers, Elastomers, Properties and Applications. (5hrs)

Module – V

Ceramics- Basic concepts of ceramics science, traditional and new ceramics. Oxide and Non-Oxide ceramics, Ceramics for high temperature applications. Glass, applications of ceramics, and glass. (5hrs)

Module -VI

Composite materials- Definition, general characteristics. Particles reinforced and fiber reinforced composite materials, MMC, CMC, PMC, properties and applications. (5hrs)

Text Books:

1. Elements of Material Science by Van Vlack
2. Material Science by O.P. Khanna
3. Material Science and Engineering by V. Raghavan
4. Material Science by R. K.Sharma and R.S. Sedha

Reference Books:

1. Material Science and Engineering by Wiliam D. Callister

Course Outcomes:

At the end of this course, the students would be able to :

- Select different materials other than conventional metals and alloys for specific engineering applications.
- To solve the materials problems associated with the weight reduction through the appropriate choice of metals, polymers, ceramics and composites.
- Selection criterion for polymers and composites for various engineering applications.

ENVIRONMENTAL SCIENCE

Course code –BSC 302

L	T	P	CR.
2	0	0	0

(COMMON FOR ALL BRANCH)

Module-1

Concept and scope of Environment science, components of environment, environmental segment and their importance. **(2 Hrs)**

Module-II

Ecology: Ecosystem and its characteristics features, structure and function of forest ecosystem, grassland ecosystem, desert ecosystem and aquatic ecosystem, ecological balance and consequences of imbalance. **(4 Hrs)**

Module-III

Atmosphere: Atmospheric composition, energy balance, climate, weather, depletion of ozone layer, green house effect, acid rain, particles, ions and radicals in the atmosphere, chemical and photochemical reactions in the atmosphere.

Module-IV

(4 Hrs)

Air pollution and control: Air pollutants, sources and effect of air pollutants, primary and secondary pollutants, photochemical smog, fly ash, inorganic and organic particulate matter. Air quality standards, sampling, monitoring and control measures for pollutants. **(4 Hrs)**

Module-V

Water pollution and control: Aquatic environment, water pollution, sources and their effect, lake and ground water pollution, eutrophication, water quality standard and water pollution control measures, waste water treatment.

Module-VI **(4 Hrs)**

Land pollution; Lithosphere, composition of soil, acid base and ion exchange reactions in soil, soil erosion, landslides, desertification, pollutants (municipal, industrial, commercial, agricultural , hazardous solid wastes), origin and effects, collection and disposal of solid wastes, recovery and conversion methods.

(5 Hrs)

Module-VII

Noise pollution; Noise classification and its sources, effects and measurement, noise pollution hazards, standards and noise pollution control. **(2 Hrs)**

Books and References:

1. Master, G.M Introduction to environment engineering and science, Pearson Education.
2. Nebel, B.J., Environment science, Prentice Hall Inc.
3. Odum, E.P. Ecology: The link between the natural and social sciences. IBH Publishing Company Delhi
4. De, A.K. Environmental Chemistry, Merrut.
5. Sharma B.K Envrionmental Chemistry, Krishna Prakashan Media Merrut.
6. Kaushik, A and Kaushik, C.P. Perspectives in Environmental studies, New Age International Publication.
7. Menon, S.E. Environmental Chemistry.

MATERIALS ENGINEERING LAB

MT301P

List of experiments

1. To study the Metallurgical Microscope.
2. To study the lattice structure of various types of unit cells, observe the mille indices for

various planes & directions in unit cells.
3. To study the microstructure of cast iron, cold work forged, rolled condition.
4. To study the microstructure of mild steel.
5. To study the microstructure of brass solder underancaed.
6. To verify Hall effect.
7. To verify the fracture, characteristics of ductile & brittle materials.
8. To determine the chemical composition of a few common alloys.

9. To determine the percentage of carbon & sulphur contents in a alloy with Fe as main constituent.
10. Estimation of percentage carbon composition of mild steel.

FLUID MECHANICS LAB

Course Code-ME302P

1. To determine the coefficient of impact for vanes.

2. To determine coefficient of discharge of an orifice meter.

3. To determine the coefficient of discharge of Notch (V and Rectangular types).

4. To determine the friction factor for the pipes.

5. To determine the coefficient of discharge of venturi meter.

6. To determine the coefficient of discharge, contraction & velocity of an orifice.

7. To verify the Bernoulli's Theorem.

8. To find critical Reynolds number for a pipe flow.

9. To determine the meta-centric height of a floating body.

10. To determine the minor losses due to sudden enlargement, sudden contraction and bends.

11. To show the velocity and pressure variation with radius in a forced vertex flow.
12.Verification of momentum theory by impact of Jet
13 .To study the performance characteristics of a Pelton Turbine
14.Determine the operating characteristic of a reaction turbine
15. Determine the operating characteristic of a reciprocating pump
16.Verification of momentum theory by impact of Jet

Strength of Material Lab

ME303P

Name of the Experiment

1.Tensile test: To prepare the tensile test upon the given specimen (Mild Steel)
2.Compression test: To determine the compressive strength of the given specimen
3.Torsion test: To perform the Torsion test on the given specimen.
4.Impact test: To determine the Impact toughness of the given material
5.Brinell hardness test: To determine the hardness of the given specimen
6.Vicker,s Hardness test : To determine the hardness of the given specimen
7.Rockwell Hardness test: To determine the hardness of the given specimen.
8.To determine the shear strength of a mild steel specimen by Double Shear Test
9.To determine the modulus of rigidity of a solid circular rod by conducting Torsion Test.
10.To obtain tensile strength, modulus of elasticity, percentage elongation and percentage reduction in area. of cross-section.

COMMUNICATION SKILL LAB

Course code HS301

This lab paper involves interactive practice sessions in Language Lab along with some class lectures to enable the students to be confident enough in language and professional sphere of life.

Module I: Listening Comprehension

To comprehend spoken material in standard Indian English/ British English & American English

- Current situation in India regarding English
- American English Vs. British English

Module II: Phonetics & Phonology

- Introduction to Phonetics & Phonology
- Organs of Speech/ Speech Mechanism
- Pronunciation, Intonation**,** Stress and Rhythm, Syllable division
- Consonants/Vowels/Diphthongs Classification

Module III: Common Everyday Situations: Conversations and Dialogues
Module IV: Communication at Workplace
Module V: Telephonic Conversation

- Introduction
- Listening/Speaking
- Telephonic Skills Required

- Problems of Telephonic Conversation
- Intensive Listening

Module VI: Interviews

- The Interview Process
- Purpose/Planning/Two-way Interaction/Informality
- Pre-interview Preparation Techniques
- Projecting a Positive Image
- Answering strategies

Module VII: Formal Presentations

- Introduction
- Nature/Importance of Presentation
- Planning
- Objective with central idea, main ideas, role of supporting materials
- Handling Stage Fright

Module VIII: Forms of Technical Communication: Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Expert Technical Lecture: Theme clarity; Analysis & Findings; C.V./Resume writing; Technical Proposal: Types, Structure & Draft.

Module IX: Technical Presentation: Strategies & Techniques Presentation: Forms; interpersonal Communication; Class room presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Module X: Technical Communication Skills: Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances: Exposition narration & Description; effective business communication competence: Grammatical; Discourse competence: combination of expression & conclusion; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and non verbal means.

Jharkhand University of Technology
Jharkhand, Ranchi

Proposed Syllabus for B.Tech 4th Semester

Mechanical Engineering

&

Production Engineering

Mechanical Engineering

4th semester course structure

Sl. No.	Course code.	Subject	L	T	P	Credits
01	ME401	Theory Of Machines	3	1	0	3
02	ME402	Fluid Machines	3	1	0	3
03	ME403	Applied Thermodynamics	3	1	0	3
04	PE401	Manufacturing Process-I	3	1	0	3
05	EC404	Electronics & Instrumentation Engg.	3	1	0	3
06	EN401/ IT402	Engineering Economics / Cyber Security	2	0	0	0
01	ME401P	Theory Of Machines Lab	0	0	3	1
02	ME403P	Applied Thermodynamics Lab	0	0	3	1
03	PE401P	Manufacturing Process-I Lab	0	0	3	1
04	EX401	Extra Activities (NSO/NSS/NCC/Yoga/ Creative Arts/Mini Project)	0	0	2	1
05	IN401	Internship/ Tour & Training/Industrial Training	0	0	0	2
Total credits						**21**

Production Engineering

4th semester course structure

Sl. No.	Course code.	Subject	L	T	P	Credit
01	PE401	Manufacturing Process-I	3	1	0	3
02	PE402	Industrial Management & Plant Engineering	3	1	0	3
03	PE403	Heat Transfer	3	1	0	3
04	ME401	Theory Of Machines	3	1	0	3
05	EC404	Electronics & Instrumentation Engg.	3	1	0	3
06	EN401/ IT402	Engineering Economics / Cyber Security	2	0	0	0
01	PE401P	Manufacturing Process – I Lab	0	0	3	1
02	ME401P	Theory Of Machines Lab	0	0	3	1
03	EC404P	Instrumentation Lab	0	0	3	1
04	EX401	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
05	IN401	Internship/ Tour & Training/Industrial Training	0	0	0	2
Total credit						**21**

THEORY OF MACHINE

(ME , PROD)

Course code -ME 402

Objective:

- To understand the kinematics and rigid-body dynamics of kinematically driven machine components
- To understand the motion of linked mechanism in terms of the displacement, velocity and acceleration at any point in a rigid link
- To understand the kinematics of gear trains

Contents:

Module -1

Classification of mechanisms- Basic kinematic concepts and definition – Degree of freedom, mobility-Grashof 's law , Kinematic inversions of four bar chain and slider crank chains-Limit proportions-Mechanical advantage-Transmission angle – Description of some common mechanisms-Quick return mechanism, Straight line generators-Universal Joint- Rocker mechanism**(8hrs)**

Module-II

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equation-kinematics analysis of simple mechanisms-slider crank mechanism dynamics-Coincident points- Coriolis component of acceleration – introduction to linkage synthesis-three position graphical synthesis for motion and path generation**(8hrs)**

Module-III

Classification of cams and followers –Terminology and definitions –Displacement diagrams –Uniform velocity, parabolic, simple harmonic and cycloidal motions-derivatives of follower motion-specified counter cams-circular and tangents cams – pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers**(8hrs)**

Module – IV

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting –helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics**(8hrs)**

Module – V

Surface contacts-sliding and rolling friction- friction drives- bearings and lubrication-friction clutches-belt and rope drives-friction in brakes**(8hrs)**

Course outcomes:

- After completing this course, the students can design various types of linkage mechanism for obtaining specific motion and analyze them for optimal functioning.

Text Book:

1.Thomas Bevan,Theory of machines,3rd edition, CBS Publishers &Distributors,2005.
2.Cleghorn W.L.,Mechanisms of Machines,Oxford University Press,2005.
3.Robert L. Norton, Kinematics and Dynamics of machinery,Tata McGrawHill,2009.
4.Ghosh A. And Mallick A.K, Theory of Mechanism and Machines, Affiliated East-West Pvt.Ltd,New Delhi,1988.

APPLIED THERMODYNAMICS

Course Code-ME 402

Objectives:

1) To learn about of 1st law for reacting systems and heating value of fuels.
2) To learn about gas and vapor cycles and their first law and second law efficiencies.
3) To understand about the properties of dry and wet air and the principles of psychometry.
4) To learn about gas dynamics of air flow and steam through nozzles.
5) To learn the about reciprocating compressors with and without intercooling
6) To analyze the performance of steam turbines.

Module-1

Introduction to solid, liquid and gaseous fuels- Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

(8Hrs)

Module -II

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, energy analysis Super- critical and ultra super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles- Air standard Brayton cycle, effect of reheat, regeneration and intercooling – Combined gas and vapor power cycles- vapor compression refrigeration cycles, refrigerants and their properties(12hrs)

Module-III

properties of dry and wet air, use of pschyrometric chart, processes involving heating/cooling and humidification/ dehumidification, dew point(4hrs)

Module-IV

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, chocked flow, subsonic and supersonic flows- normal shocks-use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super saturation-compressible flow in diffusers, efficiency of nozzle and diffuser. (8hrs)

Module-V

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. (5hrs)

Module-VI

Analysis of steam turbines, velocity and pressure compounding of steam turbine. (3hrs)

Outcomes:

1. After completing this course the students will get a good understanding of various practical power cycles and heat pump cycles.
2. They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.
3. They will be able to understand phenomena occurring in high speed compressible flows.

MANUFACTURING PROCESSES I

Course Code-PE 401

Objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Module-I

Conventional Manufacturing Processes:

Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. (5hrs)

Module-II

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria;

fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.
Metal Cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life. Surface finish and integrity, Machinability, Cutting tool materials, cutting fluids coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining (8hrs)

Module-III

Additive manufacturing: Rapid prototyping and rapid tooling (3hrs)

Module-IV

Joining/ fastening processes: Physics of welding, brazing and soldering; design considerations in welding. Solid and liquid state joining processes; Adhesive bonding (3hrs)

Module-V

Unconventional Machining Processes:
Abrasive Jet Machining, Water Jet Machining Abrasive Water Jet Machining, Ultrasonic Machining principles and process parameters (5hrs)

Module-VI

Electrical Discharge Machining principle and processes parameters, MRR, surface finish tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish.(8hrs)

Module-VII

Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining (3hrs)

Books and References:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
3. Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA.
4. Materials and Manufacturing by Paul Degarmo.
5. Manufacturing Processes by Kaushish, PHI.
6. Principles of Foundry Technology, Jain, MCGRAW HILL INDIA
7. Production Technology by RK Jain.
8. Degarmo, Black &Kohser, Materials and Processes in Manufacturing.

Course Outcomes:

Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products Objectives:

ELECTRONICS AND INSTRUMENTATION ENGINEERING

Course code – EC404

(For Civil , Mech. and Production Engineering).

Module 1: Basic Electronic Components

Active and Passive Components, Types of resistors and Colour coding, Capacitors, Inductors applications of Resistor, Capacitor and Inductor, Relay, LDR, Basic Integrated Circuits (IC 7805, 7809, 7812, 555 etc.).Measuring Instruments like CRO, Power supply, Multi-meters etc.

Module II: Semiconductors, Diode and Transistors:

Difference between Insulators, Semiconductors and Conductors, Mobility and Conductivity, Intrinsic and Extrinsic Semiconductors, Fermi Level, Energy band, P-N Junction Diode, construction, working, characteristics and diode equation Application of Diode, Rectifier: Half Wave, Full Wave and Bridge Rectifier, Zener Diode and its Applications, Varactor Diode, Schottky Diode, Regulated Power Supply using Zener Diode and Regulated ICs, LED, Photodetector, Construction, Working, Modes and Configuration of BJT, Input and Output Characteristics of all Configurations, Comparison of all Configuration & Modes, BJT as a Switch and as an Amplifier. JFET Construction, working and characteristics. MOSFET Construction, working and Characteristics, Types of MOSFET,.

ModuleIII: Digital Electronics Fundamentals:

Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

ModuleIV: Electronic Instruments:

Measurement of Temperature, RTD, Thermistors, LVDT, Strain Gauge, Piezoelectric Transducers, Digital Shaft Encoders, Tachometer, Hall effect sensors. Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors. Electronic Display Device, Digital Voltmeters, Digital Energy meter, CRO, measurement of voltage and frequency, Lissajous Patterns, Plotting B-H curve of a magnetic material, Wave Analyzers, Harmonic Distortion Analyzer. Digital Energy Meter. Measurements of R, L and C.Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.Digital Storage Oscilloscope.

ModuleV: Electronic Communication Systems:

The elements of communication system, IEEE frequency spectrum and Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system, Ultrasonic wave & its application in distance measurement.

Text Books

1. Basic Electronics and Linear Circuits by N. N. Bhargava, D. C. Kulshreshtha and S. C. Gupta,

TMH Publications.
2. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad, PHI Publications.
3. Electronic Devices and Circuits by Godse and Bakshi Technical, Vol-1 Technical Publication Pune.
4. Floyd ," Electronic Devices" Pearson Education 9th edition, 2012.
5. R.P. Jain , "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007.
6. Frenzel, "Communication Electronics: Principles and Applications", Tata Mc Graw Hill, 3rd Edition, 2001

Reference Books
1. Integrated Devices & Circuits by Millman & Halkias, TMH Publications.
2. Electronics Devices and Circuit Theory by R. Boylestad & L. Nashelsky, Pearson Publication
3. Electronic Communication System by G. Kennedy, TMH Publications.
4. Basic Electronics by Sanjeev Kumar & Vandana Sachdeva, Paragaon International Publication

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HEAT TRANSFER

Course code – PE403

Module I

Fundamental: Modes of heat transfer, effect of temperature on thermal conductivity of different solids, liquids and gases, derivation of generalized equation in Cartesian, cylindrical and spherical coordinates and its reduction to specific cases, General laws of heat transfer

Module II

Conduction: Fourier's law, One dimensional steady state conduction, heat conduction through plane and composite walls, cylinders and spheres, electrical analogy, critical radius of insulation for cylinder and sphere, overall heat transfer coefficient.
Transient heat conduction- lumped heat capacity analysis, time constant, transient heat conduction in solids with finite conduction and convective resistances Heat transfer from extended surface: Types of fin, heat flow through rectangular fin, infinitely long fin, fin insulated at the tip and fin losing heat at the tip, efficiency and effectiveness of fin, Biot number, Estimation of error in temperature measurement in a thermometer well

Module III

Convection: Newton's law of cooling, Dimensional analysis applied to forced and free convection, dimensionless numbers and their physical significance, empirical correlations for free and forced convection Continuity, momentum and energy equations, thermal and hydrodynamic boundary layer, Blasius solution for laminar boundary layer, General solution of Von-Karman integral momentum equation

Module IV

Radiation: Absorptivity, reflectivity and transmissivity, black, white and grey body, emissive power and emissivity, laws of radiation – Planck, Stefan-Boltzmann, Wein's displacement, Kirchhoff's law, intensity of radiation and solid angle, Lambert's cosine law Radiation heat exchange between black bodies, shape factor, heat exchange between non-black bodies- infinite parallel planes and infinite long concentric cylinders, radiation shield, heat exchange between two grey surfaces, electrical analogy

Module V

Heat exchanger: Classification, heat exchanger analysis, LMTD for parallel and counter flow exchanger, condenser and evaporator, overall heat transfer coefficient, fouling factor, correction factors for multi pass arrangement, effectiveness and number of transfer unit for parallel and counter flow heat exchanger, introduction of heat pipe and compact heat exchanger Two-phase heat transfer: Boiling of liquids, Pool boiling curve, different types of pool boiling, condensation of vapor. Film wise & drop wise condensation.

Reference Books:

1. Heat & Mass Transfer by P.K. Nag, McGraw Hill
2. Heat and Mass Transfer: Fundamentals and Application by Yunus Cengel, McGraw Hill
3. Fundamental of Heat and Mass Transfer by Incropera and Dewitt, Wiley Publication
4. Heat Transfer by Mills and Ganesan, Pearson Education
5. Heat Transfer by J P Holman , McGraw Hill
6. Heat and Mass Transfer by R K Rajput, S.Chand Publication
7. Heat Transfer: Principles and Applications by Dutta, Binay K, PHI Publication

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INDUSTRIAL MANAGEMENT & PLANT ENGINEERING

Course code – PE402

Module I

Introduction: Concept and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system, Industrial Ownership.

Module II

Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Social responsibilities of Management, Introduction to Human resources management: Nature of HRM, functions and importance of HRM.

Module III

Work Study: Introduction, definition, objectives, steps in work study, Method study: definition, objectives, steps of method study, Work Measurement: purpose, types of study — stop watch methods — steps — allowances — standard time calculations — work sampling, Production Planning and Control Inventory Control: Inventory, Cost, Models of inventory control: EOQ, ABC, VED

Module IV

Quality Control: statistical quality control, Control charts for variables and attributes, Acceptance Sampling- Single sampling- Double sampling plans, Introduction to TQM.

Module V

Project Management: Project network analysis, CPM, PERT and Project crashing and resource Leveling

References:

1. Engineering Management (Industrial Engineering & Management)/ S.C. Sharma & T.R.

Banga, Khanna Book Publishing Co. (P) Ltd., Delhi (ISBN: 978-93-86173-072)
2. Industrial Engineering and Management/ P. Khanna, Dhanpatrai publications Ltd.
3. Production & Operation Management /PaneerSelvam /PHI.
4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Management I RaviShankar/ Galgotia.

CYBER SECURITY

Course code –IT 402

Module I: Introduction to Cybercrime : Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, and Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

Module II: Cyber Offenses: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Module III: Cybercrime : Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

Module – IV: Tools and Methods Used in Cybercrime : Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

Module V: Cyber Security : Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

TEXT BOOK:

- Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.

REFERENCE BOOK:

- Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.

- Introduction to Cyber Security , Chwan-Hwa(john) Wu,J.David Irwin.CRC Press T&F Group

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ENGINEERING ECONOMICS

Course code –EN 401

COURSE OUTLINE:
The basic purpose of this course is to provide a sound understanding of concepts and principles of engineering economy and to develop proficiency with methods for making rational decisions regarding problems likely to be encountered in professional practice.

Module -1

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of Economics, Relation between science, engineering, technology and economics; Nature of Economic problem, Production possibility curve, Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility – its practical application and importance.

Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, measurement of elasticity of demand, practical importance & applications of the concept of elasticity of demand.

Module -II

Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale.

Various concepts of cost – Fixed cost, variable cost, average cost, marginal cost, money cost, real cost, opportunity cost. Shape of average cost, marginal cost, total cost, Cost curves.

Module III

Meaning of Market, Types of Market – Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets)

Pricing Policies- Entry Deterring policies, Predatory Pricing, Peak load Pricing. Product Life cycle

Firm as an organisation- Objective of the Firm, Type of the Firm, Vertical and Horizontal Integration, Diversification, Mergers and Takeovers.

Module -IV

Nature and characteristics of Indian economy (brief and elementary introduction), Privatization – meaning, merits and demerits. Globalisation of Indian economy – merits and demerits. Elementary Concepts of VAT, WTO, GATT & TRIPS agreement, Business cycle, Inflation

RECOMMENDED BOOKS:-

1. R.Paneer Seelvan: Engineering Economics, PHI
2. Managerial Economics, D.N.Dwivedi, Vikash Publication
3. Managerial Economics, H.L. Ahuja, S. Chand and Co. Ltd.
4. Managerial Economics, Suma Damodaran, Oxford.
5. R.molrishnd Ro T.V S 'Theory of firms : Economics and Managerial Aspects'. Affiliated East West Press Pvt Ltd New Delhi
6. Managerial Economics, H. Craig Petersen &W. Cris Lewis, Pearson Education.

APPLIED THERMODYNAMICS LAB

Course Code-ME 402P

List of Experiments: (At least 8 of the following)

1. Study of Fire Tube boiler.
2. Study of Water Tube boiler.
3. Study and working of Two stroke petrol Engine.
4. Study and working of Four stroke petrol Engine.
5. Determination of Indicated H.P. of I.C. Engine by Morse Test.
6. Prepare the heat balance sheet for Diesel Engine test rig.
7. Prepare the heat balance sheet for Petrol Engine test rig.
8. Study and working of two stroke Diesel Engine.
9. Study and working of four stroke Diesel Engine.
10. Study of Velocity compounded steam turbine.
11. Study of Pressure compounded steam turbine.
12. Study of Impulse & Reaction turbine.
13. Study of steam Engine model.
14. Study of Gas Turbine Model.

S. No.	Name of the Experiment
1	To study the construction and operation of a Cochran boiler

2	To study the construction and operation of a Babcock boiler
3	To study the construction and operation of a Lancashire boiler
4	To study the construction and operation of a vertical water tube boiler
5	To study about 2-Stroke petrol Engine
6	To study about 4-Stroke petrol Engine
7	To study about CI Engine(Diesel Engine)
8	Study of simple and compound Steam Engine
9	To determine the volumetric and isothermal efficiency
10	To determine the static efficiency and total efficiency

THEORY OF MACHINE LAB

ME402P

Name of the Experiment

1. To draw velocity diagram of four bar mechanism
2.To draw velocity diagram of slider crank mechanism.
3.To draw acceleration diagram of four bar mechanism
4.To draw acceleration diagram of slider crank mechanism
5.To study Different types of Cam profile
6.To draw displacement diagram, velocity diagram & acceleration diagram of cam follower
7.To draw a cam profile
8.To study Different types of Gears
9.To draw Involute gear profile.
10.To draw Cycloidal gear profile

MANUFACTURING PROCESS LAB

Course Code-PE401P

List of Experiments: (At least 8 of the following along-with study of the machines/processes)
1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine.
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on Milling machine.

5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses.
11. Gas welding experiment.
12. Arc welding experiment.
13. Resistance welding experiment.
14. Soldering & Brazing experiment.
15. Study and understanding of limits, fits & tolerances.
16. Study of temperature measuring equipment's.
17. Measurement using Strain gauge.
18. Experiment on dynamometers.
19. To study the displacement using LVDT.

Course Outcomes: Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products.

Jharkhand University of Technology
Jharkhand, Ranchi

Proposed Syllabus for B.Tech 3rd Semester

Electrical Engineering

&

Electrical and Electronics Engineering

Electrical Engineering

3rd semester course structure

Sl. No.	Course Code	Subject	L	T	P	Credit
01	EE301	Electrical Machine-I	3	1	0	3
02	EE302	Network Theory	3	1	0	3
03	EE303	Electromagnetic Field Theory	3	1	0	3
04	EC301	Basic Electronics	3	1	0	3
05	BSC301	Mathematics-III	3	1	0	4
06	BSC302	Environmental Science	2	0	0	0
01	EE301P	Electrical Machine-I Lab	0	0	3	1
02	EE302P	Network Theory Lab	0	0	3	1
03	EC301P	Basic Electronics Lab	0	0	3	1
04	EX301	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
05	HS301	Communication Skill Lab	0	0	2	1
Total credit						**21**

Electrical and Electronics Engineering

3rd semester course structure

Sl. No.	Course Code	Subject	L	T	P	Credit
01	EE301	Electrical Machine-I	3	1	0	3
02	EE302	Network Theory	3	1	0	3
03	EE303	Electromagnetic Field Theory	3	1	0	3
04	EC301	Basic Electronics	3	1	0	3
05	BSC301	Mathematics-III	3	1	0	4
06	BSC302	Environmental Science	2	0	0	0
01	EC301P	Basic Electronics Lab	0	0	3	1
02	EE301P	Electrical Machine-I Lab	0	0	3	1
03	EE302P	Network Theory Lab	0	0	3	1
04	EX301	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
05	HS301	Communication Skill Lab	0	0	2	1
Total credit						**21**

MATHEMATICS III

(COMMON FOR ALL BRANCH)

Course code –BSC- 301

L	T	P	CR.
3	1	0	4

Module I

Laplace Transformation: Laplace Transformation and its applications, Inverse Laplace Transformation, Convolution Theorem, Solution of ODE by Laplace Transformation.

Module II

Fourier Transform: Complex form of Fourier series, Fourier Transformation and inverse Fourier Transformation, sine,cosine Transformation, Inverse Transformations -simple illustration.

Module III

Z-Transform: Inverse Z-Transform- Properties – Initial and final value theorems- convolution theorem- Difference equations, Solution of Difference equations using Z-Transformation.

Module IV

Partial Differential Equations: Solution of Wave equation, Heat equation, Laplace's equation by the method of separation of variables and its applications. Solution of PDE by Laplace Transformation.

Module V

Numerical Method: Finite difference, Symbolic relations, Interpolation and Extrapolation, Newton – Gregory forward and backward formula, Gauss forward and backward formula, Lagrange's formula , Inverse Interpolation by Lagrange's formula , Numerical Differentiation and **N**umerical Integration : Trapezoidal rule , Simpson's $1/3^{rd}$ rule , Simpson's $3/8^{th}$ rule ,Weddle quadrature formula.

Text Books

- Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.
- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,2010.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition.

Reference Books

- R. J. Beerends ,H. G. Ter Morsche ,J. C. Van Den Berg, E. M. Van De Vrie, Fourier and Laplace Transforms, Cambridge University Press.
- Sastry S.S, Introductory Methods of Numerical Analysis, PHI.

BASIC ELECTRONICS

(ECE, EEE, EE,CSE, IT)
Course code -EC 301
L T P CR.
3 1 0 3

Module I: Basic Electronic Components

Active and Passive Components, Types of resistors and Colour coding, Capacitors, Inductors applications of Resistor, Capacitor and Inductor, Relay, LDR, Basic Integrated Circuits (IC 7805, 7809, 7812, 555 etc.).Measuring Instruments like CRO, Power supply, Multi-meters etc.

Module II: Semiconductors

Difference between Insulators, Semiconductors and Conductors, Mobility and Conductivity, Intrinsic and Extrinsic Semiconductors, Fermi Level, Energy band, Charge Densities in Semiconductors, Mass Action Law, Current Components in Semiconductors, Drift and Diffusion Current, The Continuity Equation, Injected Minority Charge Carrier, Hall Effect, P-N Junction Diode, construction, working, characteristics and diode equation Application of Diode, Rectifier: Half Wave, Full Wave and Bridge Rectifier, Zener Diode and its Applications, Varactor Diode, Schottky Diode, Regulated Power Supply using Zener Diode and Regulated ICs, LED, Photodetector.

Module III: Transistors

Construction, Working, Modes and Configuration of BJT, Input and Output Characteristics of all Configurations, Comparison of all Configuration & Modes, BJT as a Switch and as an Amplifier. JFET Construction, working and characteristics. MOSFET Construction, working and Characteristics, Types of MOSFET.

Module IV: Power electronic devices &Communication engineering

Construction, characteristics and working of SCR, DIAC, TRIAC and UJT. Introduction, Characteristics and applications of Operational Amplifier (Ic741). Modulation and its types.

Module V: Digital Logic and basic circuit Design

Number systems and conversion (DECIMAL, OCTAL, HEXADECIMAL,BINARY, BCD etc.),binary addition and subtraction, Logic Gates and their truth-table ,Boolean algebra .Design of Single Stage Amplifier, LED Driver Circuit, Infrared Transmitter Receiver Circuit, LDR Driver Circuit, Relay Driver Circuit, Square Wave and Fix Frequency Generator using 555 IC.

Text Books

1. Basic Electronics and Linear Circuits by N. N. Bhargava, D. C. Kulshreshtha and S. C. Gupta, TMH Publications.

2. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad, PHI Publications.

3. Electronic Devices and Circuits by Godse and Bakshi Technical, Vol-1 Technical Publication Pune.

Reference Books

1. Integrated Devices & Circuits by Millman & Halkias, TMH Publications.

2. Electronics Devices and Circuit Theory by R. Boylestad & L. Nashelsky, Pearson Publication
3. Electronic Communication System by G. Kennedy, TMH Publications.

4. Basic Electronics by Sanjeev Kumar & Vandana Sachdeva, Paragaon International Publication

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ELECTRICAL MACHINES-I

(EEE, EE,)
Course code -EE 301

L	T	P	CR.
3	1	0	3

Module I: Review of Magnetic circuits and Electro-mechanical Energy Conversion

MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil. Magnetic Materials, BH characteristics, Review of magnetic system, Energy in Magnetic system, Force and torque in magnetic field system, Energy balance equation, Energy conversion via electrical field, Energy in a singly excited system, Determination of the Force and Torque from energy and co-energy.

Module II: Single Phase Transformers and Autotransformers
Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests,

polarity test, back-to-back test, Autotransformers - construction, principle, applications and comparison with two winding transformers.

Module III: Three Phase Transformers
Concept of Three-phase connections – Star/Delta. Construction of Three phase transformer, open delta connection, phasor groups, 3-phase to 2-phase and3-phase to 6-phase connections with their applications, Three winding transformers. parallel operation and load sharing of single phaseand three phase transformers.Tap-changing transformers, No-load and on-load tap-changing of transformers,three-winding transformers, Cooling of transformers.

Module IV: DC machines

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation – Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

Module V: DC machine - motoring and generation
Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines.

Text Books:
1. IJ Nagrath & D.P. Kothari, "Electrical Machines", Tata McGraw Hill
2. Rajendra Prasad , "Electrical Machines", PHI
3. PS Bimbhra, "Electrical Machinery", Khanna Publisher
4. AE Fitggerald, C. Kingsley Jr and Umans, "Electric Machinery", McGraw Hill, International Student Edition.

Reference Books:
1. A. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBSPublishers, 2004.
2. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.

NETWORK THEORY

(ECE, EEE, EE)
Course code -EE 302

L	T	P	CR.
3	1	0	3

Module I: Circuit Fundamentals

Voltage sources, Current sources, Conversion of voltage sources to current sources and vice a versa. Network terminology :- Node, Junction, Branch, Loop, Network solution by branch current method, Loop or Mesh current method, Node voltage method, Star delta connection and conversion. Node and Mesh Analysis, matrix approach of network containing voltage and current sources, and reactance's, source transformation and duality. Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC, circuits. Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.

Module II: Resonance Circuits

Series resonance circuit, Frequency response of a series resonant circuit, Q factor, Bandwidth, selectivity, Effect of Q on bandwidth and selectivity, Relation between bandwidth and Q, Impedance of a series resonant circuit, Resonance by variation of L and C, Parallel resonant circuit and effect of resistance of a capacitance, Frequency response of parallel resonant circuit.

Module III: Two- Port Network

Two- port network parameters, r, y, z, h, A B C D relation between the parameters, Inter-conversion of two port networks, cascade connection series connection, series parallel connection, T and M network representation of a two port network.

Module IV: NETWORK FUNCTIONS

Laplace transform, Transform of a voltage and current, Transform of circuit elements, Network functions, Poles and zeros of the network functions, Pole zero plot, Physical significance of poles and zeroes, Stability, Two-port network parameters in the frequency domain Transient response: - step input response in RL circuit, step input response in R-C circuit, step input response in R-L-C circuit, ac transients.

Module V: FILTERS and ATTENUATORS

Definitions, classification and characteristics of different filters, filter fundamentals such as attenuation constant(alpha), phase shift (beta), propagation constant (gamma), characteristic impedance (Zo), decibel, neper. Design and analysis of constant K, M derived and composite filters (low pass, high pass, band pass, and band stop filters): T and PI sections. Definitions, classification, relation between neper and decibel, analysis and design of T type, PI type, alpha lattice, bridged –T and L types attenuators.

Text Books:

1. "A.Sudhakar, Shymmohan S. Palli, _Circuit and Network – Analysis and Synthesis‘, 3 rd Edition, Tata McGraw Hill Publication.
2. Van, Valkenburg; “Network analysis”; Prentice hall of India, 2000.
3. A. Chakrabarti, _Circuit theory (Analysis and Synthesis)‘, IIIrd edition, Dhanpat Rai and Co.

Reference Books:

1. D. Roy Choudhuri, _Networks and Systems‘, New Age International Publisher.
2. M.E.Van Valkenburg Network Analysis‘, IIIrd edition, Pearsons Education/PHI.
3.Josheph Edministrar, _Theory and Problems of Electronic Circuit (Schaum‘s Series) – Tata McGraw Hill Publication.
4. Soni Gupta, _Electrical Circuit Analysis‘, Dhanpat Rai and Co.
5. Boylestad, _Introductory Circuit Analysis‘, Universal Book Stall, New

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ELECTROMAGNETIC FIELD THEORY

(ECE, EEE, EE)
Course code -EE 303

L	T	P	CR.
3	1	0	3

Module I: Coordinate Systems and Transformation:
Basics of Vectors: Addition, subtraction and multiplications; Cartesian, Cylindrical, Spherical transformation. Vector calculus: Differential length, area and volume, line surface and volume integrals, Del operator, Gradient, Divergence of a vector, Divergence theorem, Curl of a vector, Stokes’s theorem, Laplacian of a scalar.

Module II: Electrostatic fields:
Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses’ Law- Maxwell’s equation, Electric dipole and flux line, Energy density in electrostatic fields, Electric field in material space: Properties of materials, convection and conduction currents, conductors, polarization in dielectrics, Dielectric-constants, Continuity equation and relaxation time, boundary conditions, Electrostatic boundary value problems: Poisson’s and Laplace’s equations., Methods of Images.

Module III: Magneto Statics:
Magneto-static fields, Biot - Savart’s Law, Ampere’s circuit law, Maxwell’s equation, Application of ampere’s law, Magnetic flux density- Maxwell’s equation, Maxwell’s equation for static fields, magnetic scalar and vector potential.

Module IV: Magnetic Forces:

Materials and devices, Forces due to magnetic field, Magnetic torque and moment, a magnetic dipole. Magnetization in materials, Magnetic boundary conditions, Inductors and inductances, Magnetic energy.

Module V: Waves and Applications:

Maxwell's equation, Faraday's Law, transformer and motional electromotive forces, Displacement current, Maxwell's equation in final form Electromagnetic wave propagation: Wave propagation in loss dielectrics, Plane waves in lossless dielectrics Plane wave in free space. Plain waves in good conductors, Power and the pointing vector, Reflection of a plain wave in a normal incidence. Transmission Lines, and Smith Chart.

Text Book:

1. MNO Sadiku, "Elements of Electromagnetic', Oxford University Press.

Reference Books:

1. WH Hayt and JA Buck, "Engineering Electromagnetic", McGraw- Hill Education.
2. Antenna and wave propagation by k.d parsad satya prakashan.

<u>ENVIRONMENTAL SCIENCE</u>

Course code – BSC 302

L T P CR.

2 0 0 0

<u>(COMMON FOR ALL BRANCH)</u>

Module-1

Concept and scope of Environment science, components of environment, environmental segment and their importance. **(2 Hrs)**

Module-II

Ecology: Ecosystem and its characteristics features, structure and function of forest ecosystem, grassland ecosystem, desert ecosystem and aquatic ecosystem, ecological balance and consequences of imbalance. **(4 Hrs)**

Module-III

Atmosphere: Atmospheric composition, energy balance, climate, weather, depletion of ozone layer, green house effect, acid rain, particles, ions and radicals in the atmosphere, chemical and photochemical reactions in the atmosphere.

Module-IV **(4 Hrs)**

Air pollution and control: Air pollutants, sources and effect of air pollutants, primary and secondary pollutants, photochemical smog, fly ash, inorganic and organic particulate matter. Air quality standards, sampling, monitoring and control measures for pollutants. **(4 Hrs)**

Module-V

Water pollution and control: Aquatic environment, water pollution, sources and their effect, lake and ground water pollution, eutrophication, water quality standard and water pollution control measures, waste water treatment.

Module-VI **(4 Hrs)**

Land pollution; Lithosphere, composition of soil, acid base and ion exchange reactions in soil, soil erosion, landslides, desertification, pollutants (municipal, industrial, commercial, agricultural , hazardous solid wastes), origin and effects, collection and disposal of solid wastes, recovery and conversion methods. **(5 Hrs)**

Module-VII

Noise pollution; Noise classification and its sources, effects and measurement, noise pollution hazards, standards and noise pollution control. **(2 Hrs)**

Books and References:

1. Master, G.M Introduction to environment engineering and science, Pearson Education.
2. Nebel, B.J., Environment science, Prentice Hall Inc.
3. Odum, E.P. Ecology: The link between the natural and social sciences. IBH Publishing Company Delhi
4. De, A.K. Environmental Chemistry, Merrut.
5. Sharma B.K Envrionmental Chemistry, Krishna Prakashan Media Merrut.
6. Kaushik, A and Kaushik, C.P. Perspectives in Environmental studies, New Age International Publication.
7. Menon, S.E. Environmental Chemistry.

BASIC ELECTRONICS LAB

(ECE, EEE, EE)

Course code -ECE 301P

List of Experiments (Minimum 10)

1. Identification and testing of Resistors, Inductors, Capacitors, PN-Diode. Zener Diode, LED, LCD, LDR, BJT, Photo Diode, Photo Transistor,

2. Measurement of voltage and current using multimeter ,Measure the frequency and Amplitude of a signal with the help of CRO and function generator.

3. Study of p-n junction diode AND Zener Diode I-V characteristics

4. Assemble the single phase half wave and full wave bridge rectifier & the analyze effect of capacitor as a filter(only study of waveforms).

5. Study of Zener diode as voltage regulator.

6. Measurement & study of input characteristics of a BJT in CB configuration.

7. Measurement and study of characteristics of JFET and MOSFET

8. To design and simulate IR Transmitter and Receiver Circuit.

9. To design and simulate Motor Driver using Relay.

10. To design and simulate Light detector using LDR.

11. To design and simulate Constant frequency square wave generator using.

12. To design and simulate 5 volt DC power supply from 230 AC.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

ELECTRICAL MACHINE LAB-I

List of Experiments (Minimum 10)

1. To obtain the speed characteristics of a D.C shunt motor as a function of armature voltage, field current, and externalresistance in the armature circuit.
2. To find the critical resistance (R_c) and critical speed (N_c) and O.C.C. of a dc shunt generator.
3. To conduct a load test on a dc shunt generator and obtain its internal and external characteristics.

4. To conduct load test on a dc series generator and to obtain its internal and external characteristics.

5. To perform Hopkinson's test on two similar DC shunt machines and obtain their efficiencies at various loads.

6. To separate the mechanical and iron losses (Retardation Test) of the given dc shunt machine.

7. To pre-determine the efficiency of a D.C shunt machine considering it as a motor by performing Swinburne's test on it.

8. To study about different types of DC motor starters.

9. To study power-sharing between two single-phase transformers operated in parallel.

10. To determine transformer winding polarity and explore the impact of connecting windings in series aiding and series opposing configurations.

11. To perform the short circuit and open circuit test of single-phase transformer and draw the equivalent circuit.

12.To determine Regulation and Efficiency of a single-phase transformer using direct loading test.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

NETWORK THEORY LAB

(ECE, EEE, EE)

Course code -EE 302P

List of Experiments (Minimum 10)

1. Transient response of RC circuit.

2. Transient response of RL circuit.

3. To find the resonance frequency, Band width of RLC series circuit.

4. To study and verify effect of R on frequency response of parallel resonance circuit.

5. To calculate and verify "Z" parameters of a two port network.

6. To calculate and verify "Y" parameters of a two port network.

7. To determine equivalent parameter of parallel connections of two port network.

8. To plot the frequency response of low pass filter and determine half-power frequency.

9. To plot the frequency response of high pass filters and determines the half-power frequency.

10. To plot the frequency response of band-pass filters and determines the band-width.

11. To calculate and verify "ABCD" parameters of a two port network.

12. To synthesize a network of a given network function and verify its response.

13. Introduction of P-Spice or other simulation software

COMMUNICATION SKILL LAB

Course code HS301

This lab paper involves interactive practice sessions in Language Lab along with some class lectures to enable the students to be confident enough in language and professional sphere of life.

Module I: Listening Comprehension

To comprehend spoken material in standard Indian English/ British English & American English

- Current situation in India regarding English
- American English Vs. British English

Module II: Phonetics & Phonology

- Introduction to Phonetics & Phonology
- Organs of Speech/ Speech Mechanism
- Pronunciation, Intonation**,** Stress and Rhythm, Syllable division
- Consonants/Vowels/Diphthongs Classification

Module III: Common Everyday Situations: Conversations and Dialogues

Module IV: Communication at Workplace

Module V: Telephonic Conversation

- Introduction
- Listening/Speaking

- Telephonic Skills Required
- Problems of Telephonic Conversation
- Intensive Listening

Module VI: Interviews

- The Interview Process
- Purpose/Planning/Two-way Interaction/Informality
- Pre-interview Preparation Techniques
- Projecting a Positive Image
- Answering strategies

Module VII: Formal Presentations

- Introduction
- Nature/Importance of Presentation
- Planning
- Objective with central idea, main ideas, role of supporting materials
- Handling Stage Fright

Module VIII: Forms of Technical Communication: Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Expert Technical Lecture: Theme clarity; Analysis & Findings; C.V./Resume writing; Technical Proposal: Types, Structure & Draft.

Module IX: Technical Presentation: Strategies & Techniques Presentation: Forms; interpersonal Communication; Class room presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Module X: Technical Communication Skills: Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances: Exposition narration & Description; effective business communication competence: Grammatical; Discourse competence: combination of expression & conclusion; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and non verbal means.

Jharkhand University of Technology
Jharkhand, Ranchi

Proposed Syllabus for B.Tech 4th Semester

Electrical Engineering

&

Electrical and Electronics Engineering

Electrical Engineering

4th semester course structure

Sl. No.	Course code.	Subject	L	T	P	Credit
01	EE401	Power System – I	3	1	0	3
02	EE402	Measurement & Instrumentation	3	1	0	3
03	EC401	Analog Electronics And Circuits	3	1	0	3
04	EC403	Digital Electronics And Logic Design	3	1	0	3
05	CS301	Data Structure And Algorithm	3	1	0	3
06	EN401/ IT402	Engineering Economics /Cyber Security	2	0	0	0
01	EE401P	Power System- I Lab	0	0	3	1
02	EE402P	Measurement & Instrumentation Lab	0	0	3	1
03	EC403P	Digital Electronics And Logic Design Lab	0	0	3	1
04	EX401	Extra Activities (NSO/NSS/NCC/Yoga/ Creative Arts/Mini Project)	0	0	2	1
05	IN401	Internship/ Tour & Training/Industrial Training	0	0	0	2
Total credit						**21**

Electrical & Electronics Engineering

4th semester course structure

Sl. No.	Course code	Subject	L	T	P	Cred it
01	EE401	Power System – I	3	1	0	3
02	EE402	Measurement & Instrumentation	3	1	0	3
03	EC401	Analog Electronics And Circuits	3	1	0	3
04	EC403	Digital Electronics And Logic Design	3	1	0	3
05	CS301	Data Structure And Algorithm	3	1	0	3
06	EN401/ IT402	Engineering Economics /Cyber Security	2	0	0	0
01	EE401P	Power System- I Lab	0	0	3	1
02	EE402P	Measurement & Instrumentation Lab	0	0	3	1
03	EC403P	Digital Electronics And Logic Design Lab	0	0	3	1
04	EX401	Extra Activities (NSO/NSS/NCC/Yoga/ Creative Arts/Mini Project)	0	0	2	1
05	IN401	Internship/ Tour & Training/Industrial Training	0	0	0	2
Total credit						**21**

POWER SYSTEM-1

Course Code- EE401

Module I: Basic Concepts:

Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids. Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.

Module II: Power System Components :

Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines. Transformers: Three-phase connections and Phase-shifts. Three-winding transformers, autotransformers, Neutral Grounding transformers. Tap-Changing in transformers. Transformer Parameters. Single phase equivalent of three-phase transformers. Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. Real and Reactive Power Capability Curve of generators. Typical waveform under balanced terminal short circuit conditions – steady state, transient and sub-transient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations.

Module III: Over-voltages and Insulation Requirements:

Generation of Over-voltages: Lightning and Switching Surges. Protection against Over-voltages, Overhead Line Insulators: Introduction, types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, testing of insulators. Insulation Coordination. Propagation of Surges. Voltages produced by travelling surges. Bewley Diagrams.

Module IV: Fault Analysis and Protection Systems :

Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks.

Computation of Fault Currents. Neutral Grounding. Switchgear: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application.

Module V: Introduction to DC Transmission & Renewable Energy Systems

DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators, Power Electronics interfaces of wind generators to the grid.

Text Books:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education,1994.

2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education,1995.

3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc.,1999.

4."C. L. Wadhawa", "Generation and utilization of Electrical Energy", New age International (P) Limited, Publishers 1997.

5."C. L. Wadhawa", "Electrical Power Systems", New age International (P) Limited, Publishers 1997.

6."M. L. Soni, P. V. Gupta, U. S. Bhatnagar and A. Chakraborti", "A Text Book on Power System Engineering", DhanpatRai and Co. Pvt. Ltd, 1999.

Reference Books :

1. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw HillEducation,2003.

2. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "ElectricPowerSystems", Wiley, 2012.

3."M.V. Deshpande", "Elements of Power Station design and practice", Wheeler Publishing, 3rd Edition 1999.

4."S. N. Singh", "Electrical Power Generation, Transmission and Distribution", PHI, 2003.

5."V.K Mehta and Rohit Mehta", "Principles of Power Systems", S. Chand& Company Ltd, New Delhi, 2004.

MEASUREMENT AND INSTRUMENTATION

Course Code- EE402

Module I: Measuring System Fundamentals:

Absolute standards (International, Primary, Secondary, and Working standards),True Value, Errors(Gross, Systematic and Random); Static Characteristic of instruments(Accuracy, Precision, Sensitivity, Resolution and threshold).Classification of Instruments (based upon mode of measurement- Indicating , Recording and Integrating Instruments), Generalized Instrument (block diagram and description of various blocks), the three forces in an electromechanical indicating instrument (deflecting controlling and damping forces and the interplay between them), Comparison between gravity and spring(Qualitative Study) . Errors in Measurements. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, Cp, Cpk

Module II: Analog Ammeters , Voltmeters and Watt meters :

PMMC and MI Instruments, Construction, Torque Equation, Range Extension, Effect of temperature, Classification, Errors, Advantages and Disadvantages. Analog Wattmeters Power Factor Meters and Energy Meter Power and Power Factor, Electrodynamometer type wattmeter, power factor meter, Construction, theory, Shape of scale, torque equation, Advantages and disadvantages, active and reactive power measurement in single phase, Measurement in three phase. Single phase induction type energy meters, construction, theory, Operation, lag adjustments, Max Demand meters/indicators, Measurement of VAH and VARh.

Module III: DC and AC Bridges:

Measurement of resistance, Wheatstone Bridge, Kelvin's Bridge, Kelvin's Double Bridge, Measurement of inductance, Capacitance, Maxwell's Bridge, Desauty Bridge, Anderson Bridge, Schering Bridge, Wien Bridge, Applications and Limitations.

Module IV: Instrument Transformers and Transducers

Current Transformer and Potential Transformer - construction, theory, phasor diagram, errors, testing and applications. Measurement of Temperature, RTD, Thermistors, LVDT, Strain Gauge, Piezoelectric Transducers, Digital Shaft Encoders, Tachometer, Hall effect sensors. Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors.

Module V: Electronic Instruments:

Electronic Display Device, Digital Voltmeters, Digital Energy meter, CRO, measurement of voltage and frequency, Lissajous Patterns, Plotting B-H curve of a magnetic material, Wave Analyzers, Harmonic Distortion Analyzer. Digital Energy Meter. Measurements of R, L and C.Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.Digital Storage Oscilloscope.

Text Books:

1. W.D. Coopers and Helfrick, Modern Electronic instrumentation and Measurements Techniques, Prentice Hall of India Pvt. Ltd,
2. E.W. Gowlding and F.C.Widdis, Electrical Measurements and Measuring Instruments 5/e, Wheeler Publications.
3. U. A. Bakshi, A. V. Bakshi: Electrical Measurements and Instrumentation, Technical Publications.

Reference Books

1. A. K. Sawhney: A course in Electrical Measurements Electronic Measurements Instrumentation, Edition 11, Dhanpat Rai and Sons,
2. J. B. Gupta: A course in Electrical and Electronic Measurements and Instrumentation, 13/E, Kataria and Sons.

ANALOG ELECTRONICS AND CIRCUITS

Course Code- EC401

Module I: Diode & Transistor Circuits:

P-N junction diode, I-V characteristics of a diode, review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits. Amplifier models, Voltage amplifier, current amplifier, transconductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers, high-frequency equivalent circuits.

Module II: Oscillators, DAC & ADC:

Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators. Digital-to-analog converters (DAC) Weighted resistor, R-2R ladder, resistor string etc., Analog to-digital converters (ADC): Single slope, dual slope, successive approximation, flash etc.

Module III: MOSFET circuits:

MOSFET structure and I-V characteristics, MOSFET as a switch, MOSFET as an amplifier: small signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Module IV: Differential, multi-stage and operational amplifiers:

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Module V: Linear & Nonlinear applications of op-amp:

Idealized analysis of op-amp circuits, Inverting and non-inverting amplifier, Differential amplifier, Instrumentation amplifier, Integrator, Active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, Voltage regulator, Oscillators (Wein bridge and phase shift).Analog to Digital Conversion. Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators, Precision rectifier, peak detector, Monoshot.

Text Books :

1. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988.

Reference Books:

1. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.
2. P. R. Gray, R. G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons, 2001
3. Op-Amps and Linear Integrated Circuits by A. Gayakwad, Pearson Publication

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DIGITAL ELECTRONICS AND LOGIC DESIGN

Course code -EC 302

Module I: Binary Codes and Boolean algebra

Analog and Digital, Binary Number System. Addition, Subtraction, Multiplication, Division of binary numbers, Subtraction using 2's complement method. Binary codes: weighted and non weighted codes, self complementary codes, BCD, Excess-3, Gray codes, Alphanumeric codes, ASCII Codes. *Boolean algebra*: Boolean Laws and Expression using Logic Gates, Realization of different gates using Universal gates, DeMorgan's Theorem, Duality Theorems.

Module II : Boolean function minimization Techniques

Standard forms: SOP, POS, Simplification of Switching function & representation (Maxterm & Minterm), Boolean expression & representation using logic gates, Propagation delay in logic gate. *Karnaugh map*: K-map(up to 5 variables), mapping and minimization of SOP and POS expression, Don't care condition, conversion from SOP to POS and POS to SOP form using K-map, Minimization of multiple output circuits, Quine Mc-cluskey method minimization technique, prime implicant table, Don't care condition.

Module III: Combinational Circuits Design

Adder & Subtractor (Half and Full), Parallel Binary adder, BCD Adder, Binary multipliers, Code Converters, parity bit generator, Comparators, Decoder, BCD to 7-segment Decoder, Encoders, Priority Encoders, Multiplexers, De Multiplexers.

Module IV : Sequential Circuits Elements

Introduction to sequential circuit, Flip-flop & Timing Circuits: SR latch, Gated latch, Tri state logic, Edge triggered flip-plop: - D, JK, T Flip-flop, flip-flop asynchronous inputs ,characteristic table of Flip-flop, excitation table of Flip-flop, master slave JK flip flop, inter conversion of Flip-flop. Study of timing parameters of flip-flop. Shift registers: buffer register, controlled buffer register. Data transmission in shift resistor SISO, SIPO, PISO, PIPO, Bidirectional shift register, universal shift registers. *Counter*: Classification, Ripple or asynchronous counter, Effect of propagation delay in ripple counters, up-down counter,

Design of Mod-n counter, synchronous counter, Ring counter, Johnson counter. Introduction to FSM. Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator.

Module V: Logic Families and VLSI Design flow

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA, Logic implementation using Programmable Devices VLSI Design flow: Design entry, Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits

Text Books **:**

1. Kharate "Digital Electronics" OXFORD Publication
2. A. Anand Kumar 'Fundamentals of Digital Circuits'. PHI Publications
3. R.P. Jain-'Modern Digital Electronics' IIIrd Edition- Tata Mc Graw Hill, Publication
4. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition
6. Bhaskar VHDL BASED DESIGN ,PEARSON EDUCATION

Reference Books:

1. Rajkamal 'Digital Systems Principals and Design' Pearson Education
2. A.P. Malvino, D.P. Leach 'Digital Principles & Applications' -VIth Edition-TMH publication.
3. M. Morris Mano 'Digital Design' (Third Edition). PHI Publications

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DATA STRUCTURES AND ALGORITHMS

Course code -CS 301

Module I

Basic concepts and notations: Data structures and data structure operations, Complexity Analysis: Mathematical notation and functions, algorithmic complexity and time space trade off, Big O Notation, The best, average & worst cases analysis of various algorithms. Arrays: Linear & Multidimensional Arrays, Representation & traversal. Sorting algorithms: Bubble sort, Selection sort, Insertion sort, Merge sort and Quick sort, Counting Sort. Linear search and Binary search on sorted arrays.

Module II

Abstract Data Types (ADTs) Stack: Push; Pop, stack representation using array and linked list, Applications of Stack, Recursion. Queue: Representation using array and linked list, Insertion and deletion operations, circular queue, Dequeue, priority queue. Linked Lists & their types.

(Single, Double, Circular linked lists), Operations on Varieties of Linked Lists (Search and Update) with applications

Module III

Introduction to Trees, Binary tree - definitions and properties; binary tree traversal algorithms with and without recursion., Binary Search Tree - creation, insertion and deletion operations, Threaded tree (One way and Two way). AVL tree balancing; B-tree

Module IV

Graph Algorithms: Graphs and their Representations, Graph Traversal Techniques: Breadth First Search (BFS) and Depth First Search (DFS), Applications of BFS and DFS, Minimum Spanning Trees (MST), Prim's and Kruskal's algorithms for MST, Connected Components, Dijkstra's Algorithm for Single Source Shortest Paths,, Floydd's Algorithm for All-Pairs Shortest Paths Problem

Module V

Hashing techniques, Hash function, Address calculation techniques- common hashing functions Collision resolution, Linear probing, quadratic probing, double hashing, Bucket addressing. Rehashing

Course Outcomes: At the end of the course the student will be able to:

- Understand the concept of ADT
- Identify data structures suitable to solve problems
- Develop and analyze algorithms for stacks, queues
- Develop algorithms for binary trees and graphs
- Implement sorting and searching algorithms
- Implement symbol table using hashing techniques

Text Books:

1. Data Structures Using C – A.M. Tenenbaum (PHI)

2. Introduction to Data Structures with Applications by J. Tremblay and P. G. Sorenson (TMH)

3.Data Structures, Algorithms and Application in C, 2nd Edition, Sartaj Sahni

4. Data Structures and Algorithms in C, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.

REFERENCE BOOKS:

1. Data Structure and Program Design in C by C.L. Tondo.
2. Data Structures with C++, J. Hubbard, Schaum's Outlines, TMH.
3. Data Structures and Algorithms in C, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.
4. Data Structures and Algorithm Analysis in C, 3rd Edition, M.A. Weiss, Pearson.
5. Classic Data Structures, D. Samanta, 2nd Edition, PHI.
6. Data Structure Using C by Pankaj Kumar Pandey.
7. Data Structure with C, Tata McGraw Hill Education Private Limited by Seymour Lipschutz.
8. Data Structure through C in Depth, BPB Publication, by S.K. Srivastava.
9. Data Structure and algorithm Analysis in C 2nd Edition, PEARSON Publishing House, Mark Allen Weiss

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CYBER SECURITY

Course code –IT 402

Module I: Introduction to Cybercrime : Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, and Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

Module II: Cyber Offenses: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Module III: Cybercrime : Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

Module – IV: Tools and Methods Used in Cybercrime : Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

Module V: Cyber Security : Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

TEXT BOOK:

- Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.

REFERENCE BOOK:

- Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
- Introduction to Cyber Security , Chwan-Hwa(john) Wu,J.David Irwin.CRC Press T&F Group

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ENGINEERING ECONOMICS

Course code –EN 401

COURSE OUTLINE:

The basic purpose of this course is to provide a sound understanding of concepts and principles of engineering economy and to develop proficiency with methods for making rational decisions regarding problems likely to be encountered in professional practice.

Module -1

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of Economics, Relation between science, engineering, technology and economics; Nature of Economic problem, Production possibility curve, Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility – its practical application and importance.

Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, measurement of elasticity of demand, practical importance & applications of the concept of elasticity of demand.

Module -II

Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale.

Various concepts of cost – Fixed cost, variable cost, average cost, marginal cost, money cost, real cost, opportunity cost. Shape of average cost, marginal cost, total cost, Cost curves.

Module III

Meaning of Market, Types of Market – Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets)

Pricing Policies- Entry Deterring policies, Predatory Pricing, Peak load Pricing. Product Life cycle

Firm as an organisation- Objective of the Firm, Type of the Firm, Vertical and Horizontal Integration, Diversification, Mergers and Takeovers.

Module -IV

Nature and characteristics of Indian economy (brief and elementary introduction), Privatization – meaning, merits and demerits. Globalisation of Indian economy – merits and demerits. Elementary Concepts of VAT, WTO, GATT & TRIPS agreement, Business cycle, Inflation

RECOMMENDED BOOKS:-

1. R.Paneer Seelvan: Engineering Economics, PHI
2. Managerial Economics, D.N.Dwivedi, Vikash Publication
3. Managerial Economics, H.L. Ahuja, S. Chand and Co. Ltd.
4. Managerial Economics, Suma Damodaran, Oxford.
5. R.molrishnd Ro T.V S 'Theory of firms : Economics and Managerial Aspects'. Affiliated East West Press Pvt Ltd New Delhi
6. Managerial Economics, H. Craig Petersen &W. Cris Lewis, Pearson Education.

POWER SYSTEM-1 LAB

Course Code- EE401

List of Experiments (Minimum 10)

1. To draw operating characteristics of DMT/IDMT relay.

2. To draw operating characteristics of differential relay.

3. To study Bucholtz Relay.

4. Testing of Transformer oil.

5. To find ABCD Parameters of a model of transmission line.

6. To observe Ferranti effect in a model of transmission line.

7. To study the microcontroller based differential relay for the protection of transformer.

8. To study electromechanical type negative sequence relay.

9. To study electromechanical type over current relay.

10. To study electromechanical type directional over current relay.

11. To study electromechanical type earth fault relay.

12. To determine the string efficiency of suspension type insulators with and without guard ring.

13. To plot Annual / monthly / daily load demand of nearby area.

14. To draw single line diagram of distribution system of JUVNL of nearby area of college concerned.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

MEASUREMENT AND INSTRUMENTATION LAB

Course Code- EE402

List of Experiments (Minimum 10)

1. Calibration of AC voltmeter and AC ammeter.
2. Measurement of inductance using Maxwell’s Bridge.
3. Measurement of capacitance using Schering Bridge.
4. Measurement of low resistance using Kelvin’s Double Bridge.
5. Measurement of Power using CT and PT.
6. Measuring displacement using LVDT.
7. Measuring temperature using thermocouple.
8. Measuring pressure using piezoelectric pick up.
9. Measurement of speed of DC motor by photoelectric pick up.
10. Speed measurement using Hall Effect sensor.
11. Measurement of a batch of resistors and estimating statistical parameters. Measurement of L using a bridge technique as well as LCR meter.
12. Measurement of C using a bridge technique as well as LCR meter. Measurement of Low Resistance using Kelvin’s double bridge.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

DIGITAL ELECTRONICS AND LOGIC DESIGN LAB

Course code EC 302P

List of Experiments (Minimum 10)

1. Study of TTL gates – AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.
2. Design & realize a given function using K-maps and verify its performance.
3. To verify the operation of multiplexer & Demultiplexer.
4. To verify the operation of comparator.
5. To verify the truth tables of S-R, J-K, T & D type flip flops.
6. To verify the operation of bi-directional shift register.
7. To design & verify the operation of 3-bit synchronous counter.
8. Design all gates using VHDL.
9. Design a multiplexer using VHDL
10. Design a decoder using VHDL
11. Write VHDL programs for the following circuits, check the wave forms and the hardware generated a. half adder b. full adder
12. Write VHDL programs for the following circuits, check the wave forms and the hardware generated a. multiplexer b. demultiplexer

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus. For VHDL Xilinx software may be used.

JHARKHAND UNIVERSITY OF TECHNOLOGY

METALLURGICAL ENGINEERING DEPARTMENT

3rd SEMESTER COURSE STRUCTURE

Sl. No	**Course No.**	**Subject**	**L**	**T**	**P**	**Credit**
1		Mathematics-III	3	1	0	4
2		Materials Engineering	3	0	0	3
3		Materials Thermodynamics and Kinetics (PCC)	3	0	0	3
4		Fuels, Refractories and Furnaces (PCC)	3	0	0	3
5		Metallurgical Analysis (PCC)	3	0	0	3
6		Biology/Environmental Science	3	0	0	0
1		Communication Skill Laboratory	0	0	2	1
2		Fuels, Refractories and Furnaces Laboratory	0	0	3	1
3		Metallurgical Thermodymics and Analysis Laboratory	0	0	3	1
4		Extra activity -III (NSO/NSS/NCC/YOGA/CA)	0	0	(3)	1
5		Internship				2
			Total Credit			**22**

JHARKHAND UNIVERSITY OF TECHNOLOGY

METALLURGICAL ENGINEERING DEPARTMENT

4th SEMESTER COURSE STRUCTURE

Sl. No	Course No.	Subject	L	T	P	Credit
1		Mathematics-IV	4	0	0	4
2		Electronics and instrumentation Engineering.	3	0	0	3
3		Physical Metallurgy (PCC)	3	0	0	3
4		Mineral Engineering (PCC)	3	0	0	3
5		Introduction to transport phenomena (PCC)	3	0	0	3
6		Biology/Environmental Science	3	0	0	0
1		Advance Communication Skill Laboratory	0	0	2	1
2		Metallography Laboratory	0	0	3	1
3		Mineral Engineering Laboratory	0	0	3	1
4		Extra activity -IV (NSO/NSS/NCC/YOGA/CA)	0	0	(3)	1
			Total Credit			**20**

Metallurgical Engineering Department

SUBJECT: – MATERIAL ENGINEERING

Course objective:

To increasing demand of the available materials, coupled with new applications and requirements has brought about many changes in the style of their uses.

To develop the basic knowledge of metals, polymers composites and ceramics other than conventional metals and alloys to apply them to advance engineering applications.

1. Introduction- Crystalline and Non crystalline solids. Classification of Engineering materials and their selections, bonding in Solids: Ionic, Covalent and Metallic bonding. (5hrs.)

2. Crystal Structure -Space lattices, Bravais lattices, Crystal system, Unit Cell, Metallic crystal structures: SC, BCC,FCC,HCP structures, Miller notations of planes and directions, Imperfections in crystals: Point defects, Line, surface defects, Dislocations: Edge and Screw dislocation, Burgers vectors. (12hrs.)

3. Metallic Materials- Metals and alloys, ferrous materials- introduction to Iron -carbon Diagram, Steel and their Heat treatment, properties and applications. Different types of heat treatment processes. Non-ferrous alloys:-Copper based alloys, Al based alloys, other important non ferrous alloys , properties and applications. (10)

4. Polymers- Basic concepts of Polymer Science, polymer classifications, Crystallinity of polymers, Copolymers, Thermoplastic and Thermosetting polymers, Elastomers, Properties and Applications. (5hrs)

5. Ceramics-Basic concepts of ceramics science, traditional and new ceramics, Oxide and Non-Oxide ceramics, Ceramics for high temperature applications, Glass, applications of ceramics, and glass. (5 hrs.)

6. Composite materials-Definition, general characteristics, Particles reinforced and fiber reinforced composite materials, MMC, CMC, PMC, properties and applications. (5hrs.)

Text Books:

1. Elements of Material Science by Van Vlack
2. Material Science by O.P. Khanna
3. Material Science and Engineering by V. Raghavan

4. Material Science by R.S.Khurmi and R.S. Sedha

Reference Books:

1. Material Science and Engineering by William D. Callister

Course outcomes:

At the end of this course, the students would be able to:

- Select different materials other than conventional metals and alloys for specific engineering applications.
- To Solve the materials problems associated with the weight reduction through the appropriate choice of metals, polymers, ceramics and composites.
- Selection criterion for polymers and composites for various engineering applications.

MATERIALS THERMODYNAMICS AND KINETICS (PCC)

OBJECTIVES OF THE COURSE:

To highlight the fundamental role of thermodynamics in describing metallurgical and materials processes.

To learn and use thermodynamics functions, rules and relations and interpret thermodynamics plots and diagrams.

1. History of Thermodynamics, Ideal Gas, Energy and Work, Extensive and Intensive properties. (2 hrs).

2. First Law of Thermodynamics, Internal Energy, Enthalpy, Heat Capacity, Reversible Processes (3 hrs.)

3. Second Law of Thermodynamics, entropy and equilibrium, Reversibility, Heat Engines (3 hrs.)

4. Statistical Interpretation of Entropy, Boltzmann Equation (3 hrs.)

5. Auxiliary functions Enthalpy, free Energy, Chemical potential, Maxwell's Equations, Gibbs-Helmholtz Equation (3hrs.).

6. Enthalpy as a function of temperature and composition, Third law of Thermodynamics (3 hrs.)

7. Phase Equilibrium in a one -component system, Equilibrium between Vapor and Condensed phase, and between condensed phases (3 hrs.)

8. Gases: Ideal, Real, Van dar waal's (3 hrs.)

9. Raoult's Law and Henry's Law ,Activity, Gibbs-Duhem Equation, Properties of Ideal and Non- ideal solutions, regular solutions (3 hrs.)

10. Effect of Temperature and Pressure on the Equilibrium constant for a gas mixtures (3 hrs.)

11. Ellingham Diagram of Metal oxides and Sulphide systems. (2 hrs.)

12. The Gibbs Phase rule (3 hrs).

13. Electrochemistry, Concentration and EMF, standard Reduction potentials, Pourbaix diagrams (3 hrs.)

14. Kinetic reactions, Activated complex theory, Homogeneous reaction and importance of rate controlling steps, Adsorption and reaction on surfaces, Reaction Rule, Thermodynamics of electrolytes and Concentration cells. (6 hrs.)

Reference Books:

1. Thermodynamics in Materials science, Robert Dehoff, CRC Press, 2006.
2. Introduction to Metallurgical Thermodynamics-Darken's and Gurry, MGH publication.
3. Introduction to the Thermodynamics of Materials-Gaskel

Course Outcomes:

1. Use the various thermodynamics functions appropriately under different experimental situations involving gases, liquids and solids.

2. Utilize Pourbaix diagrams.

3. Utilize Ellingham Diagrams.

4. Explain the Gibbs phase rule.

FUELS REFRACTORIE AND FURNACES (PCC)

1**. FUELS** : Classification of fuels, Indian Resources.

2. SOLID FUELS :Coal preparation, Proximate and Ultimate analysis of coal, Coal washing, Carbonization of Coal, Brief description of the manufacture of Coke and recovery of products, Testing of coal and Coke. Indian standard specifications of Metallurgical Coke to be used in blast furnace.

3. **LIQUID FUELS** : Advantages of liquids fuels , liquid fuels furnaces, storage and handling of liquid fuels.

4. **GASEOUS FUELS** : Advantages of gaseous fuels, Manufacture of Producer Gas , water Gas, By products of gaseous fuels-Blast furnace gas, Coke oven Gas.

5. **FURNACES**: Classification of furnaces, Principles of working and applications in Industries., Principles of Regenerators and Recuperators.

6. **REFRACTORIES** : Definition, Classification of Refractories, Properties of a good refractory materials and factors affecting selection of Refractories . Types of Clay, Use of Grog and its advantages. Manufacture, Properties and Application of Fireclay Refractories, high Alumina Refractories, Silica ,Chromite, Graphite, Magnesite, Dolomite, Silicon carbide, silimanite and Kyanite Refractories, Carbon Refractories : Characteristics of carbon as refractories material, manufacture, properties and applications.

Reading:

1. J.D. Gilchrist -Fuels, Furnaces and refractories, Pergamon,1977.

2. O.P.Gupta -Elements of Fuels, Furnaces and Refractories, khanna Publications,1998

3. W.Trinks, M.H. mawhinney- Industrial Furnaces, John Wiley and Sons,2003.

4. Samir Sarkar- Fuels and Combustion, Orient Longman Ltd.

COURSE OUTCOMES:

1. Select fuels, refractories and furnces to minimize the overall cost production for a given application

2. Classification of furnaces and Refractories and their operation conditions.

3. Understand the production of solid, liquid and gaseous fuels.

4. Illustrate the production, composition, properties, testing and applications of refractories.

METALLURGICAL ANALYSIS (PCC)

1. Important of Metallurgical Analysis in Metallurgical Industries, Important Methods for the preparation of standard samples. qualitative analysis of metallurgical samples, Elementary discussion on the basic principles involved in metallurgical analysis.

2. Colorimetry and Adsorptimetry: Theory of Adsorptiometry and Colorimetry, Application of Beer's Law, Colorimetric methods, Adsorptiometric method.

3. Emission Spectroscopy and its use in Metallurgical Analysis. Atomic Absorption Spectro electro photometric method of analysis. Conductimetric, Potentiometric titration, Polaroghraphic and Electro- Gravitric methods of analysis.

4. Quantitative Estimation of Important Constituents of the following items: Iron ore, Iron and steel, Lime stone and dolomite and Blast Furnace slag.

Reading:

1. B.C. Aggrawal and S.P.Jain-A text book of Metallurgical Analysis

4th SEMESTER COURSE STRUCTURE

Physical Metallurgy (PCC)

Objectives of the course

To learn about the principles of alloy design, phase diagram and strengthening Mechanisms in different metals and alloys.

To study the fundamental aspects of heat treatment and its influence on properties and applications

To obtain knowledge about the physical metallurgy of specific and important Engineering materials such as ferrous and non-ferrous alloys.

Detailed contents:

1: Phase diagrams – binary (Cu-Ni, Cu-Sn, Pb-Sn, Al-Cu, Al-Si, Cu-Zn and other alloys) and ternary, principles of alloying, Hume-Rothery rules. Strengthening mechanisms – solid solution, work hardening, precipitation hardening, dispersion strengthening (10 hours)

2: Iron carbon diagram, isothermal, and continuous cooling transformation Diagrams; influence of alloying elements on transformation characteristics (10 hours)

3: Heat treatment - annealing, normalizing, hardening and tempering of steels, hardenability (5 hours)

4: Introduction to important ferrous alloys (stainless and special steels, cast irons), aluminium alloys, titanium alloys, copper base alloys (10 hours)

5: Superalloys, shape memory alloys – classification, heat treatment, properties and applications (5 hours)

Suggested books:

1. Physical Metallurgy: Principles and Practice, V. Raghavan, PHI Learning, Delhi, 2008.

2. Physical Metallurgy Principles, R. Abbaschian, R. E. Reed-Hill, Cengage Learning, 2009

Suggested reference books

1. Physical Metallurgy Vols. I, II, III, R.W. Cahn and P. Haasen, North Holland, 1996.

2. Light Metals, I.J. Polmear, Elsevier, 2005

Course Outcomes:

By completing this course the student will have:

1. The ability to identify the concepts of alloy design, phase diagrams and strengthening mechanisms and apply them to materials systems
2. The knowledge of heat treatment and the resulting microstructure in materials
3. The knowledge of physical metallurgical aspects of important engineering alloys

MINERAL ENGINEERING (PCC)

Course objective: The basic objective of mineral processing are technical and econonmic.Theoretical aspects of common mineral processing techniques and the associated equipment used in mining and pre-extraction practices.

1. Sampling of ores by different methods -Handling Sampling, Mechanical sampling, Theory of liberation of minerals, Principle and applications of primary, Secondary Crusheres (Jaw, Gyratory, Cone, Rolls crusher). Grinding, Ball mills, Theory of ball mill operation, Rod mills and tube mills. (8 hrs.)

2. Theory of Comminution- Rittinger's Law, Kick's Law and Bond's Law theories. (2hrs)

3. Sizing : Laboratory sizing, Types of screen, Screening and factor affecting the screening Efficiency, Sedimentation and Elutriation. Industrial sizing methods. (6 hrs)

4. Movement of solids in fluids: Stoke's and Newton's laws, Terminal velocity and its relation with size, relation between time and velocity, relation between distance travelled and velocity, free and hindered settling ratios.(6 hrs)

5. Quantifying concentration operation: Ratio of concentration, Recovery and selective index. (2 hrs.)

6. Classification: Principles, Sizing and sorting classifiers. heavy media separation, processes using heavy liquids, processes using heavy suspensions, Thickening and Filtration. Jigging- Theory of jigging, types of jig, Jigging machines, Advantages and disadvantages of jigs. Tabling- Theory of flowing film concentration, shaking tables. (10 hrs)

7. Flotation: Principles of flotation, Physical Chemistry of Flotation, Factors affecting flotation, Flotation reagents, Flotation of copper, Flotation of Lead-Zinc ores Recent development in flotation process. Principles and applications of Magnetic and Electrostatic separation. (10 hrs.)

TEXT BOOKS:

1. A. M. Gaudin, *Principles of Mineral Dressing*, Tata McGraw & Hill, 1993
2. R. H. Richard and C. E. Locky, *A text Book on Ore Dressing*, A A Balkema, 2004

3. S.K.Jain ,Ore Processing, Oxford-IBH Publication Company-2005

REFERENCES:
1. Gilchrist J.D., „Extraction Metallurgy‟, 2nd Edition, Pergamon Press, 1980
2. Joseph Newton, „Extractive Metallurgy‟, 1st Edition, Wiley Eastern, 1967 Department of Metallurgical and Materials Engineering .
3. F. Taggart, *Mineral Dressing Handbook*, P & H, 2000
4. B. A. Wills,Tim Napier-Munn *Mineral Processing Technology*, Willy & Sons, 2005
5. G. C. Lowrison, *Crushing & Grinding*, Maxwell and MacMillan, 2002
6. L. Svalovsky, *Solid Liquid Separation*, Tata McGraw & Hill Inc., 2003

Course outcomes:

At the end of this course, the students would be able to:

(A) To understand the mineral processing basic principles and process.

(B) Discuss the physical and chemical properties of various minerals.

(C) To understand the various separation methods of mineral or gangue particles.

(D) Explain the different types of process control in mineral processing.

Introduction to Transport Phenomena (PCC)

Fluid Flow: Classification of fluids, Ideal and real, Newtonian & Non-Newtonian, Newton's law of viscosity. Types of fluid law: Streamline & Turbulent, continuity equation for incompressible and compressible fluid and its applications. Concept of velocity bounds layer.

Bernoulli's equation and its application for flow measurement by venturimeter, orifice meter, pilot tube and rotameter.

Dimensional analysis by Rayleigh's method of indices and Buckingham's π theorem. Example of analysis of pressure gradient, Mass transfer co-efficient & convective heat transfer co-efficient. Concept of similarly and dimensionless criteria. Dimensionless groups & their significance.

Pressure drop & friction factor in various configurations, flow in packed bad & Fludized bad. Free partially restricted jets, High velocity fluid jets.

Mass Transfer: Law of diffusion and their application, concept of mass transfer co-efficient & Concentration boundary layer, Interfacial mass transfer, overall mass balance.

Heat Transfer: Internal & external modes of Heat transfer, steady state heat conduction in monolayer and composite flat walls & Cylinders. Unsteady state heat conduction, thin & Massive heating and cooling. Finite difference method in solving unsteady state heat conduction.

Natural and forced convection, concept of heat transfer co-efficient, thermal boundary layer, some example of connective co-relations.

Law of radiation – Steffan-boltzmann's law, Kirchoff's law & Lambarth's law, Black and grey body concepts, view factor, radiation from flames & Gases. Radiation between simple surfaces with & without absorbing gas media. Radiation shields.

Suggested books:

1. 1. Transport phenomena, 2nd Edition: R. Byron Bird, Warren E. Stewart and Edwin N
2. Lightfoot; John Wiley & Sons
3. 2. Fundamentals of Momentum, Heat and Mass Transfer, 4th Edition: James R. Welty,
4. Charles E. Wicks, Robert E. Wilson and Gregory Rorrer; John Wiley & Sons

Suggested reference books:

5. 1. Transport phenomena in materials processing : D.R. Poirier and G.H. Geiger, TMS
6. 2. Introduction to Fluid Mechanics, 5th Edition: Robert W. Fox & Alan T. McDonald: John Wiley & Sons.

Course Outcomes

At the end of this course, the student should be able to:

1. T solve a problem in transport phenomena as a balance equation
2. Make suitable assumptions to make the problem a well defined one
3. Identify suitable geometry and boundary conditions for the problem

CHEMICAL ENGINEERING

SEMESTER III

Course Structure

S. No.	Subject Code	Subject	L	T	P	Cr.
		Theory				
1.		Math III	3	1	0	4
2.		Material Engineering	3	0	0	3
3.		Fluid Particle Operations	3	0	0	3
4.		Fluid Mechanics	3	0	0	3
5.		Heat Transfer	3	0	0	3
6.		Environmental Science	3	0	0	0
		Total				**16**
		Practical				
1.		Communication skills Lab	0	0	2	1
2.		Fluid Mechanics Lab	0	0	2	1
3.		Heat Transfer Lab	0	0	2	1
4.		Fluid Particle Operations Lab	0	0	2	1
5.		Extra Activities (NSO/NSS/NCC/YOGA/CRATIV ARTS/MINI PROJECT)	0	0	2	1
		Total				**5**
		Grand Total Credits	**16 + 5**			**21**

31.05.19

(Dr. S. P. Singh)
Prof. & Head
Deptt. of Chemical Engineering
BIT, Sindri, Dhanbad, Jharkhand
PIN-828123

CHEMICAL ENGINEERING

SEMESTER IV

Course Structure

S. No.	Subject Code	Subject	L	T	P	Cr.
		Theory				
1.		Electronics and Instrumentation Engineering	3	0	0	3
2.		Chemical Engineering Thermodynamics	3	0	0	3
3.		Industrial Chemical Calculations	3	0	0	3
4.		Chemical Technology	4	0	0	4
5.		Transport Phenomenon	3	0	0	3
6.		Engineering Economics	3	0	0	0
		Total				**16**
		Practical				
1.		Electronics and Instrumentation Engineering Lab	0	0	2	1
2.		Chemical Technology Lab	0	0	2	1
3.		Thermodynamics Lab	0	0	2	1
4.		Extra Activities (NSO/NSS/NCC/YOGA/CREATIV ARTS/MINI PROJECT)	0	0	2	1
5.		Internship/Task Training/ Industrial Training	0	0	2	1
		Total				**5**
		Grand Total Credits	16 + 5			**21**

31.05.19

(Dr. S. P. Singh)
Prof. & Head
Deptt. of Chemical Engineering
B.I.T. Sindri, Dhanbad, Jharkhand
PIN-828123

FLIUD AND PARTICLE OPERATIONS (CL 4105)

Lectures: 4 Periods/week
University Examination: 3 hours.

Sessional Marks: 30
University Examination Marks: 70

Semester IV

Prerequisite: None

Syllabus

UNIT-I **Lectures 10**

Size reduction: Principles of crushing & Grinding, Grindability characteristics of materials for crushing, Type of crushers, grinders and Disintergraters for coarse, intermediate and fine grinding, open and close circuit grinding, laws of crushing.

UNIT-II **Lectures 5**

Screening: Standard screens, Industrial screens, classification and performance of screens, Screen Analysis.

UNIT-III **Lectures 5**

Classifiers: Dry and wet classifiers, spitz-kasten and other types Tabling, Jigging & Hydro cyclones.

UNIT-IV **Lectures 10**

Flotation: Principle and operation of flotation cells, Reagents used in flotation, flotation machines and Industrial applications.
Sedimentation: Theory of sedimentation, Design and operation of Batch & continuous thickeners.

UNIT-V **Lectures 10**

Flow of solids through fluids: Free and hindered settling, stoke's law & Newton's Law used for separation of particles.
Filtration: Theory of filtration, batch and continuous filtration equipments, plate & frame filters, Rotary-Drum filters & leaf filters, filter Aid, Optimum time cycle and washing of filter cake.

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Text Books/Reference Books:

1. McCabe W. L., Jullian Smith C. and Peter Harriott - Unit operations of Chemical Engineering, 7th Edition, McGraw-Hill international edition, 2005.

2. Coulson J.M., Richardson J.F, Chemical Engineering, Vol. II, 4th Edition, Elsevier India, 2006.

FLUID MECHANICS FOR CHEMICAL ENGINEERING (CL 3102) (CL 3102)

Lectures: 4 Periods/week | *Sessional Marks: 30*
University Examination: 3 hours. | *University Examination Marks: 70*

Semester III

Syllabus

UNIT I **Lectures 9**

1. Introduction: Fluid continuum, density specific gravity, viscosity, Newtonian and non-Newtonian Fluids, kinematic viscosity, variation of viscosity with temperature and pressure, surface tension, capillary action, vapour pressure, thermodynamic property of gases, isothermal process, isentropic, adiabatic process, incompressible and compressible fluids
2. Fluid statics: pressure at a point, variation of static pressure, piezometric head, absolute and gauge pressure.

UNIT II **Lectures 6**

1. Pressure measurements: mechanical pressure gauge, simple manometer, differential, micro and inclined manometer.
2. Kinematic of fluid motion: classification of flow, steady and non-steady flow, one two and three dimension flow, laminar and turbulent flow, stream line, path line and streak line, introduction to stream function and velocity potential.

UNIT III **Lectures 6**

Dynamics of fluid flow: concept of system and control volume, the equation of continuity and motion, Euler equation of motion, Bernoulli equation for a real fluid, practical application of Bernoulli equation – pitot tube, venturimeter, entrance cone, coefficient of discharge, [factors influencing coefficient of discharge, water flow through an opening, air anemometer, rotameter and flow meter.]

UNIT IV **Lectures 6**

Dimensional analysis: use of Rayleigh method, Buckingham π- theorem, dynamic similarity, geometric similarity and kinematic similarity, dimensional groups and their physical significance. Reynold number, Froude number, Euler number, Mach number, Weber number etc.
Velocity distribution in a laminar flow for parallel plates and circular tubes, Hagen-Poiseuille equation.

UNIT V **Lectures 9**

Interphase transport in isothermal system; definition of friction factor, friction factor for flow in tubes, pressure drop required for a given flow rate. Flow rate for a pressure drop.

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F-Re plot, definition for drag coefficient for flow around sphere, C vs R.D.P. plot. Determination of diameter of a falling sphere, friction factor for packed bed- Ergun equation.

Lectures 6

UNIT V

Pumps: centrifugal pumps- classification, single and multistage pumps, pumps in series and parallel, suction and delivery pipes, basic equation applied in centrifugal pumps, velocity diagram at outlet, loss of head due to changed discharge and cavitations in pumps, operating characteristics of centrifugal pumps

Reciprocating pumps: introduction, working of Reciprocating pumps, double acting pumps, instantaneous rate of discharge, effects of friction and inertial pressure

Text Books/Reference Books:

- Fluid mechanics, Victor L. Streeter, Wylie, 9th Edition, Tata Mc- Graw Hill, 2010
- Fluid mechanics and hydraulic machine, Dr. R. K. Bansal, 9th Edition, Laxmi Publication, 2005.

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HEAT TRANSFER OPERATIONS (CL 3103)

Lectures: 4 Periods/week
University Examination: 3 hours.

Sessional Marks: 30
University Examination Marks: 70

Semester III

Prerequisite: None

Syllabus

Course Plan

Unit I **Lecture 10**

Introduction (1L)

Conduction convection & radiation. General laws of heat transfer.

Steady-State Heat conduction-1 dimension (7L)

Fourier's law, Thermal Conductivity – its variation with temperature & Pressure and its relationship with electrical conductivity. Heat transfer through composite walls and cylinders. insulation and R value, Overall Heat –Transfer coefficient, Critical thickness of insulation. conduction-convection system, Fins, Thermal contact resistance

Un-steady state Conduction (2L)

Introduction, Lumped system

Unit II **Lecture 9**

Principles of Convection (5L)

Introduction, viscous, Inviscid Flow, Laminar boundary layer on flat plate, Energy equation of the boundary layer, Thermal boundary layer, Turbulent boundary layer, Relation between fluid friction and Heat Transfer

Natural convection (4L)

Introduction, Free-convection heat transfer on Vertical planes, cylinders, sphere, combined free and forced convection.

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Unit III **Lecture 9**

Empirical and Practical Relations for forced convection (4L)

Introduction, Empirical relations for pipe and tube flow, Flow across cylinder and sphere, liquid metal heat transfer-brief

Radiation Heat Transfer (4L)

Physical Mechanism, Properties, radiation shape factor and relation, nonblack bodies, infinite parallel surface, shield. Absorbing and transmitting medium, radiation exchange with seculars surfaces, radiation heat transfer coefficient.

Unit IV **Lecture 12**

Condensation and boiling (4L)

Condensation heat transfer phenomena, film condensation inside horizontal and vertical tube, boiling heat transfer, the heat pipe.

Heat exchanger (8L)

Overall- heat transfer coefficient, Fouling factor, Types of heat exchanger, LMTD, Effectiveness-NTU method, Heat exchanger design considerations,

Suggested text book

1. "Heat Transfer", J. P. Holman, McGraw Hill, ninth Edition

Suggested reference book

1. "Heat Transmission", W. H. McAdams, McGraw Hill, 3rd Edition.
2. "Process Heat Transfer", D. Q. Kern, McGraw Hill

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Chemical Engineering Thermodynamics ~~II~~ (CL 3101)

Lectures: 4 Periods/week
University Examination: 3 hours.

Sessional Marks: 30
University Examination Marks: 70

Semester III

Prerequisite: None

Detailed Syllabus

Unit I **Lectures 12**

Fundamentals of thermodynamics:
Review of laws of thermodynamics & their applications, thermodynamic system, thermodynamic state and state function, heat, internal energy and work, thermodynamic equilibrium, reversible and irreversible processes, phase rule, thermodynamic analysis of the process, terminologies of thermodynamics, variables and quantities of thermodynamics, equations of state.

Unit II **Lectures 12**

Thermodynamic properties of fluids and their inter-relations

Thermodynamic relations: phase rule, Clapeyron equation, Maxwell equation, Joule Thomson coefficient, Kirchhoff Equation, specific heat relations, Helmholtz potential

Unit III **Lectures 8**

Heat Engine cycles: Power plant cycles, Rankine cycle, the Otto Engine, the Diesel Engine, the combustion gas cycle.

Unit IV **Lectures 8**

Refrigeration Cycles: The Carnot Cycle, The Air Refrigeration Cycle. The Vapor Compression cycle, Absorption Refrigeration machine and Heat pump.

TEXTBOOK

1. Introduction to Chemical Engineering Thermodynamics, Smith, J.M., Van Ness, H.C., and Abbott, M.M., 7th Edition. McGraw Hill.

Reference Books:

1. Chemical Engineering Thermodynamics, Y.V. C. Rao, Universities press.
2. A Textbook of Chemical Engineering Thermodynamics, K. V. Narayanan. Publisher PHI Learning Pvt. Ltd., 2004.

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Industrial Chemical Calculation (CL 4104)

Lectures: 4 Periods/week *Sessional Marks: 30*
University Examination: 3 hours. *University Examination Marks: 70*

Semester IV

Prerequisite: Basics of Thermodynamics

Detailed Syllabus

UNIT I **Lectures 6**

Units and dimensions, Stoichiometric and composition relations. Mathematical and engineering calculations, units dimension conversion, conversion of equations, conservation of mass, mass and volume relationship in chemical reactions. Mole percent, weight percent. Basis of calculation, excess reactant, limiting reactant. Degree of completion. Density, specific gravity, normality, molality and molarity.

UNIT II **Lectures 7**

Behavior of ideal gases: ideal gas law, gauge pressure, absolute pressure, density, molecular weight of gases, gas mixtures, average molecular weight of gas mixtures, Dalton's law, Amagat's law and their application, partial pressure, pure component volume, solving problem.

UNIT III **Lectures 7**

Vapor pressure: liquefication and liquid state, vaporization, condensation, dynamic equilibrium, equilibrium vapor pressure, superheat and quality, boiling point, effect of temperature on vapor pressures, Clausius –Clapeyron equation.

UNIT IV **Lectures 6**

Humidity and saturation: Humidity, saturation, relative saturation, percentage saturation, humid heat, dew point, wet bulb and dry bulb temperature, humidity chart.

UNIT V **Lectures 9**

Material balance: Input- output method, steady state, key component, material balance with chemical reaction and without chemical reaction, simultaneous equation, distillation, adsorption, recycle, by-pass and purge calculations, application of computer in solving material balance problems.

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UNIT V **Lectures 9**

Energy balance: Introduction to energy balance, Heat Capacity, entropy, specific heat, internal energy, first law of thermodynamics, second law of thermodynamics

Text Books/Reference Books:

1. Chemical Process Principles, O.A. Hougen, K.M. Watson, R.A. Ragatz, 2nd Edition, CBS, 2004
2. Basic principles and calculations in Chemical Engineering, David M. Himmelblau and James B. Riggs, 2nd Edition, Prentice Hall, 2012.

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Chemical Technology (CL-4106)

Lectures: 4 Periods/week
University Examination: 3 hours.

Sessional Marks: 30
University Examination Marks: 70

Semester IV

Prerequisite: None

Syllabus

UNIT- I **Lectures 12**

Introduction: Chemical industries-facts and figures, Unit operation and unit process concepts, chemical processing and role of chemical engineers.

Sulfuric Acid: Different raw materials, Methods of Production.

Nitrogen Industry: Ammonia, Reaction equilibrium of ammonia synthesis, Ammonium sulphate, Nitric acid, Ammonium nitrate, Urea; Methods of production, characteristic specifications, storage and handling.

UNIT- II **Lectures 8**

Phosphorus Industry: Phosphorous, Phosphoric acid, Sodium and Ammonium phosphates, single and triple superphosphates; Methods of production, storage and handling.

Chloro-Alkali Industry: Soda ash, Caustic soda, Bleaching powder; methods of production, storage and handling.

UNIT- III **Lectures 8**

Petrochemicals: Constituents and classifications, products of Refining, petrochemicals methods, synthetic gas, petrochemicals from Ethane, Ethylene & Acetylene, petrochemicals form Aromatics, Butanes, Butanes,

Oil & fats, Vegetable oils, animal fats, and waxes, soap and detergents, synthetic detergents, organic surface coatings.

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Lectures 10

UNIT- IV

Plastics: Polymerization fundamentals, thermosetting resins, thermoplastic resins, thermo plastics based on celluloses, laminate & synthetic fibers, viscose and cuproamonium Rayon, cellulose Acetates, nylons, Polyesters spun fibers, melt dry wet finishing of textiles.

Lectures 6

UNIT- V

Paper & pulp, production of pulp for paper, Recovery of chemical from paper manufacture, paper Board.
Sugar & starch: manufacture of sugar, starch and related products.

Text Books/Reference Books:

1. Shreve's Chemical Process Industries, Austin, G.T., McGraw Hill, 5th edition 1985.

2. Dryden's Outline of chemical technology Ed. By M.Gopal Rao and M. Sitting, 3rd edition, East West Press.

3. Chemical Process Industries , Vol.-II, CBS Publication & Distributors.

Transport Phenomena

Lectures: 3 Periods/week *Sessional Marks: 30*
University Examination: 3 hours. *University Examination Marks: 70*

Prerequisite: Heat Transfer, Fluid Mechanics
Syllabus

UNIT I **Lectures 8**
Introduction
Classification of Transport Process.
Principles of Momentum Transport
Molecular Transport of Momentum, concept of Newton's Law of Viscosity, Convective momentum transport, Shell Momentum balances and Velocity Distribution in Laminar Flow-Flow of a Falling film, Flow through a Circular Tube, Flow Through an annulus, Flow of Two adjacent immiscible Fluids.

UNIT II **Lectures 8**
Equation of Change
Equations of changes for isothermal, non-isothermal, and multi component mixtures
Turbulent transport
Laminar turbulent transition; basic characteristic features of turbulent flow; time smoothed equation of changes; Eddy viscosity, thermal conductivity and diffusivity; distribution of velocity, temp., and concentration in turbulent flows.

UNIT III **Lectures 12**
Principles of Steady State Energy Transport
Introduction to thermal conductivity and mechanisms of Energy transport, Shell energy balances, and temperature distributions in solids and Laminar Flow- Electrical Heat Source, Nuclear heat Source, Chemical Heat Source, Composite walls, concentric cylinders and Cooling Fin
Principles of Mass Transport
Mechanisms of mass transport, Equation of Molecular Mass Transport, Molecular Diffusion in Gases, Mass flux and molecular Transport by diffusion and Convection, Shell Mass Balances, Diffusion through-the stagnant gas film, Heterogeneous Chemical Reaction, Homogeneous chemical Reaction.

UNIT IV **Lectures 8**
Interphase transport
Friction factor; Heat transfer coefficient; mass transfer coefficient.
Macroscopic balances and its applications in analysis and solution of process engineering Problems
Momentum, heat and mass transfer analogies
Analogies among momentum heat and mass transfer.

Suggested text book

1. R. Byron Bird, "Transport Phenomena", 2nd Edition, John Wiley & Sons (Asia) pvt. Ltd.

Suggested reference book

1. Christie John Geankoplis, "Transport Processes and Separation Process Principles", 4th Edition, PHI Learning Private Limited., New Delhi
2. W.J.Thomson, "Introduction to Transport Phenomena", Pearson Education Asia, New Delhi, 2001.
3. Incropera, "Fundamentals of Heat and Mass Transfer", 6th Edition, John Wiley & Sons (Asia) pvt. Ltd.

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ENGINEERING ECONOMICS

3 0 0 3

L T P C

OBJECTIVES: • To enable students to understand the fundamental economic concepts applicable to engineering and to learn the techniques of incorporating inflation factor in economic decision making.

UNIT I

INTRODUCTION TO ECONOMICS 8

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis - V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

UNIT II

VALUE ENGINEERING 10

Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor - Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

UNIT III

CASH FLOW 9

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

UNIT IV

REPLACEMENT AND MAINTENANCE ANALYSIS 9

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

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UNIT V

DEPRECIATION 9

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

TOTAL: 45

PERIODS OUTCOMES : Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions.

TEXT BOOKS:

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.

REFERENCES:

1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011.

2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010.

3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 2011.

4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012

ME6811 PROJECT WORK L T P

31.05.19

Jharkhand University of Technology
Jharkhand, Ranchi

Proposed Syllabus for B.Tech 3rd Semester

Civil Engineering

Civil Engineering

3rd semester course structure

Sl. No.	Course Code	Subject	L	T	P	Credit
01	CE301	Civil Engineering Materials And Construction	3	1	0	3
02	CE302	Surveying & Geomatics -I	3	1	0	3
03	ME303	Strength Of Materials	3	1	0	3
04	BSC301	Mathematics-III	3	1	0	4
05	BSC303	Engineering Geology	3	1	0	3
06	BSC302	Environmental Science	2	0	0	0
01	CE301P	Civil Engg Material Testing Lab.	0	0	3	1
02	CE302P	Field Surveying Lab	0	0	3	1
03	CE303P	Engineering Geology Lab And Strength Of Materials Lab	0	0	3	1
04	EX301	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
05	HS301	Communication Skill Lab	0	0	2	1
Total credit						**21**

MATHEMATICS III

(COMMON FOR ALL BRANCH)

Course code –BSC- 301

L	T	P	CR.
3	1	0	4

Module I

Laplace Transformation: Laplace Transformation and its applications, Inverse Laplace Transformation, Convolution Theorem, Solution of ODE by Laplace Transformation.

Module II

Fourier Transform: Complex form of Fourier series, Fourier Transformation and inverse Fourier Transformation, sine,cosine Transformation, Inverse Transformations -simple illustration.

Module III

Z-Transform: Inverse Z-Transform- Properties – Initial and final value theorems-convolution theorem- Difference equations, Solution of Difference equations using Z-Transformation.

Module IV

Partial Differential Equations: Solution of Wave equation, Heat equation, Laplace’s equation by the method of separation of variables and its applications. Solution of PDE by Laplace Transformation.

Module V

Numerical Method: Finite difference, Symbolic relations, Interpolation and Extrapolation, Newton – Gregory forward and backward formula, Gauss forward and backward formula, Lagrange’s formula , Inverse Interpolation by Lagrange’s formula , Numerical Differentiation and **N**umerical Integration : Trapezoidal rule , Simpson’s $1/3^{rd}$ rule , Simpson’s $3/8^{th}$ rule ,Weddle quadrature formula.

Text Books

- Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.
- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,2010.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition.

Reference Books

- R. J. Beerends ,H. G. Ter Morsche ,J. C. Van Den Berg, E. M. Van De Vrie, Fourier and Laplace Transforms, Cambridge University Press.
- Sastry S.S, Introductory Methods of Numerical Analysis, PHI.

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CIVIL ENGINEERING MATERIALS AND CONSTRUCTIONS

Course code –CE 301

Module 1: Introduction to Engineering Materials covering, Cements, M-Sand, Concrete (plain, reinforced and steel fiber/glass fiber-reinforced, light-weight concrete, High Performance Concrete, Polymer Concrete) Ceramics, and Refractories, Bitumen and asphaltic materials, Timbers, Glass and Plastics Structural Steel and other Metals, Paints and Varnishes, Acoustical material and geo-textiles, rubber and asbestos, laminates and adhesives, Graphene, Carbon composites and other engineering materials including properties and uses of these **(8 Hours)**

Module II: Introduction to Material Testing covering, What is the "Material Engineering"?; Mechanical behavior and mechanical characteristics; Electricity-principle and characteristics; Plastic deformation of metals; Tensile test-standards for different material(brittle, quasi-brittle, elastic and so on) True stress-strain interpretation of tensile test; hardness tests; Bending and torsion test; strength of ceramic; Internal friction, creep-fundamentals and characteristics; Brittle fracture of steel- temperature transition approach; Background of fracture mechanics; Discussion of fracture toughness testing-different materials; concepts of fatigue of materials; Structural integrity assessment procedure and fracture mechanics **(8Hours).**

Module III: Standard Testing & Evaluation Procedures covering, Laboratory for mechanical testing; Discussion about mechanical testing; Naming systems for various irons, steels and nonferrous metals; Discussion about elastic deformation; Plastic deformation; Impact test and transition temperatures; Fracture mechanics- background; Fracture toughness- different materials; Fatigue of material; Creep. **(8 Hours)**

Module IV: Constructions: Brick Masonry; Types of bond, construction of walls, partition wall, cavity wall, advantages, disadvantages and construction procedure. D.P.C.: Purpose, types, materials and procedures, Foundation: Function, types, their stability and foundation in black cotton soil, proportioning of footings, plastering and composition, method of plastering, types of plastering, pointing construction procedure, Washing: White washing, color washing, distemper and snowcem, Roof: Flat roof, inclined roof, shells and domes, various types of roof covering materials. Floor: Types i.e. wooden, IPS, Terrazzo, marbles, tiles, synthetic mats. Construction of IPS and Terrazzo floor. Door and Windows types and fixtures including ventilators and lintel. Door and windows from PVS material and MDF. Stairs: Types and proportioning, Lifts and escalators **(16 Hours).**

Suggested Readings

1. Chudley,R.,Greeno(2006),'Building Construction Handbook'(6^{th} ed.),R.Butterworth Heinemann
2. Building Materials, S.Bhavikutti.
3. Building Materials,M.L.Gambhir.
4. Civil Engineering Materials, S.C.Rangwala, Charotar Publishing House. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO,etc. corresponding to materials used for Civil Engineering applications
5. Kyriakos Komvopolous (2011), Mechanical Testing of Engineering Materials, Cognella
6. E.N.Dowling(1993), Mechanical Behaviour of Materials, PHI
7. American Society for Testing and Materials (ASTM),Annual Books of ASTM Standards (post 2000)

8. Civil Engineering Materials and Construction Practices, R.K.Gupta, Jain Brothers,New Delhi.

SURVEYING AND GEOMATICS I

Course code –CE 302

Module I

Introduction: Importance of Surveying, Types of Surveying, Principle, Scales, Plan and Map, Shrinkage of Maps, Mapping Concepts, Map Projections, Total Station uses and application,Chain Surveying: Purpose, Chaining, accessories, Ranging and its types, Error, Chaining on uneven ground, Tape corrections, Survey stations and lines, Well conditioned triangle, basic problems, obstacles in chaining, field book. **[7 Hrs]**

Module II:

Compass Surveying: Introduction and Purpose, True Meridian, Magnetic Meridian Geographical Meridian, True Bearing, Magnetic Bearing, Whole circle &Quadrantal Bearing, Prismatic Compass and Surveyors Compass, Magnetic Declination, Isogonic and Agonic Lines, Local Attraction and its adjustments. **[4 Hrs]**

Module III:

Plane Table Surveying: Equipment and uses, principle, methods of plane tabling, closing error and its adjustment, two point problem and three point problem. **[5 Hrs]**

Module IV

Levelling: Types of levelling: Temporary Adjustment of Dumpy level, Methods of levelling, Level book and computation, missing data, curvature and refraction corrections, reciprocal levelling.Contouring: Definition, Methods of Contouring and plotting of contour.**[6 Hrs]**

Module V

Theodolite traversing: Scope, Types, temporary adjustment of transit theodolite, measurement of horizontal& Vertical angles, Method of repeatation&Direction, errors and its elimination, method of traversing, calculation of latitude and departure, balancing of traverse **[6 Hrs]**

Module VI

Tacheometric Survey: Instruments used, Principle, determination of tacheometric constant, Methods of Tacheometry: Stadia Method and Tangential Method. **[4 Hrs]**

Module VII

Classification of Curves: Simple curve, Combined curve, Compound curve, reverse curve, transition curve, Methods of layout, offsets from chord produced, Rankine's Method, Transition Curve, super-elevation, length of transition curve, characteristics, equation, shift, tangent length, and curve length of combined curve, setting out of simple and transition curve. **[12Hrs]**

Text Books:

1. Duggal, S.K. Surveying Vol. I and II, Tata McGraw Hill, 2004.

2. Punmia, B.C. Surveying Vol.I and II, Standard Publishers, 1994.

3. Arora, K. R. Surveying Vol. I and II, Standard Book House, 1996

4 N.N Basak.. Surveying and levelling

STRENGTH OF MATERIALS

(ME , PROD,CE)

Course code -ME 303

Objectives:

- To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams,shafts cylinders and spheres for various types of simple loads.
- To calculate the elastic deformation occurring in various simple geometries for different types of loading.

Contents:

Module-I

Deformation in solids-Hooks law, stress and strain-tension, compression and shear stresses – elastic constants and their relations-volumetric, linear and shear strains-principal stresses and principal planes-mohr's circle **(8 Hrs)**

Module-II

Beams and types transverse loading on beams-shear force and bending moment diagrams-Types of beam supports, simply supported and over hanging beams, cantilevers. Theory of bending of beam, bending stresses distribution and neutral axis, shear stress distribution, point and distributed loads**.(8Hrs)**

Module-III

Moment of inertia about the axis and polar moment of inertia, deflection of beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorem**.(8Hrs)**

Module-IV

Torsion, stresses and deformation in circular and hollow shafts,stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical spring**.(8Hrs)**

Module -V

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure**.(8Hrs)**

Course Outcomes:

- After completing this course, the students should able to recoginize various type of load applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components.
- The students will be able to evaluate the strains and deformation that will results due to the elastic stresses develop within the material for simple type of loading.

Test Books:

1. Egor P. Popov,Engineering Mechanics of solids,Prentice Hall of india,New Delhi,2001.
2. R.Subramanian, Strength of Materials,Oxford University Press,2007.

Ferdinand P.Been, Russel Johnson Jr and Jhon J.Dewole, Mechanism of materials, Tata McGrawHill Publication Co. Ltd., New Delhi 2005.

ENGINEERING GEOLOGY

Course code –BSC 303

Module 1: Introduction-Branches of geology useful to civil engineering , scope of geological studies in various civil engineering projects. Department dealing with his subject in India and their scope of work- GSI, Granite Dimension Stone Cell, NIRM. Mineralogy- Mineral, Origin and composition. Physical properties of minerals, susceptibility of minerals to alteration, basic of optical mineralogy,(**6 hours**)

Module II: Strength Behavior of Rocks- Stress and Strain in rocks. Concept of Rock Deformation & Tectonics. Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Main types of discontinuities according to size. Fold –Types and nomenclature, Criteria for their recognition in field . Faults: Classification, recognition in field, effects on outcrops. Joints & Uncormity; Types, Stresses responsible, geotechnical importance. Importance of structural elements in engineering operations. Consequences of failure as land sliding, Earthquake and Subsidence, Strength of Igneous rock structures(**6 hours**)

Module III: Geological Hazards- Rock Instability and Slope movement:
Concept of sliding blocks. Different controlling factors. Instability in vertical rock structures and measures to prevent collapse..Types of landslide. Prevention by surface drainage, slope reinforcement by Rock bolting and Rock Anchoring, retaining wall, Slope treatment. Case study on black clay. Ground water: Factors controlling water bearing capacity of rock. Previous & impervious rocks and ground water. Lowering of water table and Subsidence. Earthquake: Magnitude and intensity of earthquake. Seismic sea waves. Revelation from Seismic Records of structure of earth. Case Study on Elevation and Subsidence in Himalayan region in India. Seismic Zone in India.(**6 hours**)

Module IV: Geology of dam and reservoir site- Required geological consideration for selecting dam and reservoir site. Failure of Reservoir. Favorable and unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions , significance of discontinuities on the dam site and treatment giving to such structures.(**4 hours)**

Module V: Introduction and nature of soils: Soil problems in Civil Engineering, Types of soil, formation, structure and mineralogical and composition, Physical and Engineering Properties of soil, Atterberg Limit, Grain size analysis, by sieving and sedimentation, Activity of clay, All type of Classification of soil, Engineering properties of soil.**(6 hours)**

Module VI: Soil hydraulic and seepage analysis : Darcy's law, Measurement of Permeability, Factors affecting permeability and neutral pressure and effective pressure.(**4 hours**)
Seepage analysis: Laplace's equation, methods of obtaining flow nets, flow net for isotropic and anisotropic soil and their applications.(**3 hours**)
Consolidation and compaction: Definition, measurement, mechanism and analysis of data.(**4 hours)**
Shear strength of soil: Shear strength parameters of soil and laboratory methods for their determination. Liquefaction of soil.(**4 hours)**

Suggested Readings:

1. Engineering and General Geology, Prabin Singh, 8th ed.(2010),S K Kataria and sons.
2. Text Books of Engineering Geology, N.Cheena Kesavulu,2nd Edition(2009)
3. Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press(1982)
4. Soil Mechanics and Foundation Engineering, B.C.Punmia, Laxmi Publication

5. Basic and Applied Soil Mechanics, Gopal Ranjan, A.S.R. Rao, New Age Publisher
6. Advanced Soil Mechanics, B.M.Das,Taylor and Francis.

ENVIRONMENTAL SCIENCE

Course code –BSC 302

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(COMMON FOR ALL BRANCH)

Module-1

Concept and scope of Environment science, components of environment, environmental segment and their importance. **(2 Hrs)**

Module-II

Ecology: Ecosystem and its characteristics features, structure and function of forest ecosystem, grassland ecosystem, desert ecosystem and aquatic ecosystem, ecological balance and consequences of imbalance. **(4 Hrs)**

Module-III

Atmosphere: Atmospheric composition, energy balance, climate, weather, depletion of ozone layer, green house effect, acid rain, particles, ions and radicals in the atmosphere, chemical and photochemical reactions in the atmosphere.

Module-IV **(4 Hrs)**

Air pollution and control: Air pollutants, sources and effect of air pollutants, primary and secondary pollutants, photochemical smog, fly ash, inorganic and organic particulate matter. Air quality standards, sampling, monitoring and control measures for pollutants. **(4 Hrs)**

Module-V

Water pollution and control: Aquatic environment, water pollution, sources and their effect, lake and ground water pollution, eutrophication, water quality standard and water pollution control measures, waste water treatment.

Module-VI **(4 Hrs)**

Land pollution; Lithosphere, composition of soil, acid base and ion exchange reactions in soil, soil erosion, landslides, desertification, pollutants (municipal, industrial, commercial, agricultural , hazardous solid wastes), origin and effects, collection and disposal of solid wastes, recovery and conversion methods. **(5 Hrs)**

Module-VII

Noise pollution; Noise classification and its sources, effects and measurement, noise pollution hazards, standards and noise pollution control. **(2 Hrs)**

Books and References:

1. Master, G.M Introduction to environment engineering and science, Pearson Education.
2. Nebel, B.J., Environment science, Prentice Hall Inc.
3. Odum, E.P. Ecology: The link between the natural and social sciences. IBH Publishing Company Delhi
4. De, A.K. Environmental Chemistry, Merrut.

5. Sharma B.K Envrionmental Chemistry, Krishna Prakashan Media Merrut.
6. Kaushik, A and Kaushik, C.P. Perspectives in Environmental studies, New Age International Publication.
7. Menon, S.E. Environmental Chemistry.

CIVIL ENGINEERING MATERIAL TESTING LAB

Course code CE301P

List of Experiments

1. Test on Bricks: Shape and size of supplied brick, Water absorption of brick, Compressive strength of bricks.

2. Test on Fine Aggregates: Moisture Content, Specific Gravity, Bulk Density, Sieve Analysis

3. Test on Course Aggregates: Fineness modulus, Crushing Values

4. Test on Cement: Fineness of cement, Soundness of given cement, Specific gravity of cement, Standard consistency of cement, Initial and final setting time of cement.

5. Test on Soil: Sieve Analysis, Specific Gravity, Liquid & Plastic Limits

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FIELD SURVEYING LAB

Course code CE 302P

List of Experiments

1. Study of different Levels and Leveling staff. Practice for temporary adjustment. To find out the reduced levels of given points using Dumpy level. (Reduction by Height of Collimation method)
2. Study of a Tilting (LOP.) Level and to find out the levels of given points (Reduction of data by Rise and Fall method).
3. Visit to Lab, For the study of:-
   (a) Map in the making p Survey of India publication
   (b) Conventional Symbol charts and different types of maps
4. To establish a Benchmark by Check Leveling with a LOP. level and 'closing the work at the staring Bench mark.
5. To perform Fly Leveling with a LO.P. Level.
6. To draw the longitudinal rid cross- sections profiles along a given route.
7. Practice for Temporary adjustments of a Vernier Theodolite and taking Horizontal the work at the starting measurements. By Reiteration method.

8. To plot the coordinates at a given scale on Plane Table and their field checking.
9. To solve two Point and Three Point Problems in Plane Tabling.
10. To carry out Triangulation and Trilateration of a given area (2-3 turns are needed).

ENGINEERING GEOLOGY LAB & STRENGTH OF MATERIAL LAB

Course code CE 303P

ENGINEERING GEOLOGY LAB

List of Experiments

1. Study of rock forming and Economic minerals, study of different rocks
2. Methods of completing the outrop of rocks on a map
3. Drawing the geological sections of geological maps
4. Inter-relation of geological maps rind sections with respect to subsurface Structure.
5. Problems of locating sites of projects like Dams, Tunnels Highways et. In the geological sections.

STRENGTH OF MATERIAL LAB

List of Experiments

1. Tensile Test: To prepare the tensile test upon the given specimen (Mild Steel).
2. Compression Test To determine the compressive strength of the given specimen.
3. Torsion Test: To perform the Torsion test on given specimen.
4. Impact Test: To determine the impact toughness of. The given material.
5. Brinell hardness Test: To determine the hardness of the given specimen. -
6. Vicker's Hardness Test: To determine, the hardness of the given specimen.
7. Rockwell Hardness Test: To determine the hardness of the given specimen.

COMMUNICATION SKILL LAB

Course code HS301

This lab paper involves interactive practice sessions in Language Lab along with some class lectures to enable the students to be confident enough in language and professional sphere of life.

Module I: Listening Comprehension

To comprehend spoken material in standard Indian English/ British English & American English

- Current situation in India regarding English
- American English Vs. British English

Module II: Phonetics & Phonology

- Introduction to Phonetics & Phonology
- Organs of Speech/ Speech Mechanism
- Pronunciation, Intonation**,** Stress and Rhythm, Syllable division
- Consonants/Vowels/Diphthongs Classification

Module III: Common Everyday Situations: Conversations and Dialogues

Module IV: Communication at Workplace

Module V: Telephonic Conversation

- Introduction
- Listening/Speaking
- Telephonic Skills Required
- Problems of Telephonic Conversation
- Intensive Listening

Module VI: Interviews

- The Interview Process
- Purpose/Planning/Two-way Interaction/Informality
- Pre-interview Preparation Techniques
- Projecting a Positive Image
- Answering strategies

Module VII: Formal Presentations

- Introduction
- Nature/Importance of Presentation
- Planning
- Objective with central idea, main ideas, role of supporting materials
- Handling Stage Fright

Module VIII: Forms of Technical Communication: Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Expert Technical Lecture: Theme clarity; Analysis & Findings; C.V./Resume writing; Technical Proposal: Types, Structure & Draft.

Module IX: Technical Presentation: Strategies & Techniques Presentation: Forms; interpersonal Communication; Class room presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Module X: Technical Communication Skills: Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances: Exposition narration & Description; effective business communication competence: Grammatical; Discourse competence: combination of expression & conclusion; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and non verbal means.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus

Jharkhand University of Technology
Jharkhand, Ranchi

Proposed Syllabus for B.Tech 4th Semester

Civil Engineering

Civil Engineering

4th semester course structure

Sl. No.	Course code.	Subject	L	T	P	Credit
01	CE401	Surveying & Geomatics – II	3	1	0	3
02	CE402	Fluid Mechanics & Fluid Machines	3	1	0	3
03	CE403	Structural Analysis –I	3	1	0	3
04	CE404	Concrete Structure –I	3	1	0	3
05	EC404	Electronics & Instrumentation Engg.	3	1	0	3
06	EN401/ IT402/ CE405	Engineering Economics / Cyber Security/Disaster Preparedness & Planning	2	0	0	0
01	CE402P	Fluid Mechanics & Fluid Machines Lab	0	0	3	1
02	CE404P	Concrete Structure Lab	0	0	3	1
03	CE406P	CAD Building Drawing Lab	0	0	3	1
04	EX401	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
05	IN401	Internship/ Tour & Training/Industrial Training	0	0	0	2
Total credit						**21**

SURVEYING AND GEOMATICS II

Course Code: CE401

Module I:

Triangulation and Trilateration- Principle of Triangulation& trilateration,Types of Triangulation, Signals, selection of station &base line, base line measurement, choices-instruments and accessories, extension of base line, corrections, satellite station, reduction tocentre,intervisibility,[9hrs]

Module II

Trigonometric levelling: Curvature & Refraction Correction, axis signal corrections. Method of Single &reciprocal Observations &their relative advantage, (4 hrs)

Module III

Theory of errors and adjustment of figures: Types of errors, theory of propagation of errors,law of weights, weightedobservation,method to calculate most probable values, least square, normal equation, method to correlate, adjustment of plane and geodetic figures.[7hrs]

Module IV :

Modern Field Survey Systems: Principle of EDM, types of EDM instruments, Distomat, Total station- parts, accessories, advantages and application, Measurement of distance using EDM,Types of waves, modulation of frequency, resolution of ambiguity, Errors in Total station survey, Introduction to GPS- segment, measurement, errors and biases. [8hrs]

Module V

Photogrammetry Surveying: Introduction, basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning, stereoscopy, ground control extension for photographic mapping- aerial triangulation, No. of Photographs, mosaic. [6hrs]

Module VI:

Remote Sensing: Introduction and Definition of remote sensing terms, Remote sensing system, electromagnetic radiation and spectrum, atmospheric window, different types of platforms, sensors and their characteristics, orbital parameters of a satellite, multi concept in remote sensing. {*Only Introductions of all above*} [6hrs]

Text Books-

Elements of photogrammetry by P.R. wolf.

Introduction to remote sensing by J.B. campbell

FLUID MECHANICS & FLUID MACHINES

Course Code: CE402

Module I: Basic concepts and Definitions- Distinction between a fluid and a solid Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity, variation of viscosity with temperature, Newton law of viscosity; vapor pressure, boiling point, cavitations; surface tension, capillarity, Bulk modulus of elasticity, compressibility (4 hrs)

Module II: Fluid Statics- Fluid Pressure: Pressure at a point, Pascal's law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micromanometers, pressure gauges, Hydrostatic pressure and force: horizontal, vertical and Inclined surfaces. Buoyancy and stability of floating bodies (6 hrs)

Module III: Fluid Kinematics- Classification of fluid flow: steady and unsteady flow; uniform and non- uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function. velocity potential function. One, two and three dimensional continuity equations in Cartesian coordinates (6 hrs)

Module IV: Fluid Dynamics – Surface and body forces: Equations of motion- Euler's equation; Bernoulli's equations- derivation; Energy Principle; Practical applications of Bernoulli's equation: venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced (8 hrs)

Module V: Boundary layer theory, laminar and turbulent flow and flow through pipes (6 hrs)

Module VI: Dimensional Analysis and Dynamics Similitude- Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's π- Theorem . (4 hrs)
Module VII: Fluid machines; Impact of Jets; Introduction to Turbines and Pumps (8 hrs)

Text/Reference Books:

1. Fluid Mechanics and Machinery, C.S.P. Ojha, R. Berndtsson and P.N. Chandramouli, Oxford University Press 2010
2. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House.
3. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
4. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc Graw Hill.
5. Elementary fluid mechanics, Dr. R.J. Garde.
6. Fluid Mechanics, R.K. Bansal.

STRUCTURAL ANALYSIS I
Course Code: CE403

Module I: Introduction concept of energy principles, safety, sustainable development in performance; what makes a structure; principles of stability, equilibrium; Materials and Structural Design. Introduction to the analysis and design of structural systems. Analyses of determinate and indeterminate trusses, beams and frames, and design philosophies for structural engineering. Laboratory experiments dealing with the analysis of determinate and indeterminate structures: (8 hrs)

Module II : Planning and Design Process; Materials, Loads and Design Safety; Behaviour and Properties of Concrete and Steel; Wind and Earthquake Loads System Design Concepts Design Project Discussions; Cable Structures; Prestressed Concrete Bridges; Constructability and Structural Control; Fire Protecton (6 hrs)

Module III: Trusses: General theory; Classification, solution of plane determinate trusses, principle of virtual work and their applications for determination of deflection of determinate plane trusses (6 hrs)

Module IV: Three pinned structures, calculation of bending moment shear force axial force for three hinged arches and diagram of the same. Dead load, stress in three pinned determinate trusses (6 hrs)

Module V: Influence line, basic concepts of moving load and influence line, influence line for actions; shear force and bending moments of determinate beams; absolute maximum shearing forces and bending moment; influence lines for three hinged arches. (6 hrs)

Module VI: Analysis of structure by unit load method and conjugate beam method; Continuous and fixed beam: Theorem of three moments; analysis of fixed beams; settlement of support. (8 hrs)

Suggested Readings:

1. Smith, J.C., Structural Analysis, Harpor and Row, Publishers, New York.
2. Structural Analysis I and II S.S. Bhavikatti, S.Chand Publishers
3. Theory and Problem in Structural Analysis, L.S. Negi, Tata Mcgraw Hills.
4. Structural Analysis, Ramon, v. Jarquio, CRC Press.
5. Structural Analysis, A. Ghali and A.M. Neville, CRC Press

CONCRETE STRUCTURE- I

Course Code: CE404

Module I: Study of the strength, behavior, and design of indeterminate reinforced concrete structures, Load and stresses, load combinations, Working stress and limit state approach. (4 hours)

Module II: Analysis and design of sections in bending – working stress and limit state method. Rectangular and T- sections, Beams with reinforcement in compression. One-way slab. Design for shear and bond, Mechanism of shear and bond failure, Design of shear using limit state concept. Development length of bars; Design of sections in torsion. Design of two-way slabs; staircase, Placement of reinforcement in slabs; (16 hours)

Module III: Design of stairs and staircase (6 hours)

Module IV: Design of compression members, Short column, Columns with uni-axial and biaxial bending; Long columns, use of design charts (8 hours)

Module V: Design of foundation; Wall footing, isolated and combined footing for columns. All designs to be as per the most recent BIS standards as applicable (8 hours)

Suggested Readings

2. IS 456:2000 and IS 3370 (Part IV), BIS 2000
3. Design of Reinforced Concrete Structure (Limit State), A.K Jain, Nemchand Bros.
4. Limit state design of Reinforced Concrete (II) P.C. Verghese, PHI publisher
5. Limit state Design, B.C. Punmia, Laxmi Publications

ELECTRONICS AND INSTRUMENTATION ENGINEERING

Course code – EC404

(For Civil , Mech.& Production Engineering).

Module 1: Basic Electronic Components

Active and Passive Components, Types of resistors and Colour coding, Capacitors, Inductors applications of Resistor, Capacitor and Inductor, Relay, LDR, Basic Integrated Circuits (IC 7805, 7809, 7812, 555 etc.).Measuring Instruments like CRO, Power supply, Multi-meters etc.

Module II: Semiconductors, Diode and Transistors:

Difference between Insulators, Semiconductors and Conductors, Mobility and Conductivity, Intrinsic and Extrinsic Semiconductors, Fermi Level, Energy band, P-N Junction Diode, construction, working, characteristics and diode equation Application of Diode, Rectifier: Half Wave, Full Wave and Bridge Rectifier, Zener Diode and its Applications, Varactor Diode, Schottky Diode, Regulated Power Supply using Zener Diode and Regulated ICs, LED, Photodetector, Construction, Working, Modes and Configuration of BJT, Input and Output Characteristics of all Configurations, Comparison of all Configuration & Modes, BJT as a Switch and as an Amplifier. JFET Construction, working and characteristics. MOSFET Construction, working and Characteristics, Types of MOSFET,.

ModuleIII: Digital Electronics Fundamentals:

Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

ModuleIV: Electronic Instruments:

Measurement of Temperature, RTD, Thermistors, LVDT, Strain Gauge, Piezoelectric Transducers, Digital Shaft Encoders, Tachometer, Hall effect sensors. Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors. Electronic Display Device, Digital Voltmeters, Digital Energy meter, CRO, measurement of voltage and frequency, Lissajous Patterns, Plotting B-H curve of a magnetic material, Wave Analyzers, Harmonic Distortion Analyzer. Digital Energy Meter. Measurements of R, L and

C.Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.Digital Storage Oscilloscope.

ModuleV: Electronic Communication Systems:
The elements of communication system, IEEE frequency spectrum and Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system, Ultrasonic wave & its application in distance measurement.

Text Books
1. Basic Electronics and Linear Circuits by N. N. Bhargava, D. C. Kulshreshtha and S. C. Gupta, TMH Publications.
2. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad, PHI Publications.
3. Electronic Devices and Circuits by Godse and Bakshi Technical, Vol-1 Technical Publication Pune.
4. Floyd ,” Electronic Devices” Pearson Education 9th edition, 2012.
5. R.P. Jain , “Modern Digital Electronics”, Tata Mc Graw Hill, 3rd Edition, 2007.
6. Frenzel, “Communication Electronics: Principles and Applications”, Tata Mc Graw Hill, 3rd Edition, 2001

Reference Books
1. Integrated Devices & Circuits by Millman & Halkias, TMH Publications.
2. Electronics Devices and Circuit Theory by R. Boylestad & L. Nashelsky, Pearson Publication
3. Electronic Communication System by G. Kennedy, TMH Publications.
4. Basic Electronics by Sanjeev Kumar & Vandana Sachdeva, Paragaon International Publication

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CYBER SECURITY

Course code –IT 402

Module I: Introduction to Cybercrime : Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, and Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

Module II: Cyber Offenses: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Module III: Cybercrime : Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile

Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

Module – IV: Tools and Methods Used in Cybercrime : Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

Module V: Cyber Security : Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

TEXT BOOK:

- Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.

REFERENCE BOOK:

- Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
- Introduction to Cyber Security , Chwan-Hwa(john) Wu,J.David Irwin.CRC Press T&F Group

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ENGINEERING ECONOMICS

Course code –EN 401

COURSE OUTLINE:

The basic purpose of this course is to provide a sound understanding of concepts and principles of engineering economy and to develop proficiency with methods for making rational decisions regarding problems likely to be encountered in professional practice.

Module -1

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of Economics, Relation between science, engineering, technology and economics; Nature of Economic problem, Production possibility curve, Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility – its practical application and importance.

Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, measurement of elasticity of demand, practical importance & applications of the concept of elasticity of demand.

Module -II

Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale.

Various concepts of cost – Fixed cost, variable cost, average cost, marginal cost, money cost, real cost, opportunity cost. Shape of average cost, marginal cost, total cost, Cost curves.

Module III

Meaning of Market, Types of Market – Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets)

Pricing Policies- Entry Deterring policies, Predatory Pricing, Peak load Pricing. Product Life cycle

Firm as an organisation- Objective of the Firm, Type of the Firm, Vertical and Horizontal Integration, Diversification, Mergers and Takeovers.

Module -IV

Nature and characteristics of Indian economy (brief and elementary introduction), Privatization – meaning, merits and demerits. Globalisation of Indian economy – merits and demerits. Elementary Concepts of VAT, WTO, GATT & TRIPS agreement, Business cycle, Inflation

RECOMMENDED BOOKS:-

1. R.Paneer Seelvan: Engineering Economics, PHI
2. Managerial Economics, D.N.Dwivedi, Vikash Publication
3. Managerial Economics, H.L. Ahuja, S. Chand and Co. Ltd.
4. Managerial Economics, Suma Damodaran, Oxford.
5. R.molrishnd Ro T.V S 'Theory of firms : Economics and Managerial Aspects'. Affiliated East West Press Pvt Ltd New Delhi
6. Managerial Economics, H. Craig Petersen &W. Cris Lewis, Pearson Education.

DISASTER PREPAREDNESS & PLANNING

Course Code: CE405

Module 1: Introduction - Concepts and definitions: disaster, hazard, vulnerability, risks-severity, frequency and details, capacity, impact, prevention, mitigation).

Module 2: Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

Module 3: Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

Module 4: Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response(water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Module 5: Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

Text/Reference Books:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
5. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
6. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California,
EMSA no.214, June 2003
7. Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC

FLUID MECHANICS & FLUID MACHINES LAB

Course Code: CE402P

List of Experiments

1.To determine experimentally the metacentric height of a ship model
2.To verify the momentum equation experimentally.
3.To determine the coefficient of discharge of an orifice (or a month piece) of a given shape.
4.Determine the coefficient of velocity and the coefficient and the contraction of the orifice (or the mouth piece).
5.To verify Darcy's law and to find out the coefficient of permeability of the given medium
6.To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number,
7.To study the velocity distribution in a pipe and also compute the discharge by integrating the velocity profile.
8.To calibrate a venturimeter and to study the variation of coefficient of discharge with the Reynolds number.
9.To calibrate an orifice meter and study the variation of the coefficient of discharge with the Reynolds number.

10.To study the variation of friction factor "F" for turbulent flow in smooth and rough commercial pipes

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CONCRETE STRUCTURE LAB

Course Code: CE404P

List of Experiments

1.Initial drying shrinkage, moisture movement, and coefficient of expansion of concrete.
2.Stress strain curve of concrete.
3.Behavior of under reinforced and over reinforced R.C. beams in flexure.
4.Behavior of R.C. beams, with and without shear reinforcement in shear.
5.Bond strength between steel bar and concrete
  a) in a beam specimen and
  b) by pull-out test.
6. a) Fineness of cement by Air Permeability method.
  b) Soundness of cement by Le-Chatalier's Apparatus
  c) Compressive strength of cement.
7. a) water content for standard consistency of cement.
  b) Initial and final setting times of cement.
8.Moisture content and bulking of fine aggregate
9.Fineness modulus of coarse and fine aggregates.
10.Workability of cement concrete by
  a) Slump test, and b) compaction factor test.
11. Concrete mix design for a given concrete strength and slump by LS. Code method

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CAD BUILDING DRAWING LAB

Course Code: CE406P

List of Experiments

1. Introduction to AutoCAD basic commands, Code provision of IS-696 regarding Lines, Lettering and Dimensioning.
2. Drawing of Scales (Plane Scales, Diagonal Scales, Vernier Scales and Scales of Chords),
3. Construction of simple geometrical figures and Engineering curves.
4. Orthographic Projections: Projection of a point situated in various quadrants, projections of straight lines, true length, true inclinations and traces of a straight lines, auxiliary projections, auxiliary inclined and Auxiliary vertical planes, projection of plane figures.
5. Projection of simple solids, Auxiliary projection of solids, section of solids, true shape of section.
6. Development of surfaces: prisms, pyramids, cylinders, cones, spheres, pipe bends.
7. Isometric projection: Principles, Isometric scales, Isometric projection of plane figures and simple solids.
8. function and types of building (Residential, Industrial and Institutional)

Line plan. Development of plan from a line plan

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus

Jharkhand University of Technology
Jharkhand, Ranchi

Proposed Syllabus for B.Tech 3rd Semester

Electronics and Communication Engineering

Electronics and Communication Engineering

3rd semester course structure

Sl. No.	Course Code	Subject	L	T	P	Credit
01	EC301	Basic Electronics	3	1	0	3
02	EC302	Digital Electronics And Logic Design	3	1	0	3
03	EE302	Network Theory	3	1	0	3
04	EE303	Electromagnetic Field Theory	3	1	0	3
05	BSC301	Mathematics-III	3	1	0	4
06	BSC302	Environmental Science	2	0	0	0
01	EC301P	Basic Electronics Lab	0	0	3	1
02	EC302P	Digital Electronics And Logic Design Lab	0	0	3	1
03	EE302P	Network Theory Lab	0	0	3	1
04	EX301	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
05	HS301	Communication Skill Lab	0	0	2	1
Total credit						**21**

MATHEMATICS III

COMMON FOR ALL BRANCH) (

Course code –BSC- 301

L	T	P	CR.
3	1	0	4

Module I

Laplace Transformation: Laplace Transformation and its applications, Inverse Laplace Transformation, Convolution Theorem, Solution of ODE by Laplace Transformation.

Module II

Fourier Transform: Complex form of Fourier series, Fourier Transformation and inverse Fourier Transformation, sine,cosine Transformation, Inverse Transformations -simple illustration.

Module III

Z-Transform: Inverse Z-Transform- Properties – Initial and final value theorems- convolution theorem- Difference equations, Solution of Difference equations using Z-Transformation.

Module IV

Partial Differential Equations: Solution of Wave equation, Heat equation, Laplace's equation by the method of separation of variables and its applications. Solution of PDE by Laplace Transformation.

Module V

Numerical Method: Finite difference, Symbolic relations, Interpolation and Extrapolation, Newton – Gregory forward and backward formula, Gauss forward and backward formula, Lagrange's formula , Inverse Interpolation by Lagrange's formula , Numerical Differentiation and **N**umerical Integration : Trapezoidal rule , Simpson's 1/3rd rule , Simpson's 3/8th rule ,Weddle quadrature formula.

Text Books

- Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.
- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,2010.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition.

Reference Books

- R. J. Beerends ,H. G. Ter Morsche ,J. C. Van Den Berg, E. M. Van De Vrie, Fourier and Laplace Transforms, Cambridge University Press.
- Sastry S.S, Introductory Methods of Numerical Analysis, PHI.

BASIC ELECTRONICS

(ECE, EEE, EE,CSE, IT)
Course code -EC 301

L	T	P	CR.
3	1	0	3

Module I: Basic Electronic Components
Active and Passive Components, Types of resistors and Colour coding, Capacitors, Inductors applications of Resistor, Capacitor and Inductor, Relay, LDR, Basic Integrated Circuits (IC 7805, 7809, 7812, 555 etc.).Measuring Instruments like CRO, Power supply, Multi-meters etc.

Module II: Semiconductors
Difference between Insulators, Semiconductors and Conductors, Mobility and Conductivity, Intrinsic and Extrinsic Semiconductors, Fermi Level, Energy band, Charge Densities in Semiconductors, Mass Action Law, Current Components in Semiconductors, Drift and Diffusion Current, The Continuity Equation, Injected Minority Charge Carrier, Hall Effect, P-N Junction Diode, construction, working, characteristics and diode equation Application of Diode, Rectifier: Half Wave, Full Wave and Bridge Rectifier, Zener Diode and its Applications, Varactor Diode, Schottky Diode, Regulated Power Supply using Zener Diode and Regulated ICs, LED, Photodetector.

Module III: Transistors
Construction, Working, Modes and Configuration of BJT, Input and Output Characteristics of all Configurations, Comparison of all Configuration & Modes, BJT as a Switch and as an Amplifier..h –parameter, JFET Construction, working and characteristics. MOSFET Construction, working and Characteristics, Types of MOSFET.

Module IV: Power electronic devices & Communication engineering
Construction, characteristics and working of SCR, DIAC, TRIAC and UJT. Introduction, Characteristics and applications of Operational Amplifier (IC741). Modulation and its types.

Module V: Digital Logic and basic circuit Design
Number systems and conversion (DECIMAL, OCTAL, HEXADECIMAL,BINARY, BCD etc.),binary addition and subtraction, Logic Gates and their truth-table ,Boolean algebra .Design of Single Stage Amplifier,

LED Driver Circuit, Infrared Transmitter Receiver Circuit, LDR Driver Circuit, Relay Driver Circuit, Square Wave and Fix Frequency Generator using 555 IC.

Text Books

1. Basic Electronics and Linear Circuits by N. N. Bhargava, D. C. Kulshreshtha and S. C. Gupta, TMH Publications.
2. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad, PHI Publications.
3. Electronic Devices and Circuits by Godse and Bakshi Technical, Vol-1 Technical Publication Pune.

Reference Books

1. Integrated Devices & Circuits by Millman & Halkias, TMH Publications.
2. Electronics Devices and Circuit Theory by R. Boylestad & L. Nashelsky, Pearson Publication
3. Electronic Communication System by G. Kennedy, TMH Publications.
4. Basic Electronics by Sanjeev Kumar & Vandana Sachdeva, Paragaon International Publication

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DIGITAL ELECTRONICS AND LOGIC DESIGN

(ECE, CSE, IT)
Course code -EC 302

L	T	P	CR.
3	1	0	3

Module I: Binary Codes and Boolean algebra

Analog and Digital, Binary Number System. Addition, Subtraction, Multiplication, Division of binary numbers, Subtraction using 2's complement method. Binary codes: weighted and non weighted codes, self complementary codes, BCD, Excess-3, Gray codes, Alphanumeric codes, ASCII Codes. *Boolean algebra*: Boolean Laws and Expression using Logic Gates, Realization of different gates using Universal gates, DeMorgan's Theorem, Duality Theorems.

Module II: Boolean function minimization Techniques

Standard forms: SOP, POS, Simplification of Switching function & representation (Maxterm & Minterm), Boolean expression & representation using logic gates, Propagation delay in logic gate. *Karnaugh map*: K-map(up to 5 variables), mapping and minimization of SOP and POS expression, Don't care condition, conversion from SOP to POS and POS to SOP form using K-map, Minimization of multiple output circuits, Quine Mc-cluskey method minimization technique, prime implicant table, Don't care condition.

Module III: Combinational Circuits Design

Adder & Subs tractor (Half and Full), Parallel Binary adder, BCD Adder, Binary multipliers, Code Converters, parity bit generator, Comparators, Decoder, BCD to 7-segment Decoder, Encoders, Priority Encoders, Multiplexers, De Multiplexers.

Module IV: Sequential Circuits Elements

Introduction to sequential circuit, Flip-flop & Timing Circuits: SR latch, Gated latch, Tri state logic, Edge triggered flip-plop: - D, JK, T Flip-flop, flip-flop asynchronous inputs ,characteristic table of Flip-flop, excitation table of Flip-flop, master slave JK flip flop, inter conversion of Flip-flop. Study of timing parameters of flip-flop. Shift registers: buffer register, controlled buffer register. Data transmission in shift resistor SISO, SIPO, PISO, PIPO, Bidirectional shift register, universal shift registers. *Counter*: Classification, Ripple or asynchronous counter, Effect of propagation delay in ripple counters, up-down counter, Design of Mod-n counter, synchronous counter, Ring counter, Johnson counter. Introduction to FSM. Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator.

Module V: Logic Families and VLSI Design flow

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA, Logic implementation using Programmable Devices VLSI Design flow: Design entry, Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits

***Text Books* :**

1. Kharate "Digital Electronics" OXFORD Publication
2. A. Anand Kumar 'Fundamentals of Digital Circuits'. PHI Publications
3. R.P. Jain-'Modern Digital Electronics' IIIrd Edition- Tata Mc Graw Hill, Publication
4. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition
6. Bhaskar VHDL BASED DESIGN ,PEARSON EDUCATION

Reference Books:

1. Rajkamal 'Digital Systems Principals and Design' Pearson Education
2. A.P. Malvino, D.P. Leach 'Digital Principles & Applicatios' -VIth Edition-TMH publication.
3. M. Morris Mano 'Digital Design' (Third Edition). PHI Publications

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NETWORK THEORY

(ECE, EEE, EE)
Course code -EE 302

L	T	P	CR.
3	1	0	3

Module I: Circuit Fundamentals

Voltage sources, Current sources, Conversion of voltage sources to current sources and vice a versa. Network terminology :- Node, Junction, Branch, Loop, Network solution by branch current method, Loop or Mesh current method, Node voltage method, Star delta connection and conversion. Node and Mesh Analysis, matrix approach of network containing voltage and current sources, and reactance's, source transformation and duality. Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC, circuits. Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.

Module II: Resonance Circuits

Series resonance circuit, Frequency response of a series resonant circuit, Q factor, Bandwidth, selectivity, Effect of Q on bandwidth and selectivity, Relation between bandwidth and Q, Impedance of a series resonant circuit, Resonance by variation of L and C, Parallel resonant circuit and effect of resistance of a capacitance, Frequency response of parallel resonant circuit.

Module III: Two- Port Network

Two- port network parameters, r, y, z, h, A B C D relation between the parameters, Inter-conversion of two port networks, cascade connection series connection, series parallel connection, T and M network representation of a two port network.

Module IV: Network Functions

Laplace transform, Transform of a voltage and current, Transform of circuit elements, Network functions, Poles and zeros of the network functions, Pole zero plot,Physical significance of poles and zeroes, Stability, Two-port network parameters in the frequency domain Transient response: - step input response in RL circuit, step input response in R-C circuit, step input response in R-L-C circuit, ac transients.

Module V: filters and attenuators

Definitions, classification and characteristics of different filters, filter fundamentals such as attenuation constant(alpha), phase shift (beta), propagation constant (gamma), characteristic impedance (Zo), decibel, neper. Design and analysis of constant K, M derived and composite filters (low pass, high pass, band pass, and band stop filters): T and PI sections. Definitions, classification, relation between neper and decibel, analysis and design of T type, PI type, alpha lattice, bridged –T and L types attenuators.

Text Books:

1. "A.Sudhakar, Shymmohan S. Palli, ‗Circuit and Network – Analysis and Synthesis', 3 rd Edition, Tata McGraw Hill Publication.
2. Van, Valkenburg; "Network analysis"; Prentice hall of India, 2000.
3. A. Chakrabarti, ‗Circuit theory (Analysis and Synthesis)', IIIrd edition, Dhanpat Rai and Co.

Reference Books:

1. D. Roy Choudhuri, ‗Networks and Systems', New Age International Publisher.
2. M.E.Van Valkenburg Network Analysis', IIIrd edition, Pearsons Education/PHI.
3.Josheph Edministrar, ‗Theory and Problems of Electronic Circuit (Schaum's Series) – Tata McGraw Hill Publication.
4. Soni Gupta, ‗Electrical Circuit Analysis', Dhanpat Rai and Co.
5. Boylestad, ‗Introductory Circuit Analysis', Universal Book Stall, New

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ELECTROMAGNETIC FIELD THEORY

(ECE, EEE, EE)
Course code -EE 303

L	T	P	CR.
3	1	0	3

Module I: Coordinate Systems and Transformation:

Basics of Vectors: Addition, subtraction and multiplications; Cartesian, Cylindrical, Spherical transformation. Vector calculus: Differential length, area and volume, line surface and volume integrals, Del operator, Gradient, Divergence of a vector, Divergence theorem, Curl of a vector, Stokes's theorem, Laplacian of a scalar.

Module II: Electrostatic fields:

Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses' Law- Maxwell's equation, Electric dipole and flux line, Energy density in electrostatic fields, Electric field in material space: Properties of materials, convection and conduction currents, conductors, polarization in dielectrics, Dielectric-constants, Continuity equation and relaxation time, boundary conditions, Electrostatic boundary value problems: Poisson's and Laplace's equations., Methods of Images.

Module III: Magneto Statics:

Magneto-static fields, Biot - Savart's Law, Ampere's circuit law, Maxwell's equation, Application of ampere's law, Magnetic flux density- Maxwell's equation, Maxwell's equation for static fields, magnetic scalar and vector potential.

Module IV: Magnetic Forces:

Materials and devices, Forces due to magnetic field, Magnetic torque and moment, a magnetic dipole. Magnetization in materials, Magnetic boundary conditions, Inductors and inductances, Magnetic energy.

Module V: Waves and Applications:

Maxwell's equation, Faraday's Law, transformer and motional electromotive forces, Displacement current, Maxwell's equation in final form Electromagnetic wave propagation: Wave propagation in loss dielectrics, Plane waves in lossless dielectrics Plane wave in free space. Plain waves in good conductors, Power and the pointing vector, Reflection of a plain wave in a normal incidence. Transmission Lines, and Smith Chart.

Text Book:

1. MNO Sadiku, "Elements of Electromagnetic', Oxford University Press.

Reference Books:

1. WH Hayt and JA Buck, "Engineering Electromagnetic", McGraw- Hill Education.
2. Antenna and wave propagation by k.d parsad satya prakashan.

ENVIRONMENTAL SCIENCE

Course code –BSC 302

L T P CR.

2 0 0 0

(COMMON FOR ALL BRANCH)

Module-1

Concept and scope of Environment science, components of environment, environmental segment and their importance. **(2 Hrs)**

Module-II

Ecology: Ecosystem and its characteristics features, structure and function of forest ecosystem, grassland ecosystem, desert ecosystem and aquatic ecosystem, ecological balance and consequences of imbalance. **(4 Hrs)**

Module-III

Atmosphere: Atmospheric composition, energy balance, climate, weather, depletion of ozone layer, green house effect, acid rain, particles, ions and radicals in the atmosphere, chemical and photochemical reactions in the atmosphere.

Module-IV **(4 Hrs)**

Air pollution and control: Air pollutants, sources and effect of air pollutants, primary and secondary pollutants, photochemical smog, fly ash, inorganic and organic particulate matter. Air quality standards, sampling, monitoring and control measures for pollutants. **(4 Hrs)**

Module-V

Water pollution and control: Aquatic environment, water pollution, sources and their effect, lake and ground water pollution, eutrophication, water quality standard and water pollution control measures, waste water treatment.

Module-VI **(4 Hrs)**

Land pollution; Lithosphere, composition of soil, acid base and ion exchange reactions in soil, soil erosion, landslides, desertification, pollutants (municipal, industrial, commercial, agricultural , hazardous solid wastes), origin and effects, collection and disposal of solid wastes, recovery and conversion methods. **(5 Hrs)**

Module-VII

Noise pollution; Noise classification and its sources, effects and measurement, noise pollution hazards, standards and noise pollution control. **(2 Hrs)**

Books and References:

1. Master, G.M Introduction to environment engineering and science, Pearson Education.
2. Nebel, B.J., Environment science, Prentice Hall Inc.
3. Odum, E.P. Ecology: The link between the natural and social sciences. IBH Publishing Company Delhi
4. De, A.K. Environmental Chemistry, Merrut.
5. Sharma B.K Envrionmental Chemistry, Krishna Prakashan Media Merrut.

6. Kaushik, A and Kaushik, C.P. Perspectives in Environmental studies, New Age International Publication.
7. Menon, S.E. Environmental Chemistry.

BASIC ELECTRONICS LAB

(ECE, EEE, EE)

Course code -EC 301P

List of Experiments (Minimum 10)

1. Identification and testing of Resistors, Inductors, Capacitors, PN-Diode. Zener Diode, LED, LCD, LDR, BJT, Photo Diode, Photo Transistor,
2. Measurement of voltage and current using multimeter ,Measure the frequency and Amplitude of a signal with the help of CRO and function generator.
3. Study of p-n junction diode AND Zener Diode I-V characteristics
4. Assemble the single phase half wave and full wave bridge rectifier & the analyze effect of capacitor as a filter(only study of waveforms).
5. Study of Zener diode as voltage regulator.
6. Measurement & study of input characteristics of a BJT in CB configuration.
7. Measurement and study of characteristics of JFET and MOSFET
8. To design and simulate IR Transmitter and Receiver Circuit.
9. To design and simulate Motor Driver using Relay.
10. To design and simulate Light detector using LDR.
11. To design and simulate Constant frequency square wave generator using.
12. To design and simulate 5 volt DC power supply from 230 AC.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

DIGITAL ELECTRONICS AND LOGIC DESIGN LAB

(ECE, CSE, IT)

Course code EC 302P

List of Experiments (Minimum 10)

1. Study of TTL gates – AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.
2. Design & realize a given function using K-maps and verify its performance.
3. To verify the operation of multiplexer & Demultiplexer.

4. To verify the operation of comparator.
5. To verify the truth tables of S-R, J-K, T & D type flip flops.
6. To verify the operation of bi-directional shift register.
7. To design & verify the operation of 3-bit synchronous counter.
8. Design all gates using VHDL.
9. Design a multiplexer using VHDL
10. Design a decoder using VHDL
11. Write VHDL programs for the following circuits, check the wave forms and the hardware generated a. half adder b. full adder
12. Write VHDL programs for the following circuits, check the wave forms and the hardware generated a. multiplexer b. demultiplexer

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus. For VHDL Xilinx software may be used.

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NETWORK THEORY LAB

(ECE, EEE, EE)
Course code -EE 302P

List of Experiments (Minimum 10)

1. Transient response of RC circuit.
2. Transient response of RL circuit.
3. To find the resonance frequency, Band width of RLC series circuit.
4. To study and verify effect of R on frequency response of parallel resonance circuit.
5. To calculate and verify "Z" parameters of a two port network.
6. To calculate and verify "Y" parameters of a two port network.
7. To determine equivalent parameter of parallel connections of two port network.
8. To plot the frequency response of low pass filter and determine half-power frequency.
9. To plot the frequency response of high pass filters and determines the half-power frequency.
10. To plot the frequency response of band-pass filters and determines the band-width.
11. To calculate and verify "ABCD" parameters of a two port network.
12. To synthesize a network of a given network function and verify its response.
13. Introduction of P-Spice or other simulation software

COMMUNICATION SKILL LAB

Course code HS301

This lab paper involves interactive practice sessions in Language Lab along with some class lectures to enable the students to be confident enough in language and professional sphere of life.

Module I: Listening Comprehension

To comprehend spoken material in standard Indian English/ British English & American English

- Current situation in India regarding English
- American English Vs. British English

Module II: Phonetics & Phonology

- Introduction to Phonetics & Phonology
- Organs of Speech/ Speech Mechanism
- Pronunciation, Intonation**,** Stress and Rhythm, Syllable division
- Consonants/Vowels/Diphthongs Classification

Module III: Common Everyday Situations: Conversations and Dialogues

Module IV: Communication at Workplace

Module V: Telephonic Conversation

- Introduction
- Listening/Speaking
- Telephonic Skills Required
- Problems of Telephonic Conversation
- Intensive Listening

Module VI: Interviews

- The Interview Process
- Purpose/Planning/Two-way Interaction/Informality
- Pre-interview Preparation Techniques
- Projecting a Positive Image
- Answering strategies

Module VII: Formal Presentations

- Introduction
- Nature/Importance of Presentation
- Planning
- Objective with central idea, main ideas, role of supporting materials
- Handling Stage Fright

Module VIII: Forms of Technical Communication: Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Expert Technical Lecture: Theme clarity; Analysis & Findings; C.V./Resume writing; Technical Proposal: Types, Structure & Draft.

Module IX: Technical Presentation: Strategies & Techniques Presentation: Forms; interpersonal Communication; Class room presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Module X: Technical Communication Skills: Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances: Exposition narration & Description; effective business communication competence: Grammatical; Discourse competence: combination of expression & conclusion; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and non verbal means.

Jharkhand University of Technology
Jharkhand, Ranchi

Proposed Syllabus for B.Tech 4th Semester

Electronics and Communication Engineering

Electronics & Communication Engineering

4th semester course structure

Sl. No.	Course code	Subject	L	T	P	Credit
01	EC401	Analog Electronics And Circuits	3	1	0	3
02	EC402	Analog Communication	3	1	0	3
03	EE403	Signals And Systems	3	1	0	3
04	EE404	Microprocessor And Interfacing	3	1	0	3
05	CS301	Data Structure And Algorithm	3	1	0	3
06	EN401/ IT402	Engineering Economics/Cyber Security	2	0	0	0
01	EC401P	Analog Electronics And Circuits Lab	0	0	3	1
02	EC402P	Analog Communication Lab	0	0	3	1
03	EE404P	Microprocessor And Interfacing Lab	0	0	3	1
04	EX401	Extra Activities (NSO/NSS/NCC/Yoga/ Creative Arts/Mini Project)	0	0	2	1
05	IN401	Internship/ Tour & Training/Industrial Training	0	0	0	2
Total credit						**21**

ANALOG ELECTRONICS AND CIRCUITS

Course Code- EC401

Module 1: Diode & Transistor Circuits:
P-N junction diode, I-V characteristics of a diode, review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits. Amplifier models, Voltage amplifier, current amplifier, transconductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers, high-frequency equivalent circuits.

Module II: Oscillators, DAC & ADC:
Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators. Digital-to-analog converters (DAC) Weighted resistor, R-2R ladder, resistor string etc., Analog to-digital converters (ADC): Single slope, dual slope, successive approximation, flash etc.

Module III: MOSFET Circuits:
MOSFET structure and I-V characteristics, MOSFET as a switch, MOSFET as an amplifier: small signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Module IV: Differential, multi-stage and operational amplifiers:
Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Module V: Linear & Nonlinear applications of op-amp:
Idealized analysis of op-amp circuits, Inverting and non-inverting amplifier, Differential amplifier, Instrumentation amplifier, Integrator, Active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, Voltage regulator, Oscillators (Wein bridge and phase shift).Analog to Digital Conversion. Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators, Precision rectifier, peak detector, Monoshot.

Text Books :
1. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988.

Reference Books:

1. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
2. P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001
3. Op-Amps and Linear Integrated Circuits by A. Gayakwad, Pearson Publication

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ANALOG COMMUNICATION

Course Code- EC402

Module I: Introduction

Block schematic of communication system, Electromagnetic Spectrum, Necessity of modulation, Types of modulation – AM, FM, PM and Pulse Modulation. Noise types (Internal & External), Signal to Noise ratio, Noise factor, Noise figure, Noise Resistance, Noise Temperature, Noise factor of Amplifiers in Cascade(Numerical expected)

Module II: Amplitude Modulation

Amplitude Modulation principle, AM envelope, frequency spectrum & BW, phase representation of AM wave, Modulation index, % modulation, Power relations in AM (Numerical expected) AM modulating circuits: Low level AM modulation, medium power AM modulation,AM transmitters: Block diagram of low level DSBFC, High level DSBFC, Trapezoidal patterns, SSB Principles, Balanced modulator, SSB Generation Methods: Filter system, phase shift & third method ,Independent sideband system (ISB),Vestigial sideband(VSB)

Module III: Angle Modulation

Theory of frequency and phase modulation, mathematical analysis, FM and PM waveforms, frequency deviation and percentage modulation, deviation sensitivity, deviation ratio ,phase deviation and modulation index, frequency analysis of angle modulated wave-Bessel function, BW requirements, Narrow band & wide band FM, FM modulators(Direct & Indirect) , Noise and angle modulation, Pre-emphasis and de-emphasis.

Module IV: Pulse Modulation

Pulse amplitude modulation, Sampling theorem , types :Natural & flat top, PAM modulation Demodulation, TDM and FDM, Crosstalk in TDM, PWM modulator & demodulator, PPM modulators & demodulator.

Module V: Digital Modulation Schemes & AM/FM Receiver

Digital modulation schemes- phase shift keying, frequency shift keying, quadrature amplitude modulation, continuous phase modulation and minimum shift keying. Simplified block diagram of AM receiver, receiver parameters: Sensitivity, Selectivity, BW, dynamic range, fidelity, Types of AM receiver: TRF and superhetrodyne (block diagram), Block diagram, Double conversion FM receivers.

TEXT BOOKS:

1. George Kennedy, 'Electronics Communication System'--Tata McGraw Hill Publication.
2. Wayne Tomasi, 'Electronics Communication Systems Fundamentals through

Advanced' - Pearson Education.
3. Haykin S., "Communications Systems," John Wiley and Sons, 2001.
4. Proakis J. G. and Salehi M., "Communication Systems Engineering," PearsonEducation,2002.
5. R P Singh, S D Sapre 'Communication System-Analog & Digital' 2nd Edition – TMHPublication

REFERENCE BOOKS:

1. Dennis Roddy, John Coolen, 'Electronics Communications '4th Edition-Pearson Education
2. Louis E. Frenzel, 'Principles of Electronic Communication Systems' -Tata McGraw Hill
3. Taub H. and Schilling D.L., "Principles of Communication Systems," Tata McGrawHill,2001.
4. Barry J. R., Lee E. A. and Messerschmitt D. G., "Digital Communication,"KluwerAcademic Publishers, 2004.
5. Abhay Gandhi, "Analog and Digital Communication," Cengage publication, 2015.

SIGNALS AND SYSTEMS

Course Code- EE 403

Module I: Introduction to Signals and Systems:

Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

Module II: Behavior of continuous and discrete-time LTI systems:

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Module III: Fourier Transforms:

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.

Module IV: Laplace and z- Transforms:

Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Module V: Sampling and Reconstruction:
The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Text Books :
1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.
3. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.

Reference Books :
1. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.
2. A. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall, 2009.
3. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
4. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009

MICROPROCESSOR AND INTERFACING

Course Code- EE404

Module I: Architecture & Programming of 8085:
Functional block diagram—Registers, ALU, Bus systems. Pin configuration, Timing and control signals, Machine cycle and timing diagrams. Interrupts—Types of interrupt, interrupt structure, Instruction format, Addressing modes, Instruction set. Development of assembly language programs.

Module II: Interfacing Devices:
(a). The 8255 PPI chip: Architecture, pin configuration, control words, modes and Interfacing with 8085. (b). The 8254 PIC chip: Architecture, pin configuration, control words and Interfacing with 8085. Interrupt and DMA Controller (a). The 8259 Interrupt controller chip: Architecture, pin configuration and control words only (b).The 8257 DMA controller chip: Architecture, pin configuration and control words only.

Module III : Architecture & Programming of 8086:

Functional block diagram of 8086, details of sub-blocks such as EU, BIU, memory segmentation, physical address computations, pin configuration, program relocation, Minimum and Maximum modes of 8086— Block diagrams and machine cycles. Interrupts—Types of interrupt, interrupt structure. Instruction format, Addressing modes, Instruction set. Development of assembly language programs Assembler directives.

Module IV: 8051 Microcontroller :

8-bit Microprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers, Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems Overview of the 8051family. 8051 - Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Module V: Instruction Set and Programming of 8051:

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction .

Text Books :

1. Microprocessor Architecture, Programming & Applications with 8085 : Ramesh S Gaonkar; Wiley Eastern Ltd.
2. Microprocessor and applications – A.K.Ray.
3. M .A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”,Pearson Education,2007.
4. K. J. Ayala, “8051 Microcontroller”, Delmar CengageLearning,2004.
5. R. Kamal, “Embedded System”, McGraw Hill Education,2009.

Reference Books:

1. Microprocessors and interfacing : Hall; TMH
2. The 8088 & 8086 Microprocessors-Programming, interfacing, Hardware & Applications : Triebel & Singh; PHI
3. Microprocessors and Interfacing, Sanjeev Kumar, Sun India’s Publication
4. Advanced Microprocessors and Interfacing : Badri Ram; TMH
6. D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education,1991.

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DATA STRUCTURES AND ALGORITHMS

(Course code -CS 301)

Module I

Basic concepts and notations: Data structures and data structure operations, Complexity Analysis: Mathematical notation and functions, algorithmic complexity and time space trade off, Big O Notation, The best, average & worst cases analysis of various algorithms. Arrays: Linear & Multidimensional Arrays, Representation & traversal. Sorting algorithms: Bubble sort, Selection sort, Insertion sort, Merge sort and Quick sort, Counting Sort. Linear search and Binary search on sorted arrays.

Module II

Abstract Data Types (ADTs) Stack: Push; Pop, stack representation using array and linked list, Applications of Stack, Recursion. Queue: Representation using array and linked list, Insertion and deletion operations, circular queue, Dequeue, priority queue. Linked Lists & their types (Single, Double, Circular linked lists), Operations on Varieties of Linked Lists (Search and Update) with applications

Module III

Introduction to Trees, Binary tree - definitions and properties; binary tree traversal algorithms with and without recursion., Binary Search Tree - creation, insertion and deletion operations, Threaded tree (One way and Two way). AVL tree balancing; B-tree

Module IV

Graph Algorithms: Graphs and their Representations, Graph Traversal Techniques: Breadth First Search (BFS) and Depth First Search (DFS), Applications of BFS and DFS, Minimum Spanning Trees (MST), Prim's and Kruskal's algorithms for MST, Connected Components, Dijkstra's Algorithm for Single Source Shortest Paths,, Floydd's Algorithm for All-Pairs Shortest Paths Problem

UNIT-5

Hashing techniques, Hash function, Address calculation techniques- common hashing functions Collision resolution, Linear probing, quadratic probing, double hashing, Bucket addressing. Rehashing

Course Outcomes: At the end of the course the student will be able to:

- Understand the concept of ADT
- Identify data structures suitable to solve problems
- Develop and analyze algorithms for stacks, queues
- Develop algorithms for binary trees and graphs
- Implement sorting and searching algorithms
- Implement symbol table using hashing techniques

Text Books:

1. Data Structures Using C – A.M. Tenenbaum (PHI)
2. Introduction to Data Structures with Applications by J. Tremblay and P. G. Sorenson (TMH)
3. Data Structures, Algorithms and Application in C, 2nd Edition, Sartaj Sahni

4. Data Structures and Algorithms in C, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.

REFERENCE BOOKS:

1. Data Structure and Program Design in C by C.L. Tondo.
2. Data Structures with C++, J. Hubbard, Schaum's Outlines, TMH.
3. Data Structures and Algorithms in C, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.
4. Data Structures and Algorithm Analysis in C, 3rd Edition, M.A. Weiss, Pearson.
5. Classic Data Structures, D. Samanta, 2nd Edition, PHI.
6. Data Structure Using C by Pankaj Kumar Pandey.
7. Data Structure with C, Tata McGraw Hill Education Private Limited by Seymour Lipschutz.
8. Data Structure through C in Depth, BPB Publication, by S.K. Srivastava.
9. Data Structure and algorithm Analysis in C 2nd Edition, PEARSON Publishing House, Mark Allen Weiss

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CYBER SECURITY

Course code –IT 402

Module I: Introduction to Cybercrime : Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, and Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

Module II: Cyber Offenses: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Module III: Cybercrime : Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

Module – IV: Tools and Methods Used in Cybercrime : Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

Module V: Cyber Security : Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

TEXT BOOK:

- Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.

REFERENCE BOOK:

- Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
- Introduction to Cyber Security , Chwan-Hwa(john) Wu,J.David Irwin.CRC Press T&F Group

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ENGINEERING ECONOMICS

Course code –EN 401

COURSE OUTLINE:

The basic purpose of this course is to provide a sound understanding of concepts and principles of engineering economy and to develop proficiency with methods for making rational decisions regarding problems likely to be encountered in professional practice.

Module -1

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of Economics, Relation between science, engineering, technology and economics; Nature of Economic problem, Production possibility curve, Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility – its practical application and importance.

Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, measurement of elasticity of demand, practical importance & applications of the concept of elasticity of demand.

Module -II

Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale.

Various concepts of cost – Fixed cost, variable cost, average cost, marginal cost, money cost, real cost, opportunity cost. Shape of average cost, marginal cost, total cost, Cost curves.

Module_III

Meaning of Market, Types of Market – Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets)

Pricing Policies- Entry Deterring policies, Predatory Pricing, Peak load Pricing. Product Life cycle

Firm as an organisation- Objective of the Firm, Type of the Firm, Vertical and Horizontal Integration, Diversification, Mergers and Takeovers.

Module -IV

Nature and characteristics of Indian economy (brief and elementary introduction), Privatization – meaning, merits and demerits. Globalisation of Indian economy – merits and demerits. Elementary Concepts of VAT, WTO, GATT & TRIPS agreement, Business cycle, Inflation

RECOMMENDED BOOKS:-

1. R.Paneer Seelvan: Engineering Economics, PHI
2. Managerial Economics, D.N.Dwivedi, Vikash Publication
3. Managerial Economics, H.L. Ahuja, S. Chand and Co. Ltd.
4. Managerial Economics, Suma Damodaran, Oxford.
5. R.molrishnd Ro T.V S 'Theory of firms : Economics and Managerial Aspects'. Affiliated East West Press Pvt Ltd New Delhi
6. Managerial Economics, H. Craig Petersen &W. Cris Lewis, Pearson Education.

ANALOG ELECTRONICS & CIRCUITS LAB

Course Code- EC 401P

List of Experiments (Minimum 10)

1. Design & study of half wave and full wave rectifier and calculation its various parameters.
2. Design and study of clipper and clamper circuit.
3. Design & Implement Transistor as a switch.
4. To study the input & output characteristics of common emitter configuration.

5. Design & measure the frequency response of an RC coupled amplifier using discrete components. (Draw Gain vs frequency response curve on semilog graph paper).
6. Design a two stage RC coupled amplifier and determine the effect of cascading on gain and bandwidth
7. Design & study of RC Oscillator.
8. Design & realize inverting amplifier, non-inverting and buffer amplifier using 741 Op Amp.
9. Verify the operation of a differentiator circuit using 741 op amp and show that it acts as a high pass filter.
10. Verify the operation of a integrator circuit using 741 op amp and show that it acts as a low pass filter.
11. Design and verify the operations of op amp adder and subtractor circuits.
12. To design and realize Schmitt trigger using op amp 741.
13. Design & realize Wein -bridge oscillator using op amp 741.
14. To design & realize square wave generator using op amp 741.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

ANALOG COMMUNICATION LAB

Course Code- EC 402P

List of Experiments (Minimum 10)

1. Study of Amplitude Modulation (A.M.)
2. Study of Frequency Modulation.(F.M.)
3. Study of AM Detection.
4. Study of SSB Modulation & Demodulation.
5. Study of DSB Modulation & Demodulation.
6. Study of FM Demodulation.
7. Sampling and Reconstruction.
8. Study of Pulse Amplitude Modulation & Demodulation.
9. Study of Pulse Width Modulation& Demodulation.
10. Study of Pulse Position Modulation & Demodulation.
11. Study of PAM-TDM.
12. Study of AM Receiver Characteristics.(Sensitivity, Selectivity & Fidelity)
13. Visit to radio station (AM/FM) or any local communication center /mobile tower

(Visit to radio station is compulsory. Student should attach report of visit in practical file)

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

MICROPROCESSOR AND INTERFACING LAB

Course Code- EE404P

List of Experiments (Minimum 10)

1. Study of 8085 Microprocessor kit.
2. Write a program using 8085 and verify for : a. Addition of two 8-bit numbers. b. Addition of two 8-bit numbers (with carry) and write a program using 8085 and verify for : a. 8-bit subtraction (display borrow) b. 16-bit subtraction (display borrow).
3. Write a program using 8085 for multiplication of two 8- bit numbers by repeated addition method. Check for minimum number of additions and test for typical data and write a program using 8085 for multiplication of two 8- bit numbers by bit rotation method and verify.
4. Write a program using 8085 for division of two 8- bit numbers by repeated subtraction method and test for typical data and write a program using 8085 for dividing two 8- bit numbers by bit rotation method and test for typical data.
5. Write a program using 8086 and verify for: a. Finding the largest number from an array. b. Finding the smallest number from an array.
6. Write a program using 8086 for arranging an array of numbers in descending order and verify and write a program using 8086 for arranging an array of numbers in ascending order and verify.
7. Write a program for finding square of a number using look-up table and verify. .
8. Write a program to interface a two digit number using seven-segment LEDs. Use 8085/8086 microprocessor and 8255 PPI.
9. Write a program to control the operation of stepper motor using 8085/8086 microprocessor and 8255 PPI.
10. . Study of 8051 Micro controller kit/programming software.
11. Write a program using 8051 and verify for : a. Addition of two 8-bit numbers. b. Addition of two 8-bit numbers (with carry) and write a program using 8051 and verify for : a. 8-bit subtraction (display borrow) b. 16-bit subtraction (display borrow).
12. Write a program using 8051 for multiplication of two 8- bit numbers by repeated addition method. Check for minimum number of additions and test for typical data and write a program using 8051 for multiplication of two 8- bit numbers by bit rotation method and verify.
13. Write a program using 8051 for blinking of two LED with suitable delay.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

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JHARKHAND UNIVERSITY OF TECHNOLOGY, RANCHI

MINING ENGINEERING
B. Tech, Semester III (Second year]
Course Structure

3rd Semester Course Structure

Sl. No.	Course Code	Course Title	Hours per week			Credits
			L	T	P	
THEORY						
1.		Mathematics-III	3	1	0	4
2.		Mining Geology	3	1	0	3
3.		MaterialsEngineering	3	1	0	3
4.		Surveying and Geomatics - I	3	1	0	3
5.	MN301	Introduction to Mining Technology	3	1	0	3
6.		Environmental Science	2	0	0	0
PRACTICAL						
7.		MiningGeology Lab	0	0	3	1
8.		Field Surveying Lab	0	0	3	1
9.		Communication Skill Lab	0	0	2	1
10.	MN301P	Introduction to Mining Technology - Lab	0	0	3	1
11.		Extra-Curricular Activity – III (NSO/NSS/NCC/YOGA/CREATIVE ARTS / Mini Project etc.)	0	0	2	1
		Total	**17**	**5**	**13**	**21**

MN301	**INTRODUCTION TO MINING TECHNOLOGY**	**3L:1T:0P**	**3 Credits**

Course Objective

When the students enter the college to pursue a degree in Mining Engineering and as well pursue a career in Mining Engineering after graduation, they need to understand the breadth and depth available in this field for possible engagement. When many alternative disciplines of engineering appear to offer apparently more glamorous avenues for advancement, the Mining Engineering student should realize the potentials available in this engineering discipline. The students should understand the enormous possibilities available for creative and innovative works in this all-pervasive field of engineering.

This course is designed to address the following:

- to give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Mining Engineering
- to motivate the student to pursue a career in one of the many areas of Mining Engineering with deep interest and keenness.
- To expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects of public utility.

Proposed Syllabus

Definition and scope of mining: Mining as a basic industry, definition of mining terms. Economic importance of mining, Social and environmental impact of mining.

Principle of boring and purpose of boreholes; methods of boring; rotary and percussive boring methods borehole deflection and deviation.

Explosives and Blasting: Definition, Classification, Basic ideas about coal and rock drilling, basic ideas about the use of explosives in rock breaking concerning shaft sinking, drifting and drivages of adit.

Opening of mineral deposits: Types of mine opening, selection, location, shape and size of different types of opening, drivage methods for adits and incline drifts and cycle of operation, support of incline drift and their mouth.

Shaft sinking: Conventional methods of shaft sinking, shaft lining (temporary and permanent), surface arrangements, ventilation, pumping and illumination arrangement during shaft sinking, shaft fittings. Pit top and Pit bottom layouts Opening and development of mineral deposits, method of working, ventilation, transportation, hoisting and dispatch.

Introduction to common extraction method of underground mineral deposit: Coal: Bord and Pillar method, Longwall method Metal: Various stoping methods like open stoping, cut and fill stoping, shrinkage stoping, sub level stoping, block caving etc.

Overview of Surface Mining: Types of surface mine, unit operation, basic bench geometry, applicability and limitation, advantages and disadvantages.

Modules

Module 1: **Definition and scope of mining:**
Mining as a basic industry, definition of mining terms. Economic importance of mining, Social and environmental impact of mining.

Module 2: **Boring:**
Principle of boring and purpose of boreholes; methods of boring; rotary and percussive boring methods borehole deflection and deviation.

Module 3: **Explosivesand Blasting:**
Definition, Classification, Basic ideas about coal and rock drilling, basic ideas about the use of explosives in rock breaking concerning shaft sinking, drifting and drivages of adit.

Module 4: **Opening of mineral deposits:**
Types of mine opening, selection, location, shape and size of different types of opening, drivage methods for adits and incline drifts and cycle of operation, support of incline drift and their mouth.

Module 5: **Shaft sinking**: Conventional methods of shaft sinking, shaft lining (temporary and permanent), surface arrangements, ventilation, pumping and illumination arrangement during shaft sinking, shaft fittings. Pit top and Pit bottom layouts Opening and development of mineral deposits, method of working, ventilation, transportation, hoisting and dispatch.

Module 6: **Overview of Underground Mining:**
Coal: Bord and Pillar method, Longwall method
Metal: Various stoping methods like open stoping, cut and fill stoping, shrinkage stoping, sub level stoping, block caving etc.

Module 7: **Overview of Surface Mining:**
Types of surface mine, unit operation, basic bench geometry, applicability and limitation, advantages and disadvantages.

Text/Reference Books:

1. Introductory mining engineering-, Howard L.Hartman, Jan M.Mutmansky/ Wiley India (P) Ltd
2. Elements of mining technology Vol.-I - D.J. Deshmukh /Denett& Company
3. Roy Pijush Pal, Blasting in ground excavations and mines, Oxford and IBH, 1st Ed. 1993
4. C.P. Chugh, Drilling technology handbook, Oxford and IBH, 1sted, 1977.

Goals & Outcomes:

- Introduction to what constitutes Mining Engineering
- Identifying the various areas available to pursue and specialize within the overall field of Mining Engineering
- Exploration of the various possibilities of a career in this field
- Providing inspiration for doing creative and innovative work
- Highlighting possibilities for taking up entrepreneurial activities in this field
- Providing a foundation for the student to launch off upon an inspired academic pursuit into this branch of engineering

GE 302	MINING GEOLOGY	3L:1T:0P	3 Credits

Proposed Syllabus:

Module 1: **Physical Geology:**
Geology in mining engineering, scope and application, earth structure and composition, weathering processes and grade, physiographical division of India, geological work of river, wind and glacier.

Module 2: **Stratigraphy:**
Principle of stratigraphy, geological time scale, mineral resource distributions and economic importance of Archean, Cuddapah, Vindhyan, Gondwana, Tertiary deposit of India.

Module 3: **Minerology:**
Classification of minerals, physical properties of minerals, properties of silica, feldspar, pyroxene, amphibole, mica, olivine, group of minerals and calcite.

Module 4: **Petrology:**
Classification of rocks,
igneous rock: composition and diversification of magma, texture and structure of igneous rock, tabular classification of igneous rocks, study of importance igneous rock,
sedimentary rock: lithification and diagenesis, texture and structure of sedimentary rock, study of important sedimentary rock,
metamorphic rock: metamorphism, agents and types, study of important metamorphic rocks,

Module 5: **Structural Geology:**
Introduction to geological structure, faults, folds, joints and unconformities classification, criteria for recognition in the field and significance in mineral exploration, determination of strata thickness, dip and strike calculation,

Module 6: **Economic Geology**
Ore, Gauge, tenors of ore, grade, assay value cut – off grade, processes of formation of mineral deposit, magmatic concentration, hydrothermal processes, placer deposit and supergene sulphide enrichment deposit, iron, copper, Manganese, lead & zinc, mica etc.
Coal Geology: Introduction, Coal petrography, origin, classification, structural features of coal seam

Oil & Natural Gas: Introdution, origiin, classification, accumulation, migration, cap rocks, traps.

Module 7: **Mineral Exaploration**

Geological, Geophysical and Geochemical prospecting- principle and methodology

Module 8: **Hydrogeology**

Introduction, Hydrological cycle, vertical distribution of groundwater, aquifers, Darcy’s law, hydrological properties of rocks and groundwater quality

GE 302P	MININING GEOLOGY LAB	0L:0T:3P	1 Credits

SL. NO	NAME OF EXPERIMENT/EXERCISE	
A. Study of Mineral samples (Identification of minerals on the basis of colour, streak, luster, hardness, cleavage, fracture)		
1.	Rock Forming minerals	Quartz, Orthoclase, Biotite, Muscovite, Calcite, Plagioclase,
2.	Economic minerals	Galena, pyrolusite, Hematite, Magnetite, Bauxite, Chromite, Chalcopyrite, Pyrite
B. Megascopic study of hand specimens (Identification of rock on the basis of colour, mineral composition, texture, structure)		
3.	Igneous rocks	Granite, Basalt, Rhyolite, Obsidian, Dolerite, Syenite,
4.	Sedimentary rocks	Sandstone. Shale, Limestone, Conglomerate, Breccia
5.	Metamorphic rocks	Gneiss, Schist, Quarzite, Marble, Slate,
C. Study of external morphology of crystal models (Determination of axial relationship, symmetry elements and forms present in model)		
6.	Isometric System& Tetragonal System	
7.	Orthorhombic System& Hexagonal System	
8.	Monoclinic System& Triclinic System	
D.Numerical Problems related to Structural Geology		
9.	Three-point problems and its application	
10.	Borehole problems and its analysis	
11.	Structural analysis using stereonets	
12.	Lithologinterpretaion and correlation	

MN301P	INTRODUCTION TO MINING TECHNOLOGY - LAB	0L:0T:3P	1 Credits

SL. NO	NAME OF EXPERIMENT
13.	Study and sketch of Boring and various methods of Boring.
14.	Study and sketch of Explosive and its types.
15.	Study and sketch of Blasting Accessories.
16.	Study and sketch of Priming, Charging, Stemming and Shot – firing.
17.	Solid Blasting Practices in Undergroundmines.
18.	Study of Blasting Pattern in underground and surface mines.
19.	Study and sketch of incline mouth support.
20.	Study and sketch of Temporary lining of shaft during sinking.
21.	Study and sketch of Concrete lining of Shaft.
22.	Study and sketch of special methods of shaft sinking by cementation process.

JHARKHAND UNIVERSITY OF TECHNOLOGY, RANCHI

MINING ENGINEERING
B. Tech, Semester IV (Second year]
Course Structure

4th Semester Course Structure

Sl No.	Course Code	Course Title	Hours per week			Credit
			L	T	P	
THEORY						
1.		Electronics and Instrumentation Engg.	3	1	0	3
2.	MN401	Underground Coal Mining Methods	3	1	0	3
3.	MN402	Surface Mining Methods	3	1	0	3
4.	MN403	Drilling and Blasting	3	1	0	3
5.	MN404	Mine Surveying	3	1	0	3
6.		Engineering Economics/ Cyber Security	2	0	0	0
PRACTICAL						
7.	MN401P	Mine Design - I Lab	0	0	3	1
8.	MN402P	Drilling and Blasting - Lab	0	0	3	1
9.	MN403P	Mine Surveying Lab	0	0	3	1
10.		Internship/ Tour and Training/ Industrial Training	0	0	0	2
11.		Extra-Curricular Activity – IV (NSO/NSS/NCC/YOGA/CA/ Mini Project etc.)	0	0	2	1
		Total	**17**	**5**	**11**	**21**

MN401	UNDERGROUND COAL MINING METHODS	3L:1T:0P	3 CREDITS

Course Objectives:

This course is designed to address the following:

- to give an understanding to the students for opening the underground coal deposit, different mode of opening and their suitability including advantages and disadvantages.
- to give an understanding to the student of various methods of working in underground coal mining and their application.

Proposed Syllabus

Opening of Deposits: Developments of mine for in-seam mining and horizon mining (including shaft pillar), their comparison, advantages and disadvantages, division into levels and districts.
General principle of Bord& Pillar Development, their choice, suitability, advantages and disadvantages.
Open and Panel Systems, Layout of Bord& Pillar panel, size of panel and statutory provisions, Concurrent development activities like support, track laying, lighting, transportation of materials and minerals in and out of the mine etc.
Preparatory arrangement for depillaring operation, statutory provision fordepillaring, principle and designing of pillar extraction, size of a district, factors affecting choice of pillar extraction, depillaring with caving, stowing, mechanized depillaring operation, organization and safety.
Longwall methods of working, their choice, suitability,advantages and disadvantages. Shape & size of development roadways and gate roads and their maintenance, support systems of longwall face and gate roads.
Layout of the workings for the required output, length and orientation of longwall faces. Advancing and retreating longwall faces, longwall face and gate road machineries, mechanized longwall faces with shearers, AFC, power support and gate road machineries.

Modules:

Module 1: **Opening of Deposits:** Developments of mine for in-seam mining andhorizon mining (including shaft pillar), their comparison, advantages and disadvantages, division into levels and districts.

Module 2: **Bord and Pillar Development:**
General principle of Bord& Pillar Development, their choice, suitability, advantages and disadvantages,

Module 3: **Bord and Pillar Panels:**
Open and Panel Systems, Layout of Bord& Pillar panel, size of panel and statutory provisions, Concurrent development activities like support, track laying, lighting, transportation of materials and minerals in and out of the mine etc.

Module 4: **Pillar Extraction:**

Preparatory arrangement for depillaring operation, statutory provisionfordepillaring, principle and designing of pillar extraction, size of a district, factors affecting choice of pillar extraction, depillaring with caving, stowing, mechanized
depillaring operation, organization and safety.

Module 5: **Longwall Panel Development:**

Longwall methods of working, their choice, suitability,advantages and disadvantages. Shape & size of development roadways and gate roads and their maintenance, support systems of longwall face and gate roads.

Module 6: **Longwall Panel Extraction:**

Layout of the workings for the required output, length and orientation of longwall faces. Advancing and retreating longwall faces, longwall face and gate road machineries, mechanized longwall faces with shearers, AFC, power support and gate road machineries.

Text/Reference Books:

1. Wining and working – R. T. Deshmukh & D. J. Deshmukh
2. Elements of Mining Technology Vol. I, III – D. J. Deshmukh
3. Principle and Practices of Modern Coal Mining – R. D. Singh
4. Modern Coal Mining – S. K. Das
5. Introductory mining engineering-, Howard L.Hartman, Jan M.Mutmansky/ Wiley India (P) Ltd
6. SME Mining Engineers Handbook 3rd Edition - Peter Darling

Goals and Outcomes:

This course qualifies participants to apply basic concepts of Mining in

1. Explain different mining methods and their selection.
2. Describe details working of bord and pillar method and its development & depillaring.
3. Explain longwall working.

Knowledge:

1. Analyse and evaluate the development of surface mines, with stripping ratio.
2. Analyse the operation and application of the equipment used in surface mining and advanced appreciation of the systems engineering involved with interacting machines.

Skills:

1. Review, analyze, consolidate and synthesizes knowledge to identify and provide to selection of Mining method.
2. Assess and evaluate complex ideas in surface mining and selection of the number required and the size of appropriate equipment

MN402	SURFACE MINING METHODS	3L:1T:0P	3 CREDITS

Course Objectives:

This course is designed to address the following:

- to give an understanding to the students for basic concept of surface mining including selection between surface mining verses underground mining for a particular project.
- to give an understanding to the student of various cycle of operation of extraction of deposit including opening of deposit, production of different benches, drilling and blasting, excavation and transportation etc.

Proposed Syllabus:

Status of surface mining in India. Selection between surface mining and underground mining. Preliminary evaluation of surface mining prospects; different stripping ratios -- concepts and significance.
Box Cut: Selection of site and machineries, Calculation of rock movement in box cutting for given geometry.

Geometrical parameters of the benches, bench height, bench slope, bench width etc. with regard to the geometry of the deposits and overlying rocks. Formation parameters and factors affecting their selection.

Working principles of Excavation machineries, deployment of drills, dozer, shovel - dumper, dragline, hydraulic shovels, Ripper and Scraper, surface miners etc. their cycle of operation, application and limitation.

Drilling principles, types of blast hole drills, estimation of number of drill for a given mine production, blast design, determination of charge weight, factors affecting blast design, calculation of charge required per hole, problems associated with drilling and blasting, secondary blasting.
Cyclic methods-- shovel-dumper, pay-loader, dragline and their annual capacity calculation.

Modules:

Module 1: Basic Concept of Surface Mining:
Status of surface mining in India. Selection between surface mining and underground mining. Preliminary evaluation of surface mining prospects; different stripping ratios -- concepts and significance.

Module 2: **Opening up of Deposits:**

Box Cut: Selection of site and machineries, Calculation of rock movement in box cutting for given geometry.

Module 3: **Production benches**

Geometrical parameters of the benches, bench height, bench slope, bench width etc. with regard to the geometry of the deposits and overlying rocks. Formation parameters and factors affecting their selection.

Module 4: **Preparation for Excavation:**

Working principles of Excavation machineries, deployment of drills, dozer, shovel - dumper, dragline, hydraulic shovels, Ripper and Scraper, surface miners etc. their cycle of operation, application and limitation.

Module 5: **Drilling and blasting:**

Drilling principles, types of blast hole drills, estimation of number of drill for a given mine production, blast design, determination of charge weight, factors affecting blast design, calculation of charge required per hole, problems associated with drilling and blasting, secondary blasting.

Module 6: **Excavation and Transportation:**

Cyclic methods-- shovel-dumper, pay-loader, dragline and their annual capacity calculation.

Text/Reference Books:

1. Surface Mining- Misra, G.B.,
2. Surface Mining -B.A. Kennedy
3. Surface Mining Operations -S.K. Das,
4. SME Mining Engineers Handbook 3rd Edition - Peter Darling
5. Surface Mining Technology - T.N. Singh
6. Surface Mine Blast Evaluation, AMIE Publication

Course Learning Outcomes:

1. Provide a detailed description of the proposed surface mining method and related equipment and support infrastructure (including illustrations, sketches, plans, etc.);
2. Design and evaluate materials handling and transport options;
3. Conduct productivity analysis for the selected mining system;
4. Identify and evaluate core risks in each mining method;
5. Appraise mining systems with respect to safe, efficient, economic and environmentally and socially responsible operations; and
6. Demonstrate awareness of major technological trends.

MN403	DRILLING AND BLASTING	3L:1T:0P	3 CREDITS

Course Objectives:

This course is designed to address the following:

- to give an understanding to the students for basic concept of drilling and blastingin both surface mining and underground mining.
- to give an understanding to the student of various cycle of operation of drilling andblasting including exploratory drilling, production drilling in both metal as well as coal mines.

Proposed Syllabus:

Exploration Drilling Boring for exploration; Various types of exploratory drills and their applicability – Auger, Cable-tool, Odex, Core Drills; Core recovery: single and double tube core barrels, wire line core barrel; Storage of cores; Interpretation of borehole data. Explosives and Initiating Systems Types of explosives, their composition and properties, classification; Selection of explosives; Manufacture, transport, storage and handling of explosives; Testing of explosives; Types of initiating systems – Electrical Detonators, Detonating Fuse, Detonating Relays, NONEL, Electronic Detonators, Blasting accessories, exploders. Drilling & Blasting in Surface Mines Drilling: Blasthole drills – types, classification, applicability and limitations; Mechanics of drilling, performance parameters, drilling cost, compressed air requirement for hole cleaning; Selection of drilling systems, drilling errors, organization of drilling. Blasting: Mechanics of rock fragmentation; Livingstone theory of crater formation; Factors affecting blasting, Blast design - estimation of burden and spacing, estimation of charge requirement; Initiation patterns; Secondary blasting – pop and plaster shooting; Problems associated with blasting, Ground vibration and air over pressure, Blast instrumentation Drilling & Blasting in Underground Mines Coal mines: Drilling systems and their applicability, blasting-off-solid, different blasting cuts, ring hole blasting, calculation of specific charge, specific drilling and detonator factor, initiation patterns. Metal mines: Drilling systems and their applicability, blast design for horizontal drivages, different blasting cuts, longhole blasting, vertical crater retreat blasting.

Modules:

Module 1: **Exploration Drilling:**
Boring for exploration; Various types of exploratory drills and their applicability – Auger, Cable-tool,Odex, Core Drills; Core recovery: single and double tube core barrels, wire line core barrel; Storage ofcores; Interpretation of borehole data

Module 2: **Explosives and Initiating Systems:**
Types of explosives, their composition and properties, classification; Selection of explosives;Manufacture, transport, storage and handling of explosives; Testing of explosives; Types of initiatingsystems – Electrical Detonators, Detonating Fuse, Detonating Relays, NONEL, Electronic Detonators,Blasting accessories, exploders.

Module 3: Drilling in Surface Mines

Drilling: Blasthole drills – types, classification, applicability and limitations; Mechanics of drilling, performance parameters, drilling cost, compressed air requirement for hole cleaning; Selection of drillingsystems, drilling errors, organization of drilling.

Module 4: Blasting in Surface Mines

Mechanics of rock fragmentation; Livingstone theory of crater formation; Factors affecting blasting, Blast design - estimation of burden and spacing, estimation of charge requirement; Initiation patterns; Secondary blasting – pop and plaster shooting; Problems associated with blasting, Ground vibration and air over pressure, Blast instrumentation

Module 5: Drilling & Blasting in Underground Coal Mines:

Drilling systems and their applicability, blasting-off-solid, different blasting cuts, ring hole blasting, calculation of specific charge, specific drilling and detonator factor, initiation patterns.

Module 6: Drilling & Blasting in Underground Metal Mines:

Drilling systems and their applicability, blast design for horizontal drivages, different blasting cuts, longhole blasting, vertical crater retreat blasting.

Text/Reference Books:

1. Rock blasting effects and operations, Lovely Prakashan: P. Pal Roy.
2. Blasting Practices in Surface Mines: S K Das.
3. Explosives and Blasting Technology: G.K.Pradhan.
4. Rock Blasting: Sushil Bhandari.
5. Drilling and Blasting: chapters in SME Mining Engineers Handbook: P Darling.
6. Drilling and blasting of rock, CRC publications:Jimino.
7. Surface and Underground Excavations: R RTatiya.
8. Blasting principles for open pit mining, SME vol. I &II: W Hustrulid.
9. Surface Blast Design: C.J.Konya.
10. Indian Explosive Act 1884.
11. Legislation in Indian Mines – A Critical Appraisal: Rakesh and Prasad.

Course Learning Outcomes:

After completion of the subject the students will be able to:

1. Identifying and relating various drilling procedures to various rock characteristics.
2. Outline and define various blasting practices, accessories, explosives & their suitability in Indianmines both underground and opencast.
3. Analyse and optimize blast performance and productivity improvements.
4. Formulate and list the documentation for safe blasting practices.
5. To understand and appreciate environmental and social implications of rock/coal blasting.

MN404	MINE SURVEYING	3L:1T:P	3 Credits

Course Objectives:

The course is designed where, students can apply knowledge of mathematics in surveying to calculate and analyse different parameters of survey. Students can get the ability to identify, formulate and solve problems in the field of advanced surveying using advanced surveying instruments. Ability to analyze survey data and design mining engineering projects.

This course is designed to address the following:

- To give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Mine Surveying.
- To motivate the student to pursue a career in one of the many areas of Mine Surveying with deep interest and keenness.
- To expose the students to the various avenues and Instruments available for doing creative and innovative work in this field by showcasing the applications in many monuments and inspiring projects of public utility.
- To introduce the students to advanced and astronomical surveying.

Proposed Syllabus:

Surveying Instruments: Mining theodolite, miner's dial, loose and fast needle traversing with miner's dial, EDM & Total Station -- their applications. Introduction to Gyro-theodolite & GPS.
Triangulation Survey: Classification; Reconnaissance; Procedures for angles and base-line measurement; Comparison with precise EDM traversing
Correlation Survey: Correlation of underground and surface surveys and different methods of correlation- connection through adit, incline and shafts, method of connection through single or double vertical shafts. Corrections by means of magnetic needle.
In-pit Survey: Setting out a point of known rectangular co-ordinate. Control of directions and gradients for inclined shafts, slopes, levels and tunnels. Maintaining alignments, simple curve laying underground, laying out and fixing of mine boundaries claims, subsidence surveys on surface and underground. Volume calculations.
Stope Surveying: Stope surveying with Hanging Compass and Alignometer, tape triangulation, radiation and other methods.
Mine Plans and Sections: Legal requirements as to mine plans and sections in India, preparation and preservation of plans and sections, representation of geological and other surface and underground features on mine plans and sections.
Astronomy: Astronomical terms and definitions, Introduction to field astronomy, determination of true meridian, latitude, longitude and time including hour angle.

Modules

Module 1: Surveying Instruments:

Mining theodolite, miner's dial, loose and fast needle traversing with miner's dial, EDM & Total Station- their applications. Introduction to Gyro-theodolite & GPS.

Module 2: Triangulation Survey:

Classification; Reconnaissance; Procedures for angles and base-line measurement; Comparison with precise EDM traversing.

Module 3: Correlation Survey:
Correlation of underground and surface surveys and different methods of correlation- connection through adit, incline and shafts.Method of connection through single or double vertical shafts. Corrections by means of magnetic needle

Module 4: In-pit Survey:
Setting out a point of known rectangular co-ordinate. Control of directions and gradients for inclined shafts, slopes, levels and tunnels. Use of Top telescope and side telescope.Maintaining alignments, simple curve laying underground, laying out and fixing of mine boundaries claims, subsidence surveys on surface and underground. Volume calculations.

Module 5: Stope Surveying:
Stope surveying with Hanging Compass and Alignometer, tape triangulation, radiation and other methods.

Module 6: Mine Plans and Sections:
Legal requirements as to mine plans and sections in India, preparation and preservation of plans and sections, representation of geological and other surface and underground features on mine plans and sections.

Module 7: Photogrammetric:
Introduction to photogrammetric, Scale of a vertical photograph, photographs verses maps, application of photogrammetric in mining

Module 8: Astronomy:
Astronomical terms and definitions, Introduction to field astronomy, determination of true meridian, latitude, longitude and time including hour angle.

Application of Computer in surveying and computation.

Text/Reference Books:

1. Surveying (Vol – 1,2 & 3), by B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain – Laxmi Publications (P) Ltd., New Delhi.
2. Surveying (Vol 1, 2& 3), Duggal S.K. Tata Mc.Graw Hill Publishing Co.Ltd. New Delhi, 2004
3. Text book of surveying by C. Venkataramaiah, Universities Press.
4. Engineering surveying by Schofield, Wilfred, and Mark Breach.. CRC Press, 2007
5. Surveying (Vol 1, 2&3), Arora K R, standard Book House, Delhi, 2004.
6. Plane Surveying, Chandra A M. New age International Pvt. Ltd. Publisher, New Delhi, 2002

7. Higher Surveying, Chandra A M., New Age International Pvt. Ltd. Publisher, New Delhi, 2002
8. Surveying and leveling by R. Subramanian, Oxford University Press, New Delhi.

Goals & Outcomes:

Upon successful completion of this course, the student will be able to:
(Knowledge based)

- Know the various surveying instruments and their purpose;
- Have complete understanding of the significant role ofsurveying play in mining.
- Understanding the setting out concepts and different kind of techniques.
- Understanding the Legal requirements of mine plans and sections in India
- Understand and remember different Astronomical terms, definition and their significance.
- Can remember different kind of representations of geological, surface and underground features on mine plans and sections

(Skills)
Use operations of Mine Surveying to:

- Identify and analyzethe applications of Surveying Instruments in different kind of Mining scenario.
- Apply and evaluate the techniques used in correlation for correlation survey depending on the type of mine.
- Apply and analyse different setting out procedure in direction and gradient control in Mining Scenario.
- Apply the different techniques of stope surveying in different kind of mining methods.
- Apply different techniques to analyse the volume of mined-out area, heap and etc.
- Identify and evaluate different kind of representations of geological, surface and underground features on mine plans and sections.

MN401P	MINE DESIGN - I	0L:0T:3P	1 CREDITS

SL. NO	NAME OF EXPERIMENT
1.	Determination of annual production capacity of a rope shovel with given bucket capacity, dumper capacity and numbers and distance of dumping yard.
2.	Determination of annual excavation capacity of a dragline of given specification including bucket capacity.
3.	Determination of total drilling requirement for an opencast overburden/ coal bench with given geometry and excavation volume/ production requirement per round of blasting.
4.	Determination of matching number of dumpers per shovel for a target output when the shovel and dumper capacities are given.
5.	Determination of volume of rock excavation in box cutting for a given geometry of the entry and depth of first bench.
6.	Determination of haul road dimensions for a given condition.
7.	Study and sketch of an inclined drivage showing support requirements, transport mode, safety features, illumination etc.
8.	Study and sketch of a conventional/ mechanized Bord and Pillar panel being developed.
9.	Study and sketch of a Bord and Pillar panel being depillared with hydraulic sand stowing showing systematic support.
10.	Study and sketch of a Bord and Pillar panel being depillared with caving showing systematic support.
11.	Study and sketch of longwall main gate and tail gate roads with respective gate machineries.
12.	Study and sketch of a mechanized longwall face in a coal seam with given specifications.

MN402P	DRILLING & BLASTING LAB	0L:0T:3P	1 CREDITS

SL. NO	NAME OF EXPERIMENT/ EXERCISE
1.	Study & sketch of Hand held Coal drill, drill rods and drag bits.
2.	Study & sketch of air leg mounted compressed air drill, drill rod with bit.
3.	Study and sketch of rotary drill with Diamond coring bit.
4.	Study and sketch of Churn/percussive drilling component including water flushing system.
5.	Study and sketch of Down the Hole (DTH) drill for O/C Mines.
6.	Study and sketch of P_3 and P_5 explosives with priming and initiation (direct and reverse) methods.
7.	Study and sketch of copper and aluminium tube delay Detonators with sectional views.
8.	Study and sketch of non – electric delays, detonation chord with sectional views.
9.	Study and sketch of multi shot exploders with internal views.
10.	Exercise for deciding drilling pattern, number of holes, amount and type of explosive, stemming material in respect of a given coal face with desired yield.
11.	Exercise for deciding drilling pattern, number of holes, amount and type of explosive, stemming material in respect of a given stone drift.
12.	Exercise for deciding drilling pattern, number of holes, amount and type of explosive, stemming material in respect of a given coal/ overburden bench.

MN403P	MINE SURVEYING LAB	0L:0T:3P	1 CREDITS

SL. NO	NAME OF EXPERIMENT/ EXERCISE
1.	Study of EDM and total station.
2.	Study of gyro theodolite.
3.	GPS and its applications.
4.	GNSS and its characteristics.
5.	Correlation survey by alignment/ co-planning method.
6.	Correlation survey by weisbach triangle method.
7.	Correlation survey by weiss-quadrilateral method.
8.	Setting out of simple curves.
9.	To determine the most probable value of the included angles of given triangle by method of least squares.
10.	Subsidence monitoring using precise instruments.
11.	Study of photo theodolite.
12.	Measurement of muck pile volume.

Jharkhand University of Technology
Jharkhand, Ranchi

Proposed Syllabus for B.Tech 3rd Semester

Computer Science & Engineering
&
Information Technology

Computer Science & Engineering

3rd semester course structure

Sl. No.	Course Code	Subject	L	T	P	Credit
01	CS301	Data Structures And Algorithms	3	1	0	3
02	IT301	Object Oriented Programming	3	1	0	3
03	EC301	Basic Electronics	3	1	0	3
04	EC302	Digital Electronics And Logic Design	3	1	0	3
05	BSC301	Mathematics-III	3	1	0	4
06	BSC302	Environmental Science	2	0	0	0
01	CS301P	Data Structures And Algorithms Lab	0	0	3	1
02	IT301P	Object Oriented Programming Lab	0	0	3	1
03	EC302P	Digital Electronics & Logic Design Lab	0	0	3	1
04	EX301	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
05	HS301	Communication Skill Lab	0	0	2	1
Total credit						**21**

Information Technology

3rd semester course structure

Sl. No.	Course Code	Subject	L	T	P	Credit
01	IT301	Object Oriented Programming	3	1	0	3
02	CS301	Data Structures And Algorithms	3	1	0	3
03	EC301	Basic Electronics	3	1	0	3
04	EC302	Digital Electronics And Logic Design	3	1	0	3
05	BSC301	Mathematics-III	3	1	0	4
06	BSC302	Environmental Science	2	0	0	0
01	IT301P	Object Oriented Programming Lab	0	0	3	1
02	CS301P	Data Structures And Algorithms Lab	0	0	3	1
03	EC302P	Digital Electronics & Logic Design Lab	0	0	3	1
04	EX301	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
05	HS301	Communication Skill Lab	0	0	2	1
Total credit						**21**

MATHEMATICS III

(COMMON FOR ALL BRANCH)

Course code –BSC- 301

L	T	P	CR.
3	1	0	4

Module I

Laplace Transformation: Laplace Transformation and its applications, Inverse Laplace Transformation, Convolution Theorem, Solution of ODE by Laplace Transformation.

Module II

Fourier Transform: Complex form of Fourier series, Fourier Transformation and inverse Fourier Transformation, sine,cosine Transformation, Inverse Transformations - simple illustration.

Module III

Z-Transform: Inverse Z-Transform- Properties – Initial and final value theorems- convolution theorem- Difference equations, Solution of Difference equations using Z-Transformation.

Module IV

Partial Differential Equations: Solution of Wave equation, Heat equation, Laplace's equation by the method of separation of variables and its applications. Solution of PDE by Laplace Transformation.

Module V

Numerical Method: Finite difference, Symbolic relations, Interpolation and Extrapolation, Newton – Gregory forward and backward formula, Gauss forward and backward formula, Lagrange's formula , Inverse Interpolation by Lagrange's formula , Numerical Differentiation and **N**umerical Integration : Trapezoidal rule , Simpson's $1/3^{rd}$ rule , Simpson's $3/8^{th}$ rule ,Weddle quadrature formula.

Text Books

- Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.
- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,2010.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition.

Reference Books

- R. J. Beerends ,H. G. Ter Morsche ,J. C. Van Den Berg, E. M. Van De Vrie, Fourier and Laplace Transforms, Cambridge University Press.
- Sastry S.S, Introductory Methods of Numerical Analysis, PHI.

BASIC ELECTRONICS

(ECE, EEE, EE,CSE, IT)
Course code -EC 301

L	T	P	CR.
3	1	0	3

Module I

Basic Electronic Components

Active and Passive Components, Types of resistors and Colour coding, Capacitors, Inductors applications of Resistor, Capacitor and Inductor, Relay, LDR, Basic Integrated Circuits (IC 7805, 7809, 7812, 555 etc.).Measuring Instruments like CRO, Power supply, Multi-meters etc.

Module II

Semiconductors

Difference between Insulators, Semiconductors and Conductors, Mobility and Conductivity, Intrinsic and Extrinsic Semiconductors, Fermi Level, Energy band, Charge Densities in Semiconductors, Mass Action Law, Current Components in Semiconductors, Drift and Diffusion Current, The Continuity Equation, Injected Minority Charge Carrier, Hall Effect, P-N Junction Diode, construction, working, characteristics and diode equation Application of Diode, Rectifier: Half Wave, Full Wave and Bridge Rectifier, Zener Diode and its Applications, Varactor Diode, Schottky Diode, Regulated Power Supply using Zener Diode and Regulated ICs, LED, Photodetector.

Module III:

Transistors

Construction, Working, Modes and Configuration of BJT, Input and Output Characteristics of all Configurations, Comparison of all Configuration & Modes, BJT as a Switch and as an Amplifier. JFET Construction, working and characteristics. MOSFET Construction, working and Characteristics, Types of MOSFET.

Module IV: Power electronic devices &Communication engineering

Construction, characteristics and working of SCR, DIAC, TRIAC and UJT. Introduction, Characteristics and applications of Operational Amplifier (Ic741). Modulation and its types.

Module V: Digital Logic and basic circuit Design

Number systems and conversion (DECIMAL, OCTAL, HEXADECIMAL,BINARY, BCD etc.),binary addition and subtraction, Logic Gates and their truth-table ,Boolean algebra .Design of Single Stage Amplifier, LED Driver Circuit, Infrared Transmitter Receiver Circuit, LDR Driver Circuit, Relay Driver Circuit, Square Wave and Fix Frequency Generator using 555 IC.

Text Books

1. Basic Electronics and Linear Circuits by N. N. Bhargava, D. C. Kulshreshtha and S. C. Gupta, TMH Publications.
2. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad, PHI Publications.
3. Electronic Devices and Circuits by Godse and Bakshi Technical, Vol-1 Technical Publication Pune.

Reference Books

1. Integrated Devices & Circuits by Millman & Halkias, TMH Publications.
2. Electronics Devices and Circuit Theory by R. Boylestad & L. Nashelsky, Pearson Publication 3. Electronic Communication System by G. Kennedy, TMH Publications.
4. Basic Electronics by Sanjeev Kumar & Vandana Sachdeva, Paragaon International Publication

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DATA STRUCTURES AND ALGORITHMS

(CSE, IT)

Course code -CS 301

(3-CREDIT) (L-T-P/3-0-0)

Module I

Basic concepts and notations: Data structures and data structure operations, Complexity Analysis: Mathematical notation and functions, algorithmic complexity and time space trade off, Big O Notation, The best, average & worst cases analysis of various algorithms. Arrays: Linear & Multidimensional Arrays, Representation & traversal. Sorting algorithms: Bubble sort, Selection sort, Insertion sort, Merge sort and Quick sort, Counting Sort. Linear search and Binary search on sorted arrays.

Module II

Abstract Data Types (ADTs) Stack: Push; Pop, stack representation using array and linked list, Applications of Stack, Recursion. Queue: Representation using array and linked list, Insertion and deletion operations, circular queue, Dequeue, priority queue. Linked Lists & their types (Single, Double, Circular linked lists), Operations on Varieties of Linked Lists (Search and Update) with applications

Module III

Introduction to Trees, Binary tree - definitions and properties; binary tree traversal algorithms with and without recursion., Binary Search Tree - creation, insertion and deletion operations, Threaded tree (One way and Two way). AVL tree balancing; B-tree

Module IV

Graph Algorithms: Graphs and their Representations, Graph Traversal Techniques: Breadth First Search (BFS) and Depth First Search (DFS), Applications of BFS and DFS, Minimum Spanning Trees (MST), Prim's and Kruskal's algorithms for MST, Connected Components, Dijkstra's Algorithm for Single Source Shortest Paths,, Floydd's Algorithm for All-Pairs Shortest Paths Problem

Module V

Hashing techniques, Hash function, Address calculation techniques- common hashing functions Collision resolution, Linear probing, quadratic probing, double hashing, Bucket addressing. Rehashing

Course Outcomes: At the end of the course the student will be able to:

- Understand the concept of ADT
- Identify data structures suitable to solve problems
- Develop and analyze algorithms for stacks, queues
- Develop algorithms for binary trees and graphs
- Implement sorting and searching algorithms
- Implement symbol table using hashing techniques

Text Books:

1. Data Structures Using C – A.M. Tenenbaum (PHI)
2. Introduction to Data Structures with Applications by J. Tremblay and P. G. Sorenson (TMH)
3. Data Structures, Algorithms and Application in C, 2nd Edition, Sartaj Sahni
4. Data Structures and Algorithms in C, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.

REFERENCE BOOKS:

1. Data Structure and Program Design in C by C.L. Tondo.
2. Data Structures with C++, J. Hubbard, Schaum's Outlines, TMH.
3. Data Structures and Algorithms in C, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.
4. Data Structures and Algorithm Analysis in C, 3rd Edition, M.A. Weiss, Pearson.
5. Classic Data Structures, D. Samanta, 2nd Edition, PHI.
6. Data Structure Using C by Pankaj Kumar Pandey.
7. Data Structure with C, Tata McGraw Hill Education Private Limited by Seymour Lipschutz.
8. Data Structure through C in Depth, BPB Publication, by S.K. Srivastava.
9. Data Structure and algorithm Analysis in C 2nd Edition, PEARSON Publishing House, Mark Allen Weiss

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OBJECT ORIENTED PROGRAMMING

(CSE, IT)
Course code -IT 301
(3-CREDIT) (L-T-P/3-0-0)

Course Outcome:

1. To be able to apply an object-oriented approach to programming and identify potential benefits of object-oriented programming over the approaches.
2. To be able to reuse the code and write the classes which work like built in types.
3. To be able to design applications which are easier to debug, maintain and extend.
4. To be able to apply object-oriented concepts in real world applications.
5. To be able to develop applications using multi-threading.
6. To be able to handle exceptions in any applications.

Module-I 12 Hrs

Introduction to Java and Java Programming Environment, Object Oriented Programming, Fundamental Programming Structure: Data Types, Variable, Typecasting Arrays, Operators and their Precedence. Control Flow: Java's Selection Statements (if, Switch, Iteration, Statement, While, Do While, for, Nested Loop). Concept of Objects and Classes, Using Exiting Classes Building your own Classes, Constructor Overloading, Static, Final this Keyword, Inheritance: Using Super to Call Super Class Constructor, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using Final with Inheritance. The Object Class Packages & Interfaces: Packages, Access Protection, Importing Package, Interface, Implementing Interfaces, Variables in Interfaces, Interfaces can be Extended. Exception Handling: Fundamentals, Types Checked, Unchecked Exceptions, Using Try & Catch, Multiple Catch, Throw, Throws, Finally Java's Built in Exceptions, User Defined Exception.

Module-II 12 Hrs

Multi-Threading: Java Thread Model, Thread Priorities, Synchronization, creating a Thread, Creating Multiple Threads, Using is Alive () and Join () Wait () & Notify (). String Handling: String Constructors, String Length, Character Extraction, String Comparison, Modifying a String. Java I/O: Classes & Interfaces, Stream Classes, Byte Streams, Character Streams, Serialization, JDBC: Fundamentals, Type I, Type II, Type III, Type IV Drivers. Networking: Basics, Socket Overview, Networking Classes, & Interfaces, TCP/IP Client Sockets, Whois, URL Format, URL Connection, TCP/IP Server Sockets.

Module-III 12 Hrs

Applets: Basics, Architecture, Skeleton, The HTML APPLET Tag, Passing Parameters to Applets, Applet Context and Show Documents (). Event Handing: Delegation Event Model, Event Classes, Event Listener Interfaces, Adapter Classes. AWT: AWT Classes Window Fundamentals, Component, Container, Panel Window, Frame, Canvas, Creating a Frame Window in an Applet, Working with Graphics, Control Fundamentals, Layout Managers, Handling Events by Extending AWT Components. Core Java API package, reflection, remote method invocation (RMI) swing applet, icons & labels, text fields, Buttons, combo boxes, tabbed panes, scroll panes, trees, tables exploring Java-language: Simple type wrappers, runtime memory management, object fusing clone () and the cloneable interface, thread, thread group, runnable.

TEXT BOOK:

1. Introduction to Java Programming: Liang, Pearson Education, 7th Edition.
2. Java the Complete Reference: Herbert Schildt, TMH, 5th Edition.

REFERENCE BOOKS:

1. Balguruswamy, Programming with Java, TMH.
2. Programming with Java: Bhave&Patekar, Person Eduction.
3. Big Java: Horstman, Willey India, 2nd Edition.
4. Java Programming Advanced Topics: Wigglesworth, Cengage Learning.

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DIGITAL ELECTRONICS AND LOGIC DESIGN

(ECE, CSE, IT)
Course code -EC 302

L	T	P	CR.
3	1	0	3

Module I: Binary Codes and Boolean algebra

Analog and Digital, Binary Number System. Addition, Subtraction, Multiplication, Division of binary numbers, Subtraction using 2's complement method. Binary codes: weighted and non weighted codes, self complementary codes, BCD, Excess-3, Gray codes, Alphanumeric codes, ASCII Codes. *Boolean algebra*: Boolean Laws and Expression using Logic Gates, Realization of different gates using Universal gates, DeMorgan's Theorem, Duality Theorems.

Module II: Boolean function minimization Techniques

Standard forms: SOP, POS, Simplification of Switching function & representation (Maxterm & Minterm), Boolean expression & representation using logic gates, Propagation delay in logic gate. *Karnaugh map*: K-map(up to 5 variables), mapping and minimization of SOP and POS expression, Don't care condition, conversion from SOP to POS and POS to SOP form using K-map, Minimization of multiple output circuits, Quine Mc-cluskey method minimization technique, prime implicant table, Don't care condition.

Module III: Combinational Circuits Design

Adder & Subtractor (Half and Full), Parallel Binary adder, BCD Adder, Binary multipliers, Code Converters, parity bit generator, Comparators, Decoder, BCD to 7-segment Decoder, Encoders, Priority Encoders, Multiplexers, De Multiplexers.

Module IV: Sequential Circuits Elements

Introduction to sequential circuit, Flip-flop & Timing Circuits: SR latch, Gated latch, Tri state logic, Edge triggered flip-plop: - D, JK, T Flip-flop, flip-flop asynchronous inputs ,characteristic table of Flip-flop, excitation table of Flip-flop, master slave JK flip flop, inter conversion of Flip-flop. Study of timing parameters of flip-flop. Shift registers: buffer register, controlled buffer register. Data transmission in shift resistor SISO, SIPO, PISO, PIPO, Bidirectional shift register, universal shift registers. *Counter*: Classification, Ripple or asynchronous counter, Effect of propagation delay in ripple counters, up-down counter, Design of Mod-n counter, synchronous counter, Ring counter, Johnson counter. Introduction to FSM. Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator.

Module V: Logic Families and VLSI Design flow

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA, Logic implementation using Programmable Devices VLSI Design flow: Design entry, Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits

***Text Books* :**

1. Kharate "Digital Electronics" OXFORD Publication
2. A. Anand Kumar 'Fundamentals of Digital Circuits'. PHI Publications

3. R.P. Jain-‘Modern Digital Electronics’ IIIrd Edition- Tata Mc Graw Hill, Publication
4. Douglas Perry, “VHDL”, Tata McGraw Hill, 4th edition, 2002.
5. Charles Roth, “Digital System Design using VHDL”, Tata McGraw Hill 2nd edition
6. Bhaskar VHDL BASED DESIGN ,PEARSON EDUCATION

Reference Books:

1. Rajkamal ‘Digital Systems Principals and Design’ Pearson Education
2. A.P. Malvino, D.P. Leach ‘Digital Principles & Applicatios’ -VIth Edition-TMH publication.
3. M. Morris Mano ‘Digital Design’ (Third Edition). PHI Publications

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ENVIRONMENTAL SCIENCE

Course code – BSC 302

L	T	P	CR.
2	0	0	0

(COMMON FOR ALL BRANCH)

Module-1

Concept and scope of Environment science, components of environment, environmental segment and their importance. **(2 Hrs)**

Module-II

Ecology: Ecosystem and its characteristics features, structure and function of forest ecosystem, grassland ecosystem, desert ecosystem and aquatic ecosystem, ecological balance and consequences of imbalance. **(4 Hrs)**

Module-III

Atmosphere: Atmospheric composition, energy balance, climate, weather, depletion of ozone layer, green house effect, acid rain, particles, ions and radicals in the atmosphere, chemical and photochemical reactions in the atmosphere.

Module-IV **(4 Hrs)**

Air pollution and control: Air pollutants, sources and effect of air pollutants, primary and secondary pollutants, photochemical smog, fly ash, inorganic and organic particulate matter. Air quality standards, sampling, monitoring and control measures for pollutants. **(4 Hrs)**

Module-V

Water pollution and control: Aquatic environment, water pollution, sources and their effect, lake and ground water pollution, eutrophication, water quality standard and water pollution control measures, waste water treatment.

Module-VI **(4 Hrs)**

Land pollution; Lithosphere, composition of soil, acid base and ion exchange reactions in soil, soil erosion, landslides, desertification, pollutants (municipal, industrial, commercial, agricultural , hazardous solid wastes), origin and effects, collection and disposal of solid wastes, recovery and conversion methods. **(5 Hrs)**

Module-VII

Noise pollution; Noise classification and its sources, effects and measurement, noise pollution hazards, standards and noise pollution control. **(2 Hrs)**

Books and References:

1. Master, G.M Introduction to environment engineering and science, Pearson Education.
2. Nebel, B.J., Environment science, Prentice Hall Inc.
3. Odum, E.P. Ecology: The link between the natural and social sciences. IBH Publishing Company Delhi
4. De, A.K. Environmental Chemistry, Merrut.
5. Sharma B.K Envrionmental Chemistry, Krishna Prakashan Media Merrut.
6. Kaushik, A and Kaushik, C.P. Perspectives in Environmental studies, New Age International Publication.
7. Menon, S.E. Environmental Chemistry.

DATA STRUCTURE LAB

(CSE, IT)

Course code -CS 301P

Course Objective: The objective is to develop linear and non-linear data structure, express different operation on AVL tree, evaluate infix to postfix expression, and apply searching and sorting algorithms in real life applications.

1. C Programs on :
   - Bubble sort
   - Selection sort
   - Insertion sort,
   - Quick sort
   - Heap sort, Merge Sort
2. C Programs on :
   - Sequential Search
   - Binary Search
3. Write a C Program to create a stack using an array and perform
   - Push operation , Pop operation
4. Write a C Program that uses Stack Operations to perform the following:-
   - Converting an infix expression into postfix expression
   - Evaluating the postfix expression

5. Write a C Program to create a queue and perform
    - Push, Pop, Traversal
6. Write a C Program that uses functions to perform the following operations on a single linked list : i)Creation, ii) Insertion, iii) Deletion, iv) Traversal
7. Write a C Program that uses functions to perform the following operations on a double linked list: i)Creation, ii) Insertion, iii) Deletion
8. Write a C Program that uses functions to perform the following operations on a Binary Tree :i) Creation, ii) Insertion, iii) Deletion
9. Write a C Program for Single Source Shortest Paths using Dijkstra's Algorithm
10. Write a C Program for All-Pairs Shortest Paths using Floydd's Algorithm

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

OBJECT ORIENTED PROGRAMMING LAB

(CSE, IT)

Course code -IT 301P

Course Outcome:

1. Able to do program in object-oriented concept.
2. Able to create user defined exception.
3. Able to create GUI.
4. Able to understand JDBC and ODBC concept.

To do various Java Programs on:

1. Introduction, compiling & executing a Java program.
2. Data types & variables, decision control structures: if, nested if etc.
3. Loop control structures: do while, for etc.
4. Classes and objects.
5. Data abstraction & data biding, inheritance, polymorphism.
6. Using concept of package.
7. Threads, exception handlings and applet programs.
8. Interfaces and inner classes, wrapper classes, generics.
9. Programs on JDBC.
10. Creating GUI.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus

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DIGITAL ELECTRONICS AND LOGIC DESIGN LAB

(ECE, EEE,EE,CSE, IT)
Course code EC 302P

List of Experiments (Minimum 10)

1. Study of TTL gates – AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.
2. Design & realize a given function using K-maps and verify its performance.
3. To verify the operation of multiplexer & Demultiplexer.
4. To verify the operation of comparator.
5. To verify the truth tables of S-R, J-K, T & D type flip flops.
6. To verify the operation of bi-directional shift register.
7. To design & verify the operation of 3-bit synchronous counter.
8. Design all gates using VHDL.
9. Design a multiplexer using VHDL
10. Design a decoder using VHDL
11. Write VHDL programs for the following circuits, check the wave forms and the hardware generated a. half adder b. full adder
12. Write VHDL programs for the following circuits, check the wave forms and the hardware generated a. multiplexer b. demultiplexer

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus. For VHDL Xilinx software may be used.

COMMUNICATION SKILL LAB

Course code HS301

This lab paper involves interactive practice sessions in Language Lab along with some class lectures to enable the students to be confident enough in language and professional sphere of life.
Module I: Listening Comprehension

To comprehend spoken material in standard Indian English/ British English & American English

- Current situation in India regarding English
- American English Vs. British English

Module II: Phonetics & Phonology

- Introduction to Phonetics & Phonology
- Organs of Speech/ Speech Mechanism
- Pronunciation, Intonation**,** Stress and Rhythm, Syllable division
- Consonants/Vowels/Diphthongs Classification

Module III: Common Everyday Situations: Conversations and Dialogues
Module IV: Communication at Workplace
Module V: Telephonic Conversation

- Introduction
- Listening/Speaking
- Telephonic Skills Required
- Problems of Telephonic Conversation
- Intensive Listening

Module VI: Interviews

- The Interview Process
- Purpose/Planning/Two-way Interaction/Informality
- Pre-interview Preparation Techniques
- Projecting a Positive Image
- Answering strategies

Module VII: Formal Presentations

- Introduction
- Nature/Importance of Presentation
- Planning
- Objective with central idea, main ideas, role of supporting materials
- Handling Stage Fright

Module VIII: Forms of Technical Communication: Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Expert Technical Lecture: Theme clarity; Analysis & Findings; C.V./Resume writing; Technical Proposal: Types, Structure & Draft.

Module IX: Technical Presentation: Strategies & Techniques Presentation: Forms; interpersonal Communication; Class room presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Module X: Technical Communication Skills: Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances: Exposition narration & Description; effective business communication competence: Grammatical; Discourse competence: combination of expression & conclusion; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and non verbal means.

Jharkhand University of Technology
Jharkhand, Ranchi

Proposed Syllabus for B.Tech 4th Semester

Computer Science & Engineering
&
Information Technology

Computer Science & Engineering

4th semester course structure

Sl. No.	Course code	Subject	L	T	P	Credit
01	CS401	Operating System	3	1	0	3
02	CS402	Design And Analysis Of Algorithms	3	1	0	3
03	CS403	Formal Language And Automata Theory	3	1	0	3
04	BSC401	Discrete Mathematics	3	1	0	3
05	IT401	Database Management Systems	3	1	0	3
06	EN401/ IT402	Engineering Economics / Cyber Security	2	0	0	0
01	CS401P	Operating System Lab	0	0	3	1
02	CS402P	Design And Analysis Of Algorithms Lab	0	0	3	1
03	CS403P	Formal Language And Automata Theory Lab	0	0	3	1
04	EX401	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
05	IN401	Internship/ Tour & Training/Industrial Training	0	0	0	2
Total credit						**21**

Information Technology

4th semester course structure

Sl. No.	Course code	Subject	L	T	P	Credit
01	IT401	Database Management Systems	3	1	0	3
02	CS401	Operating System	3	1	0	3
03	CS402	Design And Analysis Of Algorithms	3	1	0	3
04	CS403	Formal Language And Automata Theory	3	1	0	3
05	BSC401	Discrete Mathematics	3	1	0	3
06	EN401/ IT402	Engineering Economics / Cyber Security	2	0	0	0
01	CS401P	Operating System Lab	0	0	3	1
02	CS402P	Design And Analysis Of Algorithms Lab	0	0	3	1
03	CS403P	Formal Language And Automata Theory Lab	0	0	3	1
04	EX401	Extra Activities (NSO/NSS/NCC/Yoga/ Creative Arts/Mini Project)	0	0	2	1
05	IN401	Internship/ Tour & Training/Industrial Training	0	0	0	2
Total credit						**21**

OPERATING SYSTEM

Course Code- CS401

(3-CREDIT) (L-T-P/3-1-0)

Module - I

OPERATING SYSTEMS OVERVIEW: Introduction, Evolution of operating system, operating system operations, operating system structure, System Calls, Types of System Calls

Modul – II

PROCESS MANAGEMENT: Process concepts, process state, process control block, scheduling queues, process scheduling, Interposes Communication, Threads and implementation of threads.

CPU SCHEDULING: Objective and Criteria, CPU scheduling algorithms: FCFS, SJF, Priority Scheduling, Round robin, multilevel queue scheduling and multilevel feedback queue scheduling.

Modul- III

CONCURRENCY AND SYNCHRONIZATION: Process synchronization, critical section problem, and its solutions. Semaphores, classical problems of synchronization: readers and writers problem, dining philosophers problem, sleeping barber problem.

Modul- IV

DEADLOCKS: Introduction, deadlock characterization, Resource allocation graph, Methods for Handling Deadlocks: deadlock prevention, avoidance and deadlock detection, recovery from deadlock.

Modul V

MEMORY MANAGEMENT: Introduction, memory allocation techniques, paging, implementation of paging, segmentation and its implementation, segmentation with paging, virtual memory, demand paging, page-replacement algorithms, thrashing and its solution.

Modul VI

FILE SYSTEM: Concept of a file, access methods, directory structure, file system mounting, file sharing, protection. File system implementation: file system structure, directory implementation, allocation methods, free-space management, efficiency and performance.

Mass-Storage Structure: Overview of mass storage structure, disk structure, disk scheduling algorithms,

TEXT BOOKS:

1. **ABRAHAM SILBERSCHATZ, PETER BAER GALVIN, GREG GAGNE (2012)**, Operating System Principles, 9th edition, Wiley India Private Limited, New Delhi.

REFERENCE BOOKS:

1. **William Stallings**, Operating Systems, Internals and Design Principles, 7th edition, Pearson Education, India. 2.

2. **Andrew S. Tanenbaum (2007)**, Modern Operating Systems, 2nd edition, Prentice Hall of India, India. 3. Deitel & Deitel (2008), Operating systems, 3rd edition, Pearson Education, India.

COURSE OVERVIEW:

Operating systems course is intended as a general introduced to the techniques used to implement operating systems and related kinds of systems software. The topics covered will be functions and structure of operating systems, process management (creation, synchronization, and communication); processor scheduling; deadlock prevention, avoidance, and recovery; main-memory management; virtual memory management (swapping, paging, segmentation and page-replacementalgorithms); control of disks and other input/output devices; file-system structure and implementation; and protection and security

COURSE OBJECTIVES:

- To explain main components of OS and their working.
- To familiarize the operations performed by OS as a resource Manager.
- To impart various scheduling policies of OS.
- To teach the different memory management techniques.

COURSE OUTCOMES: At the end of the course students will be able to the following

- Outline various concepts and features of Operating systems.
- Compare various operating systems with respect to characteristics and features.
- Implement algorithm of CPU Scheduling, Memory Management and disk scheduling.
- Make changes in the OS configurations as per need.

DESIGN AND ANALYSIS OF ALGORITHM

Course Code- CS402

(3-CREDIT) (L-T-P/3-1-0)

Course Outcome:

1. Ability to analyze the performance of algorithms.
2. Ability to choose appropriate algorithm design techniques for solving problems.
3. Ability to understand how the choice of data structures and the algorithm design methods impact the performance of programs.

MODULE-I

INTRODUCTION & ANALYSIS:

Analyzing Algorithms, Recurrence Equations, Growth Function: Asymptotic Notation, Standard Notation & Common Functions, Recurrence Relation, Different Methods of Solution of Recurrence Equations with Examples.

MODULE-II

DIVIDE AND CONQUER & BACKTRACKING PARADIGM:

Introduction to Divide and Conquer Paradigm, Quick and Merge Sorting Techniques, Linear Time Selection Algorithm, The Basic Divide and Conquer Algorithm for Matrix Multiplication, Backtracking & Recursive Backtracking, Applications of Backtracking Paradigm, Heaps.

MODULE-III

GREEDY PARADIGM & DYNAMIC PROGRAMMING:

Greedy Paradigm: The Basic Greedy Strategy & Computing Minimum Spanning Trees, Algorithms of Kruskal and Prim, Union to Find Algorithm & Their Applications, Disjoint Set, The Relationship in Dijkstra’s and Prim’s Algorithms, Use of Greedy Strategy in Algorithms for the Knapsack Problem and Huffman Trees. The Basic Dynamic Programming Paradigm, Dynamic Programming

Solution to the Optimal Matrix Chain Multiplication and the Longest Common Subsequence Problems.

MODULE-IV

GRAPHS ALGORITHMS & STARING MATCHING ALGORITHMS:

Representational Issues in Graphs, Depth First Search & Breath First Search on Graphs, Computation of Bi-connected Components and Strongly Connected Components Using DFS, Topological Sorting & Applications, Shortest Path Algorithms on Graphs: Bellman-Ford Algorithm, Dijkstra's Algorithm & Analysis of Dijkstra's Algorithm Using Heaps, Floyd-Warshall's all Pairs Shortest Path Algorithm and its Refinement for Computing the Transitive Closure of a Graph. The General String Problem as a Finite Automata, Kunth Morris and Pratt Algorithms.
MODULE-V

NP-COMPLETE PROBLEMS:

Solvable Problems, Types of Problems, The Notion of a Non-Deterministic Algorithm and its Basic Relationship to Backtracking, Polynomial Time Non-Deterministic Algorithms for Problems Like Satisfiability, Clique Problem, Hamiltonian Path Problems etc. The Definition of NP-Hardness and NP-Completeness, The Statement of Cook's Theorem and a Discussion of its Implication, The Notion of Polynomial Transformation, Vertex Cover, Subset Sum and Hamiltonian Cycle Problems are NP-Complete, Other Models for Computations.

Text Books:

1. Introduction to Algorithms (Second Edition); Cormen, Leserson, Rivert; PHI.
2. Fundamentals of Algorithms, Sahni& Horowitz; Galgotia.

Reference Books:

1. The Design & Analysis of Computer Algorithms, Hopcroft-Aho-Ullman, AWL.
2. Handbook of Algorithms & Data Structures, G.H. Gonnet, AWL.
3. Introduction to Design & Analysis of Algorithms, Levitin, PE-LPE.

FORMAL LANGUAGES AND AUTOMATA THEORY

Course Code- CS403

(3-CREDIT) (L-T-P/3-1-0)

Module I: Fundamentals & Finite Automata:
Alphabet, Strings, Language, Operations, Mathematical proving techniques, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, Deterministic Finite Automaton (DFA) and Non deterministic Finite Automaton (NFA), transition diagrams and Language recognizers. Equivalence of DFA and NFA, NFA to DFA conversion, NFA with ε -transitions - Significance, acceptance of languages. Equivalence between NFA with and without ε -

transitions, minimization of FSM, Finite Automata with output- Moore and Mealy machines and conversion of Mealy to Moore and vice-versa.

Module II: Regular Expression and Languages:

Regular sets, regular expressions, identity rules, Constructing finite Automata for a given regular expressions, Conversion of Finite Automata to Regular expressions. Regular grammars-right linear and left linear grammars, conversion of right linear grammar to left linear and vice-versa, equivalence between regular grammar, regular expression and FA, Pumping lemma of regular sets, closure properties of regular sets.

Module III: Context Free Grammars and Push Down Automata:

Context free grammar, derivation trees, sentential forms. Right most and leftmost derivation of strings. Ambiguity in context free grammars. Reduction of Context Free Grammars. Chomsky normal form(CNF), Greiback normal form(GNF), Pumping Lemma for Context Free Languages. Simplification of CFL.

Push down automata(PDA) definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFG and PDA, interconversion. Introduction to DCFL and DPDA. DPDA Vs NPDA.

Module IV: Turing Machine:

Turing Machine definition, representation of Turing Machines model, Variants of TM, design of TM, linear bounded automata,

Module V: Computational Complexity & Decidability, Recursively Enumerable Languages:

Complexity : Growth rate of a function, class P and NP, polynomial time reduction and NP-Completeness, NP-Complete problems(SAT, CSAT,Hamiltonian circuit, travelling salesman, vertex cover). **Decidability:** decidability, decidable language, undecidable language, halting problem of Turing Machine.**Computability:** primitive recursive function and recursive function.

TEXT BOOKS:

1. Theory of Computer Science (Automata Language and Computation) K.L.P. Mishra and N. Chandrasekran, PHI.
2. Introduction to Automata Theory, Language and Computation, John E, Hopcropt and Jeffery D. Ullman, Narosa Publishing House.

REFERENCE BOOKS:

1. Theory of Automata and Formal Language, R.B. Patel & P. Nath, Umesh Publication.
2. An Introduction and Finite Automata Theory, Adesh K. Pandey, TMH.
3. Theory of Computation AM Natrajan, Tamilarasi, Bilasubramani, New Age International Publishers, Chhattisgarh Swami Vivekan.
4. An introduction to Formal Languages and Automata by Peter Linz, Narosa Publ

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DATABASE MANAGEMENT SYSTEMS

Course Code- IT401

Module I

Introduction: Overview, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence and Database Language and Interfaces, Data Definitions Language, DML, Overall Database Structure. Data Modeling Using the Entity Relationship Model: ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Concepts of Super Key, Candidate Key, Primary Key, Generalization, Aggregation, Reduction of an ER Diagrams to Tables, Extended ER Model, Relationship of Higher Degree.

Module II

Relational data Model and Language: Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra, Relational Calculus, Tuple and Domain Calculus. Introduction on SQL: Characteristics of SQL, Advantage of SQL. SQl Data Type and Literals. Types of SQL Commands. SQL Operators and Their Procedure. Tables, Views and Indexes. Queries and Sub Queries. Aggregate Functions. Insert, Update and Delete Operations, Joins, Unions, Intersection, Minus, Cursors, Triggers, Procedures in SQL/PL SQL

Module III

Data Base Design & Normalization: Functional dependencies, normal forms, first, second, 8 third normal forms, BCNF, inclusion dependence, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design

Module IV

Transaction Processing Concept: Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Checkpoints, Deadlock Handling. Distributed Database: Distributed Data Storage, Concurrency Control, Directory System.

Module V

Concurrency Control Techniques: Concurrency Control, Locking Techniques for Concurrency Control, Time Stamping Protocols for Concurrency Control, Validation Based Protocol, Multiple Granularity, Multi Version Schemes, Recovery with Concurrent Transaction, Case Study of Oracle.

References:

1. Korth, Silbertz, Sudarshan,” Database Concepts”, McGraw Hill
2. Date C J, “An Introduction to Database Systems”, Addision Wesley
3. Elmasri, Navathe, “ Fundamentals of Database Systems”, Addision Wesley
4. O’Neil, Databases, Elsevier Pub.
5. RAMAKRISHNAN"Database Management Systems",McGraw Hill
6. Leon & Leon,”Database Management Systems”, Vikas Publishing House
7. Bipin C. Desai, “ An Introduction to Database Systems”, Gagotia Publications
8. Majumdar & Bhattacharya, “Database Management System”, TMH
9. R.P. Mahapatra, Database Management System, Khanna Publishing House

DISCRETE MATHEMATICS

Course Code- BSC401

(3-CREDIT) (L-T-P/3-1-0)

MODULE-I

Mathematical Logic:

Introduction, Statements and Notation, Connectives, Normal Forms, Theory of Inference for the Statement Calculus, The Predicate Calculus, Inference Theory of the Predicate Calculus.

MODULE-II

Set Theory:

Introduction, Basic Concepts of Set Theory, Representation of Discrete Structures, Relations and Ordering, Functions.

Algebraic Structures:

Introduction, Algebraic Systems, Semi Groups and Monoids, Groups, Lattices as Partially Ordered Sets, Boolean Algebra.

MODULE-III
Elementary Combinations:

Basic of Counting, Combinations and Permutations, Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with Repetitions, Enumerating Permutations with Constrained Repetitions, Binomial Coefficients, The Binomial and Multi-Nominal Theorems, The Principle of Inclusion-Exclusion.

MODULE-IV
Recurrence Relations:

Generating Functions of Sequences, Calculating Coefficients of Generating Functions, Recurrence Relations, Solving Recurrence Relations by Substitution and Generating Functions, The Method of Characteristic Roots, Solutions of Inhomogeneous Recurrence Relations.

MODULE-V

Graphs and Trees:

Basic Concepts, Isomorphisms and Subgraphs, Trees and Their Properties, Spanning Trees, Directed Trees, Binary Trees, Planar Graphs, Euler's Formula, Multigraphs and Euler Circuits, Hamiltonian Graphs, Chromatic Numbers, The Four-Color Problem.

TEXT BOOKS:

1. Discrete Mathematical Structures with Applications to Computer Science, J.P. Tremblay, R. Manohar, McGraw Hill Education (India) Private Limited (Units-I, II).
2. Discrete Mathematics for Computer Scientists & Mathematicians, Joe L. Mott, Abraham Kandel, Theodore P. Baker, Pearson, 2nd Edition (Units- III, IV, V).

REFERENCE BOOKS:

1. Discrete Mathematics and its Applications, Kenneth H. Rosen, 7th Edition, McGraw Hill Education (India) Private Limited.
2. Discrete Mathematics D.S. Malik & K. K. Sen, Revised Edition Cengage Learning.
3. Elements of Discrete Mathematics, C.L. Liu and D.P. Mohapatra, 4th Edition, McGraw Hill Education (India) Private Limited.
4. Discrete Mathematics with Applications, Thomas Koshy, Elsevier.
5. Discrete and Combinatorial Mathematics, R. P. Grimaldi, Pearson.
6. Discrete Mathematical Structures by Bernard Kolman, Robert C. Busby and Sharon Cutler Ross, Pearson Education.

<u>CYBER SECURITY</u>

Course code –IT 402

Module I: Introduction to Cybercrime : Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, and Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

Module II: Cyber Offenses: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Module III: Cybercrime : Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices:

Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

Module – IV: Tools and Methods Used in Cybercrime : Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

Module V: Cyber Security : Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

TEXT BOOK:

- Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.

REFERENCE BOOK:

- Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
- Introduction to Cyber Security , Chwan-Hwa(john) Wu,J.David Irwin.CRC Press T&F Group

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ENGINEERING ECONOMICS

Course code –EN 401

COURSE OUTLINE:

The basic purpose of this course is to provide a sound understanding of concepts and principles of engineering economy and to develop proficiency with methods for making rational decisions regarding problems likely to be encountered in professional practice.

Module -1

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of Economics, Relation between science, engineering, technology and economics; Nature of Economic problem, Production possibility curve, Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility – its practical application and importance.

Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, measurement of elasticity of demand, practical importance & applications of the concept of elasticity of demand.

Module -II

Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale.

Various concepts of cost – Fixed cost, variable cost, average cost, marginal cost, money cost, real cost, opportunity cost. Shape of average cost, marginal cost, total cost, Cost curves.

Module III

Meaning of Market, Types of Market – Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets)

Pricing Policies- Entry Deterring policies, Predatory Pricing, Peak load Pricing. Product Life cycle

Firm as an organisation- Objective of the Firm, Type of the Firm, Vertical and Horizontal Integration, Diversification, Mergers and Takeovers.

Module -IV

Nature and characteristics of Indian economy (brief and elementary introduction), Privatization – meaning, merits and demerits. Globalisation of Indian economy – merits and demerits. Elementary Concepts of VAT, WTO, GATT & TRIPS agreement, Business cycle, Inflation

RECOMMENDED BOOKS:-

1. R.Paneer Seelvan: Engineering Economics, PHI
2. Managerial Economics, D.N.Dwivedi, Vikash Publication
3. Managerial Economics, H.L. Ahuja, S. Chand and Co. Ltd.
4. Managerial Economics, Suma Damodaran, Oxford.
5. R.molrishnd Ro T.V S 'Theory of firms : Economics and Managerial Aspects'. Affiliated East West Press Pvt Ltd New Delhi
6. Managerial Economics, H. Craig Petersen &W. Cris Lewis, Pearson Education.

DESIGN AND ANALYSIS OF ALGORITHM LAB

Course Code- CS402P

Course Outcome:

1. Able to Analyze the Real World Problem and Solv it.
2. Able to analyze Any Algorithm in Terms of Complexity.
3. Able to Compare Different Sorting Algorithm.

4. Able to Design Algorithm by Following Different Approach.

list of experiments:

1. Using a Stack of Characters, Covert an Infix String of Postfix String (I Class)
2. Implement Insertion, Deletion, Searching of a BST, (I Class)
3. (a) Implement Binary Search and Liner Search in a Program.
   (b) Implement a Heap Sort Using a Max Heap.
4. (a) Implement DFS/BFS for a Connected Graph.
   (b) Implement Dijkstra's Shortest Path Algorithm Using BFS.
5. (a) Write a Program to Implement Huffman's Algorithm.
   (b) Implement MST Using Kruskal/Prim Algorithm
6. (a) Write a Program on Quick Sort Algorithm.
   (b) Write a Program on Merge Sort Algorithm.
   Take Different Input Instance for Both the Algorithm and Show the Running Time.
7. Implement Matrix Chain Order Algorithm.
8. Write Down a Program to Find Out a Solution for 0/1 Knapsack Problem.
9. Using Dynamic Programming Implement LCS.
10. (a) Find Out the Solution on the N-Queen Problem.
    (b) Implement Back Tracking Using Game Trees.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus

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OPERATING SYSTEM LAB

Course Code- CS401P

1. Study of hardware and software requirements of different operating systems (UNIX,LINUX,WINDOWS XP, WINDOWS7/8
2. Execute various UNIX system calls for i. Process management ii. File management iii. Input/output Systems calls
3. Implement CPU Scheduling Policies: i. SJF ii. Priority iii. FCFS iv. Multi-level Queue
4. Implement file storage allocation technique: i. Contiguous(using array) ii. Linked –list(using linked-list) iii. Indirect allocation (indexing)
5. Implementation of contiguous allocation techniques: i. Worst-Fit ii. Best- Fit iii. First- Fit
6. Calculation of external and internal fragmentation i. Free space list of blocks from system ii. List process file from the system
7. Implementation of compaction for the continually changing memory layout and calculate total movement of data
8. Implementation of resource allocation graph RAG)
9. Implementation of Banker‟s algorithm
10. Conversion of resource allocation graph (RAG) to wait for graph (WFG) for each type of method used for storing graph.
11. Implement the solution for Bounded Buffer (producer-consumer)problem using inter process communication techniques-Semaphores
12. Implement the solutions for Readers-Writers problem using inter process communication technique -

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FORMAL LANGUAGES AND AUTOMATA THEORY

Course Code- CS403P

1. Write a program for Pattern searching ?
2. Write a program to simulate Nondeterministic Finite Automata (NFA)
3. Write a program to simulate deterministic Finite Automata (DFA)
4. Write a Program to remove Useless Production in a C.F.G
5. Write a Program to remove Unit Productionin a C.F.G
6. Create a pushdown automata for string translation

Mechanical Engineering

Course Structure
Academic Session 2020-21 onwards
SEMESTER V

S. No.	Course Code	Subject	L	T	P	Credit
		Theory				
1.	ME501	Heat Transfer	4	1	0	4
2.	ME502	Design of Machine Elements	3	1	0	3
3.	ME503	Internal Combustion Engines	3	1	0	3
4.*	ME504 ME505 ME506	Industrial Robotics Design for Manufacturing Energy System and Management	3	1	0	3
5.**	ME507 ME508 ME509	Project Management Principles of Management Total Quality Management	3	1	0	3
		Laboratory/Sessionals				
1.	ME501P	Heat Transfer	0	0	3	1
2.	ME502P	Design of Machine Elements	0	0	3	1
3.	ME503P	Internal Combustion Engines	0	0	3	1
4.	ME504P	Industrial Robotics Lab	0	0	3	1
5		General Proficiency/Seminar	0	0	2	2
Total Credit						**22**

***Professional Elective I**

**** Open Elective I**

HEAT TRANSFER

Course Code - ME501

Objectives :

- The aim of the course is to build a solid foundation in heat transfer exposing students tothe three basic modes namely conduction, convection and radiation.
- Rigorous treatment of governing equations and solution procedures for the three modeswill be provided, along with solution of practical problems using empirical correlations.
- The course will also briefly cover boiling and condensation heat transfer, and the analysisand design of heat exchangers.

Contents :

Module I
Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady onedimensional solution for conduction heat transfer in Cartesian, cylindrical and sphericalgeometry, concept of conduction and film resistances, critical thickness of insulation, lumpedsystem approximation and Biot number, heat transfer through pin fins- Two dimensionalconduction solutions for both steady and unsteady heat transfer-approximate solution tounsteady conduction, heat transfer by the use of Heissler charts.**(12)**

Module II
Heat convection,basic equations, boundary layers- Forced convection, external and internalflows- Natural convective heat transfer- Dimensionless parameters for forced and freeconvection heat transfer-Correlations for forced and free convection- Approximate solutionsto laminar boundary layer equations (momentum and energy) for both internal and externalflow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriatecorrelations for free and forced convection. **(10)**

Module III
Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann'slaw, black and gray body radiation, Calculation of radiation heat transfer between surfacesusing radiative properties, view factors and the radiosity method.**(8)**

Module IV
Types of heat exchangers, Analysis and design of heat exchangers using bothLMTD and ε-NTU methods. Exposure of numerical technique of heat transfer. **(6)**

ModuleV
Boiling and Condensation heat transfer, Pool boiling curve **(3)**

ModuleVI

Introduction mass of transfer, Fick's law, Similarity between heat and mass transfer **(3)**

Course Outcomes:

1. After completing the course, the students will be able to formulate and analyze a heattransfer problem involving any of the three modes of heat transfer.
2. The students will be able to obtain exact solutions for the temperature variation usinganalytical methods where possible or employ approximate methods or empiricalcorrelations to evaluate the rate of heat transfer.
3. The students will be able to design devices such as heat exchangers and also estimate theinsulation needed to reduce heat losses where necessary.

Text Books:

1. P. K. Nag, Heat and Mass Transfer
2. Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002
3. Frank Kreith, Raj M. Manglik, Mark S. Bohn: Principles of Heat Transfer, Cengage Learning

References Books:

1. A. Bejan, Heat Transfer John Wiley, 1993
2. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3. F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley,Sixth Edition, 2007.
4. MassoudKaviany, Principles of Heat Transfer, John Wiley, 2002

DESIGN OF MACHINE ELEMENTS

Course Code - ME502

Objectives :

This course seeks to provide an introduction to the design of machine elements commonly encountered in mechanical engineering practice, through

- A strong background in mechanics of materials based failure criteria underpinning the safety-critical design of machine components
- An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations
- An overview of codes, standards and design guidelines for different elements
- An appreciation of parameter optimization and design iteration
- An appreciation of the relationships between component level design and overall machine system design and performance

Contents :

Module I
Design considerations - limits, fits and standardization, Review of failure theories for static and dynamic loading (including fatigue failure), (6)

Module II
Design of shafts under static and fatigue loadings, Analysis and design of sliding and rolling contact bearings, (8)

Module III
Design of transmission elements: spur, helical, bevel and worm gears; belt and chain drives, (8)

Module IV
Design of springs: helical compression, tension, torsional and leaf springs, (6)

Module V
Design of joints: threaded fasteners, pre-loaded bolts and welded joints, (6)

Module VI
Analysis and applications of power screws and couplings, Analysis of clutches and brakes, Engine Components. (9)

Course Outcomes:
Upon completion of this course, students will get an overview of the design methodologies employed for the design of various machine components

Text Books:
[1] Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.

[2] Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
[3] Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
[4] Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
[5] R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

INTERNAL COMBUSTION ENGINES

Course Code - ME503

Objectives :

- To familiarize with the terminology associated with IC Engines.
- To understand the basics of IC Engines.
- To understand Combustion and various parameters and variables affecting it in various types of IC Engines.
- To learn about various systems used in IC Engine required for various applications.

Contents :

Module I
Review of ideal cycles; Details of fuel-air cycles. [6 hrs]

Module II
Combustion in SI and CI engines, combustion stages, combustion chamber and abnormal combustion. [8hrs]

Module III
Fuel supply systems in SI and CI engines, carburetor.[7hrs]

Module IV
Port fuel injection, direct injection and common rail injection. [7hrs]

Module V
Ignition system, lubrication systems and cooling Systems [7hrs]

Module VI
Testing of IC Engines, Engine emissions and control, advanced IC engine concepts [7hrs]

Course Outcomes:

1. Students who have done this course will have a good idea of the basics of IC engines.
2. They will have good knowledge of different parameters influence the operational characteristics of IC Engines.
3. Students will have good idea about different operational parts of IC Engines.
4. They will have understand the functions of fuel combustion of IC Engines.
5. They will have the good knowledge about designing and modifying the IC engines.

Text books:

1.Obert E. F. "Internal combustion engines and air pollution " Harper and Row Publication Inc. NY,1973.
2. Heisler H. " Advanced Engine technology " Edward Arnold 1995.
3. Heywood J.B. " Internal combustion Engine fundamentals ", McGraw Hill Book Co. NY, 1989.

4. Heldt P.M. " High combustion Engines ", Oxford &IBH Publishing Co.India, 1985.
5. Stockel M.W.,Stockel TS and Johnson C, " Auto Fundamentals ", The Goodheart, Wilcox Co.Inc. Illinois, 1996.

<u>INDUSTRIAL ROBOTICS</u>

Course code-ME504

Objective:

- To Gain knowledge of Robotics and automation.
- To Understand the working methodology of robotics and automation.
- Write the program for robot for various applications

Contents:

Module-I
Robotics-classification, Sensors-Position sensors, Velocity sensors, Proximity sensors, Touch and Slip Sensors, Force and Torque sensors. **(6hrs)**

Module-II
Grippers and Manipulators-Gripper joints, Gripper force, Serial manipulator, Parallel Manipulator, selection of Robot-Selection based on the Application **(8hrs)**

Module-III
Kinematics-Manipulators Kinematics, Rotation Matrix, Homogenous Transformation Matrix, Direct and Inverse Kinematics for industrial robots for Position and orientation. **(8hrs)**

Module-IV
Differential Kinematics and static- Dynamics-Lagrangian Formulation, Newton-Euler Formulation for RR & RP Manipulators. **(6hrs)**

Module-V
Trajectory planning-Motion Control- Interaction control, Rigid Body mechanics, Control architecture- position, path velocity and force control systems, computed torque control, adaptive control, and Servo system for robot control. **(6hrs)**

Module-VI
Programming of Robots and Vision System- overview of various programming languages. **(4 hrs)**

Module-VII

Application of Robots in production systems- Application of robot in welding, machine tools, material handling, and assembly operations parts sorting and parts inspection. **(2hrs)**

Course Outcomes:

- Understand the basic components of robots.
- Differentiate types of robots and robot grippers.
- Model forward and inverse kinematics of robot manipulators.
- Analyze forces in links and joints of a robot.
- Programme a robot to perform tasks in industrial applications.
- Design intelligent robots using sensors.

Text Books:

1. Fu, K.S., Gonzalez, R.C., and Lee, C.S.G., *Robotics control, Sensing, Vision and Intelligence,* McGraw-Hill Publishing company, New Delhi, 2003.
2. Klafter, R.D., Chmielewski, T.A., and Negin. M, *Robot Engineering-An Integrated Approach,* Prentice Hall of India, New Delhi, 2002.
3. Craig, J.J., *Introduction to Robotics Mechanics and Control*, Addison Wesley, 1999.

DESIGN FOR MANUFACTURING

Course code-ME505

Objective:

- To educate students on factors to be considered in designing parts and components with focus on manufacturability.
.
- To impart the knowledge on design considerations for designing components produced using various machining operations.

Contents:

Module-I

Introduction: Overview of the course, Design for manufacturing, Typical Case studies, Innovative product and service designs. **(4hrs)**

Module-II

Material Selection: Requirements for material selection, systematic selection of processes and materials, ASHBY charts **(4hrs**)

Module-III

Design for Casting: Basic characteristics and Mold preparation, Sand casting alloys, Design rules for sand castings, Example calculations, Investment casting overview, Cost estimation, Number of parts per cluster, Ready to pour liquid metal cost, Design guidelines for Investment casting, Die casting cycle, Determination of optimum number of cavities, appropriate machine size, Die cost estimation, Design principles. **(8hrs**)

Module-IV

Design for Injection molding: Injection molding systems, Molds, molding cycle time, mold cost estimation, estimation of optimum number of cavities, Assembly techniques, Design Guidelines. **(5hrs)**

Module-V

Design for Hot Forging: Characteristics of the forging process, forging allowances, flash removal, die cost estimation,Die life and tool replacement costs. **(5hrs)**

Module-VI

Design for Sheet metal working: Press selection, press brake operations, Design rules. **(2hrs)**

Module-VII

Design for Powder Metal processing: Powder metallurgy, tooling and presses for Compaction, Sintering, materials, heat treatments, Design guidelines. Design for machining: Machining using single point cutting tools, multipoint cutting tools, abrasive wheels, Assembly, cost estimation for machined components, Design guidelines. (10) Module 8: Design for Assembly: Design guidelines for manual assembly, large assemblies, analysis of an assembly, rules for product design for automation, design for robot assembly, Design for manufacture and Computer aided design. (4hrs)

Course Outcomes:

- Understand the design principles of design for manufacturing processes
- Estimates the cost of dies, molds and machined components based on die life.
- Understand the design for manual assembly and automated assembly.
- Design typical assemblies using principles of design for X concepts.
- Understand the design rules for machining with single point and multi point cutting tools.

Text Books:

1. Geoffrey Boothroyd, Dewhurst.P, Knight.W, *roduct design for manufacture and assembly*,
2. CRC press, 2002
3. George E Dieter, *Engineering Design- A material processing approach*, 5/E. Mc Graw hill international, 2003.
4. ASM Handbook, *Design for manufacture*, 2000.

ENERGY SYSTEM AND MANAGEMENT

Course code-ME506

Objectives:

- To understand the basics of Energy Resources.
- To understand the Energy Conversion Systems and Management.
- To learn about basic concept of Power Systems Engineering.

Contents:

Module- I

Energy Resources: Energy and Development, Units and Measurements, Conventional and Non-Conventional Sources of Energy, Fossil and Mineral Energy Resources, Details of Coal, Peat, Oil, Natural Gas and Nuclear Resources, Recovery of Fossil Fuels, Classification and Characterization of Fossil fuels, Basic of Solar, Wind, Bio, Hydro, Tidal, Ocean Thermal and other Renewable Energy Sources, Impact of Energy on Environment, Flow of Energy in Ecological System, Environmental Degradation due to energy, Control of Pollution from Energy. (**7hrs)**

Module- II

Energy Conversion Systems I: Energy, Conversion routes, Direct and indirect way of Energy Conversion, Principles of heat and mass transfer, Thermodynamics, Fluid static and dynamics, Electricity generation, distribution and use, Basic of Solar Thermal Conversion, Technology of Selective Coating, Fundamentals of Flat Plate Collector and Evacuated Collector, Basic of Wind Energy Conversion, Wind machine, Wind electric generator, Wind pump. (**7hrs)**

Module- III

Energy Conversion Systems II: Basics of Photovoltaic Conversion technology and PV systems, PV system design methodologies, Basics of Bio-energy conversion, biomethanation technology, Thermochemical Conversion through Pyrolysis, Gasification and Esterification, Bio Oil, Application of Ocean Thermal Gradient and Geothermal gradient for power generation, Basics of hydropower, Tidal and Wave power, Basics of Hydrogen fuel, Fundamentals of Fuel Cells, Basics of Fusion power, Energy Storage Technologies, Mechanical storage, Chemical storage and Electrical storage, Details of Pb-acid battery, Ni-Cd-alkaline battery, Ni-iron and Na-S batteries, battery maintenance and safety precautions. (**7hrs)**

Module- IV

Energy Management: Fundamental of Energy conservation, Energy Management and Audit, Basics of Energy Demand and Supply, Principles of Economic analysis in the Energy Management and Audit Programme, Supply side and demand side energy management, Boilers and Firing System, Steam, Condensation Systems, Energy Conservation and Management in power plant, Energy conservation in Buildings, Heating, Ventilation and Air Conditioning System, Degree day in energy use monitoring, Energy Conservation Opportunities, in chemical industries, Waste heat recovery, Co-generation, Energy Conservation in Agricultural Sector, Energy conservation in illumination engineering, Combustion stoichiometry, air-fuel ratio, optimum loading in boilers, etc (**7hrs)**

Module- V

Industrial Energy Analysis: Materials and energy balance in the industries, Products and the process, industrial demand and supply networking, Optimization techniques, efficiency analysis, methods, Energy monitoring and ongoing information dissertation in terms of energy consumption, production and cumulative sum of differences. Energy efficiency analysis in various conversion systems like boilers, furnaces, compression systems, controlling systems, etc. Case studies for large scale, medium scale and small scale industries, efficiency integration methodologies. (**7hrs)**

Module- VI

Power Systems Engineering Basic concept of power plants, types of power plants, thermal power stations, various components of thermal power stations, power plant cycles, fuel handling, combustion, waste disposal methodologies, economizers, turbo alternators, heat balance and efficiencies, hydroelectric power plant, various components, capacity calculation, design methodologies, operation and maintenance methodologies, elements of nuclear power stations, reactor design, fuel, moderator, coolant control and safety, waste disposal. (**7hrs)**

Course Outcomes:

Upon completion of this course, students will be able to understand Energy Resources, Energy Conversion Systems and Energy Management.

Text Books:

1. Albert Thumann, *Handbook of Energy Audits*, The Fairmont Press Inc., Atlanta gergia, 1979.
2. Murphy W.R and Mckay G, *Energy Management*, Butterworths, London, 1982.
3. Albert Thumann, *Plant Engineer and Management guide to Energy Conservation*, Van Nost and Reinhold Co., Newyork.
4. Energy Audits, E.E.O.-Book-lets, U.K. 1988.
5. Craig B.Smith, "*Energy Management Principles*", Pergamon Press.
6. The role of Energy Manager, E.E.O., U.K.

7. The Energy conservation Design Resource Hand Book-The Royal architectural Institute of Canada.
8. Non-Conventional Energy Resources by B.H . Khan, Tata McGraw Hill

Project Management

Course code- ME507

Objective:

- To facilitate the understanding of project management principles and processes

Contents:

Module- I

Introduction: Introduction to Project Management, definitions, History of Project Management, project identifications, establishing a project, Project Life Cycle. (**4 hrs)**

Module- II

Project Analysis: Facets of Project Analysis, Resource Allocation, Market Analysis, Technical Analysis, Economic and Ecological Analysis. (**7 hrs)**

Module- III

Financial Analysis: Financial Estimates and Projections, Investment Criteria, Financing of Projects. (**8 hrs)**

Module- IV

Network Methods in PM: Origin of Network Techniques, AON and AOA differentiation, CPM network, PERT network, Other network models. (**9 hrs)**

Module- V

Optimisation in PM: Time and Cost trade-off in CPM, Crashing procedure, Scheduling when resources are limited. (**6 hrs)**

Module- VI

Project Risk Management: Risk analysis, Work Breakdown Structure, Earned Value Management. (**8 hrs)**

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand the importance of projects and its phases.
2. Analyze projects from marketing, operational and financial perspectives.
3. Evaluate projects based on discount and non-discount methods.
4. Develop network diagrams for planning and execution of a given project.
5. Apply crashing procedures for time and cost optimization.

Text Books:

1. Prasanna Chandra, Project: A Planning Analysis, Tata McGraw Hill Book Company, New Delhi, 4th Edition, 2009.
2. Cleland, Gray and Laudon, Project Management, Tata McGraw Hill Book Company, New Delhi, 3rd Edition, 2007.
3. Jack R. Meredith., Samuel J. Jr. Mantel., Project Management - A Managerial Approach, John Wiley, 6th Edition, 2011.

Principles of Management
Course code- ME508

Objectives:

- To understand the principles of Management and their application to the functioning of organization

Contents:

Module- I

Definition of management, science or art, manager vs. entrepreneur; Types of managers-managerial roles and skills; Evolution of management-scientific human relations, system and contingency approaches. **(6 hrs)**

Module- II

Types of Business organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; current trends and issues in management, Nature and purpose of planning, types of planning, objectives, policies , Strategic Management, planning Tools and Techniques, Decision making steps & processes. **(8 hrs)**

Module- III

Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization. Job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, carrier planning and Management. **(8 hrs)**

Module- IV

Directing, individual and group behavior,, motivation, motivation theories, motivational techniques, Job satisfaction, job enrichment, leadership, types and theories of leadership, effective communication. **(6 hrs)**

Module- V

Production planning and control: Forecasting models, aggregate production, and planning, scheduling, materials requirement planning; Controlling, system and process of controlling, budgetary and non-budgetary control techniques **(8 hrs)**

Module- VI

Inventory Control: Deterministic models, safety stock inventory control system Use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting. **(6 hrs)**

Course Outcomes:

Upon completion of this course, the students will

1. Get a clear understanding of management functions in an organization
2. Develop leadership quality to guide their work force to get done assigned jobs in time.
3. Maintain correct stock of spares and material for sustained production

4. Maintaining and hiring human resources of required skill and experience in time
5. Preparation of master budget and other budget to arrange required funds to carry out planned activities of organization

Text Books:

1. Robbins S.P. and Couiter M, Management, Prentice Hall India, 10^{th} ed., 2009
2. Stoner JAF, Freeman RE and Gilbert DR, Management, 6^{th} ed., Pearson Education 2004.
3. Tripathy PC & Reddy PN, Principles of Management, Tata Mcgraw Hill, 1999.
4. O.P.Khanna - Industrial Engineering and Management – Dhanpat Rai Publications O.P.Khanna

Total Quality Management

Course code- ME509

Objective:
To facilitate the understanding of total quality management principles and processes.

Contents:
Module-I
Introduction, evolution of quality control; Definitions of quality, Quality and productivity; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby.; Quality conformance, customer need, customer orientation & satisfaction, customer complaints; Quality cost, product & service costing, measuring quality cost
8 Hrs.

Module-II
TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment;
6 Hrs.

Module-III
Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCA cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.
8 Hrs.

Module-IV
The seven traditional tools of quality management; New management tools; Six sigma-concepts,methodology, applications to manufacturing, Bench marking process, evaluation; FMEA-stages, types.
6 Hrs.

Module-V
TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.
8 Hrs.

Module-VI
Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation; Quality auditing, QS 9000, ISO 14000-concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.
6 Hrs.

Course Outcomes: At the end of course ,the students will be able to
1.Understand the importance of quality and its assurance.
2.Analyze quality statements, customer focus and market plan.
3.Evaluate quality based products & methods.

4. Develop tools, methodology for the assurance of quality.
5. Apply & use the tools and techniques of TQM in manufacturing and service sector.

Text Books:

1. Besterfield D.H. et al., Total Quality Management, 3rd ed., Pearson Education Asia, 2006.
2. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
3. Janaki raman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

Mechanical Engineering

Course Structure
Academic Session 2020-21 onwards
SEMESTER VI

S. No.	Course Code	Subject	L	T	P	Credit
		Theory				
1.	ME601	Solid Mechanics	4	1	0	4
2.	ME602	Automobile Engineering	3	1	0	3
3.	ME603	Design of Transmission System	3	1	0	3
4.*	ME604 ME605 ME606	Computer Aided Design Mechatronic Systems Microprocessor in Automation	3	1	0	3
5.**	ME607 ME608 ME609	Operations Research Reliability Engineering Machine Tool Design	3	1	0	3
		Laboratory/Sessionals				
1.	ME601P	Solid Mechanics	0	0	3	1
2.	ME602P	Automobile Engineering	0	0	3	1
3.	ME604P	Manufacturing Lab	0	0	3	1
4.	ME607P	Computer Aided Design	0	0	3	1
5	IN601	Internship/Tour & Training/Industrial Training	0	0	2	2
Total Credit						**22**

***Professional Elective II**

**** Open Elective II**

SOLID MECHANICS

Course Code – ME601

Objectives:

The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.

Course Contents:

Module-I

Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, strain gauges and rosettes. **(8hrs)**

Module-II

Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions, octahedral shear stresses. **(8hrs)**

Module-III

Constitutive equations: Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition. **(6hrs)**

Module-IV

Plane stress and plane strain problems, introduction to governing equations in polar and cylindrical coordinates, axisymmetric problems. **(7hrs)**

Module-V

Application to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration, thermo-elasticity. **(8hrs)**

Module-VI

Solutions using potentials energy methods, Introduction to plasticity. **(5hrs)**

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the deformation behavior of solids under different types of loading.
2. Find mathematical solutions for simple geometries under different types of loading.
3. Transform the state of stress from one set of co-ordinate axes to another set of co-ordinate axes.
4. Apply compatibility equation for different system of strain.
5. Find the mathematical solution for axisymmetric problem.
6. Understand the concept of elasticity and plasticity.

Text Books:

[1] G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.

[2] Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.

[3] Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international, 1969.

[4] S M A Kazimi, Solid Mechanics, Mc Graw Hill, 2016

AUTOMOBILE ENGINEERING

Course Code – ME602

Objectives:
To understand the construction and working principle of various parts of an automobile

Contents:
Module-I
Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines- components, function and materials, (5)

Module-II
Engine auxiliary systems, fuel supply system, starting system, ignition system, electronic injection for SI and CI engines, engine lubrication and cooling system, engine emission control by 3-way catalytic converter system, Emission norms .(10)

Module-III
Transmission systems, AWD and 4WD transmission, clutch types & construction, gear boxes, Automatic transmission, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, (6)

Module-IV
Steering geometry and types of steering gear box, power steering, types of front axle, wheel alignment types of suspension systems. (5)

Module-V
General braking requirement, elementary theory of shoe brake, weight transfer, mean lining pressure and heat generation during braking, mechanical Pneumatic and hydraulic braking systems, power brake, antilock braking system(ABS), (6)

Module-VI
Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion &emission characteristics of alternative fuels in SI and CI engines. Electric and Hybrid vehicles, application of Fuel Cells, (10)

Module-VII

Course Outcomes:
Upon completion of this course, students will understand the function of each automobile component and also have a clear idea about the overall vehicle performance.

Text books:
(i)Kirpal Singh, Automobile Engineering, 7thed., Standard Publishers, New Delhi, 1997.
(ii) Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi,2002.
(iii)Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.
(iv)Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998.

DESIGN OF TRANSMISSION SYSTEM

Course Code – ME603

Objectives:

- To learn about the design procedures for mechanical power transmission components

Contents:

Module-I

Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets. **(6 hrs)**

Module-II

Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears. **(6 hrs)**

Module-III

Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears. **(4 hrs)**

Module-IV

Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears. **(4 hrs)**

Module-V

Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine too applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications. **(10 hrs)**

Module-VI

Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expandingrim clutches; Electromagnetic clutches; Band and Block brakes. **(6 hrs)**

Module-VII

External shoe brakes, internal expanding shoe brake. **(4 hrs)**

Course Outcomes:

1. Upon completing this course the students will be able to design transmission systems for engines and machines.

Text Books:

(i) Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8thed., Tata McGraw Hill, 2010.

(ii) Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.

(iii) Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill,2001.

COMPUTER AIDED DESIGN

Course Code – ME604

Objectives:

- To provide an overview of how computers can be utilized in mechanical component design

Contents:

Module- I

Fundamentals of Computer Graphics- Product cycle, sequential and concurrent engineering, Computer Aided Design, CAD system architecture, computer graphics, Coordinate systems, 2D and 3D transformations, viewing transformation **(8 hrs)**

Module- II

Geometric Modelling- straight line, representation of curves, Hermite curves, Bezier curves, B-spline curves, rational curves **(5 hrs)**

Module- III

Techniques of surface modelling, plane surface, cylindrical surface, surface of revolution, surface patch, Coons and bicubic patches, Bezier and B-spline surfaces **(6 hrs)**

Module- IV

Fundamental of solid design, parametric space of a solid, surface and curves in a solid, Solid modelling techniques, CSG and B-rep. **(6 hrs)**

Module- V

Visual realism- hidden line-surface-solid removal algorithms, shading, colouring, computer animation **(5 hrs)**

Module- VI

Assembly of parts- assembly modelling, interferences of positions and orientation, tolerance analysis, mass property calculations, mechanism simulation and interefence checking CAD standards- Graphical Kernel System (GKS), standards for vexchange images, Open Graphics Library (OpenGL), Data exchange standards- IGES, STEP, CALS etc., Communication standards **(12 hrs)**

Course Outcomes:

Upon completion of this course, the students will be able to:

1. Use computer and CAD software for modelling mechanical components
2. draw different types of curves in 2D
3. draw different types of surface
4. draw solid modelling
5. assembly of different part modelling

Text Books:

1. Ibrahim Zeid, Mastering CAD CAM, Tata McGraw Hill Publishing Co. 2007.
2. C. McMohan and J. Browne, CAD/CAM Principles, II edition, Pearson Education, 1999.
3. W. M. Neumann and R.F. Sproul, Principles of Computer Gra[hics, McGraw Hill, 1989.
4. D. Hearn and M.P Baker, Computer Graphics, Prentice Hall Inc., 1992.

MECHATRONIC SYSTEMS

Course Code – ME605

Objective:

- To provide an overview of mechatronics applications and the use of micro-sensors and microprocessors.

Contents:

Module-I

Introduction: Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface. **(8hrs)**

Module-II

Sensors and transducers: classification, Development in Transducer technology, Opto-electronics- Shaft encoders, CD Sensors, Vision System, etc.**(5hrs)**

Module-III

Drives and Actuators: Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control**.(5hrs)**

Module-IV

Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems**.(6hrs)**

Module-V

Smart materials: Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc**.(8hrs)**

Module-VI

Micro mechatronic systems: Micro sensors, Micro actuators; Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology. **(10hrs)**

Course Outcomes:

- To understand the structure of microprocessors and their applications in mechanical devices
- To know the use of various sensors and transducers
- To understand the principle of automatic control and real time motion control systems, with the help of electrical drives and actuators
- To know the static and dynamic characteristics of actuators
- To understand the use of micro-sensors and their applications in various fields

Text Books:

1. Devdas Shetty & Richard A. Kolk, *Mechatronics System Design*, PWS Publishing Company (Thomson Learning Inc.)
2. William Bolton, *Mechatronics: A Multidisciplinary Approach*, Pearson Education
3. R. K. Rajput, *A Textbook of Mechatronics*, S. Chand & Company Private Limited
4. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall

MICROPROCESSOR IN AUTOMATION

Course Code – ME606

Objectives:

- To introduce the basic concepts of Digital circuits, Microprocessor system and digital Controller.

Contents:

Module- I

Number Systems, codes, digital electronics: Logic Gates, combinational circuits design, Flip-flops, Sequential logic circuits design: Counters, Shift registers. Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals. **(10 hrs)**

Module- II

Machine cycles, instruction cycle and timing states, instruction timing diagrams, Memory interfacing. **(3 hrs)**

Module- III

Assembly Language Programming: Addressing modes, Instruction set, simple programs in 8085; Concept of Interrupt, Need for Interrupts, Interrupt structure, Multiple Interrupt requests and their handling, Programmable interrupt controller; Interfacing peripherals: Programmable peripheral interface (8255). **(10 hrs)**

Module- IV

Interfacing Analog to Digital Converter & Digital to Analog converter, Multiplexed seven segments LED display systems, Stepper Motor Control, Data Communication: Serial Data communication (8251), Programmable Timers (8253); 8086/8088 Microprocessor and its advanced features **(10 hrs)**

Module- V

Introduction to Digital Control: Sampling theorem, Signal conversion and Processing, Z Transform, Digital Filters, Implementation of Digital Algorithm. **(7 hrs)**

Course Outcomes:

1. Students who have done this course will have a good idea of the use of microprocessers for automation.

Text Books:

1. Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited
2. Digital Computer Electronics: An Introduction to Microcomputers, Albert Paul Malvino, Tata McGraw-Hill Publishing Company Ltd.

3. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar, PENRAM International Publishers.
4. Digital Control Systems, Benjamin C. Kuo, Oxford University Press (2/e, Indian Edition, 2007).
5. Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, Prentice Hall

OPERATIONS RESEARCH

Course Code-ME 607

Course Objectives **:** This course enables the students:

(1) Formulate a real-world problem as a mathematical programming model
(2) Know the theoretical workings of the simplex method for linear programming and perform iterations of it
(3) Analyze the relationship between a linear program and its dual, including strong duality and complementary slackness
(4) Solve specialized linear programming problems like the transportation, assignment, sequencing, games theory, and queuing model problems
(5) The use of Operations Research approaches in solving real problems in industry; mathematical models for analysis of real problems in Operations Research.

Course Outcomes: After completion of the course, the learners will be able to:

(1) Capability to recognize the importance and value of Operations Research and mathematical modeling.
(2) Ability to formulate a managerial decision problem into a mathematical model;
(3) Recognize Operations Research models and apply them to real-life problems;
(4) Use various approaches to solve a mathematical model for various practical problems in industry.
(5) Describe dynamic programming terminology.

Syllabus

MODULE I

Introduction: Scope and limitations of O.R., Linear Programming: Mathematical formulation of the problem. Graphical solution and Simplex Method. **8L**

MODULE II

Linear Programming**:** Big-M Method, Concept of duality, Dual simplex method. **6L**

MODULE III

Transportation Model**:** Basic feasible solution by different methods, Finding optimal solutions, Degeneracy in transportation problems, Unbalanced transportation problems.
Assignment Model: Balanced and unbalanced assignments,Assignment to given schedules.**10L**

MODULE IV

Sequencing: Processing of 2 jobs through machines –graphical method, Processing of n jobs through two machines, processing n jobs through three machines. **5L**

MOLULE V

Games Theory: Two-persons zero sum games, Pure and mixed strategies, Rules of dominance, Solution methods without saddle point. **5L**

MOLULE VI

Queuing Model**:** Queuing systems and their characteristics, The M/M/1/FIFO/∞ Queuing system, Introduction to dynamic programming. **8L**

Text Books:

1. P. Rama Murthy , Operations Research, New Age, New Delhi
2. P.K. Gupta & D. S. Hira , Operations Research, S.Chand & Company Ltd, New Delhi.

References Books:

1. Hamdy A Taha, 1999. Introduction to Operations Research, PHI Limited, New Delhi.

2.Sharma, J.K., 1989. Mathematical Models in Operations Research, Tata McGraw Hill publishing Company Ltd., New Delhi.

3.Beer, Stafford, 1966. Decision and Control, John Wiley & Sons, Inc., New York.

RELIABILITY ENGINEERING

Course Code – ME608

Objectives : To understand the applications of reliability in engineering decision making

Contents:

Module-I
Introduction: Probabilistic reliability, failures and failure modes, repairable and non-repairable items, pattern of failures with time, reliability economics. (6)

Module-II
Component Reliability Models: Basics of probability & statistics, hazard rate & failure rate, constant hazard rate model, increasing hazard rate models, decreasing hazard rate model, time-dependent & stress-dependent hazard models, bath-tub curve. (10)

Module-III
System Reliability Models: Systems with components in series, systems with parallel components, combined series-parallel systems, k-out-of-m systems, standby models, load-sharing models, stress-strength models, reliability block diagram. (10)

Module-IV
Life Testing & Reliability Assessment: Censored and uncensored field data, burn-in testing, acceptance testing, accelerated testing, identifying failure distributions & estimation of parameters, reliability assessment of components and systems. (8)

Module-V
Reliability Analysis & Allocation: Reliability specification and allocation, failure modes and effects and criticality analysis (FMECA), fault tree analysis, cut sets & tie sets approaches; Maintainability Analysis: Repair time distribution, MTTF / MTBF, MTTR, availability, maintainability, preventive maintenance. (6)

Course Outcomes: At the end of the course, the student will be able to:

1. Understand the concepts of reliability, availability and maintainability
2. Develop hazard-rate models to know the behavior of components
3. Build system reliability models for different configurations
4. Asses reliability of components and systems using field and test data
5. Implement strategies for improving reliability of repairable and non-repairable systems

Text Books:

(i) Ebeling CE, An Introduction to Reliability and Maintainability Engineering, TMH, New Delhi, 2004.

(ii) O'Connor P and Kleymer A, Practical Reliability Engineering, Wiley, 2012.

MACHINE TOOL DESIGN

Course Code – ME609

Objectives:

- Implement the tool design process when designing tooling for the manufacturing of a product.
- Apply Geometric Tolerancing principles in the designs of tooling.
- Evaluate and select appropriate materials for tooling applications.
- Design, develop, and evaluate cutting tools and work holders for a manufactured product.

Contents:

Module- I

Introduction to Machine Tools: Classification, similarities; various cutting tools and cutting fluids: speed of cutting, feed rate, machining rate and machining time. **(4 hrs)**

Module- II

Lathe: Construction, important mechanisms viz. apron, tail stock, head- stock, feed box; specification, operations e.g., taper turning, eccentric turning, screw cutting. **(4 hrs)**

Module- III

Milling machine: Construction, types specifications; cutters, dividing head, simple compound and differential indexing; various operations: Slab milling, angle cutting, slot milling, fly milling, slit gear milling, spur and bevel, T- slot milling, nature of operations, up and down milling. **(10 hrs)**

Module- IV

Shaper, Slotter, Planer: Construction, automatic feed mechanism, quick return mechanisms: operations e.g., horizontal, vertical and inclined machining, spline cutting, keyway cutting, contour machining. **(7 hrs)**

Module- V

Drilling machine: Construction, feed mechanism: Specification, geometry and nomenclature of twist drill, operations e.g. reaming, boring, tapping. **(5 hrs)**

Module- VI

Grinding Machines: M, N types and construction features, Operations e.g. Plane, cylindrical, internal and centreless grinding, tool and cutter grinding, grinding wheels- specifications, shapes, setting, dressing, truing. **(10 hrs)**

Course Outcomes:

At the end of the course, the student will be able to, Understand basic motions involved in a machine tool. Design machine tool structures. Design and analyze systems for specified speeds and feeds. Select subsystems for achieving high accuracy in machining. Understand control strategies for machine tool operations.

Text Books:

1. B.L.Juneja, G.S.Sekhon&Nitin Seth, Fundamentals of Metal Cutting & Machine Tools, New Age International Publications
2. P.N.Rao, Manufacturing Technology: Metal Cutting & Machine Tools, Tata McGraw Hill Publications.
3. G.K.Lal, Introduction to Machining Science ,New Age International Publications.
4. B.S.Raghuwanshi, Workshop Technology , Dhanpat Rai& Sons, Publications
5. HazraChandhari, Elements of Workshop Technology.

Jharkhand University of Technology, Ranchi

Detailed Syllabus

5th Semester

Department of Electrical Engineering

Course structure of Electrical Engineering

Semester -5th
Branch: Electrical Engineering

S.No	Course Code	Subject	L	T	P	Credit
01	**EE501**	Electrical Machine-II	4	1	0	4
02	**EE502**	Principles of Control Systems	3	1	0	3
03	**EE503**	Microprocessor and Microcontroller	3	1	0	3
04		Professional Elective-I	3	1	0	3
05		Open Elective-I	3	1	0	3
	Laboratory/sessional					
01	**EE501P**	Electrical Machine-II Lab	0	0	3	1
02	**EE502P**	Principles of Control Systems Lab	0	0	3	1
03	**EE503P**	Microprocessor and Microcontroller Lab	0	0	3	1
04	**EE504P**	Basic Computational Lab	0	0	3	1
05	**EE505P**	General Proficiency/Seminar	0	0	3	2
Total Credits						**22**

Professional Elective-I	
EE511	Signals & Systems
EE512	Electrical Machine Design
EE513	Transforms in Electrical Engineering
EE514	Applied Electrical Engineering

Open Elective-I	
EE521	Power Plant Engineering
EE522	Industrial Instrumentation and Automation
EE523	Principles of Control Systems*
EE524	Electromechanical Energy Conversion and Transformers*
Any paper floated by the other department can be selected/ opted by the Electrical Engineering Students	

***This course is not offered to Electrical Engineering students.**

Professional Core

EE501	Electrical Machines-II	L	T	Credit
		4	1	4

Course Outcomes:

After successful completion of the course, students will be able to:

CO's	CO Description
CO1	**Understand** the construction and principle of operation of synchronous machines and induction machines.
CO2	**Analyze** the effects of excitation and mechanical input on the operation of synchronous Machine.
CO3	**Analyze** starting and speed control methods of synchronous machines and induction machines.
CO4	**Evaluate** performance characteristics of synchronous machines and induction machine.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2		1					2
CO2	3	3	2	2	2		1					2
CO3	3	3	2	2	2		1					2
CO4	3	3	2	2	2		1					2
Avg.	**3**	**3**	**2**	**2**	**2**		**1**					**2**

DETAILED SYLLABUS

Module I: Fundamentals of A.C. Machines (5 Lectures)

Fundamental principles of A.C. machines: E.M.F equation of an elementary alternator, single & three phase, factors affecting the induced e.m.f, full pitch & fractional pitch windings, winding factors, armature reaction, concept of time phasor & space phasor.

Module-II: Synchronous Generator (12 Lectures)

Various types and construction, cylindrical rotor theory, phasor diagram, open circuit & short circuit characteristics, armature reaction, synchronous reactance, SCR, load characteristics, voltage regulation, E.M.F. method, MMF method, ZPF method, Potier triangle, synchronous machine connected to infinite bus, power angle characteristics.

Theory of salient pole machine: Blondel's two reaction theory, phasor diagram, direct axis and quadrature axis synchronous reactance, power angle characteristics, slip test, parallel operation: Synchronizing method, effect of wrong synchronization, load sharing between alternators in parallel, transient & sub-transient reactance.

Module-III: Synchronous Motor (7 Lectures)

General physical consideration, main features, equivalent circuit & phasor diagram, torque & power relations in salient and non-salient pole motors, V-curves & inverted V-curves, effect of change of excitation, synchronous condenser, starting of synchronous motor, performance characteristics of synchronous motor, hunting, applications.

Module-IV: Three Phase Induction Motor (10 Lectures)

Three Phase Induction Motors: Types, Construction and principle of operation, phasor diagrams, equivalent circuit, power and torque relations, condition for maximum torque, Performance characteristics, effect of rotor resistance on speed torque characteristics, stable & unstable region of operation, Operation with unbalanced supply voltage. Starting of 3 phase induction motor, speed control of induction motor, Double cage induction motor, Cogging and Crawling of Induction motor, induction generator.

Module-V: Single phase motors (5 Lectures)

Induction type, Double revolving field theory, equivalent circuit, characteristics & starting of single phase motor, shaded pole machine, synchronous type, hysteresis motor, reluctance motor.

Module VI: Single phase special type of machines (3 Lectures)

Switched reluctance motor, PMBLDC motor, tachometer, two phase control motor, Synchro.

Suggested Readings:

[1]. I. J. Nagrath & D. P. Kothari, "Electric Machines", Tata Mc Graw Hill, 7th Edition.2005

[2]. P. S. Bhimbra, "Electrical Machines", Khanna Publishers.

[3]. A.E. Fitzgerald, C.Kingsley and S.Umans, "Electric machinery", MacGraw Hill Companies, 5th edition.

[4]. Stephen Chapman, "Electric Machinery Fundamentals" Mac Graw HillCompany.

[5]. Langsdorf, "Theory of Alternating Current Machinery", Tata McGraw-Hill Companies, 2nd edition.

[6]. Performance and Design of AC Machines by M G. Say, BPB Publishers.

EE502	Principles of Control System	L	T	Credit
		3	1	3

Course Outcomes:

After successful completion of the course, students will be able to:

CO's	CO Description
CO1	**Analyze** electromechanical systems by mathematical modeling.
CO2	**Determine** Transient and Steady State behavior of systems using standard test signals.
CO3	**Analyze** linear systems for steady state errors, absolute stability and relative Stability using time domain and frequency domain techniques.
CO4	**Identify** and **design** a control system satisfying specified requirements.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	3		1	1				2
CO2	3	3	2	3	3		1	1				2
CO3	3	3	2	3	3		1	1				2
CO4	3	3	3	3	3		1	1				2
Avg.	3	3	2.33	3	3		1	1				2

DETAILED SYLLABUS

Module I: Introduction to Principles of Control System **(8 Lectures)**

Concept of systems and its classification; open-loop and closed-loop control system, benefits of feedback, mathematical modeling and representation of physical systems, analogous systems.

Transfer functions for different types of systems, block diagrams and its reduction techniques, Signal flow graphs and Mason's gain formula.

Module II: Time domain and Frequency domain **(10 Lectures)**

Time domain performance criterion, transient response of first order and second order systems; Steady state errors and error constants of different types of system; dynamic error constant: Derivation and its advantages; sensitivity; performance analysis for P, PI and PID controllers.

Module III: Stability Criterion **(8 Lectures)**

Concept of stability by Routh stability criterion. Stability analysis using root locus. Bode plot analysis. Absolute and Relative stability. Definition and computation of Gain Margin and Phase Margin. Comparison between time and frequency response plot.

Module IV: Stability Criterion Continued **(6 Lectures)**

Frequency response Polar plots and its stability criterion. Relative stability, Nyquist criterion; Graphical approach for gain and phase margin using polar plot; Advantages and disadvantages of frequency response plot.

Module V: Compensation design **(4 Lectures)**

Compensation - lag, lead and lag-lead networks, Compensation designs of networks using time domain analysis and frequency response analysis.

Module VI: State Space Analysis **(6 Lectures)**

Concepts of state, state variables, state space representation of systems, dynamic equations, transient matrix, merits for higher order differential equations and its solution; Concept of controllability and observability.

Suggested Readings:

[1]. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009

[2]. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

[3]. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.

[4]. H. Saeed, "Automatic Control System", S. K. Kataria & Sons, 2008.

[5]. S. K. Bhardwaj and S. K. Nagar, "Modern Control System with Advance Topics", New Age International, 2019.

EE503 **Microprocessor & Microcontroller**

L	T	Credit
3	1	3

Course Outcomes:

After successful completion of the course students will be able to:

CO's	CO Description
CO1	**Categorize** the basic concepts of microprocessor & microcontrollers
CO2	**Interpret** different addressing modes and types of registers in processor or controller
CO3	**Execute** simple programs on microprocessor & microcontroller
CO4	**Illustrate** how the different peripherals are interfaced with 8086 microprocessor
CO5	**Illustrate** how memory or I/O interfaced with 8051 microcontroller

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1.Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1										
CO2	2	2	2									
CO3	3	3	3	2					1			2
CO4	3		2	2	2				1			2
CO5	3		2	2	2				1			2
Avg.	**2.6**	**2.0**	**2.25**	**2.0**	**2.0**				1.0			2.0

DETAILED SYLLABUS

Module-I **(6 Lectures)**

Brief introduction to 8085 CPU Architecture, Pin configuration, Addressing Modes, Registers, Memory Addressing, Instructions Set.

Module-II **(10 Lectures)**

THE 8086 ARCHITECTURE: Pin diagram of 8086 and description of various signals. Architecture block diagram of 8086 & description of sub-blocks such as EU & BIU & of various registers; Description of address computations & memory segmentation; addressing modes; Instruction formats.

Module-III **(4 Lectures)**

Interfacing of memory and peripherals with microprocessor, Architecture and modes of operation of 8255.

Module-IV **(10 Lectures)**

Microcontrollers– Type, processor architecture memory type, hardware features, 8051 Processor architecture, Memory mapping.

Addressing modes, 8051 Instruction Set – Data movement Instruction, arithmetic instruction, Logic instruction, Branch group Instruction

Module-V **(10 Lectures)**

Addressing modes, 8051 Instruction Set – Data movement Instruction, arithmetic instruction, Logic instruction, Branch group Instruction. 8051 microcontroller: Memory interfacing and address decoding, programming Input/ Output port/ timer programming and Serial data communication controller.

Suggested Readings:

[1]. Brey , The Intel Microprocessors 8086- Pentium processor, PHI

[2]. Badri Ram, Advanced Microprocessors and Interfacing, TMH

[3]. Triekel & Singh, The 8088 & 8086 Microprocessors-Programming, Interfacing, Hardware & Applications: PHI.

[4]. D. B. Hall , Microprocessor and Interfacing, McGraw Hill

[5]. M. A. Mazidi & J. G. Mazidi,The 8051 Microcontroller & Embedded System, Pearson Education.

Professional Elective-I

(Any One)

EE511 **Signals And Systems**

	L	T	Credit
	3	1	3

Course Outcomes:

After successful completion of the course students will be able to:

CO's	CO Description
CO1	**Understand** the concepts of continuous time and discrete time systems.
CO2	**Analyze** systems in complex frequency domain.
CO3	**Understand** sampling theorem and its implications

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1								2
CO2	3	2	3	1								2
CO3	3	3	3	2								2
Avg.	**3**	**2.66**	**3**	**2**								**2**

DETAILED SYLLABUS

Module I **(5 Lectures)**

Introduction to signals and systems - Classification of signals - Basic operations on signals – Elementary signals - Concept of system - Properties of systems - Stability, invertability, time invariance - Linearity - Causality - Memory - Time domain description - Convolution - Impulse response.

Module II **(5 Lectures)**

Representation of LTI systems - Differential equation and difference equation representations of LTI systems, Continuous Time LTI systems and Convolution Integral, Discrete Time LTI systems and linear convolution.

Module III **(5 Lectures)**

Frequency Domain Representation of Continuous Time Signals- Continuous Time Fourier Series: Convergence. Continuous Time Fourier Transform: Properties.

Module IV **(9 Lectures)**

Frequency Domain Representation of Discrete Time Signals- Discrete Time Fourier Transform: Properties, Sampling Theorem, aliasing, reconstruction filter, sampling of band pass signals. Fourier Series Representation of Discrete Time Periodic Signals.

Module V **(10 Lectures)**

Laplace Transform – ROC – Inverse transform – properties – Analysis of Continuous LTI systems using Laplace Transform – unilateral Laplace Transform. Relation between Fourier and Laplace Transforms.

Laplace transform analysis of systems - Relation between the transfer function and differential equation - Causality and stability - Inverse system - Determining the frequency response from poles and zeros.

Module VI **(8 Lectures)**

Z Transform - Definition - Properties of the region of convergence - Properties of the Z transform - Analysis of LTI systems - Relating the transfer function and difference equation - Stability and causality - Inverse systems - Determining the frequency response from poles and zeros.

Suggested Readings:

[1]. Haykin. S., Venn B. V. Signals and Systems

[2]. Oppenheim A.V., Willsky A.S. &Nawab S.H., Signals and Systems, Tata McGraw Hill

[3]. Taylor F.H, Principles of Signals and Systems, McGraw Hill

R**eferences**

[1]. Bracewell R.N., Fourier Transform & Its Applications, McGraw Hill

[2]. Haykin S., Communication Systems, John Wiley

[3]. Lathi B.P., Modern Digital& Analog Communication Systems, Oxford University Press

[4]. Papoulis A., Fourier Integral & Its Applications, McGraw Hill

EE512	Electrical Machine Design	L	T	Credit
		3	1	3

Course Outcomes:

After successful completion of this course, student should be able to:

CO's	CO Description
CO1	**Understand** the construction and performance characteristics of electrical machines.
CO2	**Understand** the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines.
CO3	**Understand** the principles of electrical machine design and carry out a basic design of an ac machine
CO4	**Analyze** design aspects of rotating electrical machines.
CO5	**Use** software tools to do design calculations.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2							2
CO2	3	2	2	2	2							2
CO3	3	3	3	2	2							2
CO4	3	3	3	2	2							2
CO5	3	3	2	2	2							2
Avg.	**3**	**2.6**	**2.4**	**2**	**2**							**2**

DETAILED SYLLABUS

Module I: Factors in Design **(8 Lectures)**

Specifications for machines, output equation, limitations in design, electric and magnetic loadings, space factor, winding factor and their effects on machine performance, mechanical and high speed problems.

Module II: Design of Poly phase Asynchronous Machines **(10 Lectures)**

Details of construction, stator design, output equation, separation of D and L ,specific loadings, leakage reactance, rotor design, slip ring and squirrel cage motors, harmonic effects and slot combination, magnetizing current and losses, prediction of characteristics.

Module III: Design of Synchronous Machines **(10 Lectures)**

Details of construction, generators, salient and non-salient pole machines, specific loadings and output equation, stator design, harmonics and reduction, armature reaction, design of field winding, short circuit ratio, voltage regulation, efficiency, differences in design between salient and non-salient pole machine.

Module IV: Design of Transformers **(8 Lectures)**

Design of single and three phase transformers, output equation, specific loadings, electro mechanical stresses on windings, no load current, temperature rise.

Module V: Thermal aspects of Design **(6 Lectures)**

Generation, flow and dissipation of heat losses, thermal capacity, temperature rise curves, ratings of machines, cooling media, ventilation, types of cooling, standard enclosures.

Suggested Readings:

[1]. A.K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.

[2]. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.

[3]. Ion Boldea, Syed A. Nasar, "The Induction Machines Design Handbook", CRC Press.

[4]. Juha Pyrhonen, Tapani Jokinen, Valeria Hrabovcova, "Design of Rotating Electrical Machines",Wiley

[5]. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.

EE513 | **Transforms in Electrical Engineering** | **L** **T** **Credit** / **3** **1** **3**

Transforms in Electrical Engineering

EE513	L	T	Credit
	3	1	3

Course Outcomes:

After successful completion of the course students will be able to:

CO's	Description
CO1	**Understand** the concepts of continuous time and discrete time systems.
CO2	**Understand** the concepts of different discrete transforms.
CO3	**Analyze** systems in complex frequency domain.
CO4	**Design** of different types of filters.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1								2
CO2	3	2	3	1								2
CO3	3	3	2	2								2
CO4	3	2	2	2								2
Avg.	**3**	**2.5**	**2.5**	**1.5**								**2**

DETAILED SYLLABUS

Module I: Discrete-Time Signals **(4 Lectures)**

Concept of discrete-time signal, basic idea of sampling and reconstruction of signal, sampling theorem, sequences,-periodic, energy, power, unit-sample, unit step, unit ramp &complex exponentials, arithmetic operations on sequences..

Module II: LTI Systems **(6 Lectures)**

Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical and overlap-add methods to compute convolution supported with examples and exercise, properties of convolution, interconnection of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems.

Module III: Discrete Fourier Transform **(10 Lectures)**

Concept and relations for DFT/IDFT, Relation between DTFT & DFT. Twiddle factors and their properties, computational burden on direct DFT, DFT/DFT as linear transformation, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circulation convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences-Overlap-Save and Overlap-Add methods with examples and exercises.

Module IV: Discrete Time Fourier Transform **(5 Lectures)**

Concept of frequency in discrete and continuous domain and their relationship (radian and radian/sec), freq. response in the discrete domain. Discrete system's response to sinusoidal/complex inputs (DTFT), Representation of LTI systems in complex frequency domain.

Module V: Fast Fourier Transforms **(4 Lectures)**

Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithm, signal flow graph, Butterflies, computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations and exercises.

Module VI: Z- Transforms **(8 Lectures)**

Definition, mapping between s-plane & z-plane, unit circle, convergence and ROC, properties of Z-transform, Z-transform on sequences with examples & exercises, characteristic families of signals along with ROC, convolution, correlation and multiplication using Z- transform, initial value theorem, Parseval's relation, inverse Z transform by contour integration, power series & partial-fraction expansions with examples and exercises.

Module VII: Filter Design **(5 Lectures)**

Basic concepts of IIR and FIR filters, difference equations, design of Butterworth IIR analog filter using impulse invariant and bilinear transform, design of linear phase FIR filters no. of taps, rectangular, Hamming and Blackman windows. Effect of quantization.

Suggested Readings:

[1]. Digital Signal Processing-A computer based approach, S. Mitra, TMH

[2]. Digital Signal Processing: Principles, Algorithms & Application, J.C. Proakis& M.G. Manslakis, PHI

[3]. Fundamental of Digital Signal Processing using MATLAB , Robert J. Schilling, S.L. Harris, Cengage Learning.

[4]. Digital Signal Processing-implementation using DSP microprocessors with examples from TMS320C54XX, Avtar Singh & S. Srinivasan, Cengage Learning.

Reference Books

[1]. Digital Signal Processing, Chen, OUP

[2]. Digital Signal Processing, Johnson, PHI

[3]. Digital Signal Processing using MATLAB, Ingle, Vikas.

EE514 **Applied Electrical Engineering**

L	T	Credit
3	1	3

Course Outcomes:

After successful completion of the course, students will be able to:

CO's	CO Description
CO1	**Capable** to model the physical system into electrical system
CO2	**Apply** mathematics for electrical systems to analysis
CO3	**Select** simulation technique for DC and AC system analysis
CO4	**Able** to design the electro-mechanical systems

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3		2								
CO3				2	3							
CO4			2									
Average	**3**	**3**	**2**	**2**	**3**							

DETAILED SYLLABUS

Module I: Model of Physical Systems **(8 Lectures)**

Introduction to physical systems: Mass-spring-damper system, accelerometer, rotational mechanical system, gear trains, liquid level system; Circuit models: RL, RC, LC, RLC series and parallel circuits with sinusoidal and non-sinusoidal excitations, diode rectifier.

Module II: Solution of Differential Equations **(12 Lectures)**

Systems of linear equations, homogeneous and non-homogeneous linear equations, Polynomial equations, least squares fit; ordinary differential equations: Euler's method, Runge-Kutta method, Newton-Raphson method, Predictor-Corrector methods; Numerical integration: Forward and backward integration rules, Trapezoidal rule, Simpson's rule, Errors of integration.

Module III: Simulation Techniques **(6 Lectures)**

Continuous state simulation: circuit level simulators, Discrete-event simulation: Fixed time step, variable time step; Response analysis of circuits: DC analysis, AC Analysis, Transient analysis.

Module IV: Programming in MATLAB **(8 Lectures)**

Programming a function, repetitive and conditional control structures, Iterative solution of equations, polynomial interpolation; Plotting and analysis: two-dimensional and three-dimensional plots, Histograms, Polar plots, Function evaluation; Handling external files: saving and loading data.

Module V: PSPICE Circuit Simulator **(6 Lectures)**

Introduction, circuit descriptions, Input files, nodes, circuit elements, element values, sources, output variables; Analysis: DC sweep, Transient and AC analysis. PSPICE models.

Suggested Readings:

[1]. Biran A. and Breiner M., “MATLAB 5 for Engineers”, 2nd edition, Addison Wesley,1999

[2]. Rashid M. H. and Rashid H. M., “SPICE for Power Electronics and Electric Power”, 2nd edition, Taylor & Francis,2009

[3]. William J. P., “Introduction to MATLAB for Engineers”, 3rd edition,McGraw Hill,2010.

Open Elective-I

(Any One)

EE521 | **L** | **T** | **Credit**

Power Plant Engineering

L	T	Credit
3	1	3

Course Outcomes:

After successful completion of the course students will be able to:

CO's	CO Descriptions
CO1	**Describe** and **analyze** different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.
CO2	**Analyze** the working and layout of thermal power plants and the different systems comprising the plant and **discuss** about its economic and safety impacts
CO3	To **define** the working principle of diesel power plant, its layout, safety principles and compare it with plants of other types.
CO4	**Discuss** and **analyze** the mathematical and working principles of different electrical equipment involved in the generation of power and to **understand** co-generation.
CO5	Discuss and analyze the mathematical and working principles of different electrical equipment involved in the generation of power and to understand co-generation.

CO's-PO's Mappings Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	3	1		2					1
CO2	2	2	3	1	2		1					1
CO3	2		2	1		1	2					1
CO4	2		2	1		1	2					1
CO5	2	2	1	2	1	2	1					1
Avg.	**2**	**2.33**	**2**	**2.67**	**1.33**	**1.33**	**1.66**					**1**

DETAILED SYLLABUS

Module I: Introduction **(10 Lectures)**

Conventional & Non-Conventional Sources of Energy and their availability in India, Different Types of Power Plants, Layout of Steam , Hydel , Diesel , MHD, Nuclear and Gas turbine power plants, Combined Power cycles – comparison and selection , Load duration Curves, Steam boilers and cycles – High pressure and Super Critical Boilers – Fluidized Bed Boilers.

Module II: Thermal Power Plants **(10 Lectures)**

Basic thermodynamic cycles, various components of steam power plant-layout-pulverized coal burners-Fluidized bed combustion-coal handling systems-ash handling systems- Forced draft and induced draft fans- Boilers-feed pumps super heater- regenerator-condenser- de-aerators, cooling towers, electrostatic precipitators.

Module III: Hydel Power Plant **(8 Lectures)**

Principle of working, Classification, Site selection; Different components & their functions; Types of Dams; Types, Characteristics & Selection of Hydro-Turbines; Mini & Micro Hydro Power Plants, Pumped Storage Power Plants.

Module IV: Diesel And Gas Turbine Power Plant **(8 Lectures)**

Types of diesel plants, components, Selection of Engine type, applications. Gas turbine power plant- Fuels- Gas turbine material, open and closed cycles, reheating, Regeneration and inter cooling, combines cycle.

Module V: Co-Generation (6 Lectures)

Concept; Schemes; Brief Description; Benefits & Limitations; Applications. Non-Conventional Energy Sources, Types, Brief Description, Advantages & Limitations.

Suggested Readings:

[1]. P.K.Nag, "Power Plant Engineering", Tata McGraw Hill Publications.2007

[2]. EI-Wakil M.M, "Power Plant Technology," Tata McGraw-Hill 1984

[3]. Power Plant Engineering, Gautam S, Vikas Publishing House. 2012

[4]. Power station Engineering and Economy by Bernhardt

[5]. G.A.Skrotzki and William A. Vopat- Tata McGraw Hill Publishing Company Ltd.2002

[6]. "Modern Power Station Practice", Volume B, British Electricity International Ltd., Central Electricity Generating Board,Pergamon Press, Oxford.1991

[7]. 'Power Plant Familiarization – Vol. II', NPTI Publication.

EE522 **Industrial Instrumentation And Automation**

L	T	Credit
3	1	3

Pre-requisites: Measurements & Instrumentation

Course Outcomes:

After successful completion of the course, students will be able to:

CO's	CO Description
CO1	**Apply** the concepts and analyze the performance of physical systems using transducers for measurement of physical quantities.
CO2	**Understand** various Signal Conditioning operations and design Signal Conditioning circuitry of a measurement & instrumentation system.
CO3	**Exposure** to the technology of Industrial Automation and Control.
CO4	**Implementation** of various PLCs to Automation problems in industries.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

2. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	3	2	2	1	1	2	2
CO2	3	3	3	3	3	2	2	1	2	2	2	2
CO3	3	3	3	3	2	2	2	1	2	1	3	2
CO4	3	3	3	3	3	2	1	1	3	2	3	2
Avg.	3	3	3	3	2.5	2.25	1.75	1.25	2	1.5	2.5	2

DETAILED SYLLABUS

Module I: **(4 Lectures)**

Introduction: Static and Dynamic characteristics of Instrument. Displacement and proximity gauges. Linear Variable Differential Transformer (LVDT), Hall-effect sensors.

Module II: **(10 Lectures)**

Measurement of Temperature, Flow, Level and Viscosity: Thermocouple, Resistance Temperature Detector (RTD), Thermistor, Radiation Pyrometer, Differential Pressure flow-meter, Variable area flow- meter, Variable reluctance transducer, Turbine flow-meter, Ultrasonic flow-meter (Both transit time and Doppler Shift), electromagnetic flow-meter and Mass flow meter, Capacitance based and Float based method, pH -probe and viscosity measurement.

Module III: **(6 Lectures)**

Measurement of Pressure, strain & Vibration: Elastic transducers (Bourdon Gauge, Bellow and Diaphragm Gauge). Low pressure measurement, Strain Gauge, unbalanced Wheatstone bridge, Load cell, Torque Cell, Piezo-eiectric sensors, accelerometers.

Module IV: **(10 Lectures)**

Signal Conditioning and Processing: Estimation of errors and Calibration, Fundamentals of 4-20 mA current loops, Regulators and power supplies for industrial instrumentation.

Basics of Data transmission: Synchro and Servo motor. IEEE-488 bus, RS 232 and RS 485 interface. Pneumatic and Hydraulic Instrumentation system

Automation: Benefits and Impact of Automation on Manufacturing and Process Industries; Architecture of Industrial Automation Systems. Data Acquisition systems and PC based automation.

Module V: (6 Lectures)

Introduction to Automatic Control: P-I-D Control, Controller Tuning, Special Control Structures, Feed- forward and Ratio Control, Predictive Control, Control of Systems with Inverse Response, Cascade Control. Process and Instrumentation Diagrams.

Module VI: (6 Lectures)

Sequence Control: PLCs and Relay Ladder Logic, Scan Cycle, RLL Syntax, Structured Design Approach, Advanced RLL Programming, Hardware environment; Control of Machine tools: Introduction to CNC Machines.

Suggested Readings:

[1]. Doebelin, Measurement Systems, Applications and Design, Tata McGraw Hill, 2008.

[2]. Measurement & Instrumentation : Trends & Applications by M.K. Ghosh, S. Sen and S. Mukhopadhyay, Ane Books,2010

[3]. Fundamentals of Industrial Instrumentation Alok Barua, Wiley India Pvt Ltd,2011

[4]. Measurement and Instrumentation Principles, 3rdEdition, Alan S Morris, Butterworth-Heinemann, 2001

[5]. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A. K. Deb, Jaico Publishing House,2013

[6]. Chemical Process Control, An Introduction to Theory and Practice, George Stephanopoulos, Prentice Hall India,2012

[7]. Frank. D, Petruzella, “Programmable Logic Controllers”, Tata McGraw Hill Third Edition-2010.

EE523 | **Principles of Control System*** | **L** 3 | **T** 1 | **Credit** 3

EE523	**Principles of Control System***	**L**	**T**	**Credit**
		3	**1**	**3**

Course Outcomes:

After successful completion of the course, students will be able to:

CO's	CO Description
CO1	**Analyze** electromechanical systems by mathematical modeling.
CO2	**Determine** Transient and Steady State behavior of systems using standard test signals.
CO3	**Analyze** linear systems for steady state errors, absolute stability and relative Stability using time domain and frequency domain techniques.
CO4	**Identify** and **design** a control system satisfying specified requirements.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

3. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	3		1	1				2
CO2	3	3	2	3	3		1	1				2
CO3	3	3	2	3	3		1	1				2
CO4	3	3	3	3	3		1	1				2
Avg.	3	3	2.33	3	3		1	1				2

DETAILED SYLLABUS

Module I: Introduction to Principles of Control System **(8 Lectures)**

Concept of systems and its classification; open-loop and closed-loop control system, benefits of feedback, mathematical modeling and representation of physical systems, analogous systems.

Transfer functions for different types of systems, block diagrams and its reduction techniques, Signal flow graphs and Mason's gain formula.

Module II: Time domain and Frequency domain **(10 Lectures)**

Time domain performance criterion, transient response of first order and second order systems; Steady state errors and error constants of different types of system; dynamic error constant: Derivation and its advantages; sensitivity; performance analysis for P, PI and PID controllers.

Module III: Stability Criterion **(8 Lectures)**

Concept of stability by Routh stability criterion. Stability analysis using root locus. Bode plot analysis. Absolute and Relative stability. Definition and computation of Gain Margin and Phase Margin. Comparison between time and frequency response plot.

Module IV: Stability Criterion Continued **(6 Lectures)**

Frequency response Polar plots and its stability criterion. Relative stability, Nyquist criterion; Graphical approach for gain and phase margin using polar plot; Advantages and disadvantages of frequency response plot.

Module V: Compensation design **(4 Lectures)**

Compensation - lag, lead and lag-lead networks, Compensation designs of networks using time domain analysis and frequency response analysis.

Module VI: State Space Analysis **(6 Lectures)**

Concepts of state, state variables, state space representation of systems, dynamic equations, transient matrix, merits for higher order differential equations and its solution; Concept of controllability and observability.

Suggested Readings:

[1].I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009

[2]. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

[3]. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.

[4]. H. Saeed, "Automatic Control System", S. K. Kataria & Sons, 2008.

[5]. S. K. Bhardwaj and S. K. Nagar, "Modern Control System with Advance Topics", New Age International, 2019.

EE524 **Electromechanical Energy Conversion And Transformers***

	L	T	Credit
	3	1	3

(This course is not offered to Electrical Engg students)

Course Outcome:

After successful completion of the course students will able to:

CO's	CO Description
CO1	**Understand** the principle of operation of Electromechanical energy conversion
CO2	**Understand** the construction and principle of operation of DC machines, single phase and three phase transformers and auto transformers.
CO3	**Analyze** starting methods and speed control of DC machines.
CO4	**Analyze** parallel operation of DC Generators, single phase and three phase transformers.
CO5	**Evaluate** the performance of DC machines.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	1	2			1			2
CO2	3	3	3	1	1	2			1			2
CO3	3	3	3	2	1	2			1			2
CO4	3	3	3	2	1	2			1			2
CO5	3	3	3	2	1	2			1			2
Avg.	**3**	**3**	**3**	**1.6**	**1**	**2**			**1**			**2.0**

DETAILED SYLLABUS

Module I: Principle of Electromechanical Energy Conversion **(4 Lectures)**

Energy stored in electric and magnetic fields, energy conversion in single and multi-excited systems and torque production, reluctance torque; Reluctance and hysteresis motors.

Module II: General Description of Electrical Machines **(5 Lectures)**

Constructional details of dc and ac machines, description of magnetic and electric circuits in cylindrical rotor and salient pole machines, mmf distribution of current carrying single and multiple coils; Armature winding as a current sheet, associated mmf and flux density waves.

Module III: DC Machines and Commutations **(9 Lectures)**

Simplex lap and wave windings, emf and torque equations, interaction of the fields produced by field and armature circuits.

Module IV: DC Generators **(4 Lectures)**

Methods of excitation, shunt, series and compound generators, characteristics, testing.

Module V: DC Motors **(4 Lectures)**

Methods of excitation, characteristics, starting and speed control methods; Losses and their estimation, efficiency.

Module VI: Single-phase Transformers **(9 Lectures)**

Principle of operation, equivalent circuit, voltage regulation and efficiency; Parallel operation.

Principle of operation and comparison with two winding transformer.

Autotransformers: Principle of operation and comparison with two winding transformer

Module VII: Three Phase Transformers (6 Lectures)

Various connections and their comparative features, harmonics in emf and magnetizing current, effect of connections and construction on harmonics; Parallel operation of three-phase transformers, sharing of load, 3-phase to 2-phase conversion, 3-phase to 6-phase conversion.

Suggested Readings:

[1]. Fitzgerald A. E., Kingsley C. and Kusko A., "Electric Machinery", 6th Ed., McGraw-Hill International Book Company,2008.

[2]. Say M. G., "The Performance and Design of Alternating Current Machines", CBS Publishers and Distributors,2005.

[3]. Say M. G. and Taylor E. O., "Direct Current Machines", 3rd Ed.,ELBS and Pitman.1986

[4]. Nagrath I. J. and Kothari D. P., "Electrical Machines", 3rd Ed., Tata McGraw-Hill Publishing Company Limited,2008.

[5]. Chapman S. J., "Electric Machinery Fundamentals", 4th Ed.,McGraw-Hill International Book Company, 2005

[6]. Clayton A. E. and Hancock N., "The Performance and Design of DC Machines", CBS Publishers and Distributors, 2003.

[7]. Langsdorf A. S., "Theory of AC Machines", 2nd Ed., Tata McGraw-Hill Publishing Company Limited, 2008.

Laboratory / Sessional

EE501P	Electrical Machines-II Laboratory	P	Credit
		3	1

This Laboratory Experiments may be performed in physical/ virtual platform (as per availability of list of experiments in virtual lab portal).

<u>List of the Experiments</u>

Atleast 10 experiments should be performed in this Laboratory.

1) No Load & blocked rotor test on a three phase induction motor & draw the circle diagram.
2) Speed control of a 3-phase induction motor by rheostatic, cascading and pole changing methods.
3) Load test on three phase induction motor & draw the various characteristics.
4) To perform slip test on a given alternator and to determine d-axis reactance (Xd) and q-axis reactance (Xq)
5) Determination of sub-transient reactance of a synchronous generator by static method.
6) To perform load test on Schrage motor at different speed setting (1000, 1400 rpm).
7) To perform open circuit test and short circuit tests on a three phase Synchronous generator and calculate its voltage regulation by Synchronous impedance method.
8) Determination of V curve and Inverted V curve of a 3-phase Synchronous motor at no-load.
9) To perform load test on single phase capacitor motor.
10) To determine the negative and zero sequence reactance of a given alternator.
11) Synchronization of two alternators and their load sharing.
12) To perform open circuit test and short circuit tests on a three phase Synchronous generator and calculate its voltage regulation by Synchronous impedance method.
13) To determine voltage regulation of three phase Synchronous generator by ZPF method.
14) To determine the core loss of a single phase transformer at varying frequency and separate the hysteresis and eddy current loss.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

EE502P	Principles of Control System Laboratory	P	Credit
		3	1

This Laboratory Experiments may be performed in physical/ virtual platform (as per availability of list of experiments in virtual lab portal).

List of the Experiments

Atleast 10 experiments should be performed in this Laboratory.

1) To Study the time response of a closed loop second order system.
2) Study of closed loop P, PI, PID Controllers.
3) Time response analysis of LEAD compensating network.
4) Frequency response analysis of LEAD compensating network.
5) Study of temperature control of oven using PID Controller.
6) To obtain the characteristics of Synchro Transmitter and Receiver
7) To obtain transfer function of a D.C Shunt motor.
8) To plot and analyze the Root locus, Bode & Nyquist plots using MATLAB.
9) To perform dynamic system simulation using MATLAB.
10) Design of PID controller for speed control of a dc motor using MATLAB.

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

EE503P	Microprocessor & Microcontroller Laboratory	P	Credit
		3	1

This Laboratory Experiments may be performed in physical/ virtual platform (as per availability of list of experiments in virtual lab portal).

List of the Experiments

Atleast 10 experiments should be performed in this Laboratory.

Microprocessor

1) Write an ALP for addition of two 8 bit numbers, result may be of more than 8 bit.
2) Write an ALP to find the largest/ smallest number in a data array.
3) Write an ALP to arrange the numbers of data array in ascending/descending order.
4) Write an ALP to move a block of data from a location of memory to another location of memory.
5) Design an interfacing circuit to interface 64KB of memory with 8085 microprocessor.
6) Design an interfacing circuit to interface a common anode/ cathode seven segment LED display with microprocessor and write an ALP to display digit 0 to 9 and letter A to F.
7) Write a program for addition of content of the memory location 3000:0400H to the contents of 4000:0700H and store the result in 6000:0900H by using instructions of 8086 microprocessor.
8) Design an interfacing circuit to interface 8255 with 8085 microprocessor and write an ALP for controlling LEDs with switches.
9) Write an ALP to find square of an 8 bit number using look up table.
10) Write a program for generation of square wave.

Microcontroller

1) Write a program in assembly language/C language to send data on ports of 8051 microcontroller.
2) Write a program in assembly language/C language to perform various arithmetic operations.
3) Write a program in assembly language/C language to read dot-matrix keyboard.
4) Write a program in assembly language/C language to display massage on multiple 7 segment display.
5) Write a program in assembly language/C language to generate 1kHz square wave on port line of 8051
6) Write a program in assembly language/C language to perform various logical operations.
7) Write a program in assembly language/C language to display message on LCD display.
8) Write a program in assembly language/C language to rotate stepper motor in clockwise direction.
9) Write a program in assembly language/C language send MSBTE on hyper terminal of PC.
10) Write a program in assembly language/C language to read ADC.

NOTE: At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

EE504P	Basic Computational Laboratory	P	Credit
		3	1

This Laboratory Experiments may be performed in physical/ virtual platform (as per availability of list of experiments in virtual lab portal).

List of the Experiments

Atleast 10 experiments should be performed in this Laboratory.

These experiments can be performed using any software / FOSS (Free and Open Source Software) available at the institute.

1) To create arrays and matrices and perform various arithmetic operations.
2) To write a programme for getting the desired data (largest, smallest, a range etc) from a set.
3) To write a programme for creating various types of 2D plots (single and multiple) from a set of data.
4) To write a programme to solve linear equations.
5) To perform Scientific Computation.
6) Write a program for Logical Operation.
7) To perform Laplace Transform of Symbolic Expression.
8) Write a program to evaluate Eigen values and Eigen Vector of a matrix
9) To measure and plot the Instantaneous, RMS and average values of current/voltage, power, power factor, crest factor, frequency and various other waveform parameters while simulation of behavior of basic circuit components supplied from a DC and an AC source.

NOTE: At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

Jharkhand University of Technology, Ranchi

Detailed Syllabus

6th Semester

Department of Electrical Engineering

Course structure of Electrical Engineering

Semester -6th
Branch: Electrical Engineering

S.No	Course Code	Subject	L	T	P	Credit
01	EE601	Power Systems-II	4	1	0	4
02	EE602	Power Electronics	3	1	0	3
03	EE603	Advanced Control Systems	3	1	0	3
04		Professional Elective-II	3	1	0	3
05		Open Elective-II	3	1	0	3
06						
	Laboratory/ Sessional					
01	EE601P	Power System-II Lab	0	0	3	1
02	EE602P	Power Electronics Lab	0	0	3	1
03	EE603P	Simulation Lab	0	0	3	1
04	EE604P	Electrical Workshop	0	0	3	1
05		Internship/Tour & Training/Industrial Training	0	0	3	2
Total credit						22

Professional Elective-II	
EE611	Electrical Estimation and Costing
EE612	Electrical Engineering Materials
EE613	Power System Restructuring
EE614	Green Energy Technology

Open Elective-II	
EE621	Advanced Control Systems*
EE622	Soft Computing Techniques
EE623	Power Electronics*
EE624	Mine Electrical Engineering*
EE625	Green Energy Technology*
Any paper floated by the other department can be selected/ opted by the Electrical Engineering Students	

***This course is not offered to Electrical Engineering students.**

Professional Core

EE601

L	T	Credit
4	1	4

Power Systems-II

Course Outcomes:

After successful completion of the course, students will be able to:

CO's	CO Description
CO1	**Illustrate** power system components using single line diagram and usage of per unit system.
CO2	**Calculate** symmetrical components and examine different types of faults (both symmetrical and unsymmetrical).
CO3	**Formulate** nodal admittance (Y-bus) matrix, and **develop** load flow equations and **find** its solution.
CO4	**Calculate** optimal generator allocations and analyze single area power system for load frequency control
CO5	**Illustrate** the concept of stability, power angle curve, and swing equation and diagnose steady-state and transient stability of the power system.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	3	2	1	2								
CO3	3	3	1	3								1
CO4	3	3	1	2								1
CO5	3	3	1	3	2							1
Avg.	**3**	**2.6**	**1**	**2.5**	**2**							**1**

DETAILED SYLLABUS

Module I: Per Unit System **(4 lectures)**

Per Unit meaning and its calculation. Need and advantages of per unit system, Single line diagram, Per unit representation of a given power system network, Change of base value Impedance diagram, Numerical problems

Module II: Faults Analysis: **(8 lectures)**

Symmetrical fault Analysis: Short Circuit Current and MVA Calculations, Fault levels, Reactors-Numerical Problems. Symmetrical Component Theory: Symmetrical Component Transformation, Sequence Networks: Positive, Negative and Zero sequence Networks for transformers, transmission line and synchronous machine, Numerical Problems. Unsymmetrical Fault Analysis: LG, LL, LLG faults, Interconnection of sequence networks, effect of fault impedance, Numerical Problems

Module III: Load Flow Analysis **(8 lectures)**

Bus classification, formulation of Ybus matrix, power flow equations. Gauss – Seidel method, algorithm, derivation of iterative equation, modification for PV bus, Advantages and disadvantages, acceleration factor, Numerical Problems, Newton – Raphson method, algorithm, power mismatch vector, size of Jacobian matrix and its elements. Advantages and disadvantages, Numerical Problems, FDLF.

Module IV: Economic Operation of Power Systems **(6 lectures)**

Input-output characteristics of thermal and hydro plants, Optimum generator allocations without and with transmission losses, calculation of penalty factors, incremental transmission loss, transmission loss coefficients and their calculations.

Module V: Load Frequency Control **(8 lectures)**

Necessity of keeping frequency constant, Modeling of speed governing, steam turbine and generator, Definition of Control area, Block diagram representation of an isolated power system, Steady state analysis, Dynamic response, Proportional plus Integral control of single area and its block diagram representation, , Two area system, block diagram, Tie-line-bias control.

Module VI: Stability **(8 lectures)**

Concept of stability and Classification, Description of Steady State Stability Power Limit, Transfer Reactance, Synchronizing Power Coefficient, Power Angle Curve and Determination of Steady State Stability, Methods to improve steady state stability. Derivation of Swing Equation, Determination of Transient Stability by Equal Area Criterion, Application of Equal Area Criterion, Critical Clearing Angle Calculation.

Suggested Readings:

[1]. J Grainger and W.D. Stevenson , " Power System Analysis '' , McGraw Hill Education , First Edition, 2017

[2]. Hadi Sadat, "Power System Analysis", PSA Publishing LLC, Third Edition, 2011

[3]. D.P. Kothari and I.J. Nagrath, " Modern Power System Analysis '' ,McGraw Hill Education 2003

Reference Books:

[1]. Prabha Kundur, "Power System Stability and Control", McGraw Hill Education; First Edition, 2006.

[2]. A.J. Wood and B.F. Wollenberg, "Power Generation, Operation and Control", John Wiley and Sons, 2011.

EE602 **Power Electronics**

L	T	Credit
3	**1**	**3**

Course Outcomes:

After successful completion of the course students will be able to:

CO's	CO Description
CO1	To **understand** different power semiconductor devices and their characteristics.
CO2	To **understand** the operation, characteristics and performance parameters of AC to DC Converters.
CO3	To **study** the operation and basic topologies of DC-DC Converters
CO4	To learn the different modulation techniques of PWM inverters and to **understand** commutation techniques.
CO5	To **study** the operation of AC voltage controller and it's various configurations.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1		1					1
CO2	2	2	3	3	2		1					1
CO3	2	2	3	2	1	1	1					1
CO4	2	3	2	2	2	1	1					1
CO5	2	3	3	2	1	1	1					1
Avg.	**2.2**	**2.4**	**2.6**	**2.2**	**1.4**	**1**	**1**					**1**

DETAILED SYLLABUS

Module I: Power Semiconductor Devices **(10 Lectures)**

Power Diode, BJT, MOSFET, IGBT, Thyristor, and GTO: constructional features, I-V Characteristics, switching Characteristics, Firing circuit for thyristor; protection of thyristor and gate drive circuit, Turn on techniques, Voltage and current commutation of a Thyristor.

Module II: AC-DC Converters **(8 Lectures)**

Introduction, Single-phase half-wave and full-wave rectifiers with R, R-L and R-L-E load; effect of source inductance, Three-phase full-bridge rectifier with R, R-L and R-L-E load; freewheeling effect, power factor improvement.

Module III: DC-DC Buck and Boost Converter **(6 Lectures)**

Introduction, Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, quadrant operation of chopper. Power circuit of a buck, boost and buck-boost converter, analysis and waveforms at steady state, duty ratio control of output voltage.

Module IV: Single-Phase Voltage Source Inverter **(6 Lectures)**

Introduction, Single-phase voltage source inverter, operation and analysis, concept of average voltage over a switching cycle, sinusoidal pulse width modulation, modulation index and output voltage. Current source inverter.

Module V: Three-Phase Voltage Source Inverter **(6 Lectures)**

Three-phase voltage source inverter, operation and analysis, 120- degree conduction, 180-degree conduction, three-phase sinusoidal pulse width modulation.

Module VI: AC Voltage Controllers **(6 Lectures)**

Introduction, principle of on-off control, principle of phase control and integral cycle control, configuration of three phase controllers, Cycloconvertor.

Suggested Readings:

[1]. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.

[2]. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.

[3]. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science &Business Media, 2007.

[4]. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

EE603 | **Advanced Control Systems** | L: **3** | T: **1** | Credit: **3**

EE603 Advanced Control Systems

L	T	Credit
3	**1**	**3**

Course Outcomes:

After successful completion of the course, students should be able to:

CO's	CO Description
CO1	**Evaluate** the output of a digital system for a given input.
CO2	**Describe** the dynamics of a Linear, Time Invariant systems through difference equations.
CO3	**Analyze** digital systems using the Z-transformation, state space methods.
CO4	**Design** digital controllers for physical systems.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		1	1	1	1					1
CO2	3	1	3	2	2							
CO3	3	2		2	2							
CO4	3	3	3	3	3		1					2
Avg.	**3**	**2**	**3**	**2**	**2**	**1**	**1**					**1.5**

DETAILED SYLLABUS

Module I: Sampling and Reconstruction (8 Lectures)

Introduction to digital control system, Examples of Data control systems, Sampler, Sampling Theorem, Data Reconstruction: Digital to Analog conversion and Analog to Digital conversion, sample and hold operations.

Module II: Modeling discrete-time systems by pulse transfer function (8 Lectures)

Revisiting Z-transform: Introduction to Z – transforms, Theorems of Z – Transforms, inverse Z-transforms, Z-Transform method for solving difference equations. Mapping of S-plane to Z-plane, Pulse transfer function, Pulse transfer function of closed loop system, sampled signal flow graph

Module III: State Space Analysis (12 Lectures)

State variables, State model for linear continuous-time system. Types of state models, Eigen value and Eigen vectors, Solution of state equation, State transition matrix and its Properties.

Discrete state space model: Introduction to state variable model, various canonical forms, Characteristic equation, state transition matrix, Solution to discrete state equation.

Module IV: Controllability, Observability & Stability (8 Lectures)

Concepts of Controllability and Observability, Tests for controllability and Observability Duality between Controllability and Observability. Stability analysis of discrete time systems: Jury stability test Stability analysis using Bi-linear transformation.

Module V: State Feedback Controller **(6 Lectures)**

Design of state feedback controller through pole placement – Necessary and sufficient conditions. Observer: Full Order Observer, Reduced Order Observer. Lyapunov Stability Theorem.

Suggested Readings:

[1]. Discrete-Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition

[2]. B. C Kuo, Digital Control Systems, 2nd Edition, Oxford University Press, Inc., 1992.

Reference Books:

[1]. F. Franklin, J.D. Powell, and M.L. Workman, Digital control of Dynamic Systems, Addison-Wesley Longman, Inc., Menlo Park, CA , 1998.

[2]. Digital Control and State Variable Methods by M.Gopal, TMH.

Professional Elective-II
(Any One)

EE611	Electrical Estimation & Costing	L	T	Credit
		3	1	3

Course Outcomes:

After successful completion of the course, students will be able to:

CO's	CO Description
CO1	**Understand** the purpose of estimation and costing.
CO2	**Understand** distribution of energy in a building, wiring and methods of wiring, cables used in internal wiring, wiring accessories and fittings, fuses and types of fuses..
CO3	**Analyze** design of lighting points and its number, total load, sub-circuits, size of conductor.
CO4	**Understand** types of service mains and estimation of service mains and power circuits.
CO5	**Estimate** overhead transmission and distribution systems and its components.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	3	2	1	1						2
CO2	3	3	3	2	1	1						2
CO3	3	3	3	2	1	1						2
CO4	3	3	3	2	1	1						2
CO5	3	3	3	2	1	1						2
Avg.	**3**	**3**	**3**	**2**	**1**	**1**						**2**

DETAILED SYLLABUS

Module I: Principles of Estimation **(5 Lectures)**

Introduction to estimation & costing, Electrical Schedule, Catalogues, Market Survey and source selection, Recording of estimates, Determination of required quantity of material, Labor conditions, Determination of cost material and labour,Contingencies, Overhead charges, Profit, Purchase system, Purchase enquiry and selection of appropriate purchase mode, Comparative statement, Purchase orders, Payment of bills, Tender form, General idea about IE rule, Indian Electricity Act and major applicable I.E rules.

Module II: Residential Building Electrification **(7 Lectures)**

Introduction to electrical symbols, their advantages and requirement. Concept of wiring diagram, schematic diagrams and their types. General Rules guidelines for wiring of residential installation and positioning of equipments, Principles of circuit design in lighting and power circuits Procedures for designing the circuits and deciding the number of circuits, Method of drawing single line diagram. Selection of type of wiring and rating of wires and cables Load calculations and selection of size of conductor, Selection of rating of main switch Distribution board, protective switchgear ELCB and MCB and wiring accessories, Earthing of residential Installation, sequence to be followed for preparing estimate, Preparation of detailed estimates and costing of residential installation.

Module III: Electrification of Commercial Installation **(7 Lectures)**

Concept of commercial installation, Differentiate between electrification of residential and commercial installation, Fundamental considerations for planning of an electrical installation system for commercial building, Design considerations of electrical installation system for commercial building, Load calculation and selection of size of service connection and nature of supply, Deciding the size of the cables, busbar and bus bar chambers, Mounting arrangements and positioning of switchboards, distribution boards main switch etc, Earthing of the electrical installation, Selection of type wire, wiring system and layout, Sequence to be followed to prepare estimate, Preparation of detailed estimate and costing of commercial installation.

Module IV: Service Connection, Inspection and Testing of Installation **(7 Lectures)**

Concept of service connection, Types of service connection and their features, Method of installation of service connection, Estimates of underground and overhead service connections, Inspection of internal wiring installations, Inspection of new installations, testing of installations, testing of wiring installations, Reason for excess recording of energy consumption by energy meter.

Electrical Installation For Power Circuits: Introduction, Important considerations regarding motor installation wiring, Determination of input power, Determination of input current to motors Determination of rating of cables

Determination of rating of fuse, Determination of size of Condit, distribution Board main switch and starter.

Module V: Design & Estimation of Overhead Transmission & Distribution Lines **(10 Lectures)**

Introduction, Typical AC electrical power system, Main components of overhead lines, Line supports, Factors governing height of pole, Conductor materials, Determination of size of conductor for overhead transmission line, Cross arms, Pole brackets and clamps,Guys and Stays, Conductors configuration spacing and clearances, Span lengths, Overhead line insulators, Insulator materials, Types of insulators, Lightning Arrestors, Phase plates, Danger plates, Anti climbing devices, Bird guards, Beads of jumpers, Muffs, Points to be considered at the time of erection of overhead lines, Erection of supports, Setting of stays, Fixing of cross arms, Fixing of insulators, Conductor erection, Repairing and jointing of conductor , Dead end clamps, Positioning of conductors and attachment to insulators, Jumpers, Tee-offs, Earthing of transmission lines, Guarding of overhead lines, Clearances of conductor from ground, Spacing between conductors, Testing and commissioning of overhead distribution lines, Some important specifications.

Module VI: Design and Estimation of Substations **(6 Lectures)**

Introduction, Classification of substation, Indoor substations, Outdoor substations, Selection and location of site for substation, Main Electrical Connections, Graphical symbols for various types of apparatus and circuit elements on substation main connection diagram, Key diagram of typical substations, Equipment for substation and switchgear installations, Substation auxiliaries supply, Substation Earthing.

Suggested Readings:

[1]. Raina K.B. and Bhattacharya S.K., "Electrical Design, Estimating and Costing", New Age International, New Delhi, 2010

[2]. N. Alagappan & S. Ekambaram, "Electrical Estimating & Costing", TMH,2006

[3]. Dr.S.L.Uppal, "Electrical Wiring, Estimating and Costing", 5th Edition, Khanna Publishers,2003.

[4]. M.V. Deshpande, "Elements of Electrical Power Station Design", PHI 2009.

[5]. J. B. Gupta, "A Course in Electrical Installation Estimating and Costing", S. K. Kataria and Sons, India,2013.

[6]. ISI, National Electric Code, Bureau of Indian Standard Publications, New Delhi, 2011.

EE612 **Electrical Engineering Materials**

L	T	Credit
3	1	3

Course Outcomes:
After successful completion of the course, the students will be able to:

CO's	CO Description
CO1	**Understand** various types of dielectric materials, their properties in various conditions.
CO2	**Evaluate** magnetic materials and their behavior.
CO3	**Evaluate** semiconductor materials and technologies.
CO4	**Acquire** Knowledge on Materials used in electrical engineering and applications.

CO's-PO's Mapping Matrix:
Enter correlation levels1, 2 or 3 as defined below-
1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1								2
CO2	3	2	3	1								2
CO3	3	3	2	2								2
CO4	3	2	2	2								2
Avg.	**3**	**2.5**	**2.5**	**1.5**								**2**

DETAILED SYLLABUS

Module I: Dielectric Materials

Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

Module II: Magnetic Materials

Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and hysteresis.

Module III: Semiconductor Materials

Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale integration techniques (VLSI).

Module IV: Materials for Electrical Applications

Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

Module V: Special Purpose Materials

Refractory Materials, Structural Materials, Radioactive Materials, Galvanization and Impregnation of materials, Processing of electronic materials, Insulating varnishes and coolants, Properties and applications of mineral oils, Testing of Transformer oil as per ISI.

Suggested Readings:

[1]. "R K Rajput", " A course in Electrical Engineering Materials", Laxmi Publications, 2009

[2]. "T K Basak", " A course in Electrical Engineering Materials", New Age Science Publications 2009

Reference Books:

[1]. TTTI Madras, "Electrical Engineering Materials", McGraw Hill Education, 2004.

[2]. "AdrianusJ.Dekker", Electrical Engineering Materials, PHI Publication, 2006.

[3]. S. P. Seth, P. V. Gupta "A course in Electrical Engineering Materials", Dhanpat Rai & Sons, 2011.

EE613	Power System Restructuring	L	T	Credit
		3	1	3

Course Outcomes:

After successful completion of the course, students will be able to:

CO1	**Understand** the developments of restructuring worldwide.
CO2	**Identify** the roles and responsibilities of different entities in power market.
CO3	**Identify** issues like congestion management Ancillary Services Management.
CO4	**Evaluate** the transmission pricing schemes
CO5	**Explain** the Ancillary Services Management and the reforms in Indian power sector

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	2	1	1								2
CO2	1	2	1	2		1						2
CO3	2	2	1	2		1			2			2
CO4	1	1	1	2					1			2
CO5	2	2	1	1								2
Avg.	**1.4**	**1.75**	**1.0**	**1.6**		**1**			**1.5**			**2**

DETAILED SYLLABUS

Module I: Introduction to Restructuring of Power Industry (8 Lectures)

Introduction: Deregulation of power industry, Restructuring process, Issues involved in deregulation, Deregulation of various power systems – Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, Short and long run costs, Various costs of production – Market models: Market models based on Contractual arrangements, Comparison of various market models.

Module II: Electricity Market Model (8 Lectures)

Separation of ownership and operation, Deregulated models, pool model, pool and bilateral trades model, multilateral trade model. Competitive electricity market: Independent System Operator activities in pool market, Wholesale electricity market characteristics, central auction, single auction power pool, double auction power pool, market clearing and pricing, Market Power and its Mitigation Techniques, Bilateral trading.

Module III: Transmission Congestion Management (8 Lectures)

Introduction: Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management – Classification of congestion management methods – Calculation of ATC - Non – market methods – Market methods – Nodal pricing – Inter zonal and Intra zonal congestion management – Price area congestion Management.

Module IV: Locational Marginal Prices and Financial Transmission Rights (5 Lectures)

Mathematical preliminaries: - Locational marginal pricing– Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for LMP calculation – ACOPF model for LMP calculation – Financial Transmission rights.

Module – V: Transmission Pricing Schemes (7 Lectures)

Introduction to transmission pricing, Principles of transmission pricing, Classification of transmission pricing, Rolled-in transmission pricing paradigm, Marginal transmission pricing paradigm, Composite pricing paradigm, Merits and de-merits of different paradigms, Classification of loss allocation methods, Pro-rata methods, Incremental methods, Power flow tracing based allocation.

Module – VI: Ancillary Service Management (4 Lectures)

Introduction of ancillary services – Types of Ancillary services – Classification of Ancillary services – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service.

Module-VII: Reforms in Indian Power Sector (2 Lectures)

Introduction – Framework of Indian power sector – Reform initiatives - Availability based tariff – Electricity act 2003 – Open access issues – Power exchange – Reforms in the near future.

Suggested Readings:

[1]. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, “Restructured electrical power systems: operation, trading and volatility” Pub., 2001.

[2]. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, “Operation of restructured power systems”, Kluwer Academic Pub., 2001.

[3]. Leo Lei Lai, “Power System Restructuring and Deregulation: Trading, Performance and Information Technology” Wiley Pub. November 2001.

[4]. Steven Stoft, “Power system economics: designing markets for electricity”, John Wiley & Sons, 2002.

Reference Books:

[1]. Making competition work in electricity Sally Hunt, John Wiley & Sons, Inc., 2002.

[2]. Marija llic, Francisco Galiana and Lestor Fink , Power System Restructuring Engineering & Economics , Kulwer Academic Publisher, USA-2000.

EE614 **Green Energy Technology**

L	T	Credit
3	1	3

Course Outcome:

After successful completion of the course students will be able to:

CO1	**Identify** different non-conventional energy system and **realize** their importance in today's scenario.
CO2	**Analyze** the performance and limitations of the solar and wind energy conversion system.
CO3	**Understand** the concept behind the bio-mass, geothermal, tidal, ocean thermal and wave energy conversions.
CO4	**Outline** the basics of fuel cells and hydrogen production and storage.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1		1	1		1					1
CO2	3	2	2	2	1		1					1
CO3	2	1	1	1	1		1					1
CO4	2	1	1	1	1		1					1
Avg.	**2.5**	**1.25**	**1.33**	**1.25**	**1**		**1**					**1**

DETAILED SYLLABUS

Module I: Introduction **(4 Lectures)**

Basics of energy, conventional energy sources, fossil fuels limitations, renewable energy sources, advantages and limitations, global energy scenario, energy scenario of India, new technologies (hydrogen energy, fuel cells, bio fuels).

Module II: Solar Energy **(12 Lectures)**

Theory of solar cells, solar cell materials, I-V characteristics of solar cell, PV module, PV array, MPPT, PV systems, Stand alone and grid connected PV systems, storage, PV based water pumping, solar radiation and its measurement, flat plate collectors and their materials, applications and performance, solar thermal power plants, limitations.

Module III: Wind Energy **(10 Lectures)**

Wind power and its sources, site selection, power in the wind, impact of tower height, classification of wind turbine and rotors, wind energy extraction, betz'z limit, wind characteristics, performance and limitations of wind energy conversion systems.

Module IV: Biomass and Geothermal energy **(5 Lectures)**

Availability of biomass and its conversion theory, types of biomass, gasification, biogas plant, biomass cogeneration, resources of geothermal energy, thermodynamics of geo-thermal energy conversion, geothermal power generation, environmental considerations.

Module V: Tidal, Wave and Ocean energy **(6 Lectures)**

Introduction to tidal energy, tidal characteristics, tidal power plant, tidal power development in India, introduction to wave energy, factors affecting wave energy, principles of wave energy plant, OTEC, applications of OTEC.

Module VI: Emerging technologies for power generation **(5 Lectures)**

Fuel cells, Principle of working of various types of fuel cells and their working, performance and limitations, future potential of fuel cells, emergence of hydrogen, cost analysis of hydrogen production, hydrogen storage.

Suggested Readings:

[1] Non-Conventional Energy Resources, D.S. Chauhan, New Age International Pvt Ltd., 2006.

[2] D. P. Kothari, Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI, India,2011.

[3] Solar Cells: Operating principles, Technology and Systems Applications, Martin Green, UNSW, Australia, 1997

[4] S. P. Sukhatme, Solar Energy, TMH, India. 2008.

[5] Introduction to Wind Energy Systems: Basics, Technology and Operation (Green Energy and Technology), by Hermann-josef Wagner, ISBN: 9783642020223, Publisher: Springer, September 2009.

[6] Biofuels - Securing the Planet's Future Energy Needs, Edited by A Demirbas Springer 2009

[7] Fuel Cells: The Sourcebook - New Edition 2004 Escovale 2004.

Reference Books:

[1] John Twiden and Tony Weir, Renewable Energy Resources, BSP Publications, 2006.

[2] Renewable Energy, Third Edition, Bent Sorensen, Academic Press August 2004

[3] Wind Energy Explained: Theory, Design and Application, by J. F. Manwell, ISBN: 9780470015001, Publisher: John Wiley & Sons, Publication Date: February 2010 .

[4] L.L. Freris, Wind Energy Conversion Systems, Prentice Hall, 1990.

Open Elective-II
(Any One)

EE621 **Advanced Control Systems***

L	T	Credit
3	**1**	**3**

Course Outcomes:

After successful completion of the course, students should be able to:

CO's	CO Description
CO1	**Evaluate** the output of a digital system for a given input.
CO2	**Describe** the dynamics of a Linear, Time Invariant systems through difference equations.
CO3	**Analyze** digital systems using the Z-transformation, state space methods.
CO4	**Design** digital controllers for physical systems.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		1	1	1	1					1
CO2	3	1	3	2	2							
CO3	3	2		2	2							
CO4	3	3	3	3	3		1					2
Avg.	**3**	**2**	**3**	**2**	**2**	**1**	**1**					**1.5**

DETAILED SYLLABUS

Module I: Sampling and Reconstruction **(8 Lectures)**

Introduction to digital control system, Examples of Data control systems, Sampler, Sampling Theorem, Data Reconstruction: Digital to Analog conversion and Analog to Digital conversion, sample and hold operations.

Module II: Modeling discrete-time systems by pulse transfer function **(8 Lectures)**

Revisiting Z-transform: Introduction to Z – transforms, Theorems of Z – Transforms, inverse Z-transforms, Z-Transform method for solving difference equations. Mapping of S-plane to Z-plane, Pulse transfer function, Pulse transfer function of closed loop system, sampled signal flow graph

Module III: State Space Analysis **(12 Lectures)**

State variables, State model for linear continuous-time system. Types of state models, Eigen value and Eigen vectors, Solution of state equation, State transition matrix and its Properties.

Discrete state space model: Introduction to state variable model, various canonical forms, Characteristic equation, state transition matrix, Solution to discrete state equation.

Module IV: Controllability, Observability & Stability **(8 Lectures)**

Concepts of Controllability and Observability, Tests for controllability and Observability Duality between Controllability and Observability. Stability analysis of discrete time systems: Jury stability test Stability analysis using Bi-linear transformation.

Module V: State Feedback Controller **(6 Lectures)**

Design of state feedback controller through pole placement – Necessary and sufficient conditions. Observer: Full Order Observer, Reduced Order Observer. Lyapunov Stability Theorem.

Suggested Readings:

[1]. Discrete-Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition

[2]. B. C Kuo, Digital Control Systems, 2nd Edition, Oxford University Press, Inc., 1992.

Reference Books:

[1]. F. Franklin, J.D. Powell, and M.L. Workman, Digital control of Dynamic Systems, Addison-Wesley Longman, Inc., Menlo Park, CA , 1998.

[2]. Digital Control and State Variable Methods by M.Gopal, TMH.

EE622	Soft Computing Techniques	L	T	Credit
		3	1	3

Course Outcomes:

After successful completion of the course students will be able to:

CO1	**Distinguish** the concept between the hard and soft computing techniques.
CO2	**Understand** the basic concept of the Artificial Neural Network (ANN).
CO3	**Understand** the basic concept of the fuzzy logic system
CO4	**Explain** the concept of Genetic Algorithm (GA) and its limitation.
CO5	**Choose** the different kind of evolutionary programming for multi objective optimization problem based on their application.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	2							2
CO2	3	3	3	2	2							2
CO3	3	3	3	2	2							2
CO4	3	3	3	3	2							2
CO5	3	3	3	2	2							2
Avg.	**3**	**3**	**3**	**2**	**2**							**2**

DETAILED SYLLABUS

Module I: Fundamentals of Soft Computing Techniques (4 Lectures)

Conventional and Modern Control System, Intelligence, Soft and Hard Computing, Artificial Intelligence.

Module-II: Artificial Neural Network (10 Lectures)

Introduction to Artificial neural networks-biological neurons, Basic models of artificial neural networks- Connections, Learning, Activation Functions, McCulloch and Pitts Neuron.

Learning rule- Hebbian Learning, Perceptron Learning, Delta Learning- Training and Testing algorithm, Adaptive Linear Neuron, Back Propagation Network – Architecture, Training algorithm.

Module-III: Fuzzy Logic System-I (8 Lectures)

Fuzzy Logic- Fuzzy sets- Properties- Operation on fuzzy sets, fuzzy relations- operations on fuzzy relations.

Fuzzy membership functions, fuzzification, Methods of membership value assignments- intuition- inference- rank ordering, Lambda- cuts for fuzzy sets, Defuzzification methods.

Module –IV: Fuzzy Logic System-II (7 Lectures)

Truth values and Tables in Fuzzy Logic, Fuzzy propositions, Formation of fuzzy rules – Decomposition of rules- Aggregation of rules, Fuzzy Inference Systems- Mamdani and Sugeno types, Neuro-fuzzy hybrid systems – characteristics- classification

Module-V: **(8 Lectures)**

Introduction to genetic algorithm, operators in genetic algorithm – coding – selection – cross over – mutation, Stopping condition for genetic algorithm flow, Generational Cycle, Applications.

Module-VI: **(5 Lectures)**

Evolutionary Programming, Multi-objective Optimization Problem Solving and its applications, Genetic- neuro hybrid systems, Genetic-Fuzzy rule based system.

Suggested Readings:

[1]. N.P Padhy, Artificial Intelligence and Intelligent Systems- Oxford University Press.

[2]. S. N. Sivanandam and S. N. Deepa, Principles of Soft Computing- Wiley India.

[3]. Timothy J. Ross, Fuzzy Logic with engineering applications – Wiley India.

[4]. M.E. E1- Hawary , Artificial Intelligence application in Power Systems, IEEE Press,2009

[5]. Jan Jantzen, Foundations of Fuzzy Control, A practical approach, Wiley,2013

[6]. M Gopal, Digital Control and State Variable Methods, conventional and neural-fuzzy control system, Published by Tata McGraw Hill Education Private Ltd,2012

[7]. David E Goldberg, Genetic Algorithms, published by Pearson 2008

Reference Books:

[1]. Satish Kumar, Neural Networks- Prentice Hall of India.

[2]. N. K. Sinha and M.M. Gupta, Soft Computing and Intelligent Systems: Theory & Applications- Academic Press/ Elsevier, 2009.

[3]. Simon Haykin, Neural Network- A comprehensive Foundation- PHI, Inc.

[4]. Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation, Morgan Kaufman/ Elsevier, 2007.

EE623	Power Electronics*	L	T	Credit
		3	1	3

Course Outcomes:

After successful completion of the course students will be able to:

CO's	CO Description
CO1	To **understand** different power semiconductor devices and their characteristics.
CO2	To **understand** the operation, characteristics and performance parameters of AC to DC Converters.
CO3	To **study** the operation and basic topologies of DC-DC Converters
CO4	To learn the different modulation techniques of PWM inverters and to **understand** commutation techniques.
CO5	To **study** the operation of AC voltage controller and it's various configurations.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1		1					1
CO2	2	2	3	3	2		1					1
CO3	2	2	3	2	1	1	1					1
CO4	2	3	2	2	2	1	1					1
CO5	2	3	3	2	1	1	1					1
Avg.	**2.2**	**2.4**	**2.6**	**2.2**	**1.4**	**1**	**1**					**1**

DETAILED SYLLABUS

Module I: Power Semiconductor Devices (10 Lectures)

Power Diode, BJT, MOSFET, IGBT, Thyristor, GTO: constructional features, I-V Characteristics, switching Characteristics, Firing circuit for thyristor; protection of thyristor and gate drive circuit, Turn on techniques, Voltage and current commutation of a thyristor.

Module II: AC-DC Converters (8 Lectures)

Introduction, Single-phase half-wave and full-wave rectifiers with R, R-L and R-L-E load; effect of source inductance, Three-phase full-bridge rectifier with R, R-L and R-L-E load; freewheeling effect, power factor improvement.

Module III: DC-DC Buck and Boost Converter (6 Lectures)

Introduction, Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, quadrant operation of chopper. power circuit of a buck, boost and buck-boost converter, analysis and waveforms at steady state, duty ratio control of output voltage.

Module IV: Single-Phase Voltage Source Inverter **(6 Lectures)**

Introduction, Single-phase voltage source inverter, operation and analysis, concept of average voltage over a switching cycle, sinusoidal pulse width modulation, modulation index and output voltage. Current source inverter.

Module V: Three-Phase Voltage Source Inverter **(6 Lectures)**

Three-phase voltage source inverter, operation and analysis, 120- degree conduction, 180-degree conduction, three-phase sinusoidal pulse width modulation.

Module VI: AC Voltage Controllers **(6 Lectures)**

Introduction, principle of on-off control, principle of phase control and integral cycle control, configuration of three phase controllers, cycloconverter.

Suggested Readings:

[1]. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.

[2]. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.

[3]. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science &Business Media, 2007.

[4]. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

EE624 | **L** | **T** | **Credit**

Mine Electrical Engineering*

L	**T**	**Credit**
3	**1**	**3**

Pre-requisite: Basic Electrical Engineering and Basic Electronics Engineering.

Course Outcomes:

After successful completion of the course, students will be able to:

CO's	CO Description
CO1	**Understand** different types of power supply systems and protection schemes used underground coal mines.
CO2	**Understand** different types of circuit breakers and relay used in Mines.
CO3	**Analyze** illumination, Intrinsically Safe circuit methods of attaining intrinsic safety, Zener safety barriers and their applications in mines.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1		1						2
CO2	3	3	2	1		1						2
CO3	3	3	2	1		1						2
CO4	3	3	2	1		1						2
CO5	3	3	12	1		1						2
Avg.	**3**	**3**	**2**	**1**		**1**						**2**

DETAILED SYLLABUS

Module I:

Types of electrical power supply systems for underground coal mines – solidly earthed, restricted neutral and insulated – neutral systems of electrical power supply; their comparisons.

Module II:

Earth fault protection techniques for above mine power supply systems, sensitive and fail-safe earth fault relays. On-line insulation monitoring for insulated-neutral electrical distribution system.

Module III:

Mining type circuit breakers – Air circuit breaker, vacuum and Hexa Sulfa Flouride (Sf6) circuit breakers, Field switch, Tran switch Unit, Gate End Box, Drill Panel.

Module IV:

Electrical power planning for mechanized longwall faces – general scheme of electrical power distribution, voltage drop problems and remedial measurers; Inbye substation capacity selection. General scheme of electrical power distribution in opencast projects, Quarry substation capacity selection. Choice of restricted-neutral and insulated-neutral systems in open cast mines.

Module V:

Illumination planning for mines – underground roadway lighting system; intrinsically-safe lighting system for longwall faces, opencast mine lighting. Unit-VI Earthing practice in mines – earth pits, earthing of mobile electrical equipment in mines. Mining cables – types, constructional details; layout of cables through shaft and other locations.

Module VI:

Principles of flame proof enclosures. Intrinsically safe circuit methods of attaining intrinsic safety, zeener safety barriers and their applications. Indian electricity rules as applied to mines.

Suggested Readings:

[1] A Text Book on Power Systems Engineering – Soni Gupta, Bhatnagar, Chakarbarti, Dhanpat Rai & Sons.

[2] Electrical Equipment in mines- H. Cotton.

[3] Switchgear and Protection- S.S. Rao Khanna Publications.

[4] Indian Electricity Rules.

[5] Principles of Mine Planning J. Bhattacharya, Allied Publications.

Reference Books:

[1] Universal Mining School Series (UK)

[2] Coal Mining Practice- J.C. F Statharm Vol III, Heart Series.

[3] Electrical Power Systems – C.L. Wadhwa, New Age International Publishers

EE625	**Green Energy Technology***	**L**	**T**	**Credit**
		3	**1**	**3**

Course Outcome:

After successful completion of the course students will be able to:

CO1	**Identify** different non-conventional energy system and **realize** their importance in today's scenario.
CO2	**Analyze** the performance and limitations of the solar and wind energy conversion system.
CO3	**Understand** the concept behind the bio-mass, geothermal, tidal, ocean thermal and wave energy conversions.
CO4	**Outline** the basics of fuel cells and hydrogen production and storage.

CO's-PO's Mapping Matrix:

Enter correlation levels1, 2 or 3 as defined below-

2. Slight (low) 2. Moderate (Medium) 3. Substantial (High)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1		1	1		1					1
CO2	3	2	2	2	1		1					1
CO3	2	1	1	1	1		1					1
CO4	2	1	1	1	1		1					1
Avg.	**2.5**	**1.25**	**1.33**	**1.25**	**1**		**1**					**1**

DETAILED SYLLABUS

Module I: Introduction **(4 Lectures)**

Basics of energy, conventional energy sources, fossil fuels limitations, renewable energy sources, advantages and limitations, global energy scenario, energy scenario of India, new technologies (hydrogen energy, fuel cells, bio fuels).

Module II: Solar Energy **(12 Lectures)**

Theory of solar cells, solar cell materials, I-V characteristics of solar cell, PV module, PV array, MPPT, PV systems, Stand alone and grid connected PV systems, storage, PV based water pumping, solar radiation and its measurement, flat plate collectors and their materials, applications and performance, solar thermal power plants, limitations.

Module III: Wind Energy **(10 Lectures)**

Wind power and its sources, site selection, power in the wind, impact of tower height, classification of wind turbine and rotors, wind energy extraction, betz'z limit, wind characteristics, performance and limitations of wind energy conversion systems.

Module IV: Biomass and Geothermal energy **(5 Lectures)**

Availability of biomass and its conversion theory, types of biomass, gasification, biogas plant, biomass cogeneration, resources of geothermal energy, thermodynamics of geo-thermal energy conversion, geothermal power generation, environmental considerations.

Module V: Tidal, Wave and Ocean energy **(6 Lectures)**

Introduction to tidal energy, tidal characteristics, tidal power plant, tidal power development in India, introduction to wave energy, factors affecting wave energy, principles of wave energy plant, OTEC, applications of OTEC.

Module VI: Emerging technologies for power generation **(5 Lectures)**

Fuel cells, Principle of working of various types of fuel cells and their working, performance and limitations, future potential of fuel cells, emergence of hydrogen, cost analysis of hydrogen production, hydrogen storage.

Suggested Readings:

[1] Non-Conventional Energy Resources, D.S. Chauhan, New Age International Pvt Ltd., 2006.

[2] D. P. Kothari, Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI, India,2011.

[3] Solar Cells: Operating principles, Technology and Systems Applications, Martin Green, UNSW, Australia, 1997

[4] S. P. Sukhatme, Solar Energy, TMH, India. 2008.

[5] Introduction to Wind Energy Systems: Basics, Technology and Operation (Green Energy and Technology), by Hermann-josef Wagner, ISBN: 9783642020223, Publisher: Springer, September 2009.

[6] Biofuels - Securing the Planet's Future Energy Needs, Edited by A Demirbas Springer 2009

[7] Fuel Cells: The Sourcebook - New Edition 2004 Escovale 2004.

Reference Books:

[1] John Twiden and Tony Weir, Renewable Energy Resources, BSP Publications, 2006.

[2] Renewable Energy, Third Edition, Bent Sorensen, Academic Press August 2004

[3] Wind Energy Explained: Theory, Design and Application, by J. F. Manwell, ISBN: 9780470015001, Publisher: John Wiley & Sons, Publication Date: February 2010 .

[4] L.L. Freris, Wind Energy Conversion Systems, Prentice Hall, 1990.

Laboratory/ Sessional

EE601P	Power Systems-II Laboratory	P	Credit
		3	1

This Laboratory Experiments may be performed in physical/ virtual platform (as per availability of list of experiments in virtual lab portal).

List of the Experiments

Any 10 experiments out of which atleast 7 experiments from Group-A and 3 experiments from Group-B.

Group-A: SIMULATION BASED (USING MATLAB OR ANY OTHER SOFTWARE)

1) Formation of Bus admittance matrix
2) Solution of load flow problem using Gauss-Seidel method
3) Solution of load flow problem using Newton-Raphson method.
4) Solution of load flow problem using Fast Decoupled Method
5) Formation of Z-bus matrix
6) Application of Swing equation and its solution to determine transient stability
7) Simulation of LFC for two area power system
8) Economic load dispatch without considering network losses
9) Economic load dispatch considering network losses
10) To perform symmetrical fault analysis in a power system

Group B: HARDWARE BASED

1) To determine negative and zero sequence synchronous reactance of an alternator.
2) To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation.
3) To determine location of fault in a cable using cable fault locator
4) Determination of power angle characteristics of an Alternator

NOTE : At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

EE602P	Power Electronics Laboratory	P	Credit
		3	1

This Laboratory Experiments may be performed in physical/ virtual platform (as per availability of list of experiments in virtual lab portal).

List of the Experiments

Atleast 10 experiments should be performed in this Laboratory.

1) To study 1-phase half wave and full wave mid-point uncontrolled rectifier
2) To study 1-phase half wave and full wave bridge controlled rectifier.
3) Study of three-phase half & fully wave controlled bridge converter with R and RL load.
4) To study V-I characteristics of SCR.
5) Study of AC voltage controller using TRIAC with R and RL load.
6) To study different triggering circuits for thyristors.
7) To study the operation of buck converter.
8) To study the operation of boost converter.
9) To study the function of Inverter trainer
10) To study class A and Class B commutation circuit.
11) To study class C and class D commutation circuit
12) To study the single phase cycloconverter with R and R-L Loads.
13) To study the operation of single phase dual converter fed PMDC motor
14) To determine speed vs load characteristics of BLDC motor.
15) To perform speed control of 3-phase induction motor using v/f control method

NOTE: At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

EE603P	Simulation Laboratory	P	Credit
		3	1

This Laboratory Experiments may be performed in physical/ virtual platform (as per availability of list of experiments in virtual lab portal).

List of the Experiments

Atleast 10 experiments should be performed in this Laboratory.
These experiments can be performed using any software / FOSS (Free and Open Source Software) available at the institute.

1) Simulation of Single Phase Half Wave Uncontrolled Rectifier with R and RL-Load.
2) Simulation of Single Phase Half Wave Controlled Rectifier with R and RL-Load.
3) Simulation of Single Phase Semi Controlled Rectifier with R and RL-Load.
4) Simulation of Single Phase Full Wave Uncontrolled Rectifier with R and RL- Load.
5) Simulation THD Analysis of Single Phase Full Wave Controlled Rectifier with R and RL-Load.
6) Simulation and THD Analysis of Single Phase Full Wave Rectifier with RLE-Load.
7) Simulation and THD Analysis of Three Phase Half Wave Rectifier using R and RL-Load.
8) Simulation and THD Analysis of Three Phase Full Bridge Converter using R and RL-Load.

NOTE: At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

EE604P	Electrical Workshop	P	Credit
		3	1

This Laboratory Experiments may be performed in physical/ virtual platform (as per availability of list of experiments in virtual lab portal).

List of the Experiments

Atleast 10 experiments should be performed in this Laboratory.

1) To study the different types of cable and conductors.
2) To perform house wiring for bulb, fan and a 3-pin socket.
3) To study the different types of motor starters.
4) To perform and verify the connection of fluorescent lamp, circuit, lines.
5) To Study Institute Substation.
6) Determination of dielectric strength of the given transformer oil.
7) To study different components of CT & PT.
8) To measure the resistance by using earth resistance tester.
9) To study of lap, wave, short pitch winding in machine.
10) To measure insulation resistance of 3 - induction motor.

NOTE: At least ten experiments are to be performed, minimum seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

BRANCH - PRODUCTION ENGINEERING

Course structure

5th Sem. Course structure

Sl. No.	Course No.	Subject	L	T	P	Credit
1	PE 501	Manufacturing Process-II	4	1	0	4
2	PE 502	Metrology	3	1	0	3
3	PE 503	Advanced Economic Analysis	3	1	0	3
4	PE 504 PE 505 PE 506 PE 507	**Professional Elective -I**	3	1	0	3
5	PE 508 PE 509 PE 510 PE 511	**Open Elective -I**	3	1	0	3
1	PE 501P	Manufacturing Process-II Lab	0	0	3	1
2	PE 502P	Metrology Lab	0	0	3	1
3	PE 503P	Work Study and Ergonomics Lab	0	0	3	1
4	PE 504P	Computer Aided Design Lab	0	0	3	1
5	DS 501	General Proficiency/ Seminar	0	0	2	2
					Total credit	**22**

6th Sem. Course Structures

Sl. No.	Course No.	Subject	L	T	P	Credit
1	PE 601	Machine Tool Design	4	1	0	4
2	PE 602	Manufacturing Process-III	3	1	0	3
3	PE 603	Modern Manufacturing Process	3	1	0	3
4	PE 604 PE 605 PE 606 PE 607 PE 608	**Professional Elective -II**	3	1	0	3
5	PE 609 PE 610 PE 611 PE 612 PE 613	**Open Elective -II**	3	1	0	3
1	PE 601P	Machine Tool Design Sessional	0	0	3	1
2	PE 602P	Manufacturing Process-III Lab (TMCF Lab)	0	0	3	1
3	PE 603P	Modern Manufacturing Process Lab	0	0	3	1
4	PE 604P	Automation Lab	0	0	3	1
5	IN 601	Internship/ Tour & Training/ Industrial Training	0	0	2	2
					Total credit	**22**

Professional Elective -I

PE 504	Lean Manufacturing
PE 505	Process Engineering
PE 506	Value Engineering
PE 507	Work Study and Ergonomics

Open Elective -I

PE 508	Eco-Friendly Manufacturing
PE 509	Automobile Engineering
PE 510	CAD/CAM
PE 511	Industrial Pollution

Professional Elective -II

PE 604	Processing of Non-Metals.
PE 605	Agile Manufacturing
PE 606	Product Development and Design
PE 607	Competitive Manufacturing Strategies
PE 608	Operation Research

Open Elective -II

PE 609	Mathematical Modelling and Simulation
PE 610	Maintenance Technology and Safety Engineering (MTSE)
PE 611	Industrial Automation & Robotics
PE 612	Computer Integrated Manufacturing
PE 613	System Dynamics

NAME OF DEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: Manufacturing Process-II (PE 501)Semester - V**
2. Details of Course:

S. No.	Contents	Contact Hours
1.	**Foundry:** Patterns, Pattern materials, types of patterns, Pattern allowances. Mould and core making, properties of molding and core sands, Sand testing, Machine Molding. Gating, Risering and solidification of casting.	08
2.	**Special casting processes:** Centrifugal casting, investment casting, Die casting, Continuous casting and shell molding. Working principle and operation of cupola. Cleaning of casting, inspection of casting, casting defects.	08
3.	**Welding and Allied Process:** Gas welding and Gas cutting processes. Electric Arc Welding: Carbon Arc welding, Shielded-Metal Arc Welding, Submerged Arc Welding, TIG (or GTAW) welding, MIG (or GMAW) welding, Electroslag welding, Plasma Arc welding.	08
4.	**Resistance welding :** Spot, Seam, Projections, Butt welding etc.	04
5.	**Advance Welding Methods:**Thermit welding, atomic hydrogen welding, Ultrasonic Welding, explosive welding, electron beam welding, Laser beam welding, Soldering, Brazing and Braze-welding.	10
6.	**Welding Design:** Design of welded joints. Weldability and weldability testing. Inspection (Destructive and non-destructive testing)	04
	Total	**42**

3. **Suggested Books:**

1. DeGarmo, E. P, Black, J. T., Kohser, R. A. " Materials and Processes in Manufacturing", Prentice Hall of India Pvt. Limited
2. Kalpakjian, S. and Schmid, S. R, "Manufacturing Engineering and Technology", Pearson Education
3. Groover, M. P., "Fundamentals of Modern Manufacturing", John Wiley and Sons Inc.
4. Lindberg, R. A., "Processes and Materials of Manufacture", Prentice Hall India Limited
5. Rao, P. N., "Manufacturing Technology (Vol. 1&2)", Tata McGraw Hill

NAMEOFDEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: Metrology (PE 502)** **Semester - V**
2. Details of Course:

S. No.	Contents	Contact Hours
1.	**Standard of Measurements:** Principles of measurements: Line standard: Imperial standard yard, standard meter, wave length standards, end bars, effect of environment on measuring accuracy. Constructional details of measuring instruments, Abbe principles, pivots and Bearings, sources of error, temperature variations, parallel, sine and cosine errors, elastic deformations etc.	06
2.	**Measuring accuracy:** Dimensional and geometrical accuracy. Tolerance and Limit Systems: System of tolerance and fits, ISA and BIS system of tolerances and fits, the economics of wide and close tolerance, principles of limit gauging of plain work, Design and manufacture of gauge.	08
3.	**Measuring Instruments:** Linear measurement: Direct measuring tools, comparators types, relative merit and limitations, optical instruments, projectors and microscopes, angular measurements: clinometer, taper gauges, sine bar, angle blocks and auto collimators, circular division testers, optical dividing head.	08
4.	**Geometrical form of surfaces:** Concepts and measurements of flatness, straightness, Parallelism, perpendicularity, roundness, cylindricity, Runout and concentricity, errors in positioning. Uses of interference methods, Measurements of surface texture.	06
5.	**Screw Thread Measurements:** Systems of screw threads. Principles of limit gauging of threaded work, measurements of screw threads, external and internal threads and measuring instruments. Spur Gear Measurements: Geometrical definitions of spur gears, basic parameters of spur gears, measurements of spur gear parameters, individual and accumulative error measurements.	08
6.	**Alignment and large scale measurements:** Machine tool alignments, instruments and methods for testing straightness, flatness &squarness, alignments charts, dynamic testing of machine tools. Concept of on-line inspection	06
	Total	**42**

3. **Suggested Books:**

1. Jain R K, “Engineering Metrology”, Khanna Publishers, New Delhi
2. Kumar D S, “Mechanical Measurements and Control Engineering” Metropolitan Book Company, New Delhi
3. Sawney R, “Instrumentation and Mechanical Measurements”, Dhanpat Rai and Sons, New Delhi
4. Holeman J P, “Experimental Methods for Engineers”, Tata Mc Graw Hill Publishing Company, Delhi
5. Beckwith T H, “Mechanical Measurements”, Addison Wesley, New York

NAME OF DEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title: **Advanced Economic Analysis(PE 503)** **Semester - V**
2. Details of Course:

S. No.	**Contents**	**Contact Hours**
1	Fundamental economic concepts and basic economic laws relating to market and prices. Selection in present terms economy. The time element is economy study, interest and interest formulas. Nominal and effective interest rates, calculation of equivalent involving interest. Present worth, properties, capitalized costs and capitalized values.	08
2	Comparison of alternatives, Selection and replacement of equipment from amongst multiple alternatives. Uncertainty in economy studies, decision making under known probabilities, decision trees in evaluation of alternatives.	06
3	Promotion of a company and its legal aspects. Raising of capital, equity capital and borrowed capital. General accounting and double entry, book keeping, journals and ledgers, income statement, balance sheet and their analysis.	06
4	Cost accounting, cost elements and cost structure, Methods of allocating factory overhead, various classification of cost and use of cost data in economy studies.	08
5	Depreciation and depreciation accounting, classification and types of depreciation and accounting for the recovery of cost of capital assets. Value time function, common methods of depreciation, accounting and their selection.	08
6	Economy of operation and minimum cost analysis for purchase, production order, maintenance tooling etc. Break even analysis, effect of price on profit. Income taxes, inflation.	08
	Total	**42**

3. **Suggested Books:**

1. Industrial Engg. And Mgt. B.Kumar (Dhanpat Rai.)
2. Industrial Engg. & mgt. O.P. Khanna, (Khanna Pub)
3. Engineering Economy. Gerald J. Thuesen.(PHI)
4. Engineering Economy. E. Paul DeGarmo.(EEE)

NAME OF DEPTT./CENTRE: **Department of Production Engineering**

1. Course Title**: Lean Manufacturing (PE 504)** **Semester-V**

2. Details of Course:

S. No.	Contents	Contact Hours
1.	Objectives of lean manufacturing-key principles and implications of lean manufacturing- traditional Vs lean manufacturing.	03
2.	Value creation and waste elimination- main kinds of waste- pull production-different models of pull production-continuous flow-continuous improvement/Kaizen- worker involvement -cellular layout- administrative lean.	08
3.	Standard work -communication of standard work to employees -standard work and flexibility -visual controls-quality at the source- 5S principles -preventative maintenance-total quality management-total productive maintenance -changeover/setup time -batch size reduction -production leveling.	09
4.	Value Stream Mapping-The as-is diagram-the future state map-application to the factory simulation scenario-line balancing -Poke Yoke – overall equipment effectiveness. One Piece Flow-Process razing techniques – cells for assembly line – case studies	08
5.	Introduction - elements of JIT - uniform production rate - pull versus push method- Kanban system - small lot size - quick, inexpensive set-up - continuous improvement. Optimised production technology.	08
6.	Team establishment, transformation process, Project Management, Lean implementation, Reconciling lean with other systems- lean six sigma-lean and ERP-lean with ISO 9001:2000.	06
	Total	**42**

3. **Suggested Books:**

1. Askin R G and Goldberg J B, “Design and Analysis of Lean Production Systems”, John Wiley and Sons Inc., 2003.
2. Hobbs, D.P. “Lean Manufacturing implementation”, Narosa Publisher, 2004.
3. Micheal Wader, “Lean Tools: A Pocket Guide to Implementing Lean Practices”, Productivity and Quality Publishing Pvt Ltd, 2002.
4. Michael L George, David T Rowlands, Bill Kastle, “What is Lean Six Sigma”, McGraw Hill, New York, 2004.
5. Kenichi Sekine, “One-Piece Flow”, Productivity Press, Portland, Oregon, 1992.
6. Alan Robinson “Continuous Improvement in Operations”, Productivity Press, Portland, Oregon, 1991.
7. Poke - Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, 1992.

NAME OF DEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: Process Engineering(PE 505)** **Semester - V**
2. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to process planning, Design and manufacture cycle, Process planning - the design/manufacture interface, Process planning activities, Process planning verses production planning.	05
2.	Process planning methods, Manual process planning, Experience-based process planning, Part design/drawing interpretation, Basic process planning terminology, Equivalent parts -interchangeability and standardization, Concept of dimensional chain, Dimensional and Tolerance analysis	08
3.	Process selection, Process capability analysis, Process and operations sequencing, Calculation of process parameters, Process re-engineering, Preparation of process sheet,	07
4.	Expert systems and their use in developing process planning systems,	02
5.	Computer-aided process planning (CAPP), Variant process planning, Generative and dynamic CAPP, Forward and Backward planning, Logical design of process planning systems,	06
6.	Optimal selection of manufacturing processes, tools and fixtures, coolants and other consumables required for manufacturing,	08
7.	Cost analysis and cost control for different processes, Make-or-buy decisions, Methods of process cost estimation and its application in preparation of manufacturing budget.	06
	Total	**42**

3. **Suggested Books:**

1. Process Engineering for manufacturing by Donald F. Eary and Gerald E. Johnson
2. Process Planning by Peter Scallan, ELSEVIER
3. Process Engineering techniques Evaluation by W.F. Waller
4. Product Planning systems by L.N.Goslin

NAME OF DEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: Value Engineering (PE 506)** **Semester - V**

2. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction & Value Orientation**: Reasons for unnecessary costs, VE-versatile technique, definition, beginning and the Spread. Value orientation, customer and cost, internal customers, value defined, Increasing value.	05
2.	**The Orientation Phase:** Training, Selection of projects, impact of VE application, ABC analysis, Problematic areas, production problems, maintenance problems, vendor development problems, design problems, old designs, specifications and standards. Selection of leader, team members, workshop.	08
3.	**The Information Phase**: Decision and costs, use of work book, human relations. **The Function Phase:** Importance of functions, types of functions, functions defined, levels of functions, Function-cost, concept of worth, value potential, function Analysis System Technique (FAST), scope lines.	07
4.	**The Creation Phase**: Brainstorming, split-brain theory, brainstorming process, Gordon technique, checklists, Morphological analysis technique, word association technique. **The Evaluation Phase**: Filters, ranking, feasibility rankings, weighted evaluation, factor comparison, Decision matrix.	08
5.	**The Recommendation Phase:** Conducting trails, assessing management's needs, preempting, making the presentation. **The Implementation Phase:** Action plan, record progress, report progress, organizing review meetings, problems in implementation, incorrect project selection, human factors.	06
6.	**The Audit Phase:** Technical audit, cost audit, case study, timing of audit, problems in audit, audit personnel, documentation, frequency of audit, benefits. **Managing the VE Program**: The need, management support, VE organization, VE group, VE manager, tasks, VE workshops, selection of projects, follow-up, Publicity, VE Budgets, action plan, Select a simple project, Management Presentation, Audit of savings.	08
	Total	**42**

3. **Suggested Books:**

1. Manufacturing Processes for Engineering Materials : S. Kalpakjian, 3rd edition Addison - Wesley,

2. Composite Materials: Science and Engineering: Krishan Kumar Chawla, Springer Science & Business Media

Callister's Materials Science and Engineering: R. Balasubramaniam, 2nd edition,Wiley

NAME OF DEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: Work Study and Ergonomics (PE 507)Semester - V**
2. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction: Purpose and scope of work study and its historical development. Work study as a tool for productivity enhancement.	05
2.	Method Study: Objectives and scopes; general procedure to tackle method study problems (steps; select, record, critical examination, develop, install and maintain improved method). Recording techniques and their applications (Operation process chart, flow process chart, two handed process chart, multiple activity chart, flow diagram, string diagram, photographic aids and models).	08
3.	Micro-motion Study: Preparation of motion films and analysis with the help of therbligs and SIMO charts, memomotion study, cycle graph and chronocylegraph, Principles of motion economy.	07
4.	Work Measurements: Concept, scope and objectives. Various work measurement techniques. Stop watch study, procedure in detail. Performance rating and determination of normal time. Allowances in time study and determination of Standard time Work Sampling : Concept and uses. Sampling study procedure and presentation of results. Establishing time standards by work sampling, practical applications.	08
5.	Pmts: Establishment and uses of elemental time data, predetermined motion time systems, major systems, uses and applications. Wage & Incentive: Principles and methods of job evaluation and merit rating. Principles of wage & incentive payment, comparative study of incentive schemes.	06
6.	Ergonomics: Concept, scope and objectives of human factors in engineering and Man-environment interaction. Causes and prevention of fatigue, Design of Man-environment systems and methodology.	08
	Total	**42**

3. **Suggested Books:**

1. Workstudy and Ergonomics by Lakhwinder Pal Singh Cambridge Publication
2. Workstudy and ergonomics by P.C Tewari CRC Press
3. Motion and Time Study Design and Measurement of Work by Ralph M. Barnes, Wiley Publication

NAME OF DEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: Eco -Friendly Manufacturing (PE 508)** **Semester V**

2. Details of Course:

S. No.	Contents	Contact Hours
1.	INTRODUCTION; Introduction to lean, sustainable, green manufacturing; concept of Eco-friendly manufacturing; the monozukuri principles.	04
2.	REGULATORY CONSIDERATIONS: Regulatory considerations and sustainability strategies, Imperative global warming perspectives, Carbon credits, green power and renewable energy credits;	07
3.	ENVIRONMENTAL PERFORMANCE INDICES; Effect of industrial activity on environment, measures and metrics; ranking of risks; Environmental Load Units (ELU); International green manufacturing standards and compliance; ISO 14000;	06
4.	MATERIAL FLOWS THROUGH THE ECONOMY AND THE ENVIRONMENT: Metals production, Metal recycling, Energy and other advantages of metal	06
5.	INDUSTRIAL WASTE: Type of wastes, causes of waste generation and its elimination in manufacturing industries, Hidden waste in industries, workplace organization.	07
6.	ANALYTICAL TOOLS: Lean vision and lean principles, value added and non-value-added activities Metrics for sustainable practices; life cycle assessment/impact tools; Product Stewardship in Industry	06
7.	ECO FRIENDLY MANUFACTURING SYSTEM: Green Design and Manufacturing in Consumer Products; Green rapid prototyping and rapid manufacturing; green packaging; Green collaboration processes via the Internet; Reverse supply chain, green supply chain.	6
	Total	**42**

3. **Suggested Books:**

1. Fast Track to Waste Free Manufacturing J.W. Davis, Productivity Press USA

2. Clean Production, K.B. Misra, Springer – Verlog – 1996

3. Environmentally Benign Manufacturing, WTEC Panel Report, 2001

4. Design for environment: A guide to sustainable product development: Eco- efficient product development, J, Fiksel. McGraw-Hill.- 2009

5. Green Manufacturing: Case Studies in Lean Manufacturing and Sustainability., AME, Association for Manufacturing Excellence (2007) Productivity Press, Inc.

NAME OF DEPTT./CENTRE: **Department of Production Engineering**

1. Course Title**: Automobile Engineering (PE 509)** **Semester-V**
2. Details of Course:

S. No.	**Contents**	**Contact Hours**
1.	Introduction to automobile: Importance, applications, job opportunities, classification, types of vehicles, basic structure, general layout, hybrid vehicles.	05
2.	Automotive electric and electronic systems: Electric and electronics principles, systems, and circuits, automotive batteries, construction, and operation, starting system, charging system, operation and service, ignition system, electronic ignition and fuel control, engine management, electric vehicles, electronic fuel injection system - monopoint and multipoint systems.	08
3.	Automotive drive trains: Clutch - types and construction, fluid flywheel, gear boxes, manual and automatic - overdrives - propeller clutches, drive shafts, universal joints, drive axles.	07
4.	Automotive chassis: Vehicle construction, chassis, frame and body, construction, operation, performance, steering system, wheel alignment, brakes, wheels and tyres.	07
5.	Maintenance and Trouble Shooting: Automobile performance, drivability, emissions and emission norms, noise and vibration, engine tuning, equipment for measuring various vehicle parameters such as BHP, A/F ratio, noise, vibration and emission, comfort and safety.	08
6.	Newer Fuels: Use of natural gas, LPG, hydrogen, bio- diesel in automobiles as fuels, electric and hybrid vehicles, fuel cells. Other recent advances in automobiles and automotive components.	07
	Total	**42**

3. **Suggested Books:**

1. Crouse – Anglin, “Automotive Mechanics”, McGraw Hill, 10th Edition, Singapore.
2. Pulkrabek Willard W., “Engineering Fundamental of the Internal Combustion Engine”, Prentice Hall of India, New Delhi, 2002.
3. Bosch, “Automotive Handbook”, SAE Publication.
4. Denton Tom, “Automobile Electrical and Electronics Systems”, Butterwoth, Heinemann, 2003.
5. Layne Ken, “Automotive Engine Performance: Tune up, Testing and Service”, Englewood Prentice Hall of India, 1996.

NAME OF DEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: CAM/CAM (PE 510)** **Semester - V**
2. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** CAD/CAM Processes, Role of CAD/CAM/CAE in the Product Cycle, CAD tools to support the design process and manufacturing, Benefits of CAD/CAM/CAE in the industry.	08
2.	**Geometric Modeling:** Wire frame modeling – entities, curve representation methods, parametric representation of analytic and synthetic curves, Surface modeling – parametric representation of analytic and synthetic surfaces, Solid modeling – Boundary representation, constructive solid geometry	12
3.	**Geometrical transformation:** Two-dimensional transformation Three-dimensional transformation representation of matrix: translation, scaling, rotation, mirror, shearing, Solid modeling types: parametric, solid, surface.	05
4.	**Numerical Control (NC):** Introduction, numerical control – its growth and development, components of NC system, input devices, control systems – point to point, straight cut, and continuous path NC, open loop and closed loop NC systems, NC interpolations – linear, circular, helical, parabolic and cubic interpolation, applications of NC systems, merits and demerits.	05
5.	**Part Program Terminology:** G and M Codes, Types of interpolation, Methods of CNC part programming, Manual part programming, Computer Assisted part programming: APT language, CNC part programming using CAD/CAM Introduction to Computer Automated Part Programming.	08
6.	**Factors influencing selection of CNC Machines:** Cost of operation of CNC Machines-cost of Operation of CNC Machines-Practical aspects of introduction of CNC-Maintenance features of CNC Machines-Preventive Maintenance.	04
	Total	**42**

3. **Suggested Books:**

1. Zeid, I., “Mastering CAD/CAM”, Tata McGraw Hill.
2. Hsu, T. R. and Sinha, D. K., “Computer Aided Design: An Integrated Approach”, West Publishing Company.
3. Groover, M. P., “Automation, Production systems and Computer Integrated Manufacturing”, 3rd 2007 Ed., Prentice-Hall.
4. Singh, N., “Systems Approach to Computer Integrated Design and Manufacturing”, John Wiley & Sons
5. Besant, C. B. and Lui, C. W. K., “Computer Aided Design and Manufacture”, Ellis Horwood Ltd.
6. Rao, P. N., Tiwari, N. K. and Kundra, T.K., “Computer Aided Manufacturing”, Tata McGraw Hill.

NAME OF DEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: Industrial Pollution (PE 511)** **Semester V**

2. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction: Environments and Human activities, Environments and Ecology, Consequences of population growth. Energy problem.	02
2.	Pollution of air, water and land, Fossil fuel related pollutants in the environment.	06
3.	Environmental Impacts of Hydro-electric, Nuclear energy and chemicals.	03
4.	Air pollution - Definitions and scales of concentration, classification and properties of air pollutants, Emission- sources and their classification. Air pollution laws and standards, Inversion Ambient air sampling, stack sampling, sampling system, analysis of air pollutants. Air pollution emission control, selection of a particulate: collector, control of gaseous emission, combustion	04
5.	Water pollution - Hydrologic cycle and water quality , origin of waste water and its composition, Type of water pollutants and their effects, water pollution laws: and standards, waste water sampling and analysis water quality standard, waste water treatment , Biological systems(Aerobic and Facultative ponds), Recovery of material from process effluents.	14
6.	Noise pollution- Different noise environments and their sources, measurement of noise and the equipments Noise pollution lows an, Vibration isolation and noise control in industries.	07
7.	Solid Waste Management Sources and classification, Public health aspect, effluent treatment processes and solid waste management: sources and classification. Public health aspect, effluent treatment process and solid waste management, “Solid-Solid separation technique for recovery and reuse	08
	Total	**42**

3. **Suggested Books:**

1. Bhatia S C, Managing Industrial Pollution, Macmillan India Pvt. Ltd.
2. Dix H M, Environmental Pollution, Institution of Environmental Sciences Series/ Wiley
3. Sawyer C N, Mccarty P L, Parkin G F, Chemistry for Environmental Engineering and Science, McGraw-Hill

NAMEOFDEPT./CENTRE: **Department of Production Engineering**

1. Course Title**: Manufacturing Process Lab-II (PE 501P)** **Semester – V**

2. List of experiments

I. Study of classification and basic principles of the welding processes.
II. Preparation of a butt/lap joint using oxy-acetylene gas welding technique.
III. Preparation of a butt/lap joint with mild steel plate using TIG Welding.
IV. Preparation of a butt/lap joint with mild steel plate using SAW.
V. Preparation of a butt/lap joint with mild steel strip using MIG welding.
VI. Preparation of a Lap joint with using Spot welding technique.
VII. Study of plasma arc welding (PAW).
VIII. Preparation of a joint using soldering technique.
IX. Preparation of butt joint using oxy-acetylene brazing process.
X. Study of thermal cutting of metals.

NAME OF DEPT. /CENTRE: **DEPARTMENT OF PRODUCTION ENGINEERING**

Metrology Lab (PE 502P) Semester-V

Teaching Scheme	**Examination Scheme**
Practicals : 3 hrs/week	Term work: 100

Sl No.	**Topic**
1.	Measurement of taper angle using Sine bar
2.	Measurement of alignment using Autocollimator
3.	Measurement of surface roughness (Talysurf)
4.	Measurements of surface flatness by using Monochromatic light source
5.	Measurement of linear and Angular dimensions by Tool Makers Microscope
6.	Roll test two-flank inspection measurement error
7.	Measurement of linear and Angular dimension using Coordinate Measuring Machine
8.	Measurement of linear and Angular dimension by CAD Model in CMM Machine.

NAME OF DEPT./CENTRE: **Department of Production Engineering**

Work Study and Ergonomics Lab (PE 503P) **Semester-V**

Teaching Scheme	**Examination Scheme**
Practicals : 3 hrs/week	Term work: 100

Sl No.	**Topic**
1.	Operation Analysis-Flow Process Chart
2.	Activity Chart (Right/Left Hand Activity Chart)
3.	String Diagram
4.	Motion Study (Therbligs Technique)
5.	Direct Time Study Method
6.	Work Sampling Measurement Method
7.	Tread Mill Excise (a)
8.	Tread Mill Excise (b)
9.	Tread Mill Excise (c)

NAME OF DEPTT. /CENTRE: **DEPARTMENT OF PRODUCTION ENGINEERING**

Computer Aided Design Laboratory (PE 504P) **Semester-V**

Teaching Scheme **Examination Scheme**

Practical : 4 hrs/week Term Work : 100

Sl. No.	Topic
1.	An introduction of cad software and its utilities in the engineering software.
2.	Study of the basic initial setting and viewing of drafting software interface.
3.	Study of various tools bar options and exercises to familiarize all the drawing tools.
4.	Study and implementation of co-ordinate systems and UCS.
5.	Use of basic entities in 2D.
6.	Use of various modifies commands of drafting software.
7.	Dimensioning in 2D and 3D entities.
8.	Draw different types of 3D modeling entities using viewing commands, to view them (isometric projectio).
9.	Sectioning of solid primitives and rendering in 3D.
10.	Intersection of solid primitives.

NAMEOFDEPTT./CENTRE: **Department of Production Engineering**

1. Course Title**: Machine Tool Design (PE 601)** **Semester - VI**

2. Details of Course:

S. No.	Contents	Contact Hours
1.	Stress in elementary machine members, Design stress and factor of safety, Design of rivets, welded joints, keys, cutters, knuckle joints, Power screw and springs.	08
2.	Introduction to Jigs and Fixtures, Basic principle followed in the design of Jigs and Fixtures, Jig classification and drill bushes and its types, Typical Jigs for components for drilling, reaming, tapping, counter boring.	06
3.	Job holding and clamping devices, Fixtures characteristics and setting-piece. Milling fixtures, turning Fixtures, grinding fixtures, Assembly and inspection of fixtures, Design and construction of form tool and relieving cutters, Design of Reamers and thread cutting tools	06
4.	Kinematics of machine tool drive, types of machine tool drive, standard series used for selection of spindle, Determination of speed Structures and layout for a drive, Design of main spindle and feed drive system, Design of spindle, bearings, slides and slide ways	06
5.	Press tools, classification and operation of press, design of press tools. Progressive and compound tools, Broaching, construction and design features, Vibration in machine tools and dynamic rigidity, sources of vibration, effect of vibration, Chatter theory	10
6.	Gear cutting tools for spur, helical and worm gear, types and construction concept of generation and forming, hob for spur and worm, Gear shapers, Slotters, bevel gear cutters, design features and design of fly cutters.	06
	Total	**42**

3. Suggested Books:

1. Fundamentals of Tool Engineering design, S.K. Basu, S.N. Mukherjee, R. Mishra, Oxford & IBH Publishing co.

2. Technology of Machine Tools, Krar, Gill, Smid, Tata Mc Graw Hill

3. Jigs & Fixture Design, Edwrd G Hoffman, Cengae Learning

4. A Textbook of Production Engineering, P.C. Sharma, S. Chand & Co

5. Machine Tool Design and Numerical Control, N.K.Mehta, Tata Mc Graw Hill

6. Tool Design , Donaldson,Lecain,Goold,Ghosh Tata Mc Graw Hill

NAME OF DEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title: **Manufacturing Processes III** **(PE 602)** **Semester - VI**
2. Details of Course:

S. No.	**Contents**	**Contact Hours**
1	**Principles of Metal Machining:** Metal Machining, Elements of machining, Classical metal machining process; Tool Signature, Mechanism of chip formation; types of chips. Geometry of chip formation, Forces on chips, Velocity relationships; stress and strain in chips; Mechanics of Multi-Point Cutting Tools: Milling cutters; Forces in Milling, specific cutting pressure.	08
2	**Theories on Mechanics of metal cutting for orthogonal cutting:** (Merchant, Lee and (Shaffer); Power and energy relationship; Thermal aspects of metal machining; Measurement of chip-Tool interface temperature, Friction in metal cutting. Measurement of Cutting Forces: Tool Dynamometer.	08
3	**Theory of Machinability:** Evaluation of machinability , Tool life, Tool life Plots, Types of tool failure, Flank wear and crater wear, variable influencing tool failure and tool life, Economics of metal machining.	06
4	**Principles of Metal Forming:** Principle of plastic flow of metals during hot and cold working. Hot and cold working processes: Forging, Rotary swaging, Rolling, Thread rolling, extrusion, wire drawing, Tube drawing, Sheet metal operations.	06
5	**Theory of Metal Forming:** Introduction of plasticity theories. Application of slab theory in the analysis of metal forming Processes (forging, wiredrawing, rolling, Extrusion, Deep drawing). Introduction to slip line concept and its application to simple plain strain problems.	08
6	**Powder Metallurgy:** Definition and scope of powder Metallurgy in Industry, Merits and demerits. Types of powders and their manufacturing. Fundamental properties of powders. Mech. Pulverisation, Electrolytic process, chemical reduction, Automization. Process of powder Metallurgy: Mixing, Compaction, Sintering infiltration, sieving, coining, Machining etc.	06
	Total	**42**

3. **Suggested Books:**

1. A.B. Chattopadhyay. “Machining and Machine Tools” Wiley Publication
2. Amitabha Bhattacharya. “Metal Cutting (Theory and Practice)” New Central Book Agency
3. M.C. Shaw. “Metal Cutting Principles”. CBS Publishers & Distributions
4. B.L. Juneja. “Fundamentals of Metal Forming Processes”. New Age International Publishers
5. Dr. Sadhu Singh. “Theory of Plasticity & Metal forming processes”. Khanna Publishers
6. P.C.Angelo, R.Subramaniam. “Powder Metallurgy”. Prentice Hall India Learning Pvt. Ltd

NAMEOFDEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: Processing of Non-Metals (PE 603)Semester - VI**
2. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction: Classification of engineering materials and processing techniques, structure and properties of non-metals. Glass structure and properties, glass melting and forming, glass annealing.	05
2.	Classification of ceramics: crystal structures and properties, ceramic powder preparation, Synthesis of ceramic powders, fabrication of ceramic products from powders: pressing, casting, vapour phase techniques, sintering, finishing, machining. ceramic coatings.	07
3.	Structure and mechanical properties of plastics, thermoplastics and thermosets, Processing of Plastics: Extrusion. Injection moulding. Thermoforming. Compression moulding. Transfer moulding. General behavior of polymer melts, Machining of plastics	07
4.	Classification of composite materials, properties of composites, processing methods of polymeric matrix composites: hand lay-up, autoclaving, filament winding, pultrusion, compression molding, pre-pegging, sheet molding compounds etc., process capability and application areas of various techniques.	10
5.	Ceramic matrix composites, mechanical properties of ceramic matrix composites, different processing techniques for ceramic matrix composites, process capability and applications of various techniques	06
6.	Secondary processing of composite materials, Need of secondary operations, different type of secondary operations, machining and drilling of non-metals, machining induced damage, different methods of reducing the damage on account of secondary processing.	07
	Total	**42**

3. **Suggested Books:**

1. Manufacturing Processes for Engineering Materials : S. Kalpakjian, 3rd edition Addison - Wesley,
2. Composite Materials: Science and Engineering: Krishan Kumar Chawla, Springer Science & Business Media
3. Callister's Materials Science and Engineering: R. Balasubramaniam, 2nd edition,Wiley

NAMEOFDEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title:**Agile Manufacturing (PE 604)** **Semester - VI**
2. Details of Course:

S. No.	Contents	Contact Hours
1.	Types of Production- The Agile Production Paradigm- History of Agile Manufacturing- Agile Manufacturing Vs Mass Manufacturing, Agile Manufacturing Vs Mass Customization- Agile Manufacturing Research Centers.	05
2.	Agile Practices- Agile practice for product development - Manufacturing agile practices - understanding the value of investing in people, Concept models of Agile Manufacturing- Infusing managerial principles for enabling agility.	08
3.	Implementing technology to enhance agility- Implementing new technology – reasons – guidelines preparation for technology implementation - A checklist, technology applications that enhance agility - agile technology make-or-buy decisions.	08
4.	Performance Measurement and Costing: Measurement of agility – methods – Scoring and Fuzzy approaches – Costing for Agile Manufacturing practices – Activity Based Costing.	08
5.	Creating the learning factory: Imperative for success, factory becoming a learning factory, building a road map for becoming a learning factory - core capabilities	05
6.	Guiding vision, leadership that fits, ownership and commitment, pushing the envelope, prototypes, integration, learning challenges for learning manufacturing business.	08
	Total	**42**

3. **Suggested Books:**

1. Gunasekaran A, “Agile Manufacturing, 21st Strategy Competitiveness Strategy”, Elsevier Publications, 2001.
2. Montgomery J C and Levine L O, “The Transition to Agile Manufacturing – Staying Flexible for Competitive Advantage”, ASQC Quality Press, Wisconsin, 1995.
3. Goldman S L, Nagal R N and Preiss K, “Agile Competitors and Virtual Organizations”, Van Nostrand Reinhold, 1995.
4. Brian H Maskell, “Software and the Agile Manufacturer, Computer Systems and World Class Manufacturing, Productivity Press, 1993

NAMEOFDEPTT./CENTRE: **Department of Production Engineering**

1. Course Title**: Modern ManufacturingProcesses (PE605)** **Semester - VI**
2. Details of Course:

Sl. No.	Contents	Contact Hours
1	**Introduction:** Types of advanced manufacturing processes; Evolution, need, and classification of modern machining processes (MMPs).	02
2	**Mechanical Type MMPs:** USM, Rotary Ultra Sonic Machining (RUM), AJM, WJM, AWJM, Process principles and mechanisms of material removal, Process parameters,Processcapabilities,Applications,Operationalcharacteristics, Limitations.	06
3	**Chemical Type MMPs:** Process principle and details of Chemical Machining (CHM), Photo-Chemical Machining (PCM) processes.	03
4	**Electro Chemical Type MMPs:** ECM - Process principle, Mechanism of material removal, Process parameters, Process capabilities, Applications	04
5	**Thermal Type AMPs:** EDM, Wire Electro Discharge Machining (WEDM), LBM, EBM, IBM, PAM, Process principles and mechanisms of material removal, Process parameters and characteristics, Surface finish and accuracy, Process capabilities, Applications, Limitations.	14
6	**Derived and Hybrid AMPs:** Electro Stream Drilling (ESD), Shaped Tube Electro Machining (STEM), Electro Chemical Honing (ECH), Electro Chemical Deburring (ECDE), Electro Chemical Discharge Machining (ECDM), Process parameters, Process capabilities, Applications, Limitations, Introduction to form machining.	07
7	**Additive Manufacturing (AM):** Process chain in AM, CAD model, Slicing, Model orientation for AM processes, Support Structures, Seven families of AM processes (ASTM)- Process description, Types of materials, Strengths and Limitations.	08
	Total	**42**

3. **Suggested Books:**

1. Pandey P. C., Shan H. S. "Modern Machining Processes", Tata McGraw-Hill Publishing Co. Ltd, New Delhi
2. Ghosh A., Mallik A. K., "Manufacturing Science", Affiliated East-West Press Ltd, New Delhi
3. Benedict G. F., "Nontraditional Manufacturing Processes", Marcel Dekker, Inc. New York
4. McGeough J. A.,"Advanced Method of Machining", Chapman and Hall, New York
5. Mishra P. K., "Nonconventional Machining", Narosa Publishing House, New Delhi
6. Jain V. K.,"Advanced Machining Processes", Allied Publishers, New Delhi
7. Gibson, I, Rosen, D W., and Stucker, B., Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer

NAMEOFDEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: Product Development and Design (PE 606)** **Semester - VI**
2. Details of Course:

S. No.	Contents	Contact Hours
1.	**Product Design**: Traditional and modern design processes; Organization objectives; Innovation, creation, and diffusion techniques; Evaluation of new product ideas – functional, technological, ecological, legal.	06
2.	**Product Modeling and Reverse Engineering:** Wireframe modeling; Surface modeling – boundary representation; Solid modeling – CSG; Concept of reverse engineering.	08
3.	**Product Data Exchange**: Neutral file formats for product data exchange–DXF, IGES, STEP	06
4.	**Concurrent Engineering**: Concept of concurrent engineering; Design for X; Design for manufacturability (DFM); Design for assemblability (DFA); Design for reliability (DFR); Design for quality (DFQ).	10
5.	**Rapid Prototyping Methods:** Liquid based RP methods – stereolithography apparatus (SLA), solid ground curing (SGC), solid creation system (SCS), etc.	06
6.	**Solid based RP methods:** Fused deposition modeling (FDM), laminated object manufacturing (LOM), etc.; Powder based RP methods– selective laser sintering (SLS), 3D printing (3DP), ballistic particle manufacturing (BPM), etc.	06
	Total	**42**

3. **Suggested Books:**

1. Andrearsen, M. M., and Hein, L., “Integrated Product Development”, Springer.
2. Huang, G. Q., “Design for X: Concurrent Engineering Imperatives”, Chapman and Hall.
3. Chitale, A. K. and Gutpa, R. C., “Product Design and Manufacturing”, Prentice Hall.
4. ZeidI., “CAD/CAM: Theory and Practice”, Tata McGraw Hill.
5. Boothroyd G., Dewhurst P., and Knight, “Product Design for Manufacture and Assembly”, 2nd Ed., Marcel Dekker.
6. Chua, C. K and. Leong, K. F., “Rapid Prototyping: Principles and Applications in Manufacturing”, John Wiley & Sons.

NAME OF DEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: Competitive Manufacturing Strategies (PE 607)** **Semester - VI**

2. Details of Course:

S. No.	Contents	Contact Hours
1.	The competitive environment in the market, The WTO agreement and its effect on Indian Industries, Manufacturing as a competitive strategy, Competitive Advantages and Disadvantages	05
2.	Product Variety, Modular Design, Design for manufacturability, Selection of manufacturing technologies, Vendor Development, Vendor rating.	08
3.	Just in time manufacturing, Kanban system, and Agile Manufacturing, Reengineering, TQM, MRP	08
4.	ERP, and simulation as tools for competitive manufacturing, Intelligent Manufacturing	07
5.	Elementary of manufacturing systems for different manufacturing scenarios - Dedicated manufacturing system, Flexible manufacturing system (FMS), cellular manufacturing system (CMS), and Re-configurable manufacturing system (RMS); Selection of manufacturing systems.	08
6.	Concept of CIM, FOF, Network based manufacturing, and E-Manufacturing	06
	Total	**42**

3. **Suggested Books:**

1. Manufacturing Excellence in Global Markets by W. Euershelm
2. Manufacturing Systems Design & Analysis by B. Wa.
3. Computer Automation in Manufacturing by T.O.Boucher
4. Intelligent Manufacturing Planning by P. Gu.

NAME OF DEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: Operation Research (PE 608)Semester - VI**
2. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction**: Origin and development of operations research, general methodology of OR, applications of OR to industrial problems	02
2.	**Linear Programming** Mathematical formulation of the problem, Graphic solution, the simplex method, Big-M method, concept of duality, dual simplex method.	14
3.	**Transportation Model** Basic feasible solution by different methods, finding optimal solutions, degeneracy in transportation problems, unbalanced transportation problems	06
4.	**Assignment Model** Balanced and unbalanced assignments, assignment to given schedules **Sequencing Model** Processing of 2 jobs through machines –graphical method, Processing of n jobs through two machines, processing n jobs through three machines	08
5.	**Queuing Model** Queuing systems and their characteristics, The M/M/1/FIFO/Queuing system	06
6.	**Games Theory** Two-persons zero sum games, Pure and mixed strategies, Rules of dominance, Solution methods without saddle point	06
	Total	**42**

3. **Suggested Books:**

1. Operation Research by P.K. Gupta & D. S. Hira 7e, S.Chand
2. Operation Research by Hamdy A. Taha, Pearson publication 8e
3. Operation Research by Kantiswarup, Sultan Chand & Sons Publication

NAME OF DEPT. /CENTRE: **Department of Production Engineering**

1. Course Title: **Mathematical Modelling and Simulation (PE609)** **Semester - VI**
2. Details of Course:

S. No.	**Contents**	**Contact Hours**
1.	Introduction: Basic concepts of systems, Elements of systems, event driven models, simulation as a decision making tool, types of simulation, system modeling, types of modeling	05
2.	Basic factory dynamics: Basic definitions and Parameters; Simple relationships, Little's Law; Bottleneck Rates and Cycle Times; Labour Constrained Systems	05
3.	Statistical models in Simulation: Review of terminology and concepts, Probabilistic and statistical models in simulation. Introduction to some discrete and continuous probability distributions including Bernoulli, Poisson, Geometric, Uniform, Exponential, Gamma, Erlang, Normal, and Triangular distributions. Relevance to simulation modelling.	06
4.	Random Numbers: properties of random numbers, pseudo random numbers, techniques for generating random numbers, test for random numbers, techniques for random variate generation.	8
5.	Analysis of simulation data: Input data modelling, Data collection, parameter estimation, distributional assumptions and hypothesis testing. Chi-square and Kolmogorov-Smirnov Goodness-of-fit tests.	07
6.	Recent advances and case studies/mini project: Development of simulation models for systems like queuing systems production, inventory, maintenance, material handling and replacement systems-Investment analysis etc. Introduction to the special purpose simulation language	06
7.	Model verification and validation techniques. Output data analysis of terminating and non-terminating Systems. Variance reduction techniques. Introduction to simulation experimental design methods.	5
	Total	**42**

3. **Suggested Books:**

1. Gray Beal, Wajne J and Pooch U W, "Simulation Principles & Methods", Winthrop Publishing Incorporate.
2. Severance Frank, "System Modelling and Simulation", John Wiley and Sons
3. Banks, Carson, Nelson and Nicole, "Discrete Event System Simulation", Pearson Education, Asia
4. Hopp W.J. and Spearman M.L., Factory Physics, Mc-Graw Hill Higher Education
5. Kelton W.D., Sadowski R.P., and Swets N.B., Simulation with Arena, Mc-Graw-Hill
6. Banks Jerry and Carson John S., "Discrete event system simulation", Prentice Hall

NAME OF DEPTT. /CENTRE: **Department of Production Engineering**

1. **Course Title: Maintenance Technology and Safety Engineering (PE 610) Semester - VI**
2. **Details of Course:**

S. No.	Contents	Contact Hours
1	**Introduction:** Definition, Importance, Purpose and results of maintainability efforts, maintainability in product life cycle, maintainability tools	03
2	**Failure Analysis:** failure mode, effect and critical analysis, fault tree analysis, cause and effect diagram, total quality management, Reliability, maintainability, both-tub curve, concept of repair ability	08
3	**Maintenance Strategies:** Principle, relative advantage, limitation and application of various maintenance strategies like, preventive maintenance, predictive maintenance, condition based maintenance, Reliability based maintenance etc	08
4.	**Computer Integrated Maintenance: A Maintenance Data System, Processing Recorded Data and Analyzing Information,** Maintenance / e-Maintenance through Data Mining, E-CBM, E-CMMS, Maintenance through Expert System	08
5	**Costing and Budgeting of Maintenance System:** Concept and strategies for tero-technology and Maintainability testing, costing, budgeting and control index for maintained system	06
6	**Industrial Safety Principle:** Industrial safety-concept and relevance, occupational diseases, electrical and mechanical hazards, personal protective equipment and clothing	05
7	**Safety Functions:** Safety responsibility and function of various functionaries and departments, safety & profitably employee training and safety	04
		42

Suggested Books:

1. B.S. Dhillon, Engineering Maintainability, Eastern Economy Edition PHI
2. A.K. Gupta, Reliability Engineering and Technology, Macmillan India Limited
3. N.V.S. Raju, Plant Maintenance and Reliability Engineering ,Cengage Learning India Private Limited
4. S.K. Srivastava, Maintenance Engineering Principles, Practices &Management S. Chand Publishing
5. H.P.Garg, Industrial Maintenance Engineering, S. Chand Publishing
6. E.T. Newbrough, Effective Maintenance Management Mc Graw Hill
7. Mobley, R. Keith, Higgins, R. Lindley and Wikoff, J. Darrin, Maintenance Engineering Handbook
8. Mohamed Ben- Daya, Salih O. Duffuaa, Abdul Raouf, Maintenance Modelling and Optimization, Springer

NAME OF DEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title: **Industrial Automation and Robotics(PE 611)Semester - VI**
2. Details of Course:

S. No.	Contents	Contact Hours
1.	**Basic Concepts of Automation:** Introduction of mechanization and automation, classification and strategies of automation, reasons for and arguments against automation, mechanical, electrical, hydraulic, and pneumatic devices and controls.	04
2.	**High Volume Manufacturing:** Automated flow lines, types of automatic transfer mechanisms, design and fabrication considerations, analysis of automated flow lines.	04
3.	**Assembly Systems:** Assembly systems and their types, manual assembly lines and line balancing. Assembly Automation: automated assembly lines and their types, automatic assembly transfer systems, automatic feeding and orienting devices- vibratory and mechanical feeders and their types, orientation of parts, performance and economics of assembly systems, feasibility study for assembly automation.	12
4.	**Basic concept in Robotics :** Introduction, Basic structure of robots, Resolution, Accuracy, and Repeatability Position representation, Classification and Structure of Robotic System: Point to point and continuous path Robotic systems: Trajectory planning, control loops of Robotic systems; The manipulator- Cartesian, Cylindrical, Spherical and articulated robots; Direct and indirect drives; Wrist, motions and grippers;	08
5.	**Drive and Control Systems**: Hydraulic systems; direct current servo motors control approaches of Robots. Kinematics Analysis and Co-ordinate Transformation: Direct kinematics problem in Robotics; Geometry based direct kinematics analysis. Homogeneous transformation. The necessity of interpolators; The generation of motion commands; Trajectory planning Basic structure of interpolators	08
6.	**Programming, Sensors and Application of Robots**: Manual teaching; lead-through teaching, programming languages, programming with graphics; storing and operating tasks programmes. Introduction to robotic sensors; vision systems, Range defectors: Assembly Aid Devices; force and torque sensors: artificial intelligence. Flexible manufacturing systems, Computer-Integrated Manufacturing Systems. Concept of group Technology.	06
	Total	**42**

3. **Suggested Books:**

1. Groover, M. P., “Automation, Production systems and Computer Integrated Manufacturing”, 2nd Ed., Prentice Hall.
2. Boothroyd, G., “Assembly Automation and Product Design”, 2nd Ed., Marcel Dekker.
3. Tergan, V., Andreev, I. and Lieberman, B., “Fundamentals of Industrial Automation”, Mir Publishers.
4. Craig John J., “Introduction to robotics: Mechanics & Control”, AddisonWesley
5. Schilling R. J., “Fundamentals of Robotics Analysis and Control”, Prentice Hall Inc
6. Mittal R. K. and Nagrath I. J., “Robotics and Control”, Tata McGraw Hill, New Delhi
7. GhosalAshitava, “Robotics: Fundamental Concepts and Analysis”, Oxford University Press

NAME OF DEPTT./CENTRE: **Department of Production Engineering**

1. Course Title**: Computer Integrated Manufacturing (PE612)** **Semester - VI**

2. Details of Course:

Sl. No.	Contents	Contact Hours
1	**Introduction:** Introduction to manufacturing systems and their performance analysis; Introduction to automation; Introduction to computer integrated manufacturing (CIM).	**04**
2	**Numerical Control (NC):** Introduction, numerical control – its growth and development, components of NC system, input devices, control systems – point to point, straight cut, and continuous path NC, open loop and closed loop NC systems, NC interpolations – linear, circular, helical, parabolic and cubic interpolation, applications of NC systems, merits and demerits.	**10**
3	**Extensions of NC:** Concepts of computer numerical control (CNC), machining center, and direct numerical control (DNC), and their advantages.	**06**
4	**Robotics:** Robot anatomy and related attributes, robot control systems – limited sequence, playback with point to point, playback with continuous and intelligent control; End effectors – gripper, tools; Sensors in robotics – tactile sensors, proximity, optical sensors and machine vision; Applications of industrial robots, robot programming.	**06**
5	**Material Handling and Storage:** Overview of material handling equipments, automated material handling equipments – AGVs, conveyor systems, performance analysis of material handling systems, automated material storage systems – ASRS and carousel storage, analysis of automated storage systems.	**06**
6	**Manufacturing Support Functions:** Introduction to group technology (GT), computer aided process planning (CAPP), material requirement planning (MRP), capacity planning, scheduling etc.	**06**
	Total	**42**

4. Suggested Books

1. Groover, M. P., "Automation, Production systems and Computer Integrated Manufacturing", 3rd Ed., Prentice-Hall.
2. Singh, N., "Systems Approach to Computer Integrated Design and Manufacturing", John Wiley & Sons.
3. Chang,T.-C., Wysk,R. A. and Wang, H.-P. "Computer Aided Manufacturing", 3rd Ed., Prentice Hall.
4. Rembold,U., Nnaji,B. O. and Storr A., "Computer Integrated Manufacturing", Addison Wesley.
5. Besant,C. B. and Lui,C. W. K., "Computer Aided Design and Manufacture", Ellis Horwood Ltd.
6. Rao,P. N., Tiwari,N. K. and Kundra,T.K., "Computer Aided Manufacturing", Tata McGraw Hill.
7. Koren, Y. "Computer Control of Manufacturing Systems", McGraw Hill.
8. Lynch, M., "Computer Numerical Control for Machining", McGraw-Hill.
9. Sava,M. and Pusztai,J., "Computer Numerical Control Programming", Prentice Hall.

NAMEOFDEPTT./CENTRE: **Department of Production Engineering**

1. Course Title**: System Dynamics (PE 613)** **Semester-VI**

2. Details ofCourse:

S. No.	Contents	Contact Hours
1.	Introduction, Purpose and concepts of system dynamics,Building a model,Problem definition and model purpose, building theory with causal loop diagrams	06
2.	Mapping the stock and flow structure of systems,Dynamics of stocks and flows; linking feedback with stock and flow structure	06
3.	Understanding the Dynamics of Simple Systems, Analyzing Systems and Creating Robust Policies,Industry dynamics and diffusion models,Network externalities, complementarities, and path dependence,Mark Paich System Dynamics,Interactions of Operations, Strategy, and Human Resource Policy	08
4.	Mark Paich System Dynamics,Interactions of Operations, Strategy, and Human Resource Policy, Re-engineering the Supply Chain in a High-velocity Industry,Formulating and Testing Robust Models of Business Processes	08
5.	The Supply Line and Supply Chains,Forecasting and Feedback: Bounded Rationality or Rational Expectations,Service Quality Management,Service Quality Dynamics	08
6.	Applications of System Dynamics to Environmental and Public Policy Issues, Dynamics of Project Management, Project Dynamics Modeling in the Real World	06
	Total	**42**

3. Suggested Books:

1. Business Dynamics: Systems Thinking and Modeling for a Complex World, Sterman, McGraw-Hill

2. System Dynamics Modelling: A Practical Approach, R.G.Coyle ,Chapman and Hall/CRC

3. Systems Thinking, System Dynamics: Managing Change and Complexity,Kambiz E. Maani and Robert Y. Cavana,Pearson Education

4. Strategic Modelling and Business Dynamics: A Feedback Systems Approach, John D. W. Morecroft,Wiley

5. System Dynamics: Soft and Hard Operational Research, Martin Kunc,Palgravemacmillan

NAME OF DEPT. /CENTRE: **DEPARTMENT OF PRODUCTION ENGINEERING**

Machine Tool Design Sessional (PE 601P) **Semester-VI**

Teaching Scheme **Examination Scheme**

Practicals : 3 hrs/week Term work : 100

Sl No.	**Topic**
1.	Design & Drawing of rivets.
2.	Design & Drawing of cotter joint
3.	Design & Drawing of knuckle joint
4.	Design & Drawing of indexing jig/fixture for drilling operation
5.	Design & Drawing of indexing jig/fixture for milling operation
6.	Design and draw Punching die set
7.	Design and draw a die for deep drawing
8.	Design & drawing of Broach.

NAME OF DEPTT. /CENTRE: **Department of Production Engineering**

Manufacturing Processes III Lab (PE 602P) **Semester-VI**

Teaching Scheme **Examination Scheme**

Practicals : 3 hrs/week Term work: 100

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List of Experiments

1. To analyze various forces on the chip using Merchant Circle Diagram
2. To estimate power and cutting forces required in turning process
3. To calculate machining time for various operations
4. To study economics of metal cutting
5. To analyze tool life at different machining parameters
6. To study and analyze the process of open die forging
7. To study and analyze the process of metal extrusion process
8. To study and observe thorough demonstration of the rolling process

NAMEOFDEPTT. /CENTRE: **Department of Production Engineering**

Modern Manufacturing Processes Lab (PE 603P) **Semester-VI**

Teaching Scheme **Examination Scheme**

Practicals : 3 hrs/week Term work : 100

Sl No.	Topic
1.	Electro-discharge Drilling
2.	Wire-cut Electro-discharge Machining
3.	Chemical Machining
4.	Electro-chemical Machining
5.	Ultrasonic Machining
6.	Abrasive Jet Machining
7.	Laser Beam Drilling
8.	Rapid Prototyping

NAMEOFDEPT./CENTRE: **Department of Production Engineering**

2. Course Title**: Automation/FMS Lab (PE 604P)** **Semester -VI**

3. **List of experiments**

1. Study of Industrial robots

2. Study of Common Robot Configurations.

3. Study of Articulated Robot Components.

4. Study of Robot End -Effectors.

5. Use of D H convection for three axis articulated Arm.

6. Write a robot program for the specified task by teach pendant Method.

7. Study of the integration mechanism of an flexible manufacturing systems

8. considering different elements such as CNC machines, robots etc.

9. Mechatronics in our Daily Life

NAMEOFDEPTT. /CENTRE: **Department of Production Engineering**

1. **Course Title: Production Planning and Control (PE701)** **Semester - VII**
2. **Details of Course:**

S. No.	Contents	Contact Hours
1	**Introduction to Production Planning and Control:** Production system, type of manufacturing systems and their characteristics, objectives and functions of production planning and control	03
2	**Pre-planning:** Demand forecasting, common techniques of demand forecasting, estimating factors of production, product mix and batch size decisions, aggregate planning	06
3	**Production Planning:** Routing, Loading and scheduling with their different techniques, dispatching, Progress Report, Expediting and corrective measures	05
4	**Inventory Control:** Field and scope of inventory control, inventory types and classification, Inventory control models, static model, dynamic model both deterministic and stochastic,Economic lot size, reorder point and their application, ABC analysis, FSN analysis and VED analysis, Modern practice in purchasing and store keeping	08
5	**Material Requirement Planning & JIT:** Material requirement planning (MRP), Manufacturing Resource planning (MRP II). Japanese approach to inventory management: JIT, KANBAN	08
6	**Value Engineering:** Introduction, Different phase of value Engineering. Concept of productivity	06
7	**Aggregate Planning:** Introduction, Nature of Aggregate planning, Costs, problem structure, Methods of Aggregate planning, Introduction to Capacity planning	06
	Total	42

3. **Suggested Books:**

1. S.N Chary, Production and Operation Management, Tata McGraw Hill
2. Dr. K. C. Arora Production and Operation Management, Laxmi Publication Pvt. Ltd.
3. R. K. Garg & V. Sharma, Production planning and Control Management, Dhanpat Rai & C Sons
4. E.D. Scheele, W.L. Westerman and R.J. Wimment, Principles and Design of Production Control Systems
5. Production Control Engineering D. K. Corke, Hodder Arnold
6. Production Planning and Inventory Control- Seetharama L. Narasimhan, Dennis W. McLeavey, Peter J. Billington.

NAMEOFDEPTT./CENTRE: **Department of Production Engineering**

1. Course Title**: Statistical Quality Control (PE 702)** **Semester - VII**

2. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction**: The meaning of quality and Quality improvement; Brief history of Quality methodology, Statistical methods for Quality Control and improvement; Total Quality management(quality philosophy, links between quality and productivity, quality costs, legal aspects of quality implementing, quality improvement)	04
2.	**Methods and philosophy of SPC**: Chance and Assignable causes, Statistical basis of the control charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length - ARL)	06
3.	**Control Charts for Variables:** Control Charts for X-bar and R charts, Type I and Type II errors, the probability of Type II error, simple numerical problems.	08
4.	**Process Capability:** The foundation of process capability, Natural tolerance limits, C_p- process capability index, C_{pk}, P_p- process performance index, summary of process measures. Numerical problems.	06
5.	**Control Charts for Attributes:** Binomial distribution, Poisson Distribution (from the point of view of Quality Control), Control chart for fraction nonconforming, Control chart for number nonconforming, Control charts for nonconformities or defects, Control chart for number of nonconformities per unit, Numerical Problems	08
6.	**Lot by lot Acceptance Sampling for Attributes and CUSUM and EWMA control charts:** The acceptance sampling problem, single sampling plan for attributes, Double, Multiple, Sequential sampling, AOQL, LTPD, OC curves, Cumulative sum control chart, Exponentially Weighted Moving Average control chart, Numerical Problems.	10
	Total	**42**

3. **Suggested Books:**

1. M. Mahajan., “Statistical Quality Control”, 5th Ed.,

2. Dhanpat Rai and co.

3. Eugen L. Grant, Richard S. Leavenworth “Statistical Quality Control”

4. 6th edition, McGraw Hill

5. AmitavaMitra, “Fundamentals of Quality Control and Improvement”, Wiley India

6. S.A.H Rizvi, Zahid A. Khan., “Quality Control (for engineers and managers)”,

NAMEOFDEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: Total Quality Management (PE 703)Semester - VII**
2. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to Quality Management Evolution of Quality Management, Concepts of Product and Service Quality, Dimensions of Quality, Deming's, Juran's, Crosby's Quality Philosophy, Quality Cost	04
2.	Process Quality Improvement Introduction to Process Quality, Graphical and statistical techniques for Process Quality Improvement, Graphical tools for data representation, 7 QC tools, Sampling, sampling distribution, DMAIC process.	08
3.	Statistical Process control Control charts for variables, control charts for attributes, application of control charts.	08
4.	Process capability analysis, Measurement system analysis, Analysis of Variance (ANOVA), Design and Analysis of Experiment (DOE), Acceptance sampling plan.	12
5.	TQM, Leadership, Lean and JIT Quality Philosophy, Benchmarking, Process failure mode and effect analysis (PFMEA), Service Quality, Six sigma for Process Improvement, ISO 9001 and QS 9000, Quality Audit, Quality Circles.	06
6.	Quality Function Deployment, Robust Design and Taguchi Method. Design Failure Mode & Effect Analysis, Product Reliability Analysis of Six Sigma in Product Development.	04
	Total	**42**

3. **Suggested Books:**

1. Total Quality Management by Dale H. Besterfield, Pearson Publication
2. Principles of Total Quality Management by VipinMathur
3. Fundamentals of Quality Control and Management by AmitavaMitra, Wiley Publication

NAME OF DEPTT./CENTRE: **Department of Production Engineering**

1. Course Title**: Quality and Reliability Engineering. (PE 704)** **Semester - VII**

2. Details of Course:

Sl. No.	Contents	Contact Hours
1	Control chart : Introduction to quality control, objectives, applications and cost consideration. Control charts, general theory of control charts, Control charts for variables and attributes, Theory and application of control charts for averages, ranges, standard deviation, fraction defective and number of defects, Process capability study, Interpretation of control chart. Acceptance sampling : Elementary concepts, sampling by attributes, single, double and multiple sampling plans, construction and use of o.c. curves, Sequential sampling techniques. Concept of quality circle. ISO -9000 Quality systems. Total quality control-quality and competitiveness in a Global Market place, Establishing a customer focus. Employee involvement. Six sigma, Introduction to Taguchi methods.	**10**
2	Reliability concept, Failure-statistics: Failure density, Failure rate, Probability of failure, Mean failure rate, mean time to failure(MTTF), mean time between failure(MTBF).Graphical plots.	**6**
3	Hazard Models: Introduction, Constant Hazard, Linearly increasing Hazard, The weibull model. Distribution functions and Reliability analysis. Hazard Rate as Conditional Probability.	**6**
4	System Reliability: Introduction, Series configuration, Parallel configuration, Mixed configuration. Application to specific Hazard Models. Reliability analysis of (i) Complex systems and (ii)Systems not reducible to mixed Configuration. Mean time to failure of systems. Logic diagrams, Markov Models.	**6**
5	Reliability Improvement: Improvement of components, Redundancy (Element redundancy, Unit redundancy, Stand by redundancy), Optimization, Reliability Cost Trade-off.	**6**
6	Calculation of Reliability from: (i) Fault tree analysis (ii) Tie set and Cut-set methods (iii) by use of Boolean Algebra.	**4**
7	Maintainability and Availability: Introduction, Maintainability, System downtime, Availability, Inherent Availability, Achieved Availability, Operational Availability, Reliability and Maintainability Tradeoff.	**4**
	Total	**42**

3. Suggested Books

1. Fundamentals of Quality Control and Improvement: AmitavaMitra, Wiley
2. Statistical Quality Control – Eugen L. Grant , Richard S. Leavenworth
3. Statistical Quality Control – M. Mahajan
4. Quality Control (For Engineers and Managers) – S.A.H. Rizvi, Zahid A. Khan, D.K. Singh, GauharAlam
5. Reliability Engineering – E. Balagurusamy
6. Reliability Engineering and Life Testing – V. N. A. Naikan

NAMEOFDEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: Surface Engineering (PE 705)** **Semester - VII**

2. Details ofCourse:

S. No.	Contents	Contact Hours
1.	**Fundamentals of surface engineering** 1. Introduction: Engineering components, surface dependent properties and failures, importance and scope of surface engineering. 2. Surface and surface energy: Structure and types of interfaces, surface energy and related equations. 3. Surface engineering: classification, definition, scope and general principles.	04
2.	**Conventional surface engineering** Surface engineering by material removal: Cleaning, pickling, etching, grinding, polishing, buffing / puffing (techniques employed, its principle). Role and estimate of surface roughness. 5. Surface engineering by material addition: From liquid bath - hot dipping (principle and its application with examples). 6. Surface engineering by material addition: Electrodeposition / plating (theory and its scope of applicatio). 7. Surface modification of steel and ferrous components: Pack carburizing (principle and scope of applicatio).	08
3.	**Conventional surface engineering** 8. Surface modification of ferrous and non ferrous components: Aluminizing, calorizing, diffusional coatings (principle and scope of applicatio). 9. Surface modification using liquid/molten bath: Cyaniding, liquid carburizing (diffusion from liquid state) (principle and scope of applicatio). 10. Surface modification using gaseous medium: Nitridingcarbonitriding (diffusion from gaseous state) (principle and scope of applicatio).	08
4.	**Advanced surface engineering practices** 11. Surface engineering by energy beams: Laser assisted microstructural modification – surface melting, hardening, shocking and similar processes. 12. Surface engineering by energy beams: Laser assisted compositional modification – surface alloying of steel and non-ferrous metals and alloys. 13. Surface engineering by energy beams: Laser assisted compositional modification – surface cladding, composite surfacing and similar techniques. 14. Surface engineering by energy beams: Electron beam assisted modification and joining. 15. Surface engineering by energy beams: Ion beam assisted microstructure and compositional modification.	12
5.	**Characterization of coatings and surfaces** 16. Measurement of coatings thickness 17. Porosity & adhesion of surface coatings 18.. Measurement of residual stress & stability 19. Surface microscopy & topography by scanning probe microscopy 20. Spectroscopic analysis of modified surfaces	06
6.	**Functional Coatings & Applications** 21. Functional and nano-structured coatings and their applications in photovoltaics, bio- and chemical sensors 22. Surface passivation of semiconductors & effect on electrical properties 23. . Surface engineering of polymers and composites	04
	Total	**42**

3. **Suggested Books:**

1. K.G. Budinski, Surface Engineering for Wear Resistances, Prentice Hall, Englewood Cliffs.
2. M. Ohring, The Materials Science of Thin Films, Academic Press Inc,
3. Introduction to Surface Engineering by P. A. Dearnley

NAMEOFDEPT./CENTRE: **Department of Production Engineering**

1. Course Title**: Advance Casting and Welding (PE 706)** **Semester - VII**
2. Details of Course:

S. No.	Contents	Contact Hours
1.	**Gating system:** Elements of gating system**,** top and bottom getting system. Design of gating system ,Riser design-Caine method, modulus method, NRL method; time of pouring, casting yield	6
2.	**Meting and solidification of casting:** Melting and quality control of various steels and non-ferrous alloys - Nucleation and grain growth, solidification of pure metals, short and long freezing range alloys. Fluidity and its measurement	6
3.	**Special casting technique:** shell moulding, squeeze casting, vacuum die casting, counter-gravity flow-pressure casting, centrifugal casting, continuous casting & squeeze casting ,semisolid metal casting	5
4.	**Advance arc Welding process:** Plasma TIG, Hot wire TIG, cold metal transfer, Under water arc welding, Solid state welding; friction welding , Friction stir welding	5
5.	**Welding process used for special fabrication:** Thermit welding, Electroslag welding, electron beam welding, Laser beam welding, Ultrasonic Welding; special welding process (friction stir welding and hybrid (laser +GMAW/GTAW) process	7
6.	**Inspection and testing of welding**: Defects, Destructive tests – Non-destructive testing techniques – surface treatments-safety aspects in welding processes-	5
7.	**CAE of Welding And Casting:** Design of weldment, application of finite element method in welding – determination of distortion in weldments, modeling of temperature distribution – case studies. Design for casting, application of finite element method in casting-determination of hot spots, location of turbulence, and other defects, modeling of flow in molds, modeling of heat transfer in castings case studies	8
	Total	**42**

3. **Suggested Books:**

1. **P**.L.Jain " Principles of foundry Technology" Tata Mc Graw Hill Publishers
2. Dr.R.S.Parmer "Welding processes and Technology" Khanna Publishers.
3. Howard B Cary, " Modern Welding Technology" Prentice Hall, 2002
4. "Manufacturing & Technology: Foundry Forming and Welding",P.N.Rao, 3rd Ed., Tata McGraw Hill, 2003.
5. H.S.Bawa "Manufacturing Technology-I" Tata Mc Graw Hill Publishers New Delhi, 2007.
6. S.V.Nadkarni, Modern Arc Welding Technology, Oxford & IBH Publishing Co. Pvt. Ltd.

NAMEOFDEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: Material Deformation Process (PE 707) Semester - VII**

2. Details of Course:

S. No.	Contents	Contact Hours
1.	**Basic Concepts** State of stress at a point, equilibrium equations, stress tensor, spherical tensor and deviator stress tensor, principal stress, deformation tensor	05
2.	**Theory of Plasticity** Engineering and true stress –strain, flow curve, idealized stress-strain model, plastic deformation equations, levy–mises equations, prandlt–reuss equations, strain hardening, strain rate and bauschinger effects	07
3.	**Flow Rule and Yield Criterion** Velocity field and strain rate, compatibility equation, von – mises and tresca yield criterion, biaxial and triaxial yield surfaces, experimental verification of yield criterion, lode–stress, parameter	07
4.	**Friction and Lubrication** Interfacial friction laws–Coulombs friction law, constant shear factor law, composite friction, law and hydrodynamic friction law, friction mechanism during plastic deformation, lubrication mechanisms– boundary, hydrodynamic and solid lubrication, metal working, lubricants–types and characteristic	10
5.	**Plain Strain Deformation Processes** Basic concepts of slip-line method, slab method (equilibrium technique) and energy method, (upper bound technique), analysis of following deformation processes, Forging of strip: pressure distribution and forging load Rolling of strip: pressure distribution, roll–separating force and driving torque	06
6.	**Axi-Symmetric Deformation Processes** Analysis of following deformation processes:-Forging of disc: pressure distribution and forging load Extrusion of cylindrical rod: extrusion load and frictional power loss Drawing of cylindrical wire: drawing load and maximum allowable reduction	07
	Total	**42**

3. **Suggested Books:**

1. Principle of Industrial Metal Working G.W. Rowe, Edward Arnold , London

2. Principles of Metal Working S. Kumar, IBH & Co., New Delhi

3. Metal Working Processes and Analysis B. Avitzur, McGraw Hill, USA Metal Working Processes and Analysis B. Avitzur, McGraw Hill, USA

4. Metal Working Processes and Analysis B. Avitzur, McGraw Hill, USA

NAME OF DEPT. /CENTRE: **DEPARTMENT OF PRODUCTION ENGINEERING**

1. **Course Title: Supply Chain Management (PE 708)** **Semester - VII**
2. **Details of Course:**

S. No.	Contents	Contact Hours
1	Introduction to Supply Chain Management: Concepts, Objectives, Information and Material flows in the Supply Chain, Supply Chain Planning, Supply Chain Decision Making, Managing uncertainties in Supply chain, Benefits of Supply Chain Management in Industry	4
2	Dynamics of SCM: Supply Chain Process Cycles, Supply Chain Integration, Bullwhip effect in Supply Chain, Information Systems and Processing in Supply Chain, Collaborative Planning Forecasting and Replenishment (CPFR), Inventory Planning and control	6
3	Information and Communication Technology used in Supply Chain: Need and Role of an Information System in SCM, Enterprise Resource Planning (ERP), Concept of SAP in Supply chain, Current Trends of use of IT in SCM, Use of IT enabled technologies / services in Logistical system	7
4	Supply Chain Management Practices: Bar-coding, Tierization of suppliers, Vendor Managed Inventory, Hub and Spoke concept, Dynamic pricing, Third Party Logistics (3 PL's) providers, Fourth Party Logistics (4 PL's) providers, Reverse Logistics, Green Logistics, Electronic Data Interface, Lean Operations	7
5	Procurement and Outsourcing Strategies: Make / In sourcing or Buy / Outsourcing Decisions, Green Purchasing, Strategic Outsourcing, Strategic partnership with the suppliers, Suppler Selection process, Supplier Rating and Control, Strategic Sourcing Decisions, Continuous Improvement of Suppliers, Quality Assurance Program of suppliers	8
6	Customer Relationship Management in Supply Chain: CRM, Strategic Partnership with the Customer, Linkage between CRM and SRM, Functional components of a CRM system, CRM Business cycle	5
7	Performance Benchmarking in SCM Implementation: Supply Chain Integration, Supply Chain Operations Reference (SCOR) Model, Supply Chain Performance Benchmarking	5
	Total	42

3. **Suggested Books:**

1. Chopra, Sunil and Peter Meindl, Supply Chain Management - Strategy, Planning and Operation, Prentice Hall of India.6th Edition
2. Sunil Sharma, Supply Chain Management - Concepts, Practices and Implementation, Oxford University Press
3. Mohanty R. P and S. G. Desmukh, Essentials of Supply Chain Management, Phoenix publishing
4. Ballou, Donald H. and S. Srivastava, Business Logistics / Supply Chain Management, Pearson Education, 5th Edition,
5. Simchi - Levi, D.P Kaminsky, Edith Simchi –Levi, Designing and Managing the supply Chain concepts, Strategies and Cases Tata McGraw – Hill, 3rd Edition,
6. Buffa, E. S. and Sarin, R. K., John Wiley & Sons Ltd , Modern Production / Operations Management, 8th Revised Edition,

NAMEOFDEPT./CENTRE: **Department of Production Engineering**

1. Course Title**: Enterprise Resource Planning(PE 709)** **Semester - VII**

2. Details of Course:

S. No.	Contents	Contact Hours
1.	**Enterprise:** An Overview: Business Functions and Business Processes, importance of Information: Characteristics of information; Types of information, Information System: Components of an information system; Different types of information systems; Management information system, Enterprise Resource Planning: Business modelling; Integrated data model	6s
2.	**Introduction to ERP:** Defining ERP, Origin and Need for an ERP System, Benefits of an ERP System, Reasons for the Growth of ERP Market, Reasons for the Failure of ERP Implementation: Roadmap for successful ERP implementation	7
3.	**ERP and Related Technologies:** Business Process Re-engineering, Management Information systems, Decision Support Systems, Executive Information Systems- Advantages of EIS; Disadvantages of EIS, Data Warehousing, Data Mining, On-Line Analytical Processing, Product Life Cycle Management, Supply Chain Management, ERP Security	7
4.	**ERP Implementation Life Cycle:** ERP Tools and Software, ERP Selection Methods and Criteria, ERP Selection Process, ERP Vendor Selection, ERP Implementation Lifecycle, Pros and cons of ERP implementation, Factors for the Success of an ERP Implementation	6
5.	**ERP Modules Structure**: Finance, Sales and Distribution, Manufacturing and Production Planning- Material and Capacity Planning; Shop Floor Control; Quality Management; JIT/Repetitive Manufacturing; Cost Management ; Engineering Data Management; Engineering Change Control ; Configuration Management ;Tooling, Human Resource, Plant Maintenance- Preventive Maintenance Control; Equipment Tracking; Component Tracking; Plant Maintenance Calibration Tracking; Plant Maintenance Warranty Claims Tracking, Quality Management Materials Management- Pre-purchasing; Purchasing; Vendor Evaluation; Inventory Management and Invoice Verification and Material Inspection	8
6.	**ERP – A Manufacturing Perspective:** Role of Enterprise Resource Planning (ERP) in manufacturing, Computer Aided Design/Computer Aided Manufacturing (CAD/CAM), Materials Requirement Planning (MRP)-Master Production Schedule (MPS);Bill of Material (BOM);Inventory Records; Closed Loop MRP; Manufacturing Resource Planning (MRP-II), Manufacturing and Production Planning Module of an ERP System , Distribution Requirements Planning (DRP), Just-in-Time(JIT) & KANBAN - Kanban; Benefits of JIT	8
	Total	**42**

3. **Suggested Books:**

1. Manufacturing Resource Planning (MRP II) with Introduction to ERP; SCM; an CRM by Khalid Sheikh, Publisher: McGraw-Hill
2. ERP and Supply Chain Management by Christian N. Madu, Publisher: CHI
3. Implementing SAP ERP Sales & Distribution by Glynn C. Williams, Publisher McGraw-Hill
4. The Impact of Enterprise Systems on Corporate Performance: A study of ERP, SCM, and CRM System Implementations [An article from: Journal of Operations Management] by K.B. Hendricks; V.R. Singhal; and J.K. Stratman, Publisher: Elsevier

NAMEOFDEPTT. /CENTRE: **Department of Production Engineering**

1. Course Title**: Management Information System(PE 710)Semester - VII**

2. Details ofCourse:

S. No.	**Contents**	**Contact Hours**
1.	**The Meaning and Role of Management Information System**: Decision support system, System Approach, The system view of Business, MIS organization within the company. **Management Organizational Theory and the System Approach:** Development of organizational theory, Management and organizational behavior, Management, Information, and the system approach.	06
2.	**Technology of Information System:** Introduction, Data Processing, Transaction Processing, Application Processing, Information System Processing, TQM of information system, Human Factors and user interface, Real Time Systems and Good Design, Strategic nature of IT Decisions, Evaluation and feasibility of IT Solutions. **Data Base Management**: The Business setting, Data base management system, Objective of a DBMS, Computer, Database Technical overview.	08
3.	**Decision Support Systems and Knowledge Management:** Decision Support Systems (DSS): Concept and Philosophy, Artificial Intelligence (AI) system, Knowledge based Expert System (KBES), DSS Application in E-enterprise.	05
4.	**Information Security: Threats and Management** Information Security: Threats and vulnerability, Controlling Security Threat and Vulnerability, Managing security Threat in E-business, Disaster Management, Application system's Security management, Information Security Management, Measure of Information Security, Network Security, and Cyber Security.	05
5.	**Application Manufacturing Sector: Introduction,** Personnel Management, Financial Management, Production Management, Raw Materials Management, Marketing Management.	04
6.	**Application in Service Sector:** Introduction to Service sector, creating a distinctive Service, Service Concept, Service Process Cycle and Analysis, Customer Service Design, Service Management System, MIS Application in Service Industry.	06
7.	**Management of Global Enterprise:** Enterprise Management System (EMS), Enterprise Resource Planning(ERP) System, ERP Models and Modules, Benefits of the ERP, ERP Product Evaluation, ERP Implementation, Supply Chain Management, Information Management in SCM, Customer Relationship Management, Management of Global Enterprise, EMS and MIS.	08
	Total	**42**

1. **Suggested Books:**

1. Information system for modern management by Robert Murdick& James Claggett, PHI Publication

2. Management Information Systems by James A. O'Brien, George M. Marakas, McGraw Hill Education

3. Management Information System by Olson MIS- Rahul De, Wiley Publication

NAME OF DEPT. /CENTRE: **DEPARTMENT OF PRODUCTION ENGINEERING**

1. **Course Title: Marketing Management (PE 711) Semester - VII**
2. **Details of Course:**

S. No.	Contents	Contact Hours
1	Fundamentals of Marketing: Core concepts of marketing and Company orientation towards the market place, Market Oriented Strategic Planning: Defining the Mission, Defining SBUs, Business Portfolio Evaluation and assigning resources to SBUs, Scanning the Marketing Environment: Analyzing trends in the components of the company's Macro & Micro environment.	6
2	Market segmentation, targeting and positioning: Purpose of Segmentation, Bases of segmenting Consumer Markets - Demographic, Geographic, Psychographic & Behavioral, Evaluating & Selecting Market Segments, Dealing with competition: Identifying and analyzing competitors, Strategies for the Market leader, Follower, Challenger	8
3	Analyzing Consumer Markets: Consumer behavior- Factors affecting consumer behavior& consumer decision making process, Creating customer value, satisfaction & loyalty: Customer perceived value, customer satisfaction, measuring satisfaction, measuring customer life time value, CRM & building loyalty	6
4	Product Strategy: Classification of products, product levels, Analysis of product line & product mix, Product Life Cycle: Concept, Strategies for Introduction, Growth, Maturity & Decline Phase. Criticism of the Product Life Cycle.	5
5	Pricing Strategies: Selecting the pricing Objective, Determining demand, estimating costs, analyzing competitors, selecting a pricing method, initiating & responding to price changes, Integrated Marketing Communication: Meaning and Role of IMC, designing effective communication program, Meaning and role of the elements of communication mix, Leveraging Social Media for effective communication.	6
6	Distribution Strategies: Concept of Value Networks, Role of marketing channels. Channel design decisions, channel management decisions. Channel Integration through Vertical Marketing systems & Horizontal Marketing Systems, Retailing: Classification of Store Formats, Types of Retail Formats, Retail positioning, Store Location, Product assortment & Services, Price, promotion, Store Atmosphere	8
7	Managing services: Importance, Distinctive Characteristics, Green Marketing, Rural Marketing and Consumer Protection - Introduction and significance	3
	Total	42

3. **Suggested Books:**

1. Kotler, Keller, Koshy &Jha, Marketing Management A South Asian Perspective Prentice Hall/Pearson, Fourteenth Edition,
2. RajanSaxena, Marketing Management, TMH, Fourth Edition,
3. Arun Kumar, N Meenakshi, Marketing Management, Vikas Publishing , 3rd Edition,
4. Bruce Walker &Stanton, Fundamentals of Marketing, McGraw Hill
5. W.D. Perraut& E.J. Mc Carthy, Basic Marketing, TMH
6. Russel S. Winner, Marketing Management , Pearson

NAMEOFDEPTT./CENTRE: **Department of Production Engineering**

3. Course Title**: Intelligent Manufacturing Systems(PE 712)** **Semester - VII**

4. Details of Course:

S. No.	Contents	Contact Hours
1.	Basic concepts of Artificial intelligence and expert systems, System Components ,System architecture and Data flow, System Operations	06
2.	Knowledge based systems, knowledge representation ,knowledge acquisition and optimization, Knowledge based approaches to design mechanical parts and mechansims and design forautomated assembly	08
3.	Knowledge based system for material selection, Intelligent process planning system	06
4.	Intelligent system for equipment selection, Intelligent system for project management & factorymonitoring.	06
5.	Intelligent system for Scheduling in manufacturing ,scheduling the shop floor , Diagnosis & troubleshooting	08
6.	The role of Artificial Intelligence in the factory of the future , Intelligent systems	08
	Total	**42**

5. Suggested Books:

1. Intelligent Manufacturing Systems, Andrew Kussiak, Prentice Hall

2. Introducing Artificial Intelligence, Simons, G.L, NCC Pub

3. IntelligentScheduling,.by Monte Zweben, Morgan Kaufmann Publishers

NAME OF DEPT. /CENTRE: **DEPARTMENT OF PRODUCTION ENGINEERING**

1. Course Title: **Finite Element Method (PE713)** **Semester - VII**
2. Details of Course:

S. No.	Contents	Contact Hours
1	Basic concepts: Variational and Residual methods-Introduction - Different approaches in Finite Element Method - Direct Stiffness approach, simple examples Variational approach, Elements of variational calculus – Euler's-Lagrange equation, Rayliegh Ritz method , Weighted Residual methods, Point Collation method, Sub domain Collation method, Galerkins method - Steps involved in FEM.	08
2	Elements and Interpolation Functions: Elements and coordinate system – Interpolation Polynomials - Linear elements Shape function - Analysis of simply supported beam - Element and Global matrices - Two dimensional elements, triangular and rectangular elements - Local and Natural Co-ordinate systems.	07
3	Finite Element Solution of Field Problems: Field problems – Finite element formation of field problems - Classification of partial differential equations - Quasiharmonic equation - Steady state problems - Eigen value problems - Propogation problems - Examples, Torsional problem – Fluid flow and Heat transfer problems - Acoustic vibrations – Application in manufacturing problems – metal cutting and metal forming.	07
4	Finite Element Solution of Structural Problems: Solid mechanic problems – Finite element formulation of solid mechanic problems - Axial force member - element matrices for axial force members - Truss element analysis of pinned truss - Two dimensional elasticity problems.	08
5	Higher Order Elements and Numerical Methods: Numerical method and computer implementation –Numerical method in FEM and Computer implementation. Evaluation of shape functions - One dimensional & triangular elements	07
6	Quadrilateral elements, Isoparametric elements - Numerical Integration, Gauss Legendre quadrature - Solution of finite element equations - Cholesky decomposition, Skyline storage - Computer implementation- Use of FEM software.	05
	Total	**42**

3. **Suggested Books:**

1. Larry J Segerlind ,“ Applied Finite Element Analysis”, John Wiley
2. Bathe, K.J., “Finite Element Procedures”, Prentice Hall
3. Huebner,K.H. and Thornton, E.A., “The Finite Element Method for Engineers”, John Wiley
4. Reddy,J.N., “Introduction to Finite Element Method”, McGraw Hill,
5. S.S.Rao, “The Finite element method”, Elsevier.
6. Zienkiewich . O.C., and Taylor . R.L., “The Finite Element Method”, McGraw Hill

NAMEOFDEPTT./CENTRE: **Department of Production Engineering**

1. Course Title**: Modern Optimization Technique(PE 714)** **Semester - VII**

2. Details of Course:

S. No.	Contents	Contact Hours
1.	Dynamic Programming: Multistage Decision Processes, Concept of Suboptimization and Principle of Optimality, Computational Procedure in Dynamic Programming Continuous Dynamic Programming.	08
2.	Integer Programming: Gomory's Cutting Plane Method ,Integer Polynomial Programming, Branch and Bound Method, Sequential Linear Discrete Programming, Generalized Penalty Function Method	07
3.	Stochastic Programming: Random Variables and Probability Density Functions, Stochastic Linear Programming, Stochastic Nonlinear Programming	05
4.	Optimal Control and Optimality Criteria Methods: Calculus of Variations, Optimal Control Theory, Optimality Criteria Methods	05
5.	Modern Methods of Optimization: Genetic Algorithms, Particle Swarm Optimization, Optimization of Fuzzy Systems, Neural-Network-Based Optimization	10
6.	Practical Aspects of Optimization: Sensitivity of Optimum Solution to Problem Parameters, Multilevel Optimization, Multi objective Optimization	07
	Total	**42**

3. Suggested Books:

1. Engineering Optimization: Theory and Practice, S.S. Rao ,New Age International Pvt Ltd.,

2. Operation Research by Hamdy A. Taha, Pearson publication

3. Optimization for Engineering Design Algorithms and Examples, K. Deb, Prentice-Hall of India Pvt. Ltd

4. Modern heuristic optimization techniques, Kwang Y.Lee, Mohammed A.ElSharkawi John Wiley and Sons,

5. Dynamic Programming and Optimal Control,Dimitri P. Bertsekas,Athena Scientific

6. PrabhakarPai, Operation Research, Oxford University Press

7. Engineering Optimization, A.Ravindran, K.M.Ragsdell, G.V.Reklaitis, Wiley India Pvt. Ltd

NAME OF DEPT./CENTRE: **DEPARTMENT OF PRODUCTION ENGINEERING**

1. Course Title**:** **Mechatronics** **(PE715)** **Semester - VII**

2. Details of Course:

Sr. No.	**Contents**	**Contact Hours**
1.	Introduction: Definition of mechatronics, measurement system, control systems, microprocessor based controllers, mechatronics approach.	2
2.	Sensors and Transducers: Sensors and transducers, performance terminology, photoelectric transducers, flow transducers, optical sensors and transducers, semiconductor lasers, selection of sensors, mechanical / electrical switches, inputting data by switches.	7
3.	Actuators: Actuation systems, pneumatic and hydraulic systems, process control valves, rotary actuators, mechanical actuation systems, electrical actuation systems.	5
4.	Signal Conditioning: Signal conditioning, filtering digital signal, multiplexers, data acquisition, digital signal processing, pulse modulation, data presentation systems.	5
5.	Microprocessors and Microcontrollers: Microcomputer structure, microcontrollers, applications, programmable logic controllers.	8
6.	Modeling and System Response: Mathematical models, bond graph models, mechanical, electrical, hydraulic and thermal systems, dynamic response of systems, transfer function and frequency response, closed loop controllers.	7
7.	Design and Mechatronics: Input/output systems, computer based modular design, system validation, remote monitoring and control, designing, possible design solutions, detailed case studies of mechatronic systems used in photocopier, automobile, robots.	7
	Total	**42**

3. Suggested Books

1. Bolton, W., “Mechatronics”, Longman.
2. Alciatore, D. G. and Histrand, M. B., “Introduction to Mechatronics”, Tata McGraw Hill
3. Shetty, D. and Richard, A.K., “Mechatronics System Design”, PWS Pub. Boston
4. Mahalik, N., “Principles, Concept and Applications: Mechatronics”, Tata McGraw.
5. Bishop, R.H. “Mechatronics Handbook”, CRC Press.
6. Bolton, W., “Mechatronics: A Multidisciplinary Approach”, 4th Ed., Prentice Hal
7. Merzouki R., Samantaray A. K., Pathak P.M., Bouamama B. Ould, Intelligent Mechatronic Systems: Modeling, Control and Diagnosis, Springer.

NAMEOFDEPT./CENTRE: **Department of Production Engineering**

6. Course Title**: Project Engineering (PE716)** **Semester - VII**

7. Details of Course:

S. No.	Contents	Contact Hours
1.	The scope of project, characteristics of a project, stages of a project, Project constraints, Project Management structures, Responsibilities of project manager,	08
2.	Project productivity. The anatomy of a project. Environmental considerations in project evaluation.	07
3.	Main issues and secondary issues in feasibility study, Social cost benefit analysis, Commissioning, Evaluation of competing projects. Budgetary aspects and considerations of a project.	05
4.	Industrial/Engineering projects, R & D Projects, Turnkey projects, Network Modeling of a project, Deterministic & probabilistic activity networks, Line of Balance, Time-cost trade-off in a project, Mega projects**.**	05
5.	Project scheduling techniques, PERT, CPM Models.	08
6.	Project monitoring techniques, Performance and Cost Evaluation (PACE), Project Staffing Requirements, Resource leveling. Project Documentation, Computer Application in Project Engineering.	9
	Total	**42**

8. Suggested Books:

1. Elements of Project Management, K. Nagarajan, New Age International
2. Production and Operation Management, S.N Chary, Tata McGraw Hill
3. Information Technology Project Management, Kathy Schwable, Cengage Learning Australia
4. Guidelines for Project Evaluation, Pratha Dasgupta, Amartya Sen, & Stephen Marglin, United Nations,
5. Strategic Project Management Made Simple: Practical Tools for Leaders and Teams,Terry Schmidt
6 Effective Project Management: Robert K. Wysocki ,Traditional, Agile, Extreme, 5th Edition
7 Project Engineering: The Essential Toolbox for Young Engineers, Frederick Plummer
8. Project Management Panneerselvam R, PHI Learning Pvt. Ltd.

NAME OF DEPT. /CENTRE: **DEPARTMENT OF PRODUCTION ENGINEERING**

Modern Optimization Lab Sessional (PE 701P) **Semester-VI**

Teaching Scheme
Practicals : 3 hrs/week

Examination Scheme
Term work : 100

Sl No.	Topic
1.	Design of Continuous Beams using dynamic programming method.
2.	Optimal Design of a Gear Train using dynamic programming method
3.	Optimization using Genetic Algorithms
4.	Optimization using particle swarm optimization
5.	Optimization using Ant Colony Optimization
6.	Optimization using Simulated Annealing
7.	Multi objective Optimization using Genetic Algorithms
8.	Multi objective Optimization using particle swarm optimization

DEPARTMENT OF METALLURGICAL ENGINEERING

BIT, SINDRI, DHANBAD

5th Semester Course Structure

Sl. No.	Course No.	Subject	L	T	P	Credit
1.	MT 501	Material Characterization (Professional Core Course -I)	4	1	0	4
2.	MT 502	Degradation of Materials (Professional Core Course -II)	3	1	0	3
3.	MT 503	Heat Treatment of Metallic Materials (PCC-III)	3	1	0	3
4.		**Professional Elective – I (Any One of the Following)**				
I.	MT 504	Physics of Materials	3	1	0	3
II.	MT 505	Casting and Solidification of Materials	3	1	0	3
III.	MT 506	Mechanical working of Materials	3	1	0	3
IV	MT 507	Unit process of Extraction	3	1	0	3
V	MT 508	Non-ferrous Extractive Metallurgy	3	1	0	3
5.		**Open Elective – I (Any One of the Following)**				
I.	MT 509	Powder Metallurgy	3	1	0	3
II	MT 510	Deformation Theory of Metals	3	1	0	3
III	MT 511	Nuclear Materials	3	1	0	3
IV	MT 512	Ceramic and Polymer Materials	3	1	0	3
V	MT 513	Materials Technology	3	1	0	3
		Laboratory / Sessionals				
1.	MT 501P	Laboratory-I (Material Characterization Lab)	0	0	3	1
2.	MT 502P	Laboratory- II (Corrosion Lab)	0	0	3	1
3.	MT 503P	Laboratory-III (Heat Treatment Lab)	0	0	3	1
4.	MT 504P	Laboratory -IV (Physics of Material Lab)	0	0	3	1
5.	DS 501	General Proficiency / Seminar	0	0	2	2
					Total Credit	**22**

Materials Characterization (MT 501)

Course objectives -

To prepare students for careers in metallurgical engineering where knowledge of characterization techniques used to measure thermal properties, metallography, surface morphology, chemical properties, crystal structure etc. of the materials.

Course Detail -

Module 1 - Thermal characterization techniques: - Theory, Instrumentation and Application of Thermo gravimetric Analysis (TGA), Differential thermal analysis (DTA), Differential scanning Calorimetry (DSC). (9 L)

Module 2 - Diffraction method: Principle of X-ray diffraction methods, Brags Law, determination of crystal structure, lattice parameter, crystallite size. (8L)

Module 3 - Optical microscopy techniques: Metallurgical Microscopes, Image formation, resolving power, numerical aperture, empty magnification, depth of focus, components of microscopes, important lens defects and their correction. (10 L)

Module 4 - Electron microscopy: Interaction of electrons with matter, Construction and Working of TEM, SEM with their merits, limitations and applications, modes of operation, Electron beam. (10 L)

Module 5 -Advance Microscopic technique:- Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy. (5 L)

Suggested References/Books -

1. Elton N Kaufmann, **Characterization of Materials,** Willey Publishers, 2003.
2. Ruth E. Whan, ***Material Characterization, Metals Handbook***, Vol 10, ASM, 1986.
3. B.D. Cullity, ***Elements of X-ray diffraction***, Pearson Education, 2014.
4. Douglas B. Murphy and Michael Davidson, ***Fundamentals of Light Microscopy and Electronic Imaging***, Wiley-Blackwell, 2012.

Course Outcomes:- After attending this course, students will have

CO-1: understanding of the basics of common important characterization techniques used in Materials/Metallurgical Engineering field.

CO-2: understanding of the experimental and theoretical basics of techniques used to measure important thermal properties

CO-3: understanding of the basics of techniques used to measure the structural and morphological properties viz electron microscopy, XRD and optical microscopy.

CO-4: understanding at both theoretical and practical level at important characterization tools.

Degradation of Materials (MT 502)

Course Objective-

To introduce students with fundamentals of corrosion, its thermodynamics-kinetic aspect, methods to measure and control it.

Detailed contents

Module 1: Introduction, Definition, Forms of environmental degradation, Classification of corrosion Importance of corrosion studies and cost of corrosion. (4L)
Module 2: Corrosion principles: Electrochemical aspects, Thermodynamic aspects of corrosion – Gibbs energy and electrochemical potential (4L)
Module 3: Metal-Electrolyte Interface, EMF series, Nernst relationship and Pourbaix Diagram (6L)
Module 4. Kinetic aspects of corrosion: Corrosion rate, Current density, Exchange current density, Mixed potential theory, Polarization and Passivation. (6L)
Module 5: Forms of corrosion: Uniform Corrosion, Localized Corrosion; Pitting; Crevice Corrosion, Galvanic Corrosion and Protection; Concentration Cells, Intergranular Corrosion; De-alloying, environmentally assisted failures (SCC, Hydrogen embrittlement; corrosion fatigue), Erosion; Fretting. Experimental methods to identify corrosion susceptibility (9L)
Module 6: Corrosion Measurements and Corrosion Control: Exposure studies, Electrochemical work bench, DC and AC methods of testing, Polarization measurements-Corrosion rate assessment by Tafel's extrapolation method, Linear polarization resistance (LPR).Coatings, Inhibitors, Cathodic and Anodic protection. (9L)

Suggested References/Books-

1. Corrosion Engineering, Mars. G. Fontana, McGraw Hill Education, 2017
2. Electrochemical Techniques in Corrosion Science and Engineering. R.G. Kelly, J.R. Scully, D.W. Shoesmith, R.G. Buchheit, CRC Press., 2002

3. Corrosion: Metal / Environment Reactions, Volume 1, L.L. Shreir, R.A. Jarman, G.T. Burstein, Butterworth-Heinemann, 1994.
4. Principles and Prevention of Corrosion, Denny A. Jones, Pearson, 1995.

Course Outcomes- After attending this course, students

CO-1: will know importance of studying corrosion and its effect of ferrous and non ferrous metals/alloys.
CO-2: will have understanding of the thermodynamic and kinetic aspects of corrosion
CO-3: will have theoretical and practical knowledge of various way to measure and control corrosion rate.

Heat Treatment of Metallic Materials (MT 503)

Course objective-

To impart the knowledge of various heat treatment techniques employed commercially primarily for steel and other important non ferrous metals/alloys.

Module 1 : Objective and variables of heat treatments, Limitation of Fe-Fe3C Phase Diagram. (3L)

Module 2 : Formation of Austenite, TTT and CCT Diagram, Types of TTT Diagram. Application of TTT Diagrams (Martempering, Austempering and Patenting). (5L)

Module 3 : Annealing (Full, Homogenising, Spheroidisation and Stress-relieving annealing), Normalising, Comparison of Annealing and Normalising. (6L)

Module 4 : Hardening and Tempering of plain and alloy steels, Hardening (Objective, Austenitizing temperature and Internal stresses (4L)

Module 5 : Quenching Mediums and Methods, Retained austenite and Defects in hardening. (3L)

Module 6 : Tempering of steels, Aims and stages of tempering, Effects of Carbon and alloying elements, Tempering of alloy steels and Multiple tempering, Embrittlement during tempering. (4L)

Module 7 : Hardenability and its determination, Factors affecting hardenability. Case and Surface hardening: Carburising, Nitriding and Carbonitriding, Induction and Laser Hardening. (6L)

Module 8 : Heat treatments of general engineering steels: Spring, Bearing steels, Tool steels, HSLA steel and Maraging steels, Dual phase steels and Stainless steels. (5L)

Module 9 : Heat Treatments of Al-alloys, Cu-alloys and Ti-alloys. Age-Hardening: Types andsequence of precipitates, Mechanism and kinetics of precipitation. Heat-treatment defects and their rectification. (5L)

Suggested References/Books:

1. B. Zakharov, Heat Treatment of Metals, CBS Publishers.
2. Principles of Heat Treatment of Steels, ASM.
3. R Kumar, Physical Metallurgy of Iron and steels, Asia Publishing House.
4. G. Krauss,Steels: Processing, Structure and Performance, ASM International.
5. K E Thelning, Steel and Its Heat Treatment, Butterworth.
6. W C Leslie, The Physical Metallurgy of Steels, MeGraw-Hill International.

Course Outcomes: After attending this course, students

CO-1: will have comprehension of the fundamentals and importance of heat treatment.
CO-2: will be able to optimise the heat treatment processes used in laboratory as well as in steel industry.
CO-3: will be able to process/product problems where heat treatment is involved in the manufacturing steel industry, design and implement correct heat treatment process.

Physics of materials (MT 504)

Course Objective-

To study the basics of crystallography; semiconductor physics, magnetic materials and XRD.

Module 1: Crystallography: Crystalline and amorphous structures, Elements of Crystal Symmetry, Symmetry elements and axes, two, three, four and six fold Symmetry, Review of atomic bonding. (7L)

Module 2: Order-Disorder Transformation: Ordering, Degrees of long range and short range ordering, Anti phase Domain, Super lattice, Elements of Super lattice Theories, Properties and Applications. (6L)

Module 3: Electron Theory of Materials: Heisenberg's uncertainty Principle, Schrodinger's equation. Free Electron Theory, Zone Theory, Density of States, Fermi Energy Level, Application of Zone. (6L)

Module 4: Theory to Alloy Phases; Conductors and Insulators, Semiconductors, P & N – Type Semiconductors.
(4L)

Module 5: Magnetic Properties: Dia, Para and Ferro-magnetism, Domain Theory of Ferromagnetism Antiferromagnetism and Ferrites, Hysteris loop, Soft Magnetic Materials, Hard Magnetic Materials, Super Conductivity, BCS Theory, Type-I & Type-II Super Conductors. (10L)

Module 6: Elements of X-ray Diffraction: X-ray, Bragg's Law, Laue, Rotating Crystal and Powder Methods, Structure Determination with the help of X-ray.
(8L)

Suggested References/Books:

1. W. Hume Rothery and B. R. Coles – Atomic Theory for Students of Metallurgy. The Institute of Metals (London) (1988).
2. R. E. Reid – Hill, Physical Metallurgy Principles, East – West Press Pvt. Ltd., (New Delhi), (2004).
Supplementary Reading:
1. S. L. Kakani and A. Kakani, Material Science, New Age International Publishes Ltd., (New Delhi) (2004).
2. R. A. Higgins, Engineering Metallurgy, Standard Publishes Distributors (Delhi) (1998).
3. M. S. Vijaya, G. Rangarajan, Materials Science, Tata McGraw Hill Publishing Company Limited (New Delhi) (2004).
4. V. Raghavan, Material Science and Engineering, Princep Hall (New Delhi) (2003).
5. C. S. Barrett and T. B. Massalski, Structure of Metals, Euresia Publishing House (Pvt.) Ltd.

Couse Outcomes- After attending this course, students

CO-1: will have understanding of the basics of theory of crystallography.
CO-2: will have understanding of the basics of physics of semiconductors.
CO-3: will have knowledge of the basics of Magnetism and magnetic materials.
CO-4: will have understanding of the basics of XRD.

Casting and solidification of materials (MT 505)

Course objective:

This course is mainly intended to introduce and explain various moulding- casting techniques and equipment used. Principle of solidification and defects in castings and their remedies are also dealt in details.

Detailed Syllabus:

Module1: Introduction**:** Casting as a process of Manufacturing. Moulding Processes, Equipments and Mechanization**:** Different types of Moulds, Moulding Materials and Moulding processes, Pattern and other mould making equipment,for actingon moulds, Mould factors in metal flow, Moulding factors in casting design. (8L)

Module2: Different types of binders, mould and core-makings. Melting of Metals and Alloys for casting: Brief mention of various melting units, melting and post melting treatments, melting practices as adopted for a few metals and alloys such as Al ,Cu, steels, cast irons. (8L)

Module 3: Solidification of Metals and Alloys: Nucleation, Growth, Role of alloy constitution, Thermal conditions and inherent nucleation and growth condition, Significance and practical control of cast structure. (8L)

Module 4: Principles of Gating and Risering: Feeding characteristics of alloys, Types of Gates and Risers, Time of solidification and Chowrinov rule, Wlodawer system for feeder head calculations, gating ratio, concept of directionality in solidification, Yield of casting and prescription for its augmentation. (8L)

Module 5: Special casting Methods: Investment casting, Die casting, Centrifugal casting, Full mould casting, Vacuum sealed casting. Casting Defects: A detailed analysis of casting defects. Their causes and prescription of remedial measures. (10L)

Suggested Refernces/Books:

1. P. R. Beeley, Foundry Technology, Newnes-Buttterworths,2001.
2. P. D. Webster, Fundamentals of Foundry Technology, Portwillis press, Red hill,1980.

Supplementary Reading:

1. P. C. Mukherjee, Fundamentals of Metal casting Technology, Oxford IBH,1980.
2. R.W.Hein, C.R.LoperandP.C.Rosenthal,PrinciplesofMetalcasting,McGrawHill,1976.

Course Outcomes-

CO-1: To study the various steps in foundry viz molding, sand preparation, core/pattern making, gating system etc.
CO-2: To study the solidification of alloys and metals and same under industrial conditions.
CO-3: To study advanced and other special casting techniques besides traditional sand casting techniques.

Mechanical working of materials (MT 506)

Course objective:

Objective of metal working processes are to provide the desired shape and size, under the action of externally applied forces in metals

Detailed syllabus :

Module 1: Forming processes, effect of metallurgical structure & strain-rate, cold working, recovery, recrystallisation and grain growth, hot working, Stress, Strain fields, strain energy & line tension of a dislocation, Forces on and between dislocations, Dislocation reactions in FCC, BCC and HCP crystals. (8L)

Module 2: Dislocation intersections, Origin, multiplication and observation of dislocations, plasticity of single crystal of FCC, BCC and HCP structures, Twinning, deformation mechanisms of poly-crystalline metals, effect of grain boundary, solute atoms and second phase particles. (9L)

Module 3: Yield point phenomena and strain ageing, Forging processes, forging equipment, Forging in plane strain, Open and closed die forging, Forging defects, Rolling processes, Rolling mills. (7L)

Module 4: Rolling of bars and shapes, Forces and geometrical relationships in rolling, Simplified analysis of rolling load, rolling variables, problems and defects in rolled products, Theories of cold and hot rolling, torque and horsepower. (8L)

Module 5: Extrusion processes, extrusion equipment, Deformation and defects in extrusion, analysis of the extrusion process, Extrusion of tubing and production of seamless pipes and tubes, Rod,wire and tubedrawing, Deep drawing and redrawing, Common defects in sheet metal formed products. (8L)

Suggested References/Books:

1. G. E. Dieter: Mechanical Metallurgy, McGraw Hill Book Company,1988.
2. C.J.Richardson,et.al:Worked Examples inMetal Working,Institute of Metals,London,1985.
3. ASM Hand Book, Vol. 14: Forming and Forging, ASM,1988.

Course Outcomes- After attending this course, students

CO-1: will be able to understand the basisc of dislocation theory and plastic deformation under this theory

CO-2: will have the knowledge of basics of forging tools and operations.

CO-3: will have knowledge industrial metal working processes viz rolling, extrusion, deep drawing etc.

Unit process of extraction (MT 507)

Course Objective-

To impart the knowledge of Pyrometallurgy and its various steps viz, roasting, Calcination Smelting etc.,Basics of hydrometallurgy and electrometallurgy.

Module 1: Principles of Unit processes: Pyrometallurgy processes: Calcination, Principles and types of roasting (Oxidising roasting, Sulphating roasting, Chloridising roasting), Roasting equipment and methods (Multiple hearth, Flash roasting, Fluidized bed roasting,sintering roasting), Predominance area diagrams. Ellingham diagrams for oxides and sulphides. (8L)

Module 2: Pyrometallurgical Processes: Reduction and smelting using Blast furnace and Electric arc furnace, Flash smelting, Converting, Refining processes such as Fire refining, Liquation, Zone Refining, Distillation and Vacuum Refining. (10 L)

Module 3: Pyro-metallurgical processes using vacuum, reduction of halide by another element. Matte smelting, Principles of metallothermic reduction of oxides and halides . (2L)

Module 4: Hydrometallurgical Processes: Hydrometallurgical Process, Advantages and disadvantages of hydrometallurgy, flow sheet of hydrometallurgical steps. (2 L)

Module 5: Leaching: Leaching, Various types of Leaching such as Pressure leaching and Bacterial leaching, Effect of various factors on bacteria, leaching methods such as In-situ, Heap, and Percolation leaching,Solution purification methods (Recovery of metal from leach liquor) such asIon exchange ,Solvent extraction,and precipitation Cementation. (10 L)

Module 6: Electrometallurgical Processes: Principles of electrometallurgy, Faraday's laws of Electrolysis, Electrolysis of Aqueous solutions ,Electrolysis of fused sants and Molten salts processes, Electrolysis of fused salts, Electrode potential, Applications of electrode potentials, Kinetics of electrode processes, Electrolytic Cell, Cells and thermodynamic relations,Concentration Polarization, Elementary theory of Electrolytic decomposition. Electroplating process. (10 L)

Suggested References/Books:

1. C. Bodsworth, Extraction and Refining of Metals, CRC Press, 1994.
2. A. Ghose and H. S. Ray, Principles of Extractive Metallurgy, Wiley Eastern, 1991.

3. H. S. Ray, R. Sridhar, K. P. Abraham, Extraction of Non-ferrous Metals, Affiliated East-West Press Pvt. Ltd., New Delhi-1985.

4. T. Rosenquist, Principles of Extractive Metallurgy, McGraw hill, 1974.
5. R. D. Pehike, ***Unit Processes of Extractive Metallurgy***, American Elsevier, N. Y., 1968.

Course Outcomes: After attending this course, students

CO-1: will have knowledge of the principles of fire refining, liquation, distillation refining and zone refining.
CO-2: will have knowledge of principles of electro-metallurgy.
CO-3: will have understanding of the metal recovery of a hydrometallurgical process.
CO-4: will have knowledge of the percent reduction of metal from its ore by pyro-metallurgical route.

Non Ferrous Extractive Metallurgy (MT 508)

Course Objective- To introduce students with the thermodynamic fundamental for extraction of non ferrous metals through various commercial routes and knowledge of extraction common industrial metals

Module-1: Brief Introduction of Non Ferrous Ores ore & mineral; Thermodynamics & kinetics of metal extraction from oxides , sulphides & other forms: metal slag equilibria, Ellingham Diagram for oxides and sulphides (20L)

Module-2: Unit processes in Pyrometallurgy: Classification and design aspects of roasting process and equipment, calcinations, different types of smelting, refining, Predominance diagram, Extraction of common metals, Cu, Ni, Zn, Pb, Al, Au & Ag, Cr,Ti, etc and important rare earth metals; Secondary Metals extraction from waste products & slag. (10L)

Module-3: Unit processes in Hydrometallurgy: E-pH diagram, Leaching, Solvent extraction, Ion Exchange, precipitation, cementation, Unit processes in Electrometallurgy: Electrowining, Electrorefining, Cell potential, polarization, Electrolytic production of metals from aqueous & Fused salt electrolytes. (12L)

Suggested reference/books-

Extraction of Non-ferrous Metals, H. S. Ray, R. Sridhar and K. P. Abraham, Affiliated East-West Press. 2. Principles of Extractive Metallurgy -A. Ghosh and H. S. Ray, John Wiley & Sons. 3. Extractive Metallurgy by Joseph Newton, John Wiley & Sons. 4. Principles of Extractive Metallurgy., T. Rosenquist, McGraw Hill 5. Metallurgy of the Non ferrous metals, by W.H. Dennis, Pitman, London 1963. 6. Nuclear Reactor Fuel Elements – Metallurgy and Fabrications – Kaufmann 7. C.G. Krishnadas Nair, Non-ferrous Metals strategy cum source book, IIM publication. 8. R.Bhimarao, K. Srinivasrao and Vibhuti N. Mishra, Non-ferrous Metals in the New Millennium, 2001.

Course Outcomes- After attending this course, students

CO-1: would be able to understand the fundamentals of thermodynamic reactions required for extraction, stability of various phases etc

CO-2: will have knowledge extraction of common industrially important metals

CO-3: will have understanding of basics of electrometallurgy and hydrometallurgy

Powder metallurgy (MT 509)

Objectives of the course:

Technical knowledge and understanding of powder methodology salient features of the process contrast to others .Analysis of the problem and providing the solution.

Detailed contents

Module 1: Powder production: Mechanical, Chemical and Electrochemical methods, Atomization and other emerging processes, High energy ball milling, mechanical alloying and applications, self-propagating high temperature synthesis. Performance Evaluation of different Processes, Design and Selection of Process. (8L)

Module 2: Powder characterization: Particle Size, Shape, Distribution and morphology, Tap density, green density, Inter-particle Friction, flowability and surface Area, Particle porosity. Compressibility. (8L)

Module 3:Blending and mixing of powders-equipment, Lubricants & Binders, Particle Packing Modifications. Powder compaction: Powder Compaction: die compaction, process variables, density distribution during compaction, Isostatic Pressing, Cold and hot isostatic pressing, Injection Molding, Powder Extrusion, Slip Casting, Tape Casting. (8L)

Module 4: Sintering: Theory of Sintering, Sintering mechanisms, Sintering Variables, Sintering furnaces and atmospheres, Pressure less sintering, Liquid Phase Sintering, and Sintering of Single & Mixed Phase Powders. Modern Sintering Techniques: spark plasma sintering, microwave sintering. (8L)

Module 5: Defects in P/M route and their control, treatment of powder metallurgy Components. (2L)

Module 6: Testing and quality control, metallic and ceramic P/M components, application of P/M products. Applications of Powder Metallurgy: Filters, Tungsten Filaments, Self-Lubricating Bearings, Porous Materials, ODS Alloys, Biomaterials and Case Studies. (8L)

Suggested books

1. Powder metallurgy: science, technology and materials –Anish Upadhyaya, G.S.Upadhyaya, Universities Press (2011).
2. Power metallurgy: science, technology and materials – P.C. Angelo, R. Subramanian, Prentice Hall India Learning Pvt. Ltd., (2008).
3. Materials and processes in manufacturing, by De GARMO, BLACK & KOHSER,PHI,Publication.

Course Outcomes

After attending this course, the student will be able to

CO-1: Understand different stages of manufacturing using the powder metallurgy route

CO-2: Describe characteristics of a P/M components.

CO-3: Explain the causes, identification & remedies of defects that the arises during working in this field.

CO-4: Analyze the material and design needs of P/M components.

Deformation theory of metals (MT 510)

Course Objectives-

To impart the knowledge of basics of elasticity and plasticity; deformation behavior of materials through dislocation theory.

Course Content

Module 1 : Elastic Behaviour: Concept of elasticity in three dimensions, Generalised Hook's Law, Plane stress and plane strain state, Strain energy, Stress intensity factor, Concept of finite element method. (8L)

Module 2 : Theory of Plasticity: Flow curve; Yield criteria, Plastic stress strain relationship. (8L)

Module 3 : Dislocation Theory: Line defects, Deformation by slip, Theoretical shear strength, Critical resolved shear stress, Burger's vector and dislocation loop, Edge, Screw, Mixed and Partial dislocations, Dislocation reactions, Dislocations in FCC and BCC crystals, Cross slip and climb of dislocations, Interaction of dislocations, Energy of dislocations, Forces on dislocations, Dislocation sources and multiplication of dislocations. Dislocation pile-ups and Bauschinger's effect. (8L)

Module 4 : Strain hardening in single crystals and polycrystals, Yield point phenomenon, Strain aging, dynamic strain aging, Strengthening mechanisms. (8L)

Module 5 : Deformation Twinning: Classification, Slip vs. twinning, Stress for twinning. (10L)

Suggested Reference/ Books:

1. G. E. Dieter, Mechanical Metallurgy, McGraw Hill Publication, 1988.
2. D. Hull and DC Bacon, Introduction to Dislocation, Elsevier Butterworth – Heinemann, Pub., 4th Ed. (2001).
3. Wole Soboyejo, Mechanical Properties of Engineering Materials, Marcel Dekker Publication, 2003.
4. R. W. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, John Wiley & Sons Publication, 1995.
5. R. E. Reed–Hill, Physical Metallurgy Principals, Litton Education Publication, 2004

Course Outcomes- After attending this course, students

CO-1: will have comprehension of mechanism of deformation of materials.
CO-2: will have understanding of dislocation theory, strain hardening, strenghthening mechanism.
CO-3: will have knowledge of deformation theory through finite element method.

Nuclear materials (MT 511)

Course Objectives

Understanding the basics of radiation theory; concept of fission and fusion of reactions; mechanism to select materials for nuclear reactor; present and future challenges of nuclear energy.

Course Content:

Module 1 :Nuclear radiation, microscopic flux and microscopic cross-section, attenuation of radiation fission, elastic collision slowing down infinite multiplication constant.(15L)

Module 2: Fuel and breeder materials manufacture and properties.(12L)

Module 3: Structural materials, Radiation damage in fuel elements, Structural coolant and control rod materials, and Nuclear power, present and future states.(15L)

Suggested Reference Books:

1. Bodansky, Nuclear Energy: Principles, Practices and Projects, Springer, 2004.
2. C.A. Hampel, Rare Metals Handbook, Robert E. Krieger Publishing Company, 1971.
3. S. Glasstone and A. Sesonke, Nuclear Reactor Engineering, CBS Publishers and Distributors, Delhi, 2003.

Course Outcomes- After attending this course, students

CO-1: Will hold the comprehension of concept of radiation theory.
CO-2: basics of fission and fusion of reactions.
CO-3: Will be able to justify the criteria to choose materials for nuclear reactor.
CO-4: Will understand the present and future challenges of nuclear energy.

Ceramic and polymer materials (MT 512)

Course objective:

Develop an awareness of careers related to various areas in ceramics. Also to provide the basic building blocks of polymer science by imparting fundamental knowledge of molecular weight, polymerization mechanism, polymer reactions and environmental awareness & polymer science.

Detailed Syllabus:

Module1: Introduction of ceramics, Common ceramics crystal structures: silicates,clay,minerals, graphite and carbides. Classification and applications of ceramics materials. Raw materials preparation, Different structural ceramics: their properties and applications. (8L)

Module2: Mechanical behaviour of different structural ceramics-brittleness of ceramics,Concept of fracture toughness and different toughness measurement techniques, Elastic modulus, Strength measurement, Weibull theory. (8L)

Module 3: Basic concepts in polymer science, various polymerization mechanisms, polymerization techniques and molecular weight. Free radical polymerization: initiators, chain transfer, inhibition and retardation; Cationic and anionic polymerization: initiators; Kinetics of free radical, cationic and anionic polymerization reactions, an overview of solid phase and gas phase polymerization. (8L)

Module 4: Polycondensation, polyaddition and ring-opening polymerization, need for stoichiometric control, gelation, crosslinking, Carother's equation,kinetics of step polymerization, an overview of interfacial and melt polymerization technique. (8L)

Module 5: Step copolymerization: introduction, types, methods of synthesis; Chain copolymerization: introduction, types, copolymerization equation, monomer reactivity ratio, applicability of copolymerization equation, types of copolymerization behavior, sequence length distribution, Q-e scheme; Commercial applications of copolymerization.(10L)

Suggested References/Books:

1. W. D. Kingery, H. K. Bowen, D. R. Uhlmann, *Introduction to Ceramics*, Wiley Publishers, 1986.
2. Randall German, John Wiley & Sons, *Powder Metallurgy*,2006.
3. M. N. Rahaman, Marcel Dekker, *Ceramic processing & Sintering*,1995.

Course Outcomes- After attending this course, students

CO-1: will have understanding of importance ceramics, their crystal structure and major applications.
CO-2: will be knowing the important mechanical properties, parameters and their measurement for various applications.
CO-3: will be able to understand the basic mechanism happening in major polymerization reaction, their thermodynamics and kinetics.

Materials technology (MT 513)

Course Objectives

Understanding the basics of material science; the several heat treatment processes, the several characterization techniques, radiographic testing of materials.

Course Content:

Module 1 : Metallic Materials: Concept of phase diagram crystallography and microstructure, Steels, Different types of Steel, Iron-Iron Carbide phase diagram, TTT and CCT diagrams. (5L)
Module 2 : Heat-Treatment of steels: Annealing, Normalizing, Hardening and Tempering of steels, Plain carbon steels and their applications. (5L)
Module 3 : Alloy steels: High speed steels, stainless steels, HSLA; (5L)
Module 4 : Non Ferrous alloys: Al alloys, Cu alloys, applications of these alloys, Magnesium alloys, Titanium alloys and Zirconium alloys. (5L)
Module 5 : Electrical and Magnetic properties of materials: Band Structure, Conductors, Insulators, semiconductors, superconductors, p-n junction and application of these properties. (5L)
Module 6 : Engineering polymers and composites: Thermoplastics, Thermosetting polymers, processing of composites, Hybrid composites. Ceramics: Different ceramics available, Properties of ceramics, Crystal structure, Overview of Ceramic Applications, Processing of ceramics, Densification and sintering, (5L)

Module 7 : Mechanical properties and characterization. Mechanical Characterization: Tension test, Fatigue test, Creep test, Hardness, Impact Tests, Fracture of materials, Modes of fracture. Non Destructive Testing: (5L)

Module 8 : Ultrasonic Radiography, X-ray diffraction, Crystal Structure, Bragg's law, Liquid penetrant testing, Ultrasonic testing, Electromagnetic testing, Acoustic emission testing, Magnetic resonance imaging and NMR spectroscopy. (5L)

Suggested Reference/Books:

1. Van Vlack L H, ***Elements of Material Science and Engineering***, ISBN: 8131706001 ISBN-13: 9788131706008, Addison Wesley,6th edition, 1967.

2. W. F. Smith, ***Principles of Materials Science and Engineering (McGraw Hill Series in Materials Science and Engineering),*** McGraw-Hill College; 3rd edition (1995) ISBN-10: 0070592411. ISBN-13: 978-0070592414

3. William D. Jr. Callister, Wiley, ***Materials Science and Engineering: An Introduction***, 7th edition (2006) ISBN-10: 0471736961.

Course Outcomes- After attending this course, students will have,

CO-1: Understanding the basics of material science.
CO-2: Study the several alloys and heat treatment processes.
CO-3: Understanding the several characterization techniques and testing.
CO-4: Study the radiographic testing of materials.

DEPARTMENT OF METALLURGICAL ENGINEERING

BIT, SINDRI, DHANBAD

6th Semester Course Structure

Sl. No.	Course No.	Subject	L	T	P	Credit
1.	MT 601	Iron Making (Professional Core Course-I)	4	1	0	4
2.	MT 602	Material Forming Technology (Professional Core Course-II)	3	1	0	3
3.	MT 603	Non-ferrous Technology (Professional Core -III)	3	1	0	3
4.		**Professional Elective – II (Any One of the Following)**				
I.	MT 604	Mechanical Behaviour of Materials	3	1	0	3
II.	MT 605	Creep Fatigue and Fracture	3	1	0	3
III.	MT 606	Experimental Techniques in Materials Engineering	3	1	0	3
IV	MT 607	Computational Material Engineering	3	1	0	3
5.		**Open Elective – II (Any One of the Following)**				
I.	MT 608	Joining of Materials	3	1	0	3
II	MT 609	Nano Science and Nano Technology	3	1	0	3
III	MT 610	Surface Engineering	3	1	0	3
IV	MT 611	Advanced Materials	3	1	0	3
V	MT 612	X- Ray Difraction and Electron Microscopy	3	1	0	3
		Laboratory / Sessionals				
1.	MT 601P	Laboratory -I (Extractive Metallurgy –I Lab.)	0	0	3	1
2.	MT 602P	Laboratory -II (Mechanical Testing Lab.)	0	0	3	1
3.	MT 603P	Laboratory -III (Extractive Metallurgy-II Lab.)	0	0	3	1
4.	MT 607P	Laboratory -IV (Computational Engineering. Lab.)	0	0	3	1
5.	IN 601	Internship/Tour & Training / Industrial Training	0	0	2	2
					Total Credit	**22**

6th Semester Syllabus / Course Content

Iron Making (MT 601)

Course objective: To know the importance of the Iron making and to apply them for the advancement of the production feasibilities in Industries to compete with the modern day manufacturing routes.

Module 1 : Blast furnace raw materials and their properties: Iron Ores, agglomerates and coke, Preparation of ores: sintering and pelletizing. Blast furnace burdening and distribution, testing of raw materials for blast furnace. (5L)

Module 2 : Blast furnace profile: Constructional feature of blast furnace, profile, Stove and gas cleaning units, instrumentation, refractories used in blast furnace. Charging mechanism, Bell and bell-less charging systems. (5L)

Module 3 : Blast furnace reactions: Physico-chemical principles of blast furnace, Reaction in stack, tuyere zone, bosh and hearth. Thermodynamics equilibria, Direct and indirect reduction, Kinetics of iron oxide reduction.Formation of primary and bosh slag, slag composition.Slag-metal reactions, Desiliconization, Desulphurization. (15L)

Module 4 : Blast furnace operation: Blast Furnace irregularities and remedial measures, operational steps, blast furnace gas properties, cleaning and utilization. (5L)

Module 5 : Modern Developments: High top pressure, Humidified and oxygen enriched blast and auxiliary fuel injection through tuyers and their effect on productivity and coke rate. (5L)

Module 6 : Alternative methods of iron making: DRI, MIDREX, COREX, SL/RN, HYL-III, Fluidised bed reactor, Hismelt. (5L)

Suggested References/Books:

1. Ahindra Ghosh and Amit Chatterjee: Ironmaking and Steelmaking Theory and Practice, Prentice-Hall of India Private Limited,
2. R.H.Tupkary, Khanna Publishers `
3. Anil K. Biswas: Principles of Blast Furnace Iron making, SBA Publication, 1999.

Course outcomes:

After attending this course, the student would be able to:

CO-1: know different kinds of furnaces and their ancillary equipment used for Iron making

CO-2: hold understanding of thermodynamics and kinetics of major reactions during iron making

CO-2: Analyze the irregularities and cause of failures in blast furnace and apply the remedial measures for immediate rectification.

<u>Metal Forming Technology (MT 602)</u>

Course objectives -

- To develop the fundamental aspects of mechanics of deformation and fracture of materials.
- To provide knowledge about various metal forming operations, their process parameters, and mathematical equations associated with the process.
- To develop the ability to solve the problem which encounters during metal forming

Course Detail -

Module 1: Fundamentals of Metal Working: Classification of forming processes; Temperature in Metal– working, Hot working, Cold working and Warm working of metals, Heating of metals and alloys for hot working, Friction in Metal working, Lubrication, concept of yield criteria. (6L)

Module 2: Rolling of Metals: Classification of Rolled products, Types of rolling mills, Terminology used in rolling; Forces and Geometrical relationships in rolling, rolling variables, Theories of rolling, Rolling Torque and HP calculations. Roll-pass Design: Fundamentals of Roll-pass-design; Mill type, Layout and rolling practice adopted for some common products such as Slabs, Blooms, Billets, Plates, Sheets etc. Rolling defects and their control. (8L)

Module 3: Forging of Metals: Forging principles, types of forging and equipment needed; calculation of forging load under sticking and slipping friction conditions. Forging defects and their control. Manufacture of rail wheels. (6L)

Module 4: Extrusion: Types, Principles and Equipment. Variables in extrusion, deformations in extrusion, calculation of extrusion pressure under plane strain conditions; extrusion defects; production of tubes and seamless pipes. (8L)

Module 5: Wire Drawing: Drawing of Rods, Wires and Tubes, calculation of drawing load; drawing defects. (6L)

Module 6: Sheet Metal Forming: Forming methods such as bending, stretch forming, shearing and blanking, deep drawing, and redrawing. Defects in formed products. Special forming methods such as explosive forming (elementary ideas excluding mathematical treatment). (8L)

Suggested References/Books:

1. G. E. Dieter, Mechanical Metallurgy, Mc Graw Hill-1988
2. Roll pass Design, the united steel companies Ltd., U. K. -1960
3. Metal Forming: Fundamentals and Applications by Taylan Altan (ASM Series in Metal Processing)

Course Outcomes: After attending this course,

CO-1: Students will be able to solve the numerical problems to calculate stresses on inclined planes.

CO-2: Student will be able to apply theory of failure for the given process.

CO-3: Student will estimate the working loads for pressing, forging, wire drawing etc. processes.

Non ferrous technology (MT 603)

Course objective: A thorough knowledge of this topic helps an engineer for selecting of non ferrous and an alloy for a component or structure. To evaluate the various microstructure of the non-ferrous metals and alloys using microscope and apply the concepts to make tailor made materials for given engineering design and applications.

Module 1: General principles of extraction of metals from oxides and sulphides; Mineral resources of non – ferrous metals in India, Future of non – ferrous metal industries in India. (6 L)

Module 2: Introduction : Pyrometallurgy, Hydrometallurgy and Electrometallurgy processes, Kinetics of leaching of ores , Ion exchange and solvent extraction processes. (4 L)

Module 3 : Aluminium: Sources of aluminium, Bayer's process and factors affecting its operation; Hall – Heroult process: principle & practices, anode effect, Cause of anode effect ; Refining of Aluminium; Alternative methods of Alumina and Aluminium production like Alcoa process,Toth process, ALCAN process. Uses of Aluminium. (5L)

Module 4 : Production and refining of Cu from Sulphide ores. Newer processes like Noranda, Mitsubishi and WORCRA in Cu extraction, Flow sheet of hydrometallurgy process of copper. (5 L)

Module 5 : Zinc: Production and refining of Zn from Sulphide ores. ISP process for Zn extraction , Applications of Zn. (4 L)

Module 6: Lead: Production and refining of Pb from sulphide ore. (4L)

Module 7 : Magnesium ores, methods of Magnesium extraction from oxide ores and Sea water. (4 L)

Module 8: Other Metals: Simplified flow sheets and relevant chemical principles of extraction of Ni, Ti, Sn,Zr ,U, etc. (10 L)

Suggested References/Books:

1. Extraction of Non-ferrous Metals, Affiliated East- West Press, 2001– H. S. Ray, K. P. Abraham and R. Sridhar .
2. K Grjotheim & B J Welch: Aluminium Smelter Technology, Aluminium – Verlag, 2nd Edn. 1988.
3. A K Biswas & W G Devenport: Extractive Metallurgy of Copper, Pergamon, 4th Edn. 2002.
4. W H Dennis, Metallurgy of Non – Ferrous Metals, Pitman, London, 1954.
5. J N Anderson & P Queneau, Pyrometallurgical Processes in Non – Ferrous Metallurgy, Gorden & Breach, New York, 1967.
6. N Sevryukov, Non – Ferrous Metallurgy, Trans. By I V Savin, Mir Publishers, Moscow, 1975.
7. J L Bray, Non – Ferrous Production Metallurgy, John Wiley, New York.
8. R D Pehlke, Unit Processes of Extraction Metallurgy, Elsevier, Amsterdam, 1982.

Course outcomes: At the end of this course, the students

CO-1: Will have the knowledge of extraction of important non ferrous metals from its ore.
CO-2: Will have knowledge of other routes of extraction besides pyrometallurgical route of extraction.

CO-3: Will have understanding of thermodynamics and kinetics of major reactions that take place during extraction.

Mechanical Behavior of Materials (MT 604)

Course objectives -

- Primary objective is to present the basic fundamentals of failures of the materials.
- Help students to possess a solid foundation in advanced materials with emphasis on the fundamental engineering principles that govern the properties, processing and their applications.
- To apply the different methods or techniques in improving the properties of materials

Course Detail -

Module 1: Tensile Behavior of Metals: True stress-true strain curve, Strain hardening coefficient, Instability in tension, Effect of strain rate and temperature on flow properties. (8L)

Module 2: Fracture: Theoretical cohesive strength of metals, Griffith's theory of brittle fracture, Mechanism of brittle and ductile fracture, Fractographic aspects of fracture, Notch effects. (9 Hours)
Module 3: Impact Behavior: Notched bar impact test, Transition temperature phenomenon, Factors affecting transition temperature. (6L)
Module 4: Fracture Mechanics: Strain energy release rate, Stress intensity factor, Plane strain fracture toughness, Design approach (6L)
Module 5: Fatigue: Micro mechanisms of crack initiation and growth, Stress and strain approaches of fatigue, Fracture mechanics approach, Fatigue crack growth (6L)
Module 6: Environmental Assisted Cracking: Stress corrosion cracking, Hydrogen embrittlement, Corrosion fatigue. (4L)
Module 7: Creep: Creep curves, Mechanisms of creep, Stress rapture test, Life prediction, High temperature alloys. Composites: Fracture and fatigue of composites. (6L)

Suggested references/Books:

1. G E Dieter, Mechanical Metallurgy –McGraw – Hill Publication (1988).
2. R W Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, John Wiley & Sons Publication (1995).
3. R E Reed, Physical Metallurgy Principals —Hill Litton Education Publication (2004).
4. W. Soboyejo, Mechanical Properties of Engineering Materials –Marcel Dekker Publication (2003).

Course Outcomes: After attending this course, students

CO-1: will be able to Explain the theories of elastic and plastic behaviour of materials.
CO-2: will be knowing different mechanical testing methods of materials.
CO-3: will have knowledge the strengthening mechanisms of materials
CO-4: will have knowledge various modes of failure mechanisms in materials

Creep, Fatigue and Fracture (MT 605)

Course Objectives

- Study the fracture mechanism of mechanical equipment.
- Understanding of wear behaviour of components.
- Understanding strengthening mechanism of materials.
- Study the creep, fatigue, and fracture for the materials

Course Content:

Module 1 : Fracture- use of fracture mechanics in the prediction of mechanical failure, Griffiths analysis concept of energy release rate and fracture energy, Linear Elastic Fracture Mechanics, (LEFM)- Loading modes, stress ahead of the crack tip, stress concentration factor, stress intensity factor and the material parameter the critical stress intensity factor, Plasticity at the crack tip and the principles behind the approximate derivation of plastic zone shape and size, limits on the applicability of LEFM. (10L)

Module 2 : The effect of constraint, definition of plane stress and plane strain and the effect of component thickness, Elastic-Plastic Fracture Mechanics (EPFM)- Alternative failure prediction parameters, Crack Tip Opening Displacement, and J integral, measurement of parameters and examples of use, Effect of Microstructure on fracture mechanism and path, cleavage and ductile failure, factors improving toughness, (10L)

Module 3 : Fatigue- High Cycle Fatigue, Low Cycle Fatigue, mean stress, R ratio, strain and load control, S-N curves, Goodman diagram, fatigue limit, mechanism of fatigue failure, effect of stress concentration, specimen size, Total life and damage tolerant approaches, Paris law. (10L)

Module 4 : Creep- Creep curve, creep properties of metals, stress-rupture test, deformation and fracture at elevated temperature, theories of creep, prediction of long time properties.. Effect of metallurgical variables on creep, Creep resistant materials. (10L)

Suggested references/books:

1. G. E. Dieter: Mechanical Metallurgy, McGraw Hill, 1988.
2. Michael Kassner: Fundamentals of Creep in Metals and Alloys, 2nd Edition, Elsevier Science, 2009.

Course Outcomes: After attending this course, students

CO-1: Will have knowledge and understanding of basics of elastic and plastic fracture mechanics.
CO-2: Will have knowledge of various mode of fracture.
CO-3: Will have basic knowledge of high temperature deformation

Experimental Techniques in Materials Engineering (MT 606)

Course objectives –

- To obtain knowledge on various structural and microstructural characterization techniques of materials.
- To study the principles, theory and practice of various characterization techniques

Course Detail -

Module 1: Optical Microscopy and Image analyser: Understanding of image formation, resolution, numerical aperture, magnification, depth of field and depth of focus of a microscope. Quantitative and phase analysis (inclusion, size distribution etc.). (7L)
Module 2: X-ray diffraction and analysis: Production and properties of X-rays, X-ray diffraction, Structure factor and intensity calculations. (7L)
Module 3: Effect of texture, particle size, micro strain on diffraction lines. Indexing of powder photographs. X-rays florescence: basics and applications in materials science. (7L)
Module 4: SEM and FESEM: Principle and applications, Modes of operation, Image formation - plane and fractured surfaces. Microanalysis (EDX, WDS etc.) (7L)
Module 5: TEM: Principle and operation. Bright field and dark field images, Sample preparation techniques. Selected area diffraction, Reciprocal lattice and Ewald sphere construction, indexing of selected area diffraction patterns. (7L)
Module 6: Advanced Characterization Techniques: STEM, AFM, Nanoindentation Testing, EELS- Principle and applications. DTA/DSC-TG: Scope and applications in materials science. (7 L)

Suggested references/books:

1. B. D. Cullity, Elements of X-ray Diffraction (II edition), Addison-Wesley Publishing Co. Reading, USA, 1978.
2. P. J. Goodhew and F. J. Humphreys, Taylor and Francis, Electron Microscopy and Analysis, London, 2001(ISBN-0-7484-0968-8).
3. S. H. Cohen and Marcia L. Light body (Editors), Atomic Force Microscopy / Scanning Tunnelling Microscopy, Plenum Press, New, York, 1994.
4. P. J. Haines (Editor), Principles of Thermal Analysis and Calorimetry Royal Society of Chemistry (RSC), Cambridge, 2002.
5. G. F. Vander Voort, Metallography: Principles and Practice ASM International, Materials Park, USA, 1984
6. S. Amelinckx, D. van Dyck, J. van Landuyt and G. van Tendeloo (Editors), Electron Microscopy: Principles And Fundamentals, VCH, Weinheim, 1997.
7. C. Suryanarayana and M. Norton, X-ray Diffraction, A Practical Approach, Plenum Press, New York, (1998).
8. Metallography and Microstructures, Metals Handbook, Volume 9, 9th edition, American Society for Metals, Metals Park, Ohio,1986.
9. Materials Characterization, Metals Handbook, Volume 10, 9th edition, American Society for Metals, Metals Park, Ohio, 1986.

Course Outcomes: After attending this course, students

CO-1: will have Understanding of the principles of optical and electron microscopy.

CO-2: will be able Interpret optical and electron micrographs.

CO-3: will be able to describe composition analysis techniques in SEM.

CO-4: will have understanding of the principle of XRD, thermal analysis techniques includes DSC and TGA.

CO-5: will be able to choose correct characterization techniques for a given range of metallurgical problem.

Computational Materials Engineering (MT 607)

Course objectives -

- To acquaint the candidate with the ability of programming languages and various software packages like COMSOL, MATLAB, etc.
- To impart the knowledge and understanding of physical and chemical properties of complex materials.
- To make them understand molecular dynamics, thermodynamics, phase diagrams and processes of modelling.
- To develop the ability of designing of new materials with modified properties.

Course Detail -

Module 1: Review of Computer Basics and programming, Techniques in Computer simulation, Finite element analysis, Monte Carlo methods. (6L)

Module 2: General Methodology, Understanding of the physical and chemical properties of complex materials by applying molecular dynamics, Monte Carlo method, and continuum mechanics. (8L)

Module 3: Thermodynamics and Phase Diagrams, Kinetics & Microstructure Modelling, Process Modelling, Integrated Selection of Materials and Processes, Calculation of materials properties starting from microscopic theories. (12L)

Module 4: Neural Networks, Fuzzy Logic, Genetic Algorithms, Molecular Modelling, Cellular Automata. (7L)

Module 5: Designing of new materials, modifying materials properties and optimizing chemical processes. (6L)

Module 6: Practical examples and programming in computational materials engineering. (3L)

References:

1. K. Ohno, K. Esfarjani, and Y. Kawazoe: Computational Materials Science - From Ab Initio to Monte Carlo Methods, Springer, 1999.
2. Koenraad George Frans Janssens, Dierk Raabe, et al: Computational Materials Engineering- An Introduction to Microstructure Evolution, Academic Press, 2007.
3. June Gunn Lee: Computational Materials Science, CRC Press, 2011.
C R A Catlow: Computational Materials Science, IOS Pr Inc., 2003.

Course Outcomes: After attending this course, students

CO-1: will be able to approach the problem through modelling in materials engineering.

CO-2: will be able to use software to code and analyze the possible outcomes.

Joining of Materials (MT 608)

Course objectives -

1. Technical knowledge of joining of materials.

2. Analysis of problems come into the way of joining and its remedies.

3. Metallurgy behind the joining techniques.

Course Detail -

Module 1: Introduction: Principle, Theory and Classification of welding and other joining processes. (2L)
Module 2: Manual metal arc (MMA): Equipment requirement, electrodes for welding of structural steels, coating constituents and their functions, types of coatings, current and voltage selection for electrodes. (6L)
Module 3: Arc welding power sources; Conventional welding transformers, rectifiers and current and voltage. The influence of these power sources on welding. Metal transfer. Submerged arc welding (SAW): Process details, consumables such as fluxes and wires for welding mild steel, Variations in submerged arc welding process. (6L)
Module 4: Gas metal arc welding (GMAW) or MIG/ MAG welding: Process details, shielding gases, electrode wires, their sizes, and welding current ranges. TIG welding: Process details, power sources requirements, electrode sizes and materials, current carrying capacities of different electrodes, shielding gases, application of process. (8L)

Module 5: Resistance welding: General principle of heat generation in resistance welding, application of resistance welding processes. Process details and working principle of spot, seam, and. projection welding, electrode materials, shapes of electrodes, electrode cooling, selection of welding currents, voltages. (8L)

Module 6: Welding metallurgy of carbon and alloy steels, Cast irons, Stainless steels, Al- and Cu-based alloys. Weldability and Heat affected zones (HAZ). Welding defects and detection techniques.
Soldering and brazing: Difference between both the processes, consumables used, methods of brazing, fluxes used, their purposes and flux residue treatment. High energy density welding techniques like: Electron beam welding and laser welding technique. (12L)

Suggested refernces/books:

1. J F Lancaster, Allen and Unwin, Metallurgy of Welding.
2. R L Little, Welding and Welding Technology, TMH.
3. J Norrish, Woodhead, Advanced Welding Processes.
4. K Weman, Woodhead. Welding Processes Handbook.
5. Welding technology & Design by V.M.Radhakrishnan, New Age International publication.

Course Outcomes-After attending this course, students will be able to

CO-1: Classify and differentiate welding processes.
CO-2: explain heat flow in welding.
CO-3: Identify various defects and remedial measures in weldment.
CO-4: Complete concept of welding metallurgy.

Nano Science and Nano Technology (MT 609)

Course objectives -

- To foundational knowledge of the Nanoscience and related fields.
- To make the students acquire an understanding the Nanoscience and Applications
- To help them understand in broad outline of Nanoscience and Nanotechnology.

Course Detail -

Module 1: Significance of Nano materials, properties of materials at Nano level, Nano clusters, synthesis of metal and ceramic Nano materials, classical, chemical and biological methods, carbon Nano tubes, aerogels, zeolites and special nanomaterials, Changes in order behaviour and compositional changes due to reduction in size. (6L)
Module 2: Carbon Nano structures- carbon molecules, carbon clusters, carbon Nano tubes-synthesis, formation mechanisms, strength, separation, stability and applications, Properties of Nano materials- Mechanical and structural properties, Elastic and plastic behaviour of Nano materials. Effect of temperature and nature of dislocations and their mobility super plasticity in Nano materials, improvements in strength and ductility. (10L)
Module 3: Nano indentation, principles and mechanisms leading to enhanced properties of composite materials, Fatigue, super plastic behaviour of Nano grained materials, Nano control for high strength and high ductility in light weight alloys. (4L)
Module 4: Ceramic Nano systems- Nano ceramic powders, Nano grained ceramics, Quantum effects, quantum confinement, quantum wells, wires and dots, effect of size reduction on optical, electrical, electronic, mechanical, magnetic and thermal properties of materials due to size. Surface effects, Nano electronics, Differences between Nano and microelectronics, 1-D, 2-D, 3-D Nano structures, Nano fluidics, Nano layered composites, Nano filamentary and Nano wire composites. (11L)
Module 5: Nano particulate composites, Capacity building in Nano materials such as capacitors, superconductors, super capacitors etc., (6L)
Module 6: Nano electromechanical systems (NEMS) organic optoelectronic nanostructures, photonic crystals, biomimetic Nano structures. (5L)

Suggested References/books:

1. Sulabha K. Kulkarni: Nanotechnology Principles and Practices, Capital Publishing Company, 2007.
2. H. Hosono, Y. Mishima, H. Takezoe and K.J.D Mackenzie: Nanomaterials- From Research to Applications, Elsevier Ltd., Noida, 2008.
3. Massimilano Di Ventra, S. Evoy and James R. Heflin, Jr.: Introduction to Nanoscale Science and Technology, Springer, Noida, 2009.
4. Charles P. Poole Jr. and Frank J. Owens: Introduction to Nanotechnology, Wiley India, 2010.

Course Outcomes: After attending this course, the student will be able to:

CO-1: Indicate the differences between nanomaterials and conventional materials
CO-2: Indicate how specific synthesis techniques can result in nanomaterials
CO-3: Give examples of specific nanomaterials and explain the scientific reasons for the properties displayed by them.
CO-4: Describe how specific characterization techniques can be used to analyze nanomaterials
surface

Surface Engineering (MT 610)

Course Objectives

- Understanding the theory degradation of materials.
- Study the different types of materials degradation.
- Study the different surface modification techniques.
- Study the advanced surface modification techniques.

Course Content:

Module 1 : Introduction tribology, surface degradation, wear and corrosion, types of wear, adhesive, abrasive, oxidative, corrosive, erosive and fretting wear, roles of friction and lubrication-overview of different forms of corrosion. (8L)
Module 2 : Chemical and electrochemical polishing, significance, specific examples, chemical conversion coatings, phosphating, chromating, chemical colouring, anodizing of aluminium alloys, (8L)
Module 3 : Thermochemical processes -industrial practices Surface pre-treatment, deposition of copper, zinc, nickel and chromium - principles and practices, alloy plating, electrocomposite plating, properties of electro deposits, electroless, electroless composite plating; application areas, properties. (8L)
Module 4 : Definitions and concepts, physical vapour deposition (PVD), evaporation, sputtering, ion plating, plasma nitriding, process capabilities, chemical vapour deposition (CVD), metal organic CVD, plasma assisted CVD. (8L)
Module 5 : Thermal spraying, techniques, advanced spraying techniques - plasma surfacing, detonation gun and high velocity oxy-fuel processes, laser surface alloying, laser cladding, specific industrial applications, tests for assessment of wear and corrosion (8L)

Suggested reference/books:

1. Sudarshan T S, „Surface modification technologies - An Engineer‟s guide‟, Marcel Dekker, Newyork,

2. Varghese C.D, „Electroplating and Other Surface Treatments - A Practical Guide‟, TMH, 1993
3. Tadeusz Burakowski and Tadeusz Wierzchon, Surface Engineering of Metals: Principles, Equipment, Technologies, CRC Press LLC, 1999.
4. K. G. Budinski, Surface Engineering for Wear Resistance, Prentice Hall, New Jersey, 1998.
5. Surface Engineering, Process Fundamentals and Applications, Vol I &Vol II, Lecture Notes of SERC School on Surface Engineering, 2003.

Course outcomes: After attending this course, the student will be able to:

CO-1: Define different forms of processing techniques of surface engineering materials.

CO-2: Know the types of Pre-treatment methods to be given to surface engineering.

CO-3: Select the Type of Deposition and Spraying technique with respect to the application.

CO-4: Study of surface degradation of materials.

Advanced Materials (MT 611)

Course objectives -

- To understand the various strengthening mechanisms and also failure mechanisms for alloy systems to achieve enhanced mechanical performance.
- To gain knowledge with regards to kinetics of phase transformations and their effect on mechanical properties of alloys.
- To gain knowledge about the characteristics, processing and applications of polymers and composite materials.

Course Detail -

Module 1: Special purpose steels. Light metals and alloys, Titanium and Ti-based alloys and Intermetallic, Advanced Aluminium alloys. (7L)
Module 2: High temperature materials, Ultra high temperature materials. Cryogenic materials, Functional and Functionally graded materials-synthesis and their thermal and mechanical treatment. (8L)
Module 3: Quasi Crystals, Metallic Glasses, Amorphous materials. (6L)
Biomaterials, Carbon-based materials, Advanced Magnetic. (5L)
Module 4: Electrical and Electronic materials, Optical materials (6L)
Shape Memory Alloys, Smart Materials. (4L)
Module 5: Materials for Automobiles, Lasers, Sensors. (5L)

Suggested References/books:

CO-1: M.F. Ashby: Engineering Materials, 4th Edition, Elsevier, 2005.
CO-2: M.F. Ashby: Materials Selection in Mechanical Design, Butterworth Heinemann, 2005.
CO-3: ASM Publication, Vol.20: Materials Selection and Design, ASM, 1997.
CO-4: Pat L. Mangonon: The Principles of Materials Selection and Design, Prentice Hall International, Inc. 1999.

Course Outcomes: After attending this course,

CO-1: Students will be able to compile about the properties, structure of ceramic materials and their need for newer applications and processing techniques.

CO-2: Students will be able to express the different fabrication techniques, how the properties are improved after they are processed with different methods.
CO-3: Students will be able to demonstrate the need for newer materials by comparing the limitations of conventional materials.

X-ray Diffraction and Electron Microscopy (MT 612)

Course objectives –

- To impart the basic knowledge of material characterization with the help of SEM, TEM.
- To provide a thorough introduction to the principles and practice of X-ray diffraction.
- To provide practical experience in laboratory methods of material characterization and it's reporting.
- To analyze the variation in properties of materials with respect to the variation in their microstructure.

Course Detail -

Module 1: Introduction to crystallography, Symmetry – point group and space group, Reading of the space group tables. (4L)

Module 2: X-ray diffraction – Generation of X-rays, characteristic X-ray spectrum, Bragg's Law, Diffraction methods – Laue method, rotating crystal method, powder method, Principle, equipment and applications, structure factor, derivation of diffraction conditions for SC, BCC and FCC Bravais lattice. (8L)

Module 3: X-ray diffractometer, filters and counters/detectors, texture, importance of texture, measurement of texture, pole figures (stereographic projections), orientation distribution function, sample symmetry, and its importance, applications of X-ray diffraction in materials characterization – determination of crystal structure, lattice parameter, examples of textures in cubic materials. (8L)

Module 4: Electrons as source, properties of electron beam, elastic and inelastic scattering of electrons, importance in electron microscopy. (3L)

Module 5: Principles of transmission electron microscopy, construction, ray-diagram, working, sample preparation, contrast mechanisms, ring and spot diffraction patterns, detectors and imaging modes, Kikuchi lines, measurement of lattice parameter, orientation relationship determination. (10L)

Module 6: Principles of scanning electron microscopy, construction, ray-diagram, working, sample preparation, contrast mechanisms, Bright field and dark field imaging. Detection of secondary electrons. Detection of backscattered electrons. (9L)

Suggested References/Books:

1. B D Cullity, S R Stock: Elements of X-ray Diffraction, Prentice Hall, Inc 2001
2. D. Brandon and W. Kaplan: Microstructural Characterization of Materials, Wiley & Sons, 2000.
3. K R Hebbar: Basics of X-Ray Diffraction and its Applications, I.K. International Publishing House Pvt Ltd, New Delhi, 2007
4. Goodhew, Humphreys and Beanland: Electron Microscopy and Microanalysis, Taylor and Francis, New York, 2001.

Course Outcomes: After attending this course, students will hold

CO-1: An ability to use the techniques, skills, and modern tools necessary to perform x-ray diffraction, scanning electron microscopy, energy dispersive spectroscopy and related microanalytical techniques.

CO-2: An ability to conduct experiments, analyse and interpret data, and to relate the composition and atomic, structural and microstructural configuration with other material properties.

CO-3: An understanding of the crystallography of simple structures, Miller indices, reciprocal space, structure factors and the general concepts of stereographic projections, pole figures and inverse pole figures.

CO-4: An understanding of professional and ethical responsibilities with regard to preparing materials for structural and microstructural observation, reporting observations, and drawing engineering conclusions.

CHEMICAL ENGINEERING DEPARTMENT

Course Structure
Academic Session 2020-21 onwards
SEMESTER V

S. No.	Subject Code	Subject	L	T	P	Cr.
		Theory				
1.	P. Core	Mass Transfer Operations	4	1		4
2.	P. Core	Chemical Reaction Engineering	3	1		3
3.	P. Core	Solutions Thermodynamics	3	1		3
4.	P. Elective	1. Numerical Methods in Chemical Engineering 2. Computer Application in Chemical Engineering 3. Optimization of Chemical Processes 4. Fluidization Engineering	3	1		3
5.	Open Elective Course	1. Environmental Engineering 2. Industrial Pollution Control 3. Solid Waste Management 4. Water Pollution Control	3	1		3
Total						**16**
		Practical				
1.	Lab	Mass Transfer Lab	0	0	3	1
2.	Lab	Physical and Chemical Equilibria	0	0	3	1
3.	Lab	Fluidization Engineering Lab	0	0	3	1
	Lab	Chemical Engineering Drawing	0	0	3	1
		GP/Seminar	0	0	2	2
Total						**6**
Grand Total Credits			**16 + 6**			**22**

CHEMICAL ENGINEERING DEPARTMENT

Course Structure
Academic Session 2020-21 onwards
SEMESTER VI

S. No.	Subject Code	Subject	L	T	P	Cr.
		Theory				
1.	P. Core	Process Equipment Design	3	1		3
2.	P. Core	Instrumentation and Process Control	4	1		4
3.	P. Core	Advance Mass Transfer	3	1		3
4.	P. Elective	1. Heterogeneous Catalysis 2. Chemical Reactor Analysis 3. Material Characterization 3. Reactor Design	3	1		3
5.	Open Elective*	1. Energy Option 2. Fertilizer Technology 3. Fuel and Combustion Technology	3	0		3
Total						**16**
		Practical				
1.	Lab	Process Equipment Design Sessional	0	0	2	1
2.	Lab	Chemical Reaction Engineering Lab	0	0	3	1
3.	Lab	Instrumentation & Process control	0	0	3	1
4.	Lab	Energy Option Lab	0	0	3	1
		Internship	0	0	2	2
Total						**6**
Grand Total Credits			**16 + 6**			**22**

CHEMICAL ENGINEERING DEPARTMENT

Syllabus
Academic Session 2020-21 onwards
SEMESTER V

Mass Transfer Operations

Lectures: 4 Periods/week ***Sessional Marks: 30***
University Examination: 3 hours. ***University Examination Marks: 70***

COURSE OBJECTIVE: The students will be able to understand the concepts of basic mass transfer operations involved in industrial processes as well as relate them to practical problems in everyday lives.

Unit 1 **Lecture 10**

Introduction to mass transfer operations, Molecular mass transfer, Fick's law, Diffusivities, Differential equation for diffusion steady state equimolar counter diffusion, Diffusion of A through stagnant B for liquid or gases. Convective diffusion mass transfer coefficient, Diffusion between two phases, inter phase diffusion, Equilibrium; Equilibrium relation, two film theory, overall mass transfer coefficient, Diffusion of turbulent flow-eddy diffusion, Mixing length, Wetted wall column, Mass, heat and momentum transfer: Analogies, J_D factor.

Unit 2 **Lectures 8**

Distillation: Vapor-liquid equilibrium and enthalpy concentration diagram, Principles of distillation, Principles of batch distillation, Flash distillation, Differential distillation, McCabe Thiele methods, Feed plate location and efficiency, Optimum reflux, Types of equipment , Bubble cap plate, Sieve plate, Valve tray, Packed tower, Packed columns: Concept of height evaluation to theoretical plate(HETP), NTU(Number of Transfer Units).

Unit 3 **Lectures 6**

Gas absorption & stripping: Mechanism of absorption, Equilibrium relations, Operating line, Absorption factor, NTU & HTU, Column diameter, Gas absorption equipments: Plates and & Packed column, Packing materials, Capacity of packed towers, Special Case: Flooding in column.

Unit 4 **Lecture 8**

Extraction: Solid-liquid extraction, Multistage counter counters operations, Number of equilibrium stages, Liquid –liquid extraction: Ternary liquid-liquid equilibrium, Batch and continuous liquid–liquid equilibrium, Batch and continuous liquid- liquid extraction, Stage calculations, Extraction with intermediate feed and reflux, Reflux, selectivity, Rate of extraction, Systems with complete immiscibility.

Unit 5 **Lectures 8**

Drying: Equilibrium: Insoluble solids, soluble solids, soluble solid equilibrium, Critical, free, bound and unbound moisture content. Drying operation and mechanism, rates of batch drying and continuous drying, drying curve, direct dryers, indirect dryers, drying at high temperature and low temperature.

Text Book/Reference Books:

1. Mass Transfer Operations, Treybal Robert E., 3rd edition, International Edition, McGraw Hill.
2. Unit Operations of Chemcal Engineering, Warren L., McCabe, Julian C., Smith, Peter, Harriot, 7th edition, McGraw Hill.

Suggested Textbooks:

1. Treybal, R. E.: "Mass transfer Operations", 3rd ed., McGraw-Hill, New York, 1980.
2. Unit Operations of Chemical Engineering, McCabe W.L., and Smith J.C. & Harriot, McGraw Hill Book Co., New York 1980, 5th Edition.

Reference books:

1. Geankpolis, C.J., Transport Processes and Separation Process Principles (Includes Unit Operations),Prentice Hall of India, New Delhi, 4th Edition, 2003.

2. Roman Zarzytci, Andrzai Chacuk, Absorption: Fundamentals and Application, Pergamon, Press, 1993.

Course Outcomes:

After completion of this course, the student will be able to:

CO1	Solve diffusion and diffusion related problems.
CO2	Estimate mass transfer coefficients for gas–liquid contacting systems.
CO3	Explain the humidification and dehumidification operations.
CO4	Estimate the rate of batch and continuous drying.
CO5	Apply design calculations of single and multiple effect evaporators.

Mapping of course outcomes with program specific outcomes:

Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	2	-	-	-	-	-	-	-
CO2	1	3	3	3	2	-	-	-	-	-	-	-
CO3	2	2	2	3	-	-	-	-	-	-	-	-
CO4	1	2	3	3	1	2	1	-	-	-	-	-
CO5	1	2	3	1	2	3	1	-	-	-	-	-

Chemical Reaction Engineering

Lectures: 4 Periods/week — ***Sessional Marks: 30***
University Examination: 3 hours. — ***University Examination Marks: 70***

Course objective

This course will provide students understand the kinetics of reaction engineering and provide basis for design of simple chemical reactors.

Unit – I — **Lectures 8**

Classification of reactions, rate of reaction, Variable effecting the rate, reaction mechanism, order of reaction and its determination through different methods, collision and activated complex theory.

Unit-II — **Lectures 8**

Classification of reactors: Concept of ideality. Development of design Equation for batch reactor, CSTR, and PFR, properties of ideal reactor.

Unit-III — **Lectures 8**

Combination of reactors, reactors with recycles Yield and selectivity in multiple reactions. Multiple reactions in batch, CSTR and PFR. Autocatalytic reaction.

Unit-IV — **Lectures 8**

Design of isothermal and non-isothermal batch, CSTR, PFR, optimum temperature progression, thermal characteristics of reactors.

Unit- V — **Lectures 8**

Non-ideal reaction, evaluation of RTD characteristics, non-ideal models: axial dispersion model and tank in series model.

Course Outcomes:

After completion of this course, the student will be able to

CO1	Explain the basic concepts in reaction and reactor engineering.
CO2	Design performance equations of reactors.
CO3	Analyse Non-Isothermal operation in Ideal Reactors
CO4	Examine the Non-Ideal Behaviour of real reactor.

Mapping of course outcomes with program specific outcomes:

Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**1**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**3**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Suggested Reading:

1. Chemical Reaction Kinetics By J.M. Smith (3^{rd} Edition Mc Graw Hill)
2. Chemical Reaction Theory an Introduction By K.G. Denbigh & K.G. Turner (2^{nd} Edition United Press & ELBS 1972)
3. Chemical Kinetic and Reactor Engineering By G. Copper & GVJ jeffery`s (Prentice Hall 1972)
4. Chemical reaction engineering By O.Levenspiel (2^{nd} Edition Willey Eastern, Singapore)
5. Chemical process Principal Part-III By Houghen Watsn & Ragatz [Kinetics & catalysis (2^{nd} Edition asian publication House Bombay)]
6. Element of Chemical Reaction Engineering By Fogler ,H.S. (2^{nd} edition Prentice Hall of India Pvt. Ltd. New Delhi 1999)

Solution Thermodynamics

Lectures: 4 Periods/week — ***Sessional Marks: 30***
University Examination: 3 hours. — ***University Examination Marks: 70***

Objective : To impart fundamental concepts of solution thermodynamics involving ideal and non – ideal systems and to compute phase and reaction equilibrium data.

Detailed Syllabus

Unit I **Lectures 8**

Equation of states, generalized correlations, acentric Factor, Calculation of thermodynamic properties using fugacity and fugacity coefficient and activity and activity coefficient, Excess properties of mixing, Gibbs Duhem equation and its correlation in terms of partial pressure.

Unit II **Lectures 8**

Phase Rule and Phase Equilibria: Phase rule, Claussius-Claypron equation, VLE calculation-Bubble Point, Dew Point, Dew point and flash calculation. Phase Equilibrium VLE.

UNIT III **Lectures 8**

Excess Free Energy: Concept of excess free energy of mixing and its Gibbs-Duhem equation, in relation to Raoult's Law, Henry's Law, Lewis Randle Rule and partial pressure.

UNIT IV **Lectures 8**

Gibbs/Duhem equation and its interacted form like, Porter Van Laar, Margules, Wilson and Redlich/Kister Equation. Excess function of non-ideal solution.

UNIT V **Lectures 8**

Chemical Equilibria: Criteria for Equilibrium, Equilibrium Constant and its dependence on temperature and pressure, Evaluation of equilibrium constant. Equilibrium conversion for single and multiple reaction systems, Phase rule for reacting substances.

TEXTBOOK

1. Introduction to Chemical Engineering Thermodynamics, Smith, J.M., Van Ness, H.C., and Abbott, M.M., 7th Edition, McGraw Hill.

Reference Books:

1. Chemical Engineering Thermodynamics, Y.V. C. Rao, Universities press.
2. A Textbook of Chemical Engineering Thermodynamics, K. V. Narayanan. Publisher, PHI Learning Pvt. Ltd., 2004.

Course outcomes (COs)

<u>At the end of the course, the students will be able to:</u>

CO1: Apply basic equation of states to calculation of state variables for a chemical process.

CO2: Determine the thermodynamic properties of gas mixture/solution and their correlation to standard equation.

CO3: Calculate Bubble-P&T, Dew P&T, Flash P&T in VLE for a binary and multi component systems.

CO4: Determine Equilibrium constant & composition of the chemical solution at given state conditions.

NUMERICAL METHODS IN CHEMICAL ENGINEERING

Lectures: 4 Periods/week	***Sessional Marks: 30***
University Examination: 3 hours.	***University Examination Marks:70***

Course Objective: To study the numerical+ analysis methods and their applications in solving chemical engineering problems.

Syllabus

UNIT I **Lectures 6**

Introduction, Approximation and Concept of Error & Error Analysis. Linear Algebraic Equations: Methods like Gauss elimination, LU decomposition and matrix inversion, Gauss-Siedel method, Chemical engineering problems involving solution of linear algebraic equations.

UNIT II **Lectures 7**

Root finding methods for solution on non-linear algebraic equations: Bisection, Newton-Raphson and Secant methods, Chemical engineering problems involving solution of non-linear equations.

Interpolation and Approximation, Newton's polynomials and Lagrange polynomials, spline interpolation, linear regression, polynomial regression, least square regression.

UNIT III **Lectures 10**

Numerical integration: Trapezoidal rule, Simpson’s rule, integration with unequal segments, quadrature methods, Chemical engineering problems involving numerical differentiation and integration.

UNIT IV **Lectures 7**

Ordinary Differential Equations: Euler method, Runge-Kutta method, Adaptive Runge-Kutta method, Initial and boundary value problems, Chemical engineering problems involving single, and a system of ODEs .

UNIT V **Lectures 5**

Introduction to Partial Differential Equations: Characterization of PDEs, Laplace equation, Heat conduction/diffusion equations, explicit, implicit, Crank-Nicholson method.

Course Outcomes:

After completion of this course, the student will be able to

CO1	**Solve linear and non linear equations using bisection and Newtons method.**
CO2	**Evaluate sets of linear equations.**
CO3	**Apply laplace equations to heat and mass transfer governing equations.**
CO4	**Understand linear and non linear regression techniques and to correlate with experimental data.**
CO5	**Solve initial and boundary value problems of ordinary differential equations.**

Mapping of course outcomes with program specific outcomes:

Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**2**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**2**	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**2**	**1**	**2**	**1**	**2**							

Suggested Text Books

1. Gupta, S. K., "Numerical Methods for Engineers, New Academic Science, 2012.

Suggested References Books

1.S.C. Chapra& R.P. Canale, "Numerical Methods for Engineers with Personal Computer Applications", McGraw Hill Book Company, 1985.

2. R.L. Burden & J. D. Faires, "Numerical Analysis", 7th Ed., Brooks Coles, 2000.

3. Atkinson, K. E., "An Introduction to Numerical Analysis", John Wiley & Sons, 1978.

4. Press, W. H. et al., "Numerical Recipes in C: The Art of Scientific Computing, 3rd Edition, Cambridge University Press, 2007.

Mathematical Methods in Chemical Engineering

Teaching Scheme: ***Sessional Marks: 30***

Lectures: 3 periods/week ***University Examination Marks: 70***

University Examination: 3 hours

Course Objectives:

1. To impart the knowledge of partial differential equations.
2. To understand concept of probability and distributions.
3. To know the probable errors while using different techniques.
4. To understand model writing techniques.

Course Outcomes: At the end of the course, the students will be able to:

5. Understand the vectors and partial differential equations.
6. Understand probability and distributions
7. Estimate error analysis in different techniques.
8. Write model equations for numerical techniques for solution of ODE and PDEs.

UNIT 1 **Lectures 9**

Vector and tensor spaces; Metric,norm and inner products; orthonormalization; matrices, operators and transformations; eigen values and eigen vectors; Fredholm alternative, Rayleigh quotient and its application to chemical engineering systems; self adjoint and non self adjoint systems

UNIT 2 **Lectures 6**

Partial differential equations and their application in chemical engineering; Strum-louiville theory; Separation of variables and Fourier transformations.

UNIT 3 **Lectures 8**

Applications of Greens function for solution of ODE and PDEs in chemical engineering; Numericals techniques for solution of ODE and PDEs; Linear stability and limit cycles; Bifurcation theory; Secondary bifurcation and chaos.

UNIT 4 **Lectures 6**

Probability concepts and distributions, random variables, error analysis, point estimation and confidence intervals, hypothesis testing

UNIT 5 **Lectures 8**

Development of empirical chemical engineering models using regression techniques, design of experiments, process monitoring based on statistical quality control techniques, case studies

Text/Reference Books:

1. Pushpavnam, S., Mathematical Methods in Chemical engineering, Prentice Hall of India, New Delhi, IsBN-81-203-1262-7

Course outcome mapping with Programme outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	3
CO2	3	2	1	-	-	-	-	-	-	-	-	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3
CO4	3	2	3	1	-	-	-	-	-	-	-	3

OPTIMIZATION OF CHEMICAL PROCESS

Lectures: 3 periods/week *Sessional Marks: 30*
University Examination: 3 hrs. *University Examination Marks: 70*

Course Objectives:-

1. To understand the different optimization techniques
2. To impart knowledge of linear programming's
3. To apply optimization techniques for the design of different equipment
4. To apply optimization techniques for the optimization of process parameters

UNIT – I: **[4L]**
Nature and Organization of optimization problems, fitting models to data, formulation of objective functions.

UNIT – III **[6L]**
Basic concepts of optimization, optimization of unconstrained function, one dimensional search.

UNIT – III: **[6L]**
Linear programming and applications.

UNIT – IV: **[10L]**
Optimization recovery of waste heat, shell and tube heat exchanger, evaporator design, liquid-liquid extraction process, optimal design of staged distillation column.

UNIT – V: **[10L]**
Optimal pipe diameter, optimal residence time for maximum yield in an ideal isothermal batch reactor, chemostat, optimization of a thermal cracker using linear programming.

Text Book:
1. Optimization of chemical process, T.F.Edgar and Himmelblau.D.M., McGraw Hill.

Reference Book:
Optimization: Theory and Applications, S.S.Rao, Wiley Eastran Ltd.

Course Outcomes: At the end of the course, the students will be able to:

1. Understand the basic concept of optimization.
2. Estimate the recovery of waste heat from shell and tube heat exchanger.
3. Write linear programing for various problems.
4. Design evaporator, liquid-liquid extraction process and stage distillation column.

Course outcome mapping with Programme outcomes:

	POs1	POs2	POs3	POs4	POs5	POs6	POs7	POs8	POs9	POs10	POs11	POs12
CO1	2	1	1	1	-	-	-	-	-	-	-	3
CO2	3	1	3	2	-	-	-	-	-	-	-	3
CO3	3	3	3	2	1	-	-	-	-	-	-	3
CO4	3	3	3	3	1	-	-	-	-	-	-	3

FLUIDIZATION ENGINEERING

Lectures: 3 Periods/week ***Sessional Marks: 30***

University Examination: 3 hours. ***University Examination Marks: 70***

Course Objectives:

To study the fluidization phenomena, fluidized bed regimes and models.

Course Outcomes:

The students will be able to:

1. understand the fluidization phenomena and operational regimes.
2. design various types of gas distributors for fluidized beds and determine effectiveness of gas mixing at the bottom region.
3. analyse fluidized bed behaviour with respect to the gas velocity.
4. develop and solve mathematical models of the fluidized bed.

UNIT I **Lectures 4**

Flow through packed beds-Ergun equation,

UNIT II **Lectures 12**

Phenomena of fluidization liquid like behavior of a fluidized bed, Types of fluidization-particulate and Aggregative fluidization Advantages and disadvantages of fluidization over packed beds and moving beds. Industrial applications. Minimum fluidization velocity, Terminal velocity and pressure drop in a fluidized bed.

UNIT III **Lectures 8**

Average particle size, sphericity, voidage, Expansion of liquid-solid fluidized bed, Richandson, Zaki equation, use of dimensional analysis

UNIT IV **Lectures 8**

Brief idea of the mechanism of gas-solid fluidization homogeneous & bubble phase, size of bubble, bubble velocity and its expansion.

UNIT V **Lectures 8**

1. Design of batch & continuous fluidizer for heat & mass Transfer, Entrainment & Elutriation-Entrainment at or above TDH, Entrainment below TDH
2. Semi fluidizations.

Text Books:

1. Fluidization Engineering, Kunii, Diazo and Octave Levenspiel (Chapters 1,2,3,4,7,9,10 and 12).

2. Fluidization, Max Leva (Chapters 2,3, and 7)

Reference Book:

1. Perry’s Chemical Engineers Hand Book, Perry Rober H, 7th edition, McGraw Hill

Environmental Engineering

Lectures: 3 Periods/week ***Sessional Marks: 30***
University Examination: 3 hours. ***University Examination Marks: 70***

Objective: Objective of this course is to understand the different environmental issues and its consequence on the ecosystem. Further, it has been introduced the technical solution of numerous pollutions such as air, water, soil, and noise pollution. It also addresses the solid waste issue of urban area.

Course Outcome (CO): At the end of the course, student will be able to

CO1. Understand the different type of pollutions (air, water and noise) its consequence on eco-system.
CO2. Evaluate the plum size, plum rise, COD, BOD and noise label.
CO3. Identify the different control measures as well as treatment process of different pollutant.
CO4. Explain the different type of chemical and biological treatment process.

Course Plan

UNIT I **(10 lectures)**
Air Pollution: Types of air Pollutants, Classification of Industries based on Pollutants, sources of air Pollutant, line source, point source and fumigate source, Atmospheric dispersion, Dispersion model, plume size, types of calculation of plume rise, calculation of concentration, Atmospheric salability Meteorology,

UNIT II **(5 lectures)**
Gaseous pollutant control technology, ESP, cyclone separation, victory scrubber, bag filters, Air Act.

UNIT III **(10 lectures)**
Water Pollution: Sources, criteria and standards, physical and chemical characteristics, Pre Primary, Secondary and Tertiary treatments of wastewater, sludge digestion and disposal, Advanced treatment processes, Disinfections, Typical Industrial treatment processes, Municipal waste waters treatment, Water act.

UNIT IV **(05 lectures)**
Noise Pollution: Definition ,measurement, effects and control

UNIT V **(05 lectures)**
Solid Waste: Classification of solid waste, collection, chemical and biological treatment, disposal of solid waste

BOOKS RECOMMENDED

Mahajan S.P., “Pollution Control in Process Industries”, Tata McGraw Hill Inc., New Delhi, 2001.

Rao C.S., “Environmental Pollution Control Engineering”, 2nd Edition, Revised, Wiley Eastern Limited, India, 2006.

Bhatia S.C., “Environmental Pollution & Control in Chemical Process Industries”, Khanna Publications, Delhi, 2001.

Sawyer C.N., McCarty P.L. & Perkin G.F., “Chemistry for Environmental Engineering and Science”, McGraw-Hill, 5th ed., 2002

Relationship of COs to POs for Environmental Engineering

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1.	3	2	1	-	-	2	1	-	-	1	-	-
CO2.	3	3	2	2	-	2	2	-	-	-	-	-
CO3.	2	2	3	2	-	2	2	-	-	-	-	-
CO4.	3	3	3	1	-	1	3	-	-	-	-	-

Industrial Pollution Control

Teaching Scheme:

Lectures: 3 Periods/week ***Sessional Marks: 40***
University Examination: 3 hours. ***University Examination Marks: 60***

Objectives

1. To understand the importance of industrial pollution and its abatement
2. To study the underlying principles of industrial pollution control
3. To acquaint the students with case studies
4. Student should be able to design complete treatment system

Course Outcomes: At the end of the course, the student will be able to:

1. Recognize the causes and effects of environmental pollution
2. Analyze the mechanism of proliferation of pollution
3. Develop methods for pollution abatement and waste minimization
4. Design treatment methods for gas, liquid and solid wastes

Unit I **Lectures 8**

Industries & Environment

Industrial scenario in India - Industrial activity and Environment - Uses of Water by industry - Sources and types of industrial wastewater - Industrial wastewater and environmental impacts - Regulatory requirements for treatment of industrial wastewater - Industrial waste survey - Industrial wastewater generation rates, characterization and variables - Population equivalent - Toxicity of industrial effluents and Bioassay tests.

Unit II **Lectures 8**
Air Pollutant Abatement

Air pollutants scales of concentration, lapse rate and stability, plume behavior, dispersion of air pollutants, atmospheric dispersion equation and its solutions, Gaussian plume models. Air pollution control methods, Source correction methods, Design concepts for pollution abatement systems for particulates and gases. Such as gravity chambers, cyclone separators, filters, electrostatic precipitators, condensation, adsorption and absorption, thermal oxidation and biological processes.

Unit III **Lectures 8**

Waste water treatment processes

Design concepts for primary treatment, grid chambers and primary sedimentation basins, selection of treatment process flow diagram, elements of conceptual process design, design of thickner, biological treatment Bacterial population dynamics, kinetics of biological growth and its applications to biological treatment, process design relationships and analysis, determination of kinetic coefficients, activated sludge process. Design, trickling filter design considerations, advanced treatment processes, Study of environment pollution from process industries and their abatement: Fertilizer, paper and pulp, inorganic acids, petroleum and petrochemicals, recovery of materials from process effluents.

Unit IV **Lectures 8**

Solid waste and Hazardous waste management

Sources and classification, properties, public health aspects, Sanitary land fill design, Hazardous waste classification and rules, management strategies, Nuclear waste disposal Treatment methods – component separation, chemical and biological treatment, incineration, solidification and stabilization, and disposal methods, Latest Trends in solid waste management.

Unit V **Lectures 8**

Industrial Noise pollution Sources of noise pollution, characterization of noise pollution prevention& control of noise pollution, Factories Act 1948 for regulatory aspects of noise pollution.

References

1. Rao C.S., "Environmental Pollution Control Engineering", 2nd edition
2. Mahajan S.P., "Pollution Control in Process Industries".
3. Nemerow N.L., "Liquid waste of industry- theories, Practices and Treatment", Addison Wesley, New York, 1971
4. Weber W.J., "Physico-Chemical Processes for water quality control", Wiley Interscience New York, 1969
5. Strauss W., "Industrial Gas Cleaning", Pergamon, London, 1975
6. Stern A.C., "Air pollution", Volumes I to VI, academic Press, New York, 1968
7. Peterson and Gross. E Jr., "Hand Book of Noise Measurement", 7th Edn, 2003.
8. Antony Milne, "Noise Pollution: Impact and Counter Measures", David & Charles PLC, 2009.

SOLID WASTE MANAGEMENT

Lectures: 4 Periods/week *Sessional Marks: 30*
University Examination: 3 hours. *University Examination Marks: 70*

Course objective:

This course will give the idea about the solid waste management (SWM), equipment and processing technique for SWM, properties of municipal solid waste and disposal of SWM.

Module 1: Introduction **Lecture 8**

Philosophy and organization, Status of waste management, Computation an integrated waste management strategy. Evolution of solid waste management, Legislation and Government agencies

Module 2: Management **Lecture 8**

Planning solid waste management progress, Generation of solid waste, Onsite handling, Storage and processing, Transfer and transport, Processing techniques and equipment, Hazardous waste and their management, Process management issues, Planning, Recovery of resources conservation, Chemical and Biological methods.

Module 3: Properties of Municipal Solid Waste **Lecture 8**

State the Physical, Chemical and Biological properties, Describe associated considerations of Municipal Solid Waste (MSW)

Module 4: Disposal of solid waste **Lecture 8**

Land filling, Ocean disposing, Source reduction, Recycling, Incineration, Composting.

Module 5: Case studies on major industrial solid waste generation units **Lecture 8**

Coal fired, power plant, Textile industry, Brewery, Distillery, Oil refinery, radioactive generation units. Case studies on spills, Sludge lagooning and incineration.

Course outcome:

At the end of the course, the student will be able to

CO1: Idea about the solid waste management.

CO2: Outline sources, types and composition of solid waste with methods of handling, sampling and storage of solid waste

CO3: Select the appropriate method for solid waste collection, transportation, redistribution and disposal

CO4: Describe methods of disposal of hazardous solid waste.

Reference Book:

1. Solid Waste, Martell, 1975, John Wiley, NY.
2. Solid Waste, George Techobanuglour, H. Theisen and R. Eliassen.
3. Handbook of Solid Waste by Frank Krieth, 1996, McGraw Hill Inc. NY.

Water Pollution Control

UNIT I **Lectures 8**

Sources, criteria and standards, physical and chemical characteristics, Pre-Primary, Secondary and Tertiary treatments of wastewater, sludge digestion and disposal.

UNIT II **Lectures 9**

Wastewater characteristics; Wastewater treatment objectives, methods, and implementation considerations.

UNIT II **Lectures 8**

Principles of physical, chemical, and biological processes, that form the basis for wastewater and liquid hazardous waste treatment, such as chemical, biological, and thermal oxidation, carbon adsorption, ion-exchange, membrane processes, air and steam stripping, and chemical precipitation.

UNIT IV **Lectures 8**

Design of facilities for physical and chemical treatment; Design of facilities for treatment and disposal of sludge; Effluent disposal.
Water pollution legislation and regulation.

UNIT V **Lectures 9**

Schemes for treatment of some typical industrial wastes – pulp and paper, sugar, distillery, dairy, fertilizer, refinery etc.

BOOKS RECOMMENDED

Rao C.S., "Environmental Pollution Control Engineering", 2nd Edition, Revised, Wiley Eastern Limited, India, 2006.

CHEMICAL ENGINEERING DEPARTMENT

Syllabus
Academic Session 2020-21 onwards
SEMESTER VI

PROCESS EQUIPMENT DESIGN

Lectures: 4 Periods/week ***Sessional Marks: 30***

University Examination: 3 hours. ***University Examination Marks: 70***

Pre-requisites: Heat transfer and Mass transfer

Objective: Introduce the basic design concepts for chemical process equipment industrial pressure vessel, storage vessel, heat exchangers, distillation column, absorption column, and reactors used in chemical industries.

Course Outcome:

CO1. Understand the basic design concept of chemical process equipment

CO2. Design the pressure vessel and its closures, distillation column and absorption column

CO3. Design the heat exchanger as per TEMA standards.

CO4. Apply various designs in process plant.

Detailed syllabus

UNIT I **Lectures 08**
Heat-exchanger
Design of double pipe heat exchanger, Shell and tube type heat exchanger, over all heat transfer Co-efficient.

UNIT II
Evaporators **Lectures 08**
Design of evaporators (Double and triple effect), Over all heat transfer Co-efficient, heating surface and mechanism of vacuum system etc.

UNIT III **Lectures 05**
Piping system
Piping: Design of piping system for transfer of fluid covering pipes, valves, fittings, Instrumentation, insulation, Pumps etc.

UNIT IV **Lectures 08**
Design of distillation column
Design of distillation column-number of plates, stages arrangement of double caps, Dimeter and height of the tower and thickness of the shell.

UNIT V **Lectures 06**
Design of Absorption column
Design of absorption column, Number of transfer units, Dimeter, Height of the tower and the thickness of the shells

BOOKS RECOMMENDED

Bhattacharyya B.C., "Introduction to Chemical Equipment Design: Mechanical Aspects", 5th Ed., CBS Publishers, New Delhi, 2008.

Kern D.Q., "Process Heat Transfer", McGraw-Hill, New York, 1965.

Coulson & Richardson's Chemical Engineering, Vol. 6, 4th Ed., Elesevier, New Delhi, 2006.

Soares C., "Process Engineering Equipment Handbook", McGraw-Hill, New York, 2002.

Table 1. Relationship of COs to POs for Process Equipment Design (CL 506):

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1.	3	-	2	1	-	-	-	-	-	-	-
CO2.	2	2	3	2	2	-	-	-	-	-	-
CO3.	3	2	3	2	2	2	-	-	-	-	-
CO4.	3	2	3	2	-	-	-	-	-	-	-

INSTRUMENTATIION AND PROCESS CONTROL

Lectures: 4 Periods/week — ***Sessional Marks: 30***
University Examination: 3 hours. — ***University Examination Marks: 70***

Course objective: To provide detail knowledge about various techniques used for the measurement of primary industrial parameters (Flow, level, temperature and pressure) and application of different sensor/transducers, final control element for industrial and control system.

<u>Syllabus</u>:

UNIT I — **Lectures 8**

Process variable, Elements of measuring instrument, Static and dynamic response of measuring device; Different types of thermometer and Thermocouples, Absolute pressure, Gauge Pressure, Differential Pressure, Measuring pressure for corrosive fluids, Head flow meters, open channel meters, area flow meters, Flow of dry material.

UNIT II — **Lectures 10**

Transmitter, Transducers, Converter, Multiplexer, Pneumatic control valve, Stepper motor, Motorized valve; Data acquisition system and intelligent instruments, Process Instrumentation Diagrams: Representation and symbols, Instrumentation diagram for Distillation Column, Heat exchanger, Petroleum refinery**.**

UNIT III — **Lectures 7**

Introductory Concepts: Need for control and automation, Control logic, manipulate variable, Control variable, set point and load; Blending Tank, Stirred Tank, Reactor, Interacting and Non-Interacting Process, Modelling considerations for control purposes.

UNIT IV — **Lectures 9**

Linearization of Non-linear function across steady state- Deviation variable, Some Important aspects of Laplace transforms., Forcing functions (Step, Impulse, Ramp) and their Laplace transfer, Transfer functions and the input-output models; Dynamics and analysis of first, second and higher order systems, Transportation Lag, Dead Time.

UNIT V — **Lectures 6**

Concept of feedback control, Closed loop and open loop transfer function, Implementation of block diagram, Different type of controllers, Control valve characteristics.

Routh stability criterion, Root locus plot and stability analysis, Bode stability criterion Nyquist stability criterion, Frequency response technique; Phase margin and gain margin;

Text/Reference books

1. Patranabis, D "Principles of Industrial Instrumentation" Tata Mc.Graw Hill Publishing Co.
2. Johnson, C,D,"Process Control Instrumentation Technology" Pearson Education, Inc
3. Coughnaowr, D.D. Process systems Analysis and Control, Mc.Graw –Hill,Inc.
4. SeborgD.E.Edgar, T, and Mellichamp,D.A. "Process Dynamics and Control" John Wiley and Sons, Inc.
5. Stephanopolous, G "Chemical Process Control" Prenticed –Hall.

Course outcome: At the end of the course, the student will be able to

CO1: Understand the various measuring devices in chemical industry.

CO2: Able to explain instrumentation diagram in process flow sheet.
CO3: Sketch the block diagram for various chemical processes.

CO4: Examine the stability concerns of a block diagram.

Course outcome mapping with Programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	-	-	-	-	-	-	3
CO2	2	2	3	2	1	-	-	-	-	-	-	2
CO3	2	3	3	3	1	-	-	-	-	-	-	2
CO4	3	3	3	2	2	-	-	-	-	-	-	3

ADVANCE MASS TRANSFER

Lectures: 3 Periods/week — ***Sessional Marks: 30***
University Examination: 3 h — ***University Examination Marks: 70***

Pre-requisite: Mass Transfer and Separation Processes

Syllabus

Unit I

Humidification-phase rule relations and definitions. Humid heat, humid volume, Enthalpy, adiabatic saturation process, wet bulb temp., dew point Lewis relation, humidity Charle's calculation for humidification dehumidification operations.

Adsorption: Adsorption equilibria; Batch, stage-wise and continuous adsorption; Industrial absorbers

Unit II

Evaporator-Evaporation, evaporation with direct heating steam headed evaporators natural circulation units, horizontal tubes, vertical tubes coil evaporators forced circulation evaporators, film type units.

Operation of evaporators- Heat transfer coefficient, operation under vacuum, single and multiple effect evaporators, Economy and capacity of multiple effect system, calculations, forward and backward and mixed feed operation, vapor recompression, integrated evaporators, in tot total plant economy.

Unit III

Vacuum and steam distillation, azeotropic & extractive distillation. Crystallization: Nucleation and crystal growth; Controlled growth of crystals; Industrial crystallizers.

Unit IV

Introduction to advance separation techniques, Mass transfer in membranes Reverse Osmosis, ultra-filtration, Ion exchange,

Text Book / Reference Books:

1. Mass Transfer Operations, Treybal Robert E., 3rd edition, International Edition, McGraw Hill.
2. Unit Operations of Chemical Engineering, Warren, L., McCabe, Julian C.Smith, Peter Harriot, 7th Edition, McGraw Hill.
3. Principles and Modern Applications of Mass Transfer Operations, Benitez Jaime, 2nd Edition, 2009, John Wiley & Sons
4. Separation Process Principles, Seader J D and Henly E J, John Wiley & sons.
5. Principles of Mass Transfer and Separation Process, Dutta Binay K., PHI, New Delhi.

6. Fundamentals of Momentum Heat and Mass Transfer, Welty, J.R., Wicks, C.W., Wilson, R.E. and Rorrer, G., John Wiley & Sons.

Course Outcomes (COs):

After completing this course, you should be able to:

CO1: Understand the mass transfer operations and various methods of conducting mass transfer operations for multi-component system.
CO2: Estimate the diffusivity for the molecular diffusion in gases and liquids.
CO3: Understand various models of inter-phase mass transfer and estimate multi-component mass transfer coefficients.
CO4: Understand and be able to handle the physical and mathematical complexities involved in multi-component mass transfer.

Course outcome mapping with Programme outcomes:

	POs1	POs2	POs3	POs4	POs5	POs6	POs7	POs8	POs9	POs10	POs11	POs12
CO1	3	3		2		2	2					2
CO2	3	3	3	3			2					2
CO3	3	3	2	2		2	2	1				1
CO4	3	3	3	3		3	2	1				2

Heterogenous Catalysis

Teaching Scheme:

Lectures: 3 Periods/week — ***Sessional Marks: 30***

University Examination: 3 hours. — ***University Examination Marks: 70***

Course objective

This course will provide students understand the kinetics of reaction heterogenous catalytic and non-catalytic reaction.

Unit-I Heterogenous catalysts: Homogeneous processes, global and intrinsic rates, and mechanism of catalytic reactions. Engineering properties of catalysts, surface area measurement theories and techniques. **Lecture 8**

Unit-II. Development of rate equations for solid catalysed fluid phase reactions. Estimation of Kinetic parameters, deactivation of catalyst, rate equation determination for catalytic deactivation **Lecture 8**

Unit-III Effective diffusivity, Thiele modulus, effectiveness factor. Analysis of rate data. Reaction & diffusion within porous catalysts **Lecture 8**

Unit-IV Fluid- solid reactions: Rate expressions for non-catalytic fluid solid system. Kinetics of Fluid Solid Reactions: External transport processes, shrinking core model. **Lecture 8**

Unit-V Fluid-Fluid Reactions: kinetics, design, Straight Mass Transfer, Mass Transfer Plus Not Very Slow Reaction **Lecture 8**

Suggested Reading:

1. Chemical Reaction Kinetics — By J.M. Smith (3rd Edition Mc Graw Hill)
2. Chemical Reaction Theory an Introduction — By K.G. Denbigh & K.G. Turner (2nd Edition United Press & ELBS 1972)
3. Chemical Kinetic and Reactor Engineering — By G. Copper & GVJ jeffery`s (Prentice Hall 1972)
4. Chemical reaction engineering — By O.Levenspiel (2nd Edition Willey Eastern, Singapore)
5. Chemical process Principal Part-III — By Houghen Watsn & Ragatz [Kinetics & catalysis (2nd Edition asian publication House Bombay)]
6. Element of Chemical Reaction Engineering — By Fogler ,H.S. (2nd edition Prentice Hall of India Pvt. Ltd. New Delhi 1999)

Course Outcomes:

After completion of this course, the student will be able to

CO1	**Interpret heterogeneous catalytic and non-catalytic processes.**
CO2	**Evaluate the mass transfer process in reaction system.**
CO3	**Examine kinetics of catalytic and noncatalytic heterogeneous system.**

CO4	**Design reactors for heterogeneous processes.**

Mapping of course outcomes with program outcomes:

Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
CO2	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
CO3	**3**	**3**	**2**	**3**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**-**
CO4	**3**	**3**	**3**	**3**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

CHEMICAL REACTOR ANALYSIS

Lectures: 3 Periods/week ***Sessional Marks: 30***

University Examination: 3 hours. ***University Examination Marks: 70***

Course Objective:

This course will prove advanced knowledge in reactor design and analysis along with providing kinetics of heterogenous catalytic process.

UNIT I

Introduction to ideal reactors, performance equation and reaction mechanism analysis for batch reactor, plug flow reactor, CSTRs, recycle reactor and autocatalytic reactions. Design for multiple reactions: Reactions in parallel, reactions in series, contacting patterns, product distribution **Lectures 8**

UNIT II

Introduction to design for heterogeneous reacting systems: Rate equations for heterogeneous reactions, contacting patterns for two phase systems.

Lectures 8

UNIT III

Design of fixed bed catalytic reactor-isothermal, adiabatic, non-isothermal reactors, design of fluidized bed reactor. **Lectures 8**

UNIT IV

design of slurry reactor, Trickle bed reactor Intra-particle heat and mass transfer-Wheeler's parallel pore model, random pore model. **Lectures 8**

UNIT V

Introduction to biochemical reaction: enzymatic reaction kinematics, Michaelis-Menten Kinetics, Inhibition by a Foreign Substance-Competitive, fermenter reactor design **Lectures 8**

Suggested Reading:

1. Chemical Reaction Kinetics By J.M. Smith (3rd Edition Mc Graw Hill)
2. Chemical Reaction Theory an Introduction By K.G. Denbigh & K.G. Turner (2nd Edition United Press & ELBS 1972)
3. Chemical Kinetic and Reactor Engineering By G. Copper & GVJ jeffery`s (Prentice Hall 1972)

4. Chemical reaction engineering By O.Levenspiel (2nd Edition Willey Eastern, Singapore)
5. Chemical process Principal Part-III By HoughenWatsn&Ragatz [Kinetics & catalysis (2nd Edition asian publication House Bombay)]
6. Element of Chemical Reaction Engineering By Fogler ,H.S. (2nd edition Prentice Hall of India Pvt. Ltd. New Delhi 1999)

Course Outcomes:

After completion of this course, the student will be able to

CO1	**Interpret heterogeneous catalytic and non-catalytic processes.**
CO2	**Evaluate the mass transfer process in reaction system.**
CO3	**Examine kinetics of catalytic and noncatalytic heterogeneous system.**
CO4	**Design reactors for heterogeneous processes.**

Mapping of course outcomes with program specific outcomes:

Course outcomes	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**3**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Materials Characterization

Lectures: 3 Periods/week — ***Sessional Marks: 30***
University Examination: 3 hours. — ***University Examination Marks: 70***

Objective: Characterization of materials is essential to the systematic development of new materials and understanding how they behave in practical applications. This course focuses on the principal methods required to characterize broad range of materials such as polymers, ceramics, nanostructures etc. for their applications based on mechanical, optical, thermal properties of materials.

Course outcomes: At the end of the course, student will be able to

CO1	Identifies the various characterization techniques applicable for the material
CO2	Understand the physical and chemical properties of material
CO3	Analyzed the structural properties, thermal properties and morphology of the material.
CO4	Explain the of the properties of material.

Detailed Syllabus:

UNIT I — ***Lectures: 8***

Introduction to materials and Techniques, Production and properties of X-ray, absorption of X-rays and filters, X-ray - diffraction directions, diffraction methods. X-ray - diffraction intensities, factors affecting intensity, 'structure factor' calculations for simple, body centered, face centered, diamond cubic and hexagonal crystal structures. Working principles of diffractometer. Indexing of XRD patterns. Precise lattice parameter determination, Chemical analysis by X-ray diffraction & fluorescence, determination of particle size and micro/macro strains), energy dispersive X-ray microanalysis (EDS).

UNIT II — ***Lectures: 8***

Fundamentals of optics and microscopy techniques, Optical microscope and its instrumental details, Variants in the optical microscopes and image formation. Sample preparation and applications. Introduction to scanning electron microscopy (SEM), sample preparation and applications, Instrumental details and image formation, various imaging techniques and spectroscopy, electron diffraction, and low energy electron diffraction.

UNIT III — ***Lectures: 6***

Introduction to Transmission electron microscopy (TEM), instrumental details and working principles of TEM. Image formation, science of imaging and diffraction, sample preparation procedures and instruments for various materials

UNIT IV — ***Lectures: 6***

Thermal analysis technique: Differential thermal analysis (DTA), Differential Scanning Calorimetry (DSC), Thermogravimetric analysis (TGA), UV-VIS spectroscopy

UNIT V — ***Lectures: 8***

principles of characterization of other materials properties: BET surface area; chemisorption; particle size; zeta potential; rheology; and interfacial tension. Introduction to spectroscopy (UV-vis, IR and Raman)

Texts/References:

1. Y. Leng, Materials Characterization: Introduction to microscopic and spectroscopic methods, 1st Ed., John Wiley & Sons, 2008.
2. A.W. Adamson and A.P. Gast, Physical Chemistry of Surfaces, John Wiley, New York, 1997.
3. D.G. Baird and D.I. Collias, Polymer Processing Principles and Design, Butterworth-Heinemann, Massachusetts, 1995.
4. A.J. Milling, Surface Characterization Methods: Principles, techniques, and applications, Marcel Dekker, 1999.
5. G. Ertl, H. Knozinger and J. Weitkamp, Handbook of Heterogeneous Catalysis, Vol. 2, Wiley-VCH, 1997.
6. W.D. Callister (Jr.), Material Science and Engineering: An introduction, 8th Ed., John Wiley & Sons, 2010.

Chemical Reactor Design

Lectures: 3 Periods/week ***Sessional Marks: 30***

University Examination: 3 hours. ***University Examination Marks: 70***

Course objective : To increase the student's ability to do chemical reactor design by providing the knowledge and tools required to obtain, evaluate, and improve rate equations for use in design, operation and optimization of chemical reactors.

UNIT I **Lectures 6**

Introduction to Reactor design: Single ideal Reactor: Ideal batch reactor, space time and space velocity, steady state mixed flow reactor, steady state plug flow reactor, holding time and space time for flow systems.

UNIT II **Lectures 3**

Introduction to design for heterogeneous reacting systems: Rate equations for heterogeneous reactions, contacting patterns for two phase systems.

UNIT III **Lectures 7**

Thermal characteristics and design of reactors: Batch reactor, PFR, CSTR under adiabatic conditions for first order irreversible reactions

Reactor design: Reactor principles, performance. Reactor and catalyst equipment- Selection of Catalyst, Types of Reactors, Selection of Reactors and Design of Reactor Systems.

UNIT IV **Lectures 8**

Calculation of equilibrium compositions of a set of simultaneous reactions, Performance calculation for batch reactor, plug flow reactor and CSTRs, homogeneous and heterogeneous flow reactors for specific reactions.

UNIT V **Lectures 12**

Design for Single Reactions: Size comparison of single reactors, multiple reactor systems, recycle reactor, autocatalytic reactions.

Design for multiple reactions: Reactions in parallel, reactions in series, contacting patterns, product distribution.

Course Outcomes:

After completion of this course, the student will be able to

CO1	**Analyze the rates of chemical reactions for both homogeneous and heterogeneous reactions**
CO2	**Evaluate the performance calculation for CSTR, PFR , Batch reactors.**
CO3	**Understand catalyst activity, selectivity and stability in reactor design.**
CO4	**Explain Thermal characteristics and design of reactors.**
CO5	**Differentiate single and multiple reactor systems.**

Mapping of course outcomes with program specific outcomes

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

outcomes												
CO1	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**2**	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**-**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**2**	**1**	**3**	**2**							

Suggested Reading:

1. Fogler S.H., "Elements of Chemical Reaction Eng.", 3rd Ed., Prentice Hall,1999.

2. Levenspiel, O., "Chemical Reaction Eng." John Wiley & Sons 1972,

3. Froment G.F. and Bischoff K.B., "Chemical Reactor Analysis and Design" John Wiley, 1990.

4. Roberts, G.W., "Chemical Reactions and Chemical Reactors", Wiley, 2009.

Energy option

Lectures: 4 Periods/week ***Sessional Marks: 30***

University Examination: 3 hours. ***University Examination Marks: 70***

Course objective

To impart basic knowledge of current energy sources, scenario, energy conservation, audit and management.

UNIT I **Lectures 8**

Fuels: Solids, liquids and gaseous fuels, Availability and classification. Coal: Theories of formation, Coal composition petrography of Coal calorific value of Coal, Chemical Constitution of Coal, Action of heat and solvent on coal, Coal preparation, handling and storage.

UNIT II **Lectures 8**

Industrial Coal Carbonization low and high temperature carbonization processes Design of Coke ovens with recovery system. Numerical problems based on Combustion, use of grates, combustion of pulverized fuel and fluidized bed combustion, efficient utilization of Indian coals

UNIT III **Lectures 8**

Liquid fuels: Indian cruds & refinery products. Chemical Coal tar distillation Hydrogenation of Coal, FiacherTropse process, other liquefaction process, Synthesis gas from petroleum fractions. Gaseous fuel: Natural gas producer gas reactions and its manufacture, water gas, carbureted water gas

UNIT IV **Lectures 8**

Analysis of flue gases, complete gasification of Coal Lurgi, Kopper'sTotzek, and Winkler process synthesis gas form Coal. Renewable sources of energy and their potential, low Temperature application of solar Energy.

UNIT V **Lectures 8**

Conversion of Bio-mass and their characteristic, physical thermo-chemical and Bio-logical methods of their conversion, Fuel cell

Course Outcomes:

After completion of this course, the student will be able to

CO1	**Understand the basic concepts of coal energy and Indian cruds & refinery products.**
CO2	**Numerical problems based on Combustion and fluidized bed combustion.**
CO3	**Analyse of different different energy sources.**
CO4	**Examine and apply for applications.**

Suggested Reading:

1. Coal Energy system By Bruce Miller, (Published-Academic Press)

2. Fuels and their Combustion By Robert T.HASLAM (5th edition, McGraw Hill)

Fuel and Combustion Technology

Teaching Scheme: ***Sessional Marks: 30***

Lectures: 3 periods/week ***University Examination Marks: 70***

University Examination: 3 hours

Course Objective: This course will provide knowledge regarding solid, liquid and gaseous fuels, their origin, classification, properties, preparation and combustion characteristic of fuel.

Unit 1 **Lectures 8**

Solid fuels: Classification, preparation, cleaning, analysis, ranking and properties - action of heat, oxidation, hydrogenation, carbonization, liquefaction and gasification.

Liquid fuels: Petroleum origin, production, composition, classification, petroleum processing, properties, testing - flow test, smoke points, storage and handling.

Unit 2 **Lectures 8**

Secondary liquid fuels: Gasoline, diesel, kerosene and lubricating oils. Liquid fuels - refining, cracking, fractional distillation, polymerization. Modified and synthetic liquid fuels. ASTM methods of testing the fuels.

Unit 3 **Lectures 10**

Gaseous fuels: Types, natural gas, methane from coal mine, water gas, carrier gas, producer gas, flue gas, blast furnace gas, biomass gas, refinery gas, LPG - manufacture, cleaning, purification and analysis. Fuels for spark ignition engines, knocking and octane number, anti knock additives, fuels for compression, engines, octane number, fuels for jet engines and rockets. Flue gas analysis by chromatography and sensor techniques.

Unit 4 **Lectures 6**

Combustion: Stochiometry, thermodynamics. Nature and types of combustion processes – Mechanism-ignition temperature, explosion range, flash and fire points, calorific value, calorific intensity and theoretical flame temperature.

Unit 5 **Lectures 6**

Combustion calculations, theoretical air requirements, flue gas analysis, combustion kinetics– hydrogen-oxygen reaction and hydrocarbon-oxygen reactions.

Rocket propellants and Explosives - classification, brief methods of preparation, characteristics; storage and handling

Text/Reference Books:

1. Fuels and Combustion, Samir Sarkar, Orient Longman Pvt. Ltd, 3rd edition, 2009
2. Fuels - Solids, liquids and gases - Their analysis and valuation, H. Joshua Philips, Biobliolife Publisher, 2008.
3. An introduction to combustion: Concept and applications - Stephen R Turns, Tata Mc. Graw Hill, 3rd edition, 2012.
4. Fundamentals of Combustion, D P Mishra, 1st edition, University Press, 2010
5. Engineering Chemistry - R. Mukhopadhyay and Sriparna Datta, Newage International Pvt. Ltd, 2007.

Course Outcomes: After completion of this course students will able to

CO1: Classify different kinds of fuels used in process industries.

CO2: Examine the quality of fuel using different test methods.

CO3: Report the flue gas analysis from combustion process.

CO4: Demonstrate the combustion process mechanism of fuel.

Course outcome mapping with Programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	1	1	1	1	-	-	-	-	2
CO2	3	3	2	1	2	1	2	-	-	-	-	3
CO3	3	2	3	2	3	2	2	-	-	-	-	3
CO4	3	3	3	2	3	2	2	-	-	-	-	3

Fertilizer technology

Lectures: 4 Periods/week — ***Sessional Marks: 30***

University Examination: 3 hours. — ***University Examination Marks: 70***

Course objective

To enable the students to learn the fertilizer manufacturing including new or modified fertilizer products and new techniques.

Unit – I **Lectures 10**

Definition of fertilizer, nutrient requirement of different plants paddy, wheat, sugarcane

Natural way of fixing nitrogen, Nitrogen cycle, carbon cycle, different nitrogen fixing plants, bacteria and algae. Role of C/N ratio in the growth of different plants. Organic manure.

Unit-II **Lectures 10**

Production of ammonia-its feed preparation, limitations of using different feed material for hydrogen generation, Reforming process and reformer design. Partial oxidation process and partial oxidation reactor design.

Unit-III **Lectures 10**

Removal of Impurities from synthesis gas CO removal and shift reactor design.CO_2 removal methods, Design of CO_2 absorber, NH_3 synthesis loop design, Design considerations for different types of NH_3 Reactors.

Unit-IV **Lectures 10**

Phosphate fertilizers-different methods of production, NPK, production and drying of NPK fertilizers, Bio-fertilizer.

Unit-V **Lectures 10**

Urea production; special features of urea reactor, prilling tower design.

Course Outcomes:

After completion of this course, the student will be able to

CO1	**Understand the basic concepts of fertilizer for agriculture and manufacturing process.**
CO2	**Design of ammonia reactor and urea pilling tower.**
CO3	**Analyse of different fertilizers.**
CO4	**Examine different fertilizer for different agriculture purpose.**

Suggested Reading:

1. Chemistry and Technology of Fertilizers — By V. Sauchelli, (Reinhold Publications)

2. Hand book on Fertilizers — By Vasant Gowariler,
V.N.Krishnamurthy and Sudha Gowariker (published, Fertilizer Association of India, New Delhi)

3. Dryden's Outlines of Chemical Technology By M. Gopala Rao Sitting Marshal (Affiliated East West Press (Pvt) Ltd, 3 rd Ed., New Delhi).

4. Shreve's Chemical Process Industries, By Austin G.T. (5th edition, McGraw Hill publication, New Delhi)

5. Chemical Technology – By Pandey G.N. and Shukla Vol. I and II, 2nd edition (Vani Books Company – Hyderabad)

Department of Civil Engineering
B.I.T. Sindri, Dhanbad

5th semester -Course Structure

Sl.no.	Course no.	Subject	L	T	P	Credit
1	CE5PC01	PC-I - SteelStructure& Design	4	1	0	4
2	CE5PC02	PC-II -Geotechnical Engineering-I	3	1	0	3
3	CE5PC03	PC-III - Environmental Engineering	3	1	0	3
4	CE5PE01()	PE-I -	3	1	0	3
5	CE5OE01()	OE-I -	3	1	0	3
Laboratory/Sessionals						
1	Lab-1	Sessional- SteelDesign Lab	0	0	3	1
2	Lab-2	Sessional- Geotechnical Engineering Lab	0	0	3	1
3	Lab-3	Sessional- Environmental EngineeringLab	0	0	3	1
4	Lab-4	Field Survey	0	0	3	1
5		General Proficiency/Seminar	0	0	2	2
TOTAL CREDIT						**22**

PROFESSIONAL ELECTIVE – I

[CE5PE01(A)] Water Resources Engineering-I
[CE5PE01(B)] Earthquake Engineering
[CE5PE01(C)] EnvironmentalGeo-technology
[CE5PE01(D)] Advance Surveying
[CE5PE01(E)] Water resources system
[CE5PE01(F)] IndustrialStructure
[CE5PE01(G)] DesignofStructural System

OPEN ELECTIVE – I

[CE5OE01(A)] EnvironmentalImpact Assessment
[CE5OE01(B)] Reliability Engineering
[CE5OE01(C)] Global Positioning System
[CE5OE01(D)] Disaster Management
[CE5OE01(E)] Environmental Management System
[CE5OE01(F)] Advanced Engineering System – MechanicalDepartment
[ ] Human ResourceDevelopmentandOrganisationalBehaviour – Humanities Department
[] Cyber Lawand Ethics – Humanities Department

PROFESSIONAL CORE – I

CE5PC01	**STEEL STRUCTURE &DESIGN**	**PC – I**	**4-1-0**	**4 Credits**

Pre-requisites: None

Detailed Syllabus:

MODULE	**CONTENTS**	**Hrs**
1.	Introduction to steel structures and IS 800-2007- Material specifications - Rolled sections – Section classifications - Design approach; design philosophy, i.e. loading load combination, factor of safety, permissible and working stress elastic method, limit state of design, plastic design, Elements of plastic theory:- Plastic hinge, shape factor, collapse load for beams & portal frame. Uniqueness, upper & lower bound theorem. Effect of axial force & shear in plastic moment ofsections.	**12**
2.	Connections: riveted, bolted and welded connections, strength and efficiency, Eccentric connection	**12**
3.	Tension member: rolled sections and built-up sections,	**8**
4	Compression members - Slenderness ratio – Design - Simple and built- up sections - lacings and battens - Tension members.	**10**
5.	Flexural members – Rolled sections - built-up beams - Design for strength and serviceability, web crippling, webyielding, bearing stiffeners,	**10**
6.	BEAM column: stability consideration, interaction formulae and Column bases: stability of base, gusseted base and grillage footing	**8**

Plate Girder, Gantry Girder,

Reading:

1. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi2008.

2. Dayaratnam P, Design of Steel Structures, S. Chand & Co., New Delhi,2003.

3. Arya, A.S and Ajmani, A.L., Design of Steel Structures, Nemchand and brothers, Roorkee, 1992..

4. Punmia, B.C., Ashok Kumar Jain and Arun Kumar Jain. Comprehensive Design of Steel Structures, Laxmi Publications Pvt. Ltd., New Delhi2000.

5. IS 800-2007, Code of practice for general construction in steel, Bureau of Indian Standards, NewDelhi.

PROFESSIONAL CORE – II

CE5PC02	Geotechnical Engineering-I	PC – II	3-1-0	3 Credits

Pre-requisites: None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	**Engineering Properties and Classifications** Laboratory and field identification of soils: Determination of water content by oven drying– specific gravity using Pycnometer and specific gravity bottle – grain size analysis by sieveanalysis, hydrometer analysis and pipette analysis – Atterberg limit and indices, sensitivity &thixotropy field density by core cutter, sand replacement and wax coating methods.Permeability: Definition - Darcy's law - factors affecting permeability – laboratorydetermination – permeability of stratified soils. Classification of Soils: Necessity – Principles of classification – I.S. classification – plasticitychart.	10
2.	**Stress Distribution in Soils** Stress distribution: Boussinesque's and Westergaard's equations for vertical pressure due topoint loads and uniformly distributed loads - assumptions and limitations - pressure bulb – Newmarks` charts and their use	4
3.	**Compressibility of Soils** Consolidation: definition - concepts of coefficient of compressibility - coefficient of volumechange and compression index - e-log p curves - pre-consolidation pressure - Terzaghi'stheory of one-dimensional consolidation - determination of coefficient of consolidation -difference between consolidation and compaction Compaction: definition and objectives of compaction - proctor test and modified proctor test- concept of OMC and maximum dry density - zero air voids line - factors influencingcompaction - field compaction methods - Proctor needle for field control	12
4	**Shear Strength and Stability of Slopes:** Shear Strength: definition - Mohr's strength and stress circles - Mohr's envelope – MohrCoulomb strength theory - direct, triaxial and UCC tests - drainage conditions-UU, CU andCD tests - vane shear tests - total and effective stress - strength parameters Stability of slopes: slope failure, base failure and toe failure - Swedish circle method -friction circle method - Taylor's stability number - stability charts	8
5.	**Retaining Walls :** Retaining walls, Active, neutral and Passive earth pressures and their distributions, rigid and flexible retaining walls,	6

	Coulomb's and Rankine's earth pressure distribution, Tension cracks, depth of tension cracks, Critical depth of excavation	
6.	**Sub-surface Exploration :** Subsurface exploration and investigation: Preliminary and detailed investigation, Soil sampling and various terms such as clearance and recovery ratio, auguring and boring, Penetration tests such as SPT, CPT, SCPT	**4**

PROFESSIONAL CORE – III

CE5PC03	ENVIROMENTAL ENGINEERING	PC – III	3-1-0	3 Credits

Pre-requisites:None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Water demand: - Population- forecast, design period, factors affecting populations growth, water demand, factors affecting rate of demand, variations in rate of demand.	**8**
2.	Quality of water: - sources of impurities, common impurities in water and their effect, water analysis, physical, chemical and biological characteristics, water borne diseases, Indian andWHO drinking standard.	**8**
3.	Purification: Sedimentation, flocculation, coagulation, filtration, disinfection, water softening, aeration, miscellaneous treatment method.	**8**
4.	Distribution of water: - Introductions , Methods of distribution, pressure in distribution mains, system of water supply, storage and distribution reservoir, layout and design of distribution system and distribution reservoir.	**12**
5.	Waste water treatment: - Sewage characteristics. Sewerage system: - Type, design, construction and maintenance. Treatment :- Primary and secondary treatments, screens, grit chamber, sedimentation chamber, principle and design of activated sludge digestion, final disposal of sludge and effluents, Disposal of sewage by dilution, self-purification of streams, sewage disposal by irrigation, waste water reuse, solid waste collection, re-utilization/disposal, B.O.D, C.O.D.	**12**

Reference Books

1. G.B. Masters, Introduction to Environmental Engineering and Science, Pearson Education,2013.
2. Gerard Kiely, Environmental Engineering, McGraw Hill Education Pvt Ltd, Special Indian
   Edition, 2007.
3. W P Cunningham, M A Cunningham, Principles of Environmental Science, Inquiry and Applications, Tata McGraw Hill, Eighth Edition,2016.
4. M. Chandrasekhar, Environmental science, Hi Tech Publishers,2009

PROFESSIONAL ELLECTIVE – I

CE5PE01(A)	**WATER RESOURCES ENGINEERING – I**	**PE – I**	**3-1-0**	**3 Credits**

Prerequisite: Fluid Mechanics

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	**Introduction -** Hydrologic cycle, water-budget equation, history of hydrology,worldwaterbudget,WaterbudgetofIndia,Organization preserving hydrological data,	**4**
2.	**Precipitation –** types and forms of precipitation, different characteristics of rainfall and their representation, measurement of rainfall , rain gauge network, mean precipitation over an area, depth area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India	**8**
3.	**Abstractions from precipitation -** evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration,evapotranspiration equations, potential evapotranspiration, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, infiltration capacity curve, classification of infiltrationcapacities, infiltration indices	**10**
4.	**Runoff** –components ofrunoff Estimation of run off, SCS-CN method of estimating runoff, flow duration curve, flow-mass curve, Different types ofindices.	**4**
5.	**Hydrograph:** Elements of storm hydrograph, simple and complex storm hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph, Derivation of unit hydrograph from S- Curve technique, SUH and IUH.	**10**
6.	**Floods estimation and Flood Routing:** Estimation of peak discharge, rational method, SCS method and unit hydrograph method, Design flood, return period, flood frequency analysis, concepts of flow routing, Different methods of routing,PMF,SPF	**8**

Reading:

1. 1.KSubramanya, Engineering Hydrology, Mc-GrawHill.
2. K N Muthreja, Applied Hydrology, Tata Mc-GrawHill.
3. K Subramanya, Water Resources Engineering through Objective Questions, TataMc-
   a. GrawHill.

CE5PE01(B)	EARTHQUAKE ENGINEERING	PE – I	3-1-0	3 Credits

Pre-requisites: NA

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Elements of Seismology ,Definitions of Magnitude, Intensity, Epicenter, etc. General features of tectonic of seismic regions, Seismographs. Theory of Vibrations	**8**
2.	Free vibrations of single degree, two degree and multiple degree freedom systems. Computation of dynamic response to time dependent forces. Vibration isolation. Vibration absorbers.	**8**
3.	Principles of Earthquake Resistant Design ,Response spectrum theory. Brief introduction to accelerographs and S.R.R.'s.	**8**
4.	Nature of dynamic loading resulting from earthquakes. Application of Response spectrum. Theory to a seismic design to structures. Resistance of structural elements and structures for dynamic loads, design criteria-strength and deflection. Ductility and absorption of energy.	**8**
5.	Dynamic Properties of Soils, Remedial measures and management of earthquake disaster , Introduction to Indian Standard Codes IS : 1893 – 1984 and IS: 4326 – 1993	**8**

CE5PE01(C)	ENVIRONMENTAL GEO-TECHNOLOGY	PE – I	3-1-0	3 Credits

Pre-requisites:None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	A consideration of technical and scientific aspects of key geo-societal issues.	**8**
2.	Case studies and analysis of current and historic databases will be used to illustrate topics including impact of climate change, energy resources, water and soil pollution, and health risks posed by heavy metals and emerging pollutants.	**16**

3.	Influence of disposal of industrial and construction waste on the Geo-environment	**12**
4.	Effect and impact of effluent from chemical and mining industries on ground water, Design of clay liners	**8**

Reference Books

1. Introduction to Environmental Geotechnology by Hsai – YangFang
2. CDEEP, IITB video lectures on course CE 488 and CE 641 by Prof. D. N.Singh

CE5PE01(D)	ADVANCE SURVEYING	PE – I	3-1-0	3 Credits

Pre-requisites: Surveying &Geomatics

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	**Field Astronomy**: Introduction, purposes, astronomical terms, Astronomical coordinate system, astronomical triangle, determination of azimuth, declination & hour angle, different types of time, LMT, ST & GMT and interdependencies. Equation of time,	**12**
2.	**Aerial photogrammetry**: Introduction, Principle, Uses, Aerial & terrestrial photographs, Scale of vertical and tilted photograph, photographic mapping- mapping using paper prints, mapping using stereoplotting instruments, mosaics,map substitutes.	**10**
3.	**Remote Sensing And Geographical Information System**: Introduction, Electromagnetic spectrum, Principles of energy interaction in atmosphere and earth surface, Image interpretation techniques, digital satellite data; Global Positioning system: Definition of GIS, Key Components of GIS, Functions of GIS, Spatial data, spatial information system, Geospatial analysis, Integration of Remote sensing & GIS and Applications in Civil Engineering	**12**
4.	**Hydrographic surveying**: Introduction, shoreline survey, sounding method of locating sounding, Three pointproblem.	**10**

Reading:

1. Surveying Vol. II and III by Dr. B.C. Punamia, Laxmi Publishers. NewDelhi
2. Surveying Vol. II and III by Dr. K.R. Arora, Standard Book House. NewDelhi
3. Advanced Surveying by R. Agor, Khanna Publishers, NewDelhi

4. Remote Sensing and GIS by B Bhatia, Oxford University Press, NewDelhi.
5. Remote sensing and Image interpretation by T.M Lillesand,. R.W Kiefer,. and J.W Chipman, 5th edition, John Wiley and SonsIndia

CE5PE01(E)	WATER RESOURCE SYSTEM	PE – I	3-1-0	3 Credits

Pre-requisites: Fluid Mechanics & Hydrology

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	**Introduction and Basic Concepts**: Introduction, System Components, Planning and management, Concept of a system, Advantages and limitations of systems approach, Modeling of Water Resources Systems, Simulation andoptimization, Economics in water resources, Challenges in water sector	**6**
2.	**Linear Programming and Applications**: General form of LP, Standard and Canonical forms of LP, Elementary transformations, Graphical method, Feasible and infeasible solutions, Simplex method, Dual and sensitivity analysis, LP problem formulation, Reservoir sizing and Reservoir operation using LP	**8**
3.	**Simulation:** Introduction, River basin simulation, Reservoir operation simulation, Performance evaluation - Reliability, Resiliency and Vulnerability, Some simulation models	**4**
4.	**Water Resources Systems Modeling:** River basin planning and management, Water distribution systems, Groundwater systems, Water quality modeling, Floodplain management, Urban storm water management	**8**

Reading:

1. Loucks D.P, Stedinger J.R and Haith D.A, 'Water Resources Systems Planning and Analysis', Prentice Hall, USA, 1981.

CE5PE01(F)	INDUSTRIAL STRUCTURES	PE – I	3-1-0	3 Credits

Pre-requisites: Steel Structure

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Industrial steel building frames: Types of frames, bracing, crane girders and columns, workshop sheds, trussed bents	**6**
2.	Transmission and Communication towers: Types and configuration, Analysis and design; Chimneys; Loads and stresses in chimney shaft, Earthquake and wind effect, Stresses due to temperature difference, combined effect of loads and Temperature	**10**
3.	Silos and Bunkers; Jassen's theory, Airy's theory, Shallow and deep bins, Rectangular bunkers with slopping bottom, Rectangular bunkers with high side walls, Steel stacks; introduction, force acting on a steel stack, design consideration, design example of stacks	**12**
4	Concrete Shell Structures: Folded plate and cylindrical shell structures; Introduction, structural behaviour of long and short shells, beam and arch action, analysis and design of cylindrical shell structures	**10**
5.	Machine foundations; introduction, machine vibration, structural design of foundation to rotary machines, impact machines, vibration characteristics, design consideration of foundation to impact machine, grillage, pile and raft foundation.	**10**

Reading:

1. 1.Design of Steel Structures, Arya and Azmani, Nem Chand Brothers, Roorkee,2004
2. Punmia B.C, Ashok Kr. Jain, Arun Kr. Jain, RCC Designs (Reinforced Concrete Design), 10th Edition, Lakshmi Publishers,2006.
3. Ramachandra, Design of Steel Structures, 12th Edition, Standard Publishers,2009.

CE5PE01(G)	DESIGN OF STRUCTURAL SYSTEMS	PE – I	3-1-0	3 Credits

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Classification of structural systems, Loads, assumptions and Idealizations	**10**
2.	The whole structural design process including definition of functional requirements, selection of structural scheme	**18**
3.	Formulation of design criteria, preliminary and computer- aided proportioning, and analysis of response, cost, and value.	**18**

Reading:

1. Structural Stability - Theory and Implementation by W.F.Chen and E.M.Lui byElsevier.
2. Reeve,D., Chadwick, A. and Fleming, C. Coastal Engineering-Processes, theory and design practice, Spon Press, Taylor & Francis Group, London &Paris,2004.

OPEN ELLECTIVE – I

CE5OE01(A)	ENVIRONMENT IMPACT ASSESSMENT	OE – I	3-1-0	3 Credits

Prerequisites: Environmental Engineering

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Evolution of EIA: Concepts ofEIA methodologies, Screening and scoping;	**8**
2.	Rapid EIA and Comprehensive EIA; GeneralFramework for Environmental Impact Assessment, Characterization and site assessment.Environmental Risk Analysis	**8**
3.	Definition of Risk, Matrix Method. Checklist method, Faulttree analysis, Consequence Analysis; Socioeconomic aspects, measures of effectiveness of pollution control activities	**12**
4	Environmental Legislation; Introduction to EnvironmentalManagement Systems; Environmental Statement - procedures; Environmental Audit: CostBenefit Analysis; Life Cycle Assessment; Resource Balance, Energy Balance &ManagementReview; Operational Control;	**14**
5	Case Studies on EIA.	**2**

CE5OE01(B)	RELIABILITY ENGINEERING	OE – I	3-1-0	3 Credits

Pre-requisites: NA

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Introduction: Definitions and concepts, Reliability , Probability, Impossible and certain events. Failure-data and its Analysis, Hazard rate and Failure density, Reliability in terms of hazard rate, Failure density in other situations.	10
2.	Hazard Models : Type of distribution and standard deviation and variance, Expectations , Conditional probabilities.	8
3.	System Reliability : Series, Parallel and mixed configurations. Methods of solving Complex systems.	8
4.	Reliability improvement : Types of redundancies, Reliability allocation for a series of system, Optimization Reliability- cost trade-off.	8

CE5OE01(C)	GLOBAL POSITIONING SYSTEM	OE – I	3-1-0	3 Credits

Pre-requisites: NA

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Overview of GPS – Development of Global Surveying Techniques, History of GPS, New Satellite Navigations constellations, Basic concept of GPS, Space, Control and User segments.	8
2.	GPS Observables – Structure of GPS Signal, Frequency, P Code, C/A code and data format, Generation of C/A code, Navigation data bits Pseudo range measurements, Phase measurements, system accuracy characteristics, DOP, Data format.	8
3.	Surveying with GPS–Planning a GPS Survey, Positioning methods – point positioning, relative positioning, Static, Fast static, RTK, Differential Positioning, Post processing, real-time processing,	8
4	Accuracy measures, software modules, Network adjustments, Dilution of Precision.	8
5	Applications of GPS – General Uses of GPS, Attitude determination, Interoperability of GPS. Future of GPS – Modernization plans of navigational satellites, Hardware and software improvements.	8

Reading:

1. Bradford W. Parkinson, James Spilker, Global Positioning System: Theory and Applications, Vol. I, 1996.
2. Gunter Seeber, Satellite Geodesy Foundations, Methods and Applications, Walter de Gruyter Pub., 2003.
3. Hofmann W.B, Lichtenegger, H, Collins, J Global Positioning System – Theory and Practice, Springer-VerlagWein, 2001.

CE5OE01(D)	**DISASTER MANAGEMENT**	**OE – I**	**3-1-0**	**3 Credits**

Pre-requisites: NA

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Understanding Disaster:Concept of Disaster – Different approaches- Concept of Risk – Levels of Disasters – Disaster Phenomena and Events (Global, national and regional) Hazards and Vulnerabilities: Natural and man-made hazards; response time, frequency and forewarning levels of different hazards – Characteristics and damage potential or natural hazards; hazard assessment – Dimensions of vulnerability factors; vulnerability assessment – Vulnerability and disaster risk – Vulnerabilities to flood and earthquake hazards	8
2.	Disaster Management Mechanism:Concepts of risk management and crisis managements – Disaster Management Cycle – Response and Recovery – Development, Prevention, Mitigation and Preparedness – Planning for Relief	8
3.	Capacity Building:Capacity Building: Concept – Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk – Counter-Disaster Resources and their utility in Disaster Management – Legislative Support at the state and national levels	8
4	Coping with Disaster:Coping Strategies; alternative adjustment processes – Changing Concepts of disaster management – Industrial Safety Plan; Safety norms and survival kits Mass media and disaster management	8
5	Planning for disaster management:Strategies for disaster management planning – Steps for formulating a disaster risk reduction plan – Disaster management Act and Policy in India – Organizational structure for disaster management in India – Preparation of state and district disaster management plans	8

TEXT BOOKS:

Manual on Disaster Management, National Disaster Management, Agency Govt of India.
Disaster Management by MrinaliniPandey Wiley 2014.
Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

CE5OE01(E)	ENVIRONMENTAL MANAGEMENT SYSTEM	OE – I	3-1-0	3 Credits

Pre-requisites: NA

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Environmental Management System in Industry : Quality of environment. ISO 14000 Environment standards, EMS model. Policy planning process, implementation and operation in industry.	8
2.	Environmental Pollution & Control Techniques: Definition of pollution, pollutant and significance of pollution of pollution control. Types of environment pollution: air, water and land pollution and control.	8
3.	Hazardous waste management system : landfill as incineration, environment problems and solution Concept of Restoration Ecology and Reclamation of degraded land.	8
4	Environment Impact Assessment and Audits : Basic concept of EIA, Needs for EIA and Methods. Introduction and Significance of Environment Audit. Audit regulations, standards and protocols. Setting up EIA and Audit Division in Industry.	8
5	Disasters and their management: Introduction of disasters, Classification and sub types of disasters. Industrial disasters and related case studies. Precautions of SHE in disaster management. Role of SHE in disaster management	8

CE5OE01(F)	ADVANCE ENGINEERING SYSTEMS	OE – I	3-1-0	3 Credits

Pre-requisites: NA

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Equations of motion for simple physical system. mechanical, electrical and eectromechanical systems	10
2.	Equations of motion for simple heat, conduction and fluid system. Analogies. Equations of motion for mechanical system in two and three dimension. Dynamic response of first orderand second order systems	12
3.	Forced oscillations of elementary systems. Dynamic stability of compound system. Total response of compound system. Fundamentals of compound systemanalysis.	12

*** Human Resource Development and Organizational Behavior (syllabus prepared and taught by Training and placement Cell, BIT, Sindri)**
*** Cyber Law and Ethics (syllabus prepared and taught by CSE & IT Department)**

Department of Civil Engineering
B.I.T. Sindri, Dhanbad

6^{th} semester -Course Structure

Sl.no.	Course no.	Subject	L	T	P	Credit
1	CE6PC01	PC-I - Concrete Structure-II	4	1	0	4
2	CE6PC02	PC-II - Structural Analysis-II	3	1	0	3
3	CE6PC03	PC-III - Highway Engineering	3	1	0	3
4	CE6PE01()	PE-I -	3	1	0	3
5	CE6OE01()	OE-I -	3	1	0	3
Laboratory/Sessionals						
1	Lab-1	Sessional- ConcreteDesign Lab	0	0	3	1
2	Lab-2	Sessional- Transportation Engineering Lab	0	0	3	1
3	Lab-3	Sessional- Structural EngineeringLab	0	0	3	1
4	Lab-4	C.S.Q.A.	0	0	3	1
5	IN601	Tour&Training/Internship	0	0	2	2
TOTAL CREDIT						**22**

PROFESSIONAL ELECTIVE – I

[CE6PE01(A)] Water Resources Engineering-II
[CE6PE01(B)] Pavement Design
[CE6PE01(C)] Bridge engineering
[CE6PE01(D)] Structural Dynamics
[CE6PE01(E)] System Engineering &Economics
[CE6PE01(F)] Masonry Structure

OPEN ELECTIVE – I

[CE6OE01(A)] IndustrialWaste Treatment
[CE6OE01(B)] Composite Material
[CE6OE01(C)] Environmental Laws and Policy
[CE6OE01(D)] Operational Research Technique
[CE6OE01(E)] Value and Ethics in engineering
[CE6OE01(F)] Decision and Risk Analysis

PROFESSIONAL CORE – I

CE6PC01	CONCRETE STRUCTURE-II	PC-I	4-1-0	4 Credits

Pre-requisites: Strength of Materials

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Design of Residential Buildings: fundamentals of multi-storey buildings, analysis of various loads: gravity, wind, earthquake loads., method of substitute frames, design examples, bending moments in columns, analysis of multistory frames subjected to horizontal loads.	12
2.	Design of RCC water tanks: Uncracked structures and determination of basic parameters, Revision of working stress design philosophies. Introduction to water tanks and their classifications, Important IS codes and its provisions, Analysis and design of Circular water tanks with flexible base and restrained base. Analysis and design of Rectangular water tanks, Analysis of Overhead tanks, Intze tank- basic geometrical configurations; analysis methods; design of top domes, cylindrical walls, ring beam.	12
3.	Design of Silos and Bunkers: Introduction, difference between bunker and silo, design of square or rectangular bunkers, design of circular bunkers, design examples, silos for storage of cement, design examples.	10
4.	Design of Simple Bridges: Bridges – basic definition, importance, classification., Site investigations for design of a bridge, Various loads and their combinations, Relevant IRC codes and its provisions, Introduction to RC bridge-, design of Culvertand T-beam bridge,.	12

PROFESSIONAL CORE – II

CE6PC02	STRUCTURAL ANALYSIS II	PC-II	3-1-0	3 Credits

Prerequisites: Structural Analysis I

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Analysis of fixed beams, continuous beam, simple frames and redundant frames with and without translation of points. Method of consistent deformation, Strain energy method, Slope deflection method, Moment distribution method.	**12**
2.	Analysis of two hinged arches. Suspension bridges with two hinged stiffening girder.	**10**
3.	Structural theorems:-Linearity principle of superposition,virtualwork,energy theorems, reciprocal theorems, Muller's Breslau's principles.	**6**
4.	Basics of force and displacement matrix methods for beams,plane frame (rigid and pin-pointed)	**10**
5.	Influence lines:-Influence lines for propped cantilevers,continuous beams and two hinged arches	**10**

PROFESSIONAL CORE – III

CE6PC03	HIGHWAY ENGINEERING	PC-III	3-1-0	3 Credits

Prerequisites: None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Highway development and planning-Classification of roads, road development in India, Current road projects in India; highway alignment and project preparation.	**6**
2.	Geometric design of highways-: Introduction; highway cross section elements; sight distance, design of horizontal and vertical alignment; Grade compensation	**12**
3.	Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; Design of signals, design of road intersections; design of parking facilities; highway lighting; problems	**10**
4.	Design of pavements- Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems	**12**

5.	Pavement materials- Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements. Problems	**8**

PROFESSIONAL ELLECTIVE – I

CE6PE01(A)	**WATER RESOURCE ENGINEERING II**	**PE – I**	**3-1-0**	**3 Credits**

Prerequisites: Water Resources Engineering I

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Irrigation Principles and planning Definition of Irrigation, development of irrigation in India. Benefits and ill effects of Irrigation. Types of method of irrigation system. quality of irrigation water, water requirements and irrigation scheduling, duty and data & base periods and their relationship, improvements of duty.	**10**
2.	Canal design and layouts , types of canal Canal alignment – Canal design – Kennedy's Silt theory method, Laceyes regime theory. RangaRaju and Misri Method. Basak Method, Tractive shear approach ,layout of canals. Conveyance losses.	**10**
3.	Diversion head Works, Layout of diversion head works, Components of head works, Bligh's and lane's theories, Khosla theory, Design of weir& Barrage	**8**
4.	Canal Regulation Works: Different types of regulation works, Types and Design of falls. Types and design of regulators, Cross regulator, head regulator, canal escapes, canal modulus etc.	**8**
5	Cross – Drainage Works Types of cross-drainage works and design of aqueducts. River Training Works Meandering of rivers, cut off, spurs, guide banks ,marginal embankment. Channel Improvements	**6**

CE6PE01(B)	**PAVEMENT DESIGN**	**PE – I**	**3-1-0**	**3 Credits**

Prerequite: Highway Engineering

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Introduction: Types and component parts of pavements,	**6**

	Factors affecting design and performance of pavements. Highway and airport pavements.	
2.	Stresses and Deflection sin Flexible Pavements: Stresses and deflection sin homogeneous masses. Burmister's two layer theory, three layer and multi-layer theories; wheel load stresses, various factors in traffic wheel loads; ESWL of multiple wheels. Repeated loads and EWL factors; sustained loads. Pavement behaviour under transient traffic loads.	**10**
3.	Flexible Pavement Design Methods For Highways and Airports: Empirical, semi-empirical and theoretical approaches, development, principle, design steps, advantages; design of flexible pavements as per IRC; Stresses in Rigid Pavements: Types of stresses and causes, factors in fluencing the stresses; general considerations in rigid pavement analysis, EWL; wheel load stresses, warping stresses, frictional stresses, combined stresses.	**10**
4.	Rigid Pavement Design: Types of joint sin cement concrete pavements and their functions, joint spacings; design of CC pavement for roads and run ways as per IRC, design of joint details for longitudinal joints, contraction joints and expansion joints. IRC method of design by stress ratio method.	**10**
5	Design of continuously reinforced concrete pavements; Maintenance, repair and rehabilitation of pavements including design of bituminous and concrete over lays as per IRC	**8**

CE6PE01(C)	**BRIDGE ENGINEERING**	**PE – I**	**3-1-0**	**3 Credits**

Prerequisites: Highway Engineering

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	General; classification of bridges, site selection, geometric and hydraulic design consideration	**6**
2.	Loading standards for highway and railway bridges, general design consideration; optimum spans; Concrete bridges: culverts; Slab, T-beam, box girder bridges, balanced cantilever bridge, cable stayed bridge, extrados bridges; arch bridge;	**12**
3.	Special requirements for Prestressed Concrete bridges; Steel bridges: plate girder bridge, truss bridge, suspension cable	**12**

	bridge, cable stayed bridge; Substructures: design of piers and abutments, pile and well foundations, bearings and expansion joints, special wearing coats	
4.	seismic design considerations; Aerodynamic stability considerations; special durability measures; provisions for inspection and maintenance;	**10**

CE6PE01(D)	**STRUCTURAL DYNAMICS**	**PE – I**	**3-1-0**	**3 Credits**

Prerequisites: Structural Engineering I

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	THEORY OF VIBRATIONS Difference between static loading and dynamic loading – Degree of freedom – idealisation of structure as single degree of freedom, – Formulation of Equations of motion of SDOF system – D'Alemberts principles – effect of damping – free and forced vibration of damped and undamped structures – Response to harmonic and periodic forces.	**9**
2.	Two degree of freedom system – modes of vibrations – formulation of equations of motion of multi degree of freedom (MDOF) system – Eigen values and Eigen vectors – Response to free and forced vibrations – damped and undamped MDOF system – Modal superposition methods.	**9**
3.	Elements of Engineering Seismology – Causes of Earthquake – Plate Tectonic theory – Elastic rebound Theory – Characteristic of earthquake – Estimation of earthquake parameters – Magnitude and intensity of earthquakes – Spectral Acceleration.	**9**
4.	Effect of earthquake on different type of structures – Behaviour of Reinforced Cement Concrete, Steel and Prestressed Concrete Structure under earthquake loading – Pinching effect – Bouchinger Effects – Evaluation of earthquake forces as per IS:1893 – 2002 – Response Spectra – Lessons learnt from past earthquakes.	**9**
5	Causes of damage – Planning considerations / Architectural concepts as per IS:4326 – 1993 – Guidelines for Earthquake resistant design – Earthquake resistant design for masonry and Reinforced Cement Concrete buildings – Lateral load analysis – Design and detailing as per IS:13920 – 1993.	**9**

CE6PE01(E)	SYSTEM ENGINEERING AND ECONOMICS	PE – I	3-1-0	3 Credits

Prerequisites: None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Introduction to the formulation and solution of civilengineeringproblems.Engineering economy, mathematical modeling, andoptimization.	**12**
2.	Techniques, including classical optimization, linear and nonlinearprogramming, network theory, critical path methods, simulation, decision theory	**14**
3.	Dynamic programming applied to a variety of civil engineering problems.	**12**

CE6PE01(F)	MASONRY STRUCTURES	PE – I	3-1-0	3 Credits

Prerequisites: None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Introduction to analysis, design and construction of masonrystructures.	**8**
2.	Mechanical properties of clay and concrete masonry units, mortar, and grout	**8**
3.	Compressive, tensile, flexural, and shear behavior of masonry structural components.	**8**
4	Strength and behavior of unreinforced bearing walls. Detailed design of reinforced masonry beams, columns, structural walls with and without openings	**8**
5	Complete lateral-forceresisting building systems.	**8**

OPEN ELLECTIVE – I

CE6OE01(A)	INDUSTRIAL WASTE TREATMENT	OE – I	3-1-0	3 Credits

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	INTRODUCTION Types of industries and industrial pollution – Characteristics of industrial wastes – Population equivalent – Bioassay studies – effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health Environmental legislations related to prevention and control of industrial effluents and hazardous wastes	**8**
2.	CLEANER PRODUCTION Waste management Approach – Waste Audit – Volume and strength reduction – Material and process modifications – Recycle, reuse and byproduct recovery – Applications.	**8**
3.	POLLUTION FROM MAJOR INDUSTRIES Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steel plants, Refineries, fertilizer, thermal power plants – Wastewater reclamation concepts	**9**
4.	TREATMENT TECHNOLOGIES Equalisation – Neutralisation – Removal of suspended and dissolved organic solids – Chemical oxidation – Adsorption – Removal of dissolved inorganics – Combined treatment of industrial and municipal wastes – Residue management – Dewatering – Disposal	**11**

CE6OE01(B)	COMPOSITE MATERIALS	OE – I	3-1-0	3 Credits

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	**Introduction:** Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc. Types of Reinforcements/Fibers: Role and Selection or reinforcement materials, Types of fibres, Glass fibers, Carbon fibers, Aramid fibers , Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc., Mechanical properties of fibres.	**14**

2.	**<u>Various types of composites:</u>** Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC); Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Comparison with Metals, Advantages & limitations of Composites.	**10**
3.	**<u>Fabrication methods: Processing of Composite Materials:</u>** Overall considerations, Autoclave curing, Other Manufacturing Processes like filament welding, compression molding, resin-transplant method, pultrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix performs, Manufacturing Techniques: Tooling and Specialty materials, Release agents, Peel plies, release films and fabrics, Bleeder and breather plies, bagging films.	**8**
4.	Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.	**8**

CE6OE01(C)	**ENVIRONMENTAL LAWS AND POLICY**	**OE – I**	**3-1-0**	**3 Credits**

Prerequisites: Environmental Engineering

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Overview of environment, nature and eco system, Concept of laws and policies, Origin of environmental law,	**14**
2.	Introduction to environmental laws and policies, Environment and Governance, sustainable development and environment, understanding climate change, carbon crediting, carbon foot print etc.,	**12**
3.	Introduction to trade and environment. International environmental laws, Right to Environment as Human Right International Humanitarian Law and Environment, environment and conflicts management, Famous international protocols like Kyoto.	**14**

CE6OE01(D)	OPERATIONAL RESEARCH TECHNIQUE	OE – I	3-1-0	3 Credits

Prerequisites: None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Introduction: History of operation research, nature and scope of operations research, allocation.	**10**
2.	Linear programming: Mathematical formulations of the problem, Graphical solution methods, mathematical solution of L-P problems, matrix formulation of general linear programming.	**10**
3.	Simplex Method: Algorithm and computational procedures, Two phase Simplex method, Problems of degeneracy, Principles of duality in simplex method, Sensitivity analysis, Transportation problem.	**10**
4	Game Theory: Introduction, Two persons zero sum games, the maxmini and minimax principles. Integer Programming: Formulation and solution of integer programming problems	**10**

Suggested Reading

1. Taha,H A, "Operations Research - An Introduction", Sixth Edition, Prentice Hall of India Private Limited, N. Delhi, 2004.
2. Hillier, F S, "Operations Research", First Indian Edition, CBS Publishers & Distributors, Delhi, 1994.

CE6OE01(E)	VALUES AND ETHICS IN ENGINEERING	OE – I	3-1-0	3 Credits

Prerequisites: None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Human Values:Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty –	**10**

	Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.	
2.	Engineering Ethics: Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories	**10**
3.	ENGINEERING AS SOCIAL EXPERIMENTATION Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.	**10**
4	SAFETY, RESPONSIBILITIES AND RIGHTS Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination	**10**
5	GLOBAL ISSUES Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility	**8**

CE6OE01(F)	**DECISION AND RISK ANALYSIS**	**OE – I**	**3-1-0**	**3 Credits**

Prerequisites: None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Development of modern statistical decision theory and	**10**

	riskanalysis, and application of these concepts in civil engineering design and decision making;	
2.	Bayesian statistical decision theory, decision tree, utility concepts, and multi-objectivedecision problems;	**8**
3.	Modelling and analysis of uncertainties, practical risk evaluation, andformulation of risk-based design criteria,	**12**
4	Risk benefit trade-offs, and optimal decisions.	**10**

Semester - V
Branch: Electronics & Communication Engineering

Sl. N.	Code	Course Title	Lecture	Tutorial	Practical	Credits
1		Digital Signal Processing	4	1	0	4
2		Digital Communication	3	1	0	3
3		Microcontroller & Embedded system	3	1	0	3
4		**Professional Elective –I**	3	1	0	3
5		**Open Elective –I#**	3	1	0	3
		Total				16
Laboratory/Sessionals						
1		DSP Lab	0	0	3	1
2		Digital Communication Lab	0	0	3	1
3		Microcontroller & Embedded system lab.	0	0	3	1
4		Professional Elective –I Lab	0	0	3	1
5		**General Proficiency/seminar**	0	0	2	2
					Total Credits	22

to be offered by other department

Code	**Professional Elective-I**
	Linear Control System
	Optoelectronics
	Electronic Devices

Code	**Open Elective-I (Any One)***
	Communication System
	Signal & System
	Digital System Design

* Not for ECE Students

Semester -VI
Branch: Electronics & Communication Engineering

Sl. N.	Code	Course Title	Lecture	Tutorial	Practical	Credits
1		Microwave Engineering	4	1	0	4
2		VLSI	3	1	0	3
3		**IoT**	3	1	0	3
4		**Professional Elective-I I**	3	1	0	3
5		**Open Elective –II#**	3	1	0	3
		Total				16
Laboratory/Sessionals						
1		Microwave Lab	0	0	3	1
2		VLSI Lab	0	0	3	1
3		IoT Lab	0	0	3	1
4		Professional Elective –II Lab	0	0	3	1
5	IN601	Internship/Tour and training/Industrial training	0	0	2	2
		Total				6
					Total Credits	22

to be offered by other department

Code	**Professional Elective-I I**
	Biomedical signal processing
	Electronic Measurement & Instrumentation
	Biosensor

Code	**Open Elective-II (Any One)***
	Digital Signal Processing
	VLSI
	Biomedical Electronics

* Not for ECE Students

SEMESTER V

EC621N	DIGITAL SIGNAL PROCESSING*

Module	Content	No. of Lectures
1	**Signals and systems:** Basic elements of DSP, concepts of frequency in Analog and Digital Signals, sampling theorem, Discrete time signals, systems analysis of discrete time LTI systems, Z transform, Convolution, Correlation.	6
2	**Frequency transformations:** Introduction to DFT, Properties of DFT, Circular Convolution, Filtering methods based on DFT, FFT Algorithms, Decimation in time Algorithms, Decimation in frequency Algorithms, Use of FFT in Linear Filtering, DCT, Use and Application of DCT.	10
3	**IIR filter design:** Structures of IIR, Analog filter design, Discrete time IIR filter from analog filter, IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives (LPF, HPF, BPF, BRF) filter design using frequency translation.	10
4	**FIR filter design:** Structures of FIR, Linear phase FIR filter, Fourier Series, Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanning Window), Frequency sampling techniques.	8
5	**Finite word length effects in digital filters:** Binary fixed point and floating point number representations, Comparison, Quantization noise, truncation and rounding, quantization noise power, input quantization error, coefficient quantization error, limit cycle oscillations-dead band, Overflow error-signal scaling.	8

Text Books:

1. J.G.PROAKIS & D.G.MANOLAKIS, Digital Signal Processing - Principles, algorithms & Applications, PHI, 2000.
2. .B.Venkataramani, M.Bhaskar, "Digital Signal Processors, Architecture, Programming and Application", Tata McGraw Hill, New Delhi, 2003
3. A.V. Oppenheim and Ronald W. Schafer, Discrete Time Signal Processing, 2nd Edition, PHI, 2000.
4. S.K.MITRA, Digital Signal Processing – A computer Based Approach, 2nd Edition, MGH, 2001.
5. Multi Rate Systems and Filter Banks – P.P.Vaidyanathan – Pearson Education.
6. Fundamentals of Digital Signal Processing using Matlab – Robert J. Schilling, Sandra L. Harris, Thomson, 2007

EC503N	DIGITAL COMMUNICATION

Module	Course Content	No. of Lecture
1	**Introduction:** A historical perspective in the development of digital communication, Elements of digital communication system. **Source encoding:** Pulse code modulation, quantization noise, linear and non-linear quantization, companding. Differential pulse code modulation, delta modulation, adaptive delta modulation, Delta sigma modulation, linear predictive coders.	**8**
2	**Multiplexing:** Introduction to different type of multiplexing, Frequency Division & Time Division Multiplexing, Multiplexing hierarchy, synchronous and asynchronous multiplexing, pulse staffing and word staffing. **Baseband transmission:** Baseband signal receiver, integrate and dump type filter probability of error calculations, optimum filters, coherent reception, matched filter and its transfer function. Probability of error of matched filter. Regenerative repeater, Bit synchronization, In-phase and mid-phase synchronizer. Early late gate synchronizer. Frame synchronization.	**8**
3	**Different type of line coding:** UPNRZ, UPRZ, PNRZ, PRZ, Manchester, differential encoding and their spectral characteristic, self synchronization properties of some of the encoded signal. **Equalization:** Inter symbol interference (ISI), Purpose of equalization, Eye pattern, Nyquist criterion for zero ISI, fixed equalizer. Design of equalizer, Adaptive equalizer, Decision directed equalizer, Adaptive decision directed equalizer, Partial response signaling.	**10**
4	**Digital modulation techniques:** BPSK, DPSK. BFSK, MARY-PSK & -FSK, QPSK, MSK principles, QASK, Error calculation. **Spread-spectrum modulation:** Pseudo-Noise Sequence, A notion of Spread Spectrum, Direct-Sequence Spread- Spectrum with Coherent Binary Phase-Shift Keying, Processing Gain, Probability of Error, Frequency-hop Spread Spectrum, Code-Division Multiple Access.	**8**
5	**Information theory and coding:** Concept and measure of information, Entropy, Discrete and continuous messages, Message source, zero memory sources, extension of zero memory source, Markov source and their entropy, Channel with and without memory, Channel capacity, Hartlay and Shannon's law. **Properties of code:** Uniquely decodable codes, Instantaneous codes, Kraft inequality and Macmillion inequality, Construction of instantaneous codes, Hoffman and Shannon-Fano coding, Error Coding.	**6**

Text Books:

1. S.Haykin, Digital Communications, John Wiley & Sons, 2009.
2. B.Sklar, Digital Communications, 2 nd Edition, Pearson Education, New Delhi, 2009.
3. John G.Proakis, Digital Communications, 3 rd edition, McGraw Hill, 1995.

EC505N	LINEAR CONTROL SYSTEM	
Module	**Course Content**	**No. of Lecture**
1	**INTRODUCTION:** Concepts of Control Systems- Open Loop and closed loop control systems and their differences, Different examples of control systems- Classification of control systems, Feed-Back Characteristics, Effects of feedback, Mathematical models, Differential equations, Impulse Response and transfer functions.	**7**
2	**TRANSFER FUNCTION REPRESENTATION:** Block diagram representation of systems considering electrical systems as examples -Block diagram algebra – Representation by Signal flow graph-Reduction using mason's gain formula.	**6**
3	**TIME RESPONSE ANALYSIS:** Standard test signals - Time response of first order systems –Characteristic Equation of Feedback control systems, Transient response of second order systems- Time domain specifications–Steady state response-Steady state errors and error constants–Effects of proportional derivative, proportional integral systems. **STABILITY ANALYSIS IN S-DOMAIN:** The concept of stability–Routh's stability criterion – qualitative stability and conditional stability – limitations of Routh's stability.	**10**
4	**ROOT LOCUS TECHNIQUE:** The root locus concept - construction of root loci-effects of adding poles and zeros to G(s) H(s) on the root loci. **FREQUENCY RESPONSE ANALYSIS:** Introduction, Frequency domain specifications-Bode diagrams Determination of Frequency domain specifications and Phase margin and Gain margin Stability Analysis from Bode Plots. Polar Plots, Nyquist Plots Stability Analysis. Compensation techniques – Lag, Lead, and Lead-Lag Controllers design in frequency Domain, PID Controllers.	**10**
5	**State Space Analysis of Continuous Systems:** Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization-Solving the Time invariant state Equations- State Transition Matrix and it's Properties – Concepts of Controllability and Observability.	**6**

Text Books:

1. Control Systems Theory and Applications - S. K. Bhattacharya, Pearson.
2. B.C. Kuo, Automatic Control Systems, 7th Edition, Prentice Hall of India, 2009.
3. I.J. Nagarath and M. Gopal: Control Systems Engineering, 2nd Edition, New Age Pub. Co. 2008.
4. Modern Control System with Advanced topics- S. K. Bharadwaj and S. K. Nagar, New Age Publication.
5. Control Systems - N. C. Jagan, BS Publications.
6. Control Systems - A. Ananad Kumar, PHI.
7. Control Systems - N. K. Sinha, New Age International (P) Limited Publishers

	OPTOELECTRONICS	
Module	**Course Content**	**No. of Lecture**
1	**INTRODUCTION: Difference between electronic, optoelectronic and photonic devices, Electrical and Optical Bandwidth,** Wave nature of light, Polarization, Interference, Diffraction, Absorption, Light Source	**7**
2	**ELEMENTS OF LIGHT AND SOLID STATE PHYSICS:** Basic principles of light propagation. Band structure of metals and semiconductors, Semiconductors - band diagrams, direct and indirect bandgap, degenerate and nondegenerate semiconductors, intrinsic and extrinsic semiconductors.	**8**
3	**OPTICAL SOURCES** :LED Device structure, materials and characteristics. The Semiconductor Laser: Basic structure, theory and device characteristics	**10**
4	Semiconductor Optical Amplifiers(SOA) characteristics and some applications, EDFA.	**10**
5	**OPTICAL DETECTION DEVICES:** Types of photodetectors, Photoconductors, Noise in photodetection, Photodiodes, PIN diodes and APDs: structure, materials, characteristics, and device performance	**8**

Reference :

- B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., 2nd Ed. (2007), Ch.16, 17, and 18.
- P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
- J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
- G. Keiser, Optical Fiber Communications, McGraw-Hill Inc., 3rd Ed. (2000), Ch.4, 6

ELECTRONIC DEVICES

Module	Course Content	No. of Lecture
1	**Crystal Properties and charge Carriers in Semiconductors:** Elemental and compound semiconductor materials, crystal lattice structure, Bonding forces and energy bands in solids, charge carriers in semiconductors, carrier concentrations, drift of carriers in electric field	**6**
2	**Excess Carriers in Semiconductors:** Optical absorption, luminescence, carrier life time and photo conductivity, diffusion of carriers	**6**
3	**Junction Properties:** Equilibrium conditions, biased junctions, steady state conditions, reverse bias break down, transient and AC conditions. Metal semiconductor junctions.	**8**
4	**Transistors:** Metal-semiconductor-field-effect-transistors (MESFET), Metal-insulator-semiconductor-field-effect-transistors (MISFET), Metal oxide semiconductor field effect transistor (MOSFET): Construction, Operation and characteristics of above devices. Bipolar junction transistors: Fundamentals of BJT operation, amplification with BJTs.	**12**
5	**Some special devices:** Photodiodes, photo detectors, solar cell, light emitting diodes, semiconductor lasers, light emitting materials. Tunnel Diode: degenerate semiconductors, IMPATT diode; The transferred electron mechanism: The GUNN diode. P-N-P-N diode, semiconductor controlled rectifier (SCR), bilateral devices: DIAC, TRIAC, IGBT.	**8**

EC515N	Microcontroller and Embedded System

Sl No	Topics	No of Lectures
1	Introduction to Microcontroller and Embedded Processor. The 8051 Architecture- Hardware- Oscillator and clock-program counter –data pointer-registers-stack and stack pointer-special function registers- -memory organization-program memory-data memory -Input / Output Ports –External memory-counter and timer-serial data Input / output-Interrupts.	09
2	8051 Assembly Language Programming-Structure of Assembly language-Assembling and running an 8051 program- Addressing modes-Accessing memory using various addressing modes- Instruction set- Arithmetic operations and Programs-Logical operations and Programs -Jump and Call instructions and Programs -I /O Pot Programs - Single bit instructions and Programs –Timer and counter - and Programs	10
3	8051 Serial Communication -Connection to RS-232- Serial Communication Programming- Interrupts Programming	08
4	**Hardware Interfacing:** Interfacing with Key Board, LEDs, Seven Segment, Basic concepts of LCD, ADC, DAC, Relays and their interfacing to microcontroller.	08
5	Basic concept of PIC microcontroller –Microcontroller Architecture – PIC16F Family	09

	Electronics Measurement and Instrumentation

Module	Topics	No. of Lectures
1	**Measurement Errors and Standards:** Definitions, Accuracy and Precision, Significant Figures, Types of Error, Statistical Analysis, Probability of Errors, Limiting Errors, Time and Frequency Standards, Electrical Standards. **Bridge Measurements:** Wheatstone Bridge, Kelvin Bridge, AC Bridge and their Applications, Maxwell Bridge, Hay's Bridge, Unbalance Conditions, Wein Bridge. Anderson's Bridge, De Sauty’s Bridge, Schering Bridge.	8
2	**Electronics Instrument For Measuring Basic Parameters:** True RMS Responding Voltmeter, Digital Frequency Meter, Circuit for Measurement of Frequency, High Frequency Measurements, Period Measurement, Ratio and Multiple Ratio Measurements, Time Interval Measurements, Vector Impedance Meter. **Cathode Ray Oscilloscope**: Introduction, Oscilloscope Block Diagram, Cathode Ray Tube, Delay Line, Multiple Trace, Oscilloscope Scope and Transducers, Oscilloscope Techniques, Digital Storage Oscilloscope.	11
3	**Instrument for Generation and Analysis of Waveforms:** Introduction, The Sine Wave Generator, Frequency Synthesized Signal Generator, Frequency Divider Generator, Signal Generator Modulation, Sweep Frequency Generator, Pulse and Square Wave Generator, Function Generator, Wave Analyzers, Harmonic Distortion Analyzer, Spectrum Analyzer.	6
4	**Transducers:** Electrical Transducers Selection and Considerations, Resistive, Strain Gauges, Temperature Transducers: Platinum Resistance Type, Thermistor, Thermocouples, Inductive, LVDT, Capacitive, Load Cell, Piezoelectric, Photoelectric Transducers. **Signal Converters:** I to P and P to I Converter, Temperature to Voltage Converter, Conversion To Frequency, Period, or Time Duration, Measurement of Phase Difference Using X-OR and SR Flip-Flop Method, Measurement of Active And Reactive Power of Supply Line, Locking Amplifiers, Variable Oscillators, Direct Sensor- Microcontroller Interfacing.	9

Module	Topics	No. of Lectures
5	**Isolation Techniques:** Transformer Isolation, Optical Isolation, Digital Techniques For Optical Isolation, Hall-Effect Principle And Measurement Of Displacement, Current And Power Using Hall Sensors, Amplifications Of Low Level Signals, Guarding, Shielding. **Data Acquisition And Conversion:** Analog Signal Processing, Sample And Hold Operation, S/H Circuits Using Op-Amps, Introduction To Data Acquisition System, Various DAS Configurations, Single Channel DAS, Multi-Channel DAS, IC Based DAS, Data Acquisition, Data Acquisition in PLC.	12

EC515N	BIOSENSORS

Module	Course Content	No. of Lecture
1	**General principles:** A historical perspective, Signal transduction, Physico-chemical and biological transducers, Sensor types and technologies, Definitions and Concepts Terminology and working vocabulary, Main technical definitions, calibration, selectivity, sensitivity, reproducibility, detection limits, response time.	8
2	**Physico-chemical transducers:** Electrochemical transducers (amperometric, potentiometric, conductimetric), optical transducers (absorption, fluorescence, SPR), Thermal transducers, piezoelectric transducers.	5
3	**Bio recognition systems: Enzymes:** Oligonucleotides and Nucleic Acids, Lipids (Langmuir-Blodgett bilayers, Phospholipids, Liposomes), Membrane receptors and transporters, Tissue and organelles (animal and plant tissue), Cell culture, Immuno receptors, Chemoreceptors, Limitations & problems, Immobilization of biomolecules.	10
4	**Biosensor Engineering:** Methods for biosensors fabrication, self-assembled monolayers, screen printing, photolithography, micro-contact printing, MEMS, Engineering concepts for mass production.	8
5	**Application of modern sensor technologies:** Clinical chemistry, Test-strips for glucose monitoring, Urea determination; Implantable sensors for long-term monitoring, Environmental monitoring, Technological process control, Food quality control, Forensic science benefits, Problems & limitations.	8

Text Books:

1. Donald G. Buerk, Biosensors: Theory and Applications, First Edition, CRC Press, 2009.
2. Alice Cunningham, Introduction to Bioanalytical Sensors, John Wiley& Sons, 1998.
3. Brian R. Eggins, Chemical Sensors and Biosensors, John Wiley& Sons, 2003.

EC615N	COMMUNICATION SYSTEM	
Module	**Course content**	**No. of Lectures**
1	Signals and Signal Analysis: Periodic and nonperiodic signals, Composite signals, Signal analysis, Time and frequency domain representation. Introduction to Data and signal fundamentals, Analog and digital signals.	**8**
2	Analog Transmission: Concepts of carrier signal, noise, modulating signal and modulated signal; Amplitude modulation – double sideband suppressed carrier, double sideband transmitted carrier, single sideband; Frequency modulation – Narrowband FM and wideband FM; Digital to analog conversion – Amplitude shift keying, Frequency shift keying, Phase shift keying, Quadrature amplitude modulation, Performance.	**8**
3	Digital Transmission: Problems with digital transmission, Different line coding schemes, Block coding schemes, Scrambling techniques; Analog to digital conversion – Sampling techniques, Sampling theorem, Pulse amplitude modulation, Pulse code modulation, Differential pulse code modulation, Delta modulation (along with advantages and disadvantages of each technique), Transmission modes (serial and parallel).	**10**
4	Multiplexing and Spreading: Concept of multiplexing, Frequency division multiplexing, Time division multiplexing – Synchronous and Statistical time division multiplexing.	**10**
5	Error Detection and Correction: Types of errors, Basic concepts of error detection and correction, Redundancy, Hamming distance, Error detection – Simple parity check codes, Two-dimensional parity check, Cyclic redundancy check, Polynomials and cyclic code analysis, Checksum, Error correction – Hamming code.	**8**

Text Books:

1. S. Haykin, Digital Communications, John Wiley & Sons, 2009.
2. B. Sklar, Digital Communications, 2nd Edition, Pearson Education, New Delhi, 2009.
3. John G. Proakis, Digital Communications, 3rd edition, McGraw Hill, 1995.
4. BP Lathi Communication System BS Publication
5. Singh & Sapre, Analog Communication, TMH.

EC511N	SIGNAL AND SYSTEM

Module	Course Content	No. of Lecture
1	**SIGNALS AND SYSTEMS:** Continuous Time and Discrete Time signals, Exponential and Sinusoidal Signals, Unit Impulse and Unit Step Functions, Continuous and Discrete Time Systems, basic System Properties. **LINEAR TIME INVARIANT SYSTEMS:** Discrete Time LTI Systems, Continuous Time LTI Systems, properties of LTI Systems, causal LTI Systems Described by Difference equations.	6
2	**FOURIER SERIES REPRESENTATION OF PERIODIC SIGNALS:** Response of LTI systems to Complex Exponentials, Fourier series Representation of CT periodic Signals, properties of CT Fourier Series, Fourier Series representation of DT periodic Signals, properties of DFS, Fourier series and LTI Systems, Filtering, Examples of CT filters, Examples of DT filters. CONTINUOUS TIME FOURIER TRANSFORM: Representation of a periodic Signals by continuous FT, FT of periodic signals, convolution and multiplication property of continuous FT, systems characterized by Linear Constant Coefficient Differential Equations.	9
3	**TIME AND FREQUENCY CHARACTERIZATION OF SIGNALS AND SYSTEMS**: Magnitude and phase representation of FT, Magnitude and phase response of LTI systems, Time domain and Frequency domain aspects of ideal and non-ideal filters. **DISCRETE TIME FOURIER TRANSFORM (DTFT) and DISCRETE FOURIER TRANSFORM (DFT):** Properties of DTFT and DFT, convolution property, multiplication property, Duality, Systems characterized by Linear Constant Coefficient Difference Equations.	9
4	**SAMPLING:** Sampling theorem, Impulse sampling, sampling with zero order Hold, Reconstruction of signal from its samples using interpolation, Effect of under sampling **Z-TRANSFORM:** Z-transform, Region of convergence and its properties, Inverse Z transform, properties of ZT, Analysis and characterization of LTI systems using ZT, LTI Systems, System function algebra and block diagram representations.	9
5	**SIGNAL FLOWGRAPHS:** Impulse Response and Transfer function of linear Systems, Block diagrams, Signal flow graphs, Basic properties of SFG, SFG Terms, SFG Algebra, Gain formula, Application of gain formula to block diagrams.	7

Text Books:

1. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, Signals and Systems Prentice Hall India, 2nd Edition, 2009.
2. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing, Principles, Algorithms, and Applications, 4th Edition, PHI, 2007.
3. Robert A. Gable, Richard A. Roberts, Signals & Linear Systems, 3rd Edition, John Wiley,1995.

EC519N	DIGITAL SYSTEM DESIGN

Module	Course Content	No. of Lecture
1	**INTRODUCTION:** Introduction to Number Systems and Boolean Algebra Digital and Analog Basic Concepts, Number Base Conversion - Complement Codes, Binary Arithmetic , Binary codes: BCD, Weighted codes -2421, 8421, gray code - Binary Logic functions, Boolean Algebra, Theorems and Properties of Boolean Algebra. **MINIMIZATION OF BOOLEAN FUNCTION:** Minimization techniques in digital Logic Canonical forms, Generation of Switching Equations from Truth Table - K-map (Karnaugh map) 2 ,3 and 4 variables, K map with Don't care terms - Quine Mc-Cluskey minimization technique, Quine Mc-Cluskey using Don't Care Terms - Mixed logic Combinational circuits.	8
2	**COMBINATIONAL CIRCUIT DESIGN:** Design with basic logic gates, comparators, data selectors, priority encoders, decoders, full adder, serial binary adder, parallel binary adders-ripple-carry adder, carrylook ahead adder; Parallel prefix adders- Carry select Adder, Conditional sum adder, Kogge-stone Adder, Brent-kung adder, Verilog models.	8
3	**SEQUENTIAL CIRCUIT DESIGN:** Memory elements and their excitation functions SR, JK, T, and D latches and flip-flops, master slave JK flip-flop, edge-triggered flip-flop, synchronous and asynchronous counters, finite-state machine, sequence detector, minimization and transformation of sequential machines, Registers, Verilog models.	10
4	**TESTING OF COMBINATIONAL CIRCUITS:** Fault models, structural testing: path sensitization Logic families: TTL and CMOS Logic circuits, Transfer characteristics, fan-in, fan-out, noise margin, rise time and fall time analysis, realization of Boolean equations using CMOS logic.	8
5	**MEMORY:** Types of memories, MOS SRAM cells, DRAM, SDRAM, DDR SDRAM, DDR2 SDRAM, DDR4 SDRAM, organization of a SRAM, Organization of SDRAM, Periphery circuitry of Memory, Flash memory, SD card.	6

SEMESTER VI

EC601N	VLSI DESIGN

Module	Content	No. of Lectures
1	**Introduction:** Review of MOSFET characteristics, scaling and small-geometry effects, and MOSFET capacitances. MOS resistor, MOS current source, current mirror circuits. MOS voltage source, linear voltage and current converters.	**6**
2	**CMOS operational amplifier (OPAMP) design:** Differential amplifier, level shifter, source follower, output stage voltage and power amplifiers. Cascode OP-AMP. Compensation techniques. **Analog Filters:** Switched capacitor (SC) fundamentals, first order SC circuits, second-order SC circuits and cascade design. Analog to digital and digital to analog converters, speed of conversion and over sampling issues. **VLSI Interconnects:** Distributed RC model, transmission line model. Future inter connect technologies.	**14**
3	**Digital VLSI Circuit Design:** MOS inverters, CMOS inverter, state characteristics, switching characteristics, power dissipation issues. **CMOS logic gates:** NAND, NOR, XOR, CMOS logic design of half and full adders. CMOS transmission gates, pseudo-nMOS, domino logic gates.	**9**
4	**Sequential MOS Logic Circuits:** The SR latch circuit, clocked latch and flip-flop, CMOS D-latch and edge-triggered circuits, Schmitt trigger circuit, Comparator. **Dynamic Logic Circuits:** Pass transistor logic, synchronous dynamic circuit techniques.	**8**
5	**Semiconductor Memories:** ROM circuits, SRAM circuits, DRAM circuits, drivers and buffers, Buffer scaling and design issues	**5**

Text Books:

1. Sung-Mo Kang, Yusuf Leblebici Chulwoo kim, Digital Integrated Circuits: Analysis and Design, 4th Edition, McGraw Hill Education, 2016.
2. Behzad Razavi, Design of Analog CMOS Integrated Circuits, 2nd Edition, McGraw Hill Education, 2016.
3. Jan M RABAEY, Digital Integrated Circuits, 2nd Edition, Pearson Education, 2003.
4. Neil H.E. Weste and David Harris, CMOS VLSI Design: A circuits and systems perspective, 4th Edition, Pearson Education, 2015.

EC611N	MICROWAVE ENGINEERING

Module	Content	No. of Lectures
1	**Introduction:** RF and microwave spectrum, historical background, application of RF and Microwave Impedance Matching–Unknown impedance measurement using shift in minima technique and impedance matching using single and double stub matching.	8
2	**Microwave waveguides and components**: Rectangular waveguide and circular waveguide, mode structure, cutoff frequency, wall current, attenuation; microwave cavities – rectangular cavity resonator, Q factor, power divider, scattering matrix and transmission matrix, attenuator, phase shifter, directional coupler, Bethe hole coupler, magic tee, hybrid ring, circulator, isolator, Ferrite Devices	10
3	**Planar structures:** Strip line, microstrip line, coplanar structure **Microwave Tubes:** Limitations of conventional tubes, Multicavity Klystron, Reflex Klystron, Magnetron, Travelling Wave Tube, Backward Wave Oscillator Semiconductor Microwave Devices – Tunnel diode, Gunn diode and their waveguide mounts	10
4	**Avalanche diodes:** IMPATT, TRAPATT, Microwave bipolar transistor, heterojunction bipolar transistor. **Microwave field effect transistor:** JFET, MOSFET, MESFET **Applications of microwave:** Industrial Applications of microwave.	8
5	**Microwave Measurement:** VSWR measurement, power measurement, impedance measurement, frequency Measurement Equivalent RF circuit parameters Low pass filter, high pass filter, band pass filter, RF amplifier.	6

Text Books:

1. Golio M, Golio J (2008) The RF and Microwave Handbook. CRC Press.
2. Pozar DM (2005) Microwave Engineering. John Wiley & Sons.
3. Hong JS, Lancaster MJ (2001) Microstrip Filters for RF/Microwave Applications. John Wiley & Sons.

EC605N	BIOMEDICAL SIGNAL PROCESSING

Module	Content	No. of Lectures
1	**Introduction to Biomedical Signals**: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis. **Electrocardiography**: Basic electrocardiography, ECG lead systems, ECG signal characteristics. **Signal Conversion :**Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversion circuits	**8**
2	**Signal Averaging:** Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging. **Adaptive Noise Cancelling:** Principal noise canceller model, 60-Hzadaptive cancelling using a sine wave model, other applications of adaptive filtering	**8**
3	**Data Compression Techniques:** Turning point algorithm, AZTEC algorithm, Fan algorithm, Huffman coding, data reduction algorithms The Fourier transform, Correlation, Convolution, Power spectrum estimation, Frequency domain analysis of the ECG	**8**
4	**Cardiological signal processing:** Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG signal characteristics (parameters and their estimation), Analog filters, ECG amplifier, and QRS detector, Power spectrum of the ECG, Bandpass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection algorithm, Realtime ECG processing algorithm, ECG interpretation, ST segment analyzer, Portable arrhythmia monitor	**8**
5	**Neurological signal processing:** The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics (EEG rhythms, waves, and transients), Correlation. **Analysis of EEG channels:** Detection of EEG rhythms, Template matching for EEG, spike and wave detection	**8**

EC615N	INTERNET OF THINGS

Module	Course Content	No. of Lecture
1	**Introduction to IOT:** IoT and the connected world, Architecture of IoT, Security issues, Opportunities for IoT. **The Web of Things:** Linked data, Enterprise data, Importance of security, privacy, and authenticity, Industry standards, Web of Things layer as the driver for IoT systems.	8
2	**Lessons from the Internet:** Relevance of internet to network of things, network management, security, mobility and longevity.	5
3	**Technologies:** Wireless protocols, Connectivity options. **Data storage and analysis:** Managing high rate sensor data, Processing data streams, Data consistency in an intermittently connected or disconnected environment, Identifying outliers and anomalies.	10
4	**Use cases:** Smart Buildings, Smart health, Home automation, Location tracking.	6
5	**Smart Cities:** Collection of information including opportunistic sensing, crowd sensing, and adhoc sensing Response of the system including analytics and optimization, distributed action, people as intelligent actuators, the risk for cyber-attacks in centralized and distributed systems	10

Text Books:

1. Designing the Internet of Things, by Adrian McEwen, Hakim Cassimally Wiley 2013.
2. Enterprise IoT Naveen Balani Create Space Independent Publishing Platform 2016.

Vth SEMESTER

MINING ENGINEERING
B.Tech, Semester V (Third year]
Course Structure

Sl. No.	Course Code	Course Title	Hours per week			Credits
			L	T	P	
Professional Core						
1.	MN501	Mine Ventilation Engineering	4	1	0	4
2.	MN502	Mining Machinery	3	1	0	3
3.	MN503	Underground Metal Mining Methods	3	1	0	3
4.	**Professional Elective – I**					
I.	MN504	Operation Research	3	1	0	3
II.	MN505	Mine System Engineering	3	1	0	3
III.	MN506	Remote Sensing & GIS	3	1	0	3
IV.	MN507	Numerical Techniques in Geomechanics	3	1	0	3
5.	**Open Elective – I (Any One of the Following)**					
I.	MN508	Mineral Process Engineering	3	1	0	3
II.	MN509	Bulk Material Handling	3	1	0	3
III.	MN510	Clean Coal Technology	3	1	0	3
IV.	MN511	Internet of Things (IOT)	3	1	0	3
PRACTICALS						
1.	MN521P	Mine Ventilation Engineering Lab	0	0	3	1
2.	MN522P	Mining Machinery Lab	0	0	3	1
3.	MN523P	Internet of Things (IoT) Lab	0	0	3	1
4.	MN524P	Mine Design – II Lab	0	0	3	1
5.	××××××	General Proficiency/ Seminar	0	0	2	2
						22

PROFESSIONAL CORE

MN501	MINE VENTILATION ENGINEERING	3L:1T:0P	4 Credits

Overview

Excavation in the earth under even normal circumstances can be fraught with environmental problems and hazards. In undergrounds mining, and tunneling too, the most critical aspect of is the environment in the working place. It is in fact the backbone of the miner's life support system.

To the mining engineering, ventilation trends to be the environmental remedy. It is the air – condition process relied upon which accomplish most environmental control underground. Ventilation is the control of air movement, its amount and direction. As the principle means of quantity control, it is one of the constituent processes of total air conditioning, the simultaneous control within prescribed limits of the quality, quantity, and temperature – humidity of the air.

Ventilation, therefore, is not only total-air-conditioning process, nor is it adequate alone to satisfy all mine environmental objectives. That is why this course stress that mine ventilation and air conditioning are complementary and separate processes. Increase, in underground mining as in surface industry, environmental objectives require that condition air to meet quality and temperature –humidity objectives as well as quantity.

In recent years' environmental standards in mines have been raised substantially. Worker productivity and job satisfaction correlate closely with environmental quantity. No mining company today can afford to be negligent in its environmental and air-control practices.

The goal of this course is to instruct the mining engineer in the principles and practices of ventilation and air conditioning applicable to the atmosphere and the unique environmental conditions found in mines.

Course Description

The purpose of this course is to present a modern and comprehensive treatment of mine ventilation system from the viewpoint of the total mine atmosphere environment and its control. Hence, the subject is treated in terms of the theory and practices in the three broad areas of air conditioning-quantity control, quantity control(ventilation), temperature – humidity control.

From the basic physics of gases, the theory is to developed to cover air measurements, the flow of air through ducts, through opening, and through circuits, the design of networks and the design of temperature-humidity control systems. The solution of examples problems and the many references to the technical literature will further assist the reader in grasping this theory.

At the end of this course it is intended that the students will be able to:

- Describe and apply the principles of fluid flow to ventilation systems.
- Describe and apply fan behavior laws to ventilation systems
- Design and develop a ventilation system for a mine.
- Describe environmental hazards found in mines and outline the ventilation control measures that detect, monitor, minimize and/or manage these hazards.

Syllabus:

Atmospheric air- Its composition, mine air -its composition and variation, origin, occurrence, physical, chemical and physiological properties of mine gases, various types of damps. Sampling and analysis of mine air. Methane content and pressure, methane drainage and methane layering. Monitoring of gases. Heat and humidity: Sources of heat in mines, effect of heat and humidity, psychometric, kata thermometer, methods of improving of cooling power of mine air. Air conditioning – basic vapour cycle, representative layout. Air flow through mine openings: Laws of air flow, resistance of airways, equivalent orifice, distribution of air, flow control devices. Natural Ventilation: Calculation of NVP from air density, thermodynamic treatment etc., artificial aids to natural ventilation. Mechanical Ventilation: principal types of mine fan and their suitability, merits, limitation, efficiency and characteristics. Selection of mine fan, fan testing, output control in fans, series and parallel operation of mine fans. Ventilation of advancing heading-auxiliary fan, duct, matching of fan to the duct system. Reversal of air current. Fan drift, evasee, diffuser, booster fans.

Modules:

1. **Introduction and course overview:**composition of mine air, its variation, origin, occurrence, physical, chemical and physiological properties of mine gases.
2. **Classification of various types of damps:**Sampling and analysis of mine air. Methane content and pressure, methane drainage and methane layering. Monitoring of gases.
3. **Heat and humidity:**Sources of heat in mines, effect of heat and humidity, psychometric, kata thermometer,
4. **Methods of improving**: of cooling power of mine air. Air conditioning – basic vapour cycle, representative layout.
5. **Air flow through mine openings:** Laws of air flow, resistance of airways, equivalent orifice, distribution of air, flow control devices
6. **Natural Ventilation**: Calculation of NVP from air density, thermodynamic treatment etc. artificial aids to natural ventilation.
7. **Mechanical Ventilation:** principal types of mine fan and their suitability, merits, limitation, efficiency and characteristics.
8. **Selection of mine fan**: fan testing, output control in fans, series and parallel operation of mine fans.
9. **Ventilation of advancing:** heading-auxiliary fan, duct, matching of fan to the duct system.
10. **Reversal of air current**. Fan drift, evasee, diffuser, booster fans.

Text/Reference Books:

- Banerjee S.P. (2003); "Mine Ventilation"; Lovely Prakashan, Dhanbad, India.
- Panigrahi D.C: Mine Ventilation, CRC Press
- Deshmukh, D. J. (2008); "Elements of Mining Technology,Vol. II"; Denett& Co., Nagpur, India.
- Hartman, H. L., Mutmansky, J. M. & Wang, Y. J. (1982); "Mine Ventilation and Air Conditioning"; John Wiley & Sons, New York.
- Karmakar, N. C. (2001); "Handbook of gas testing"; Lovely Prakashan, Dhanbad, India.
- Le Roux, W. L. (1972); Mine Ventilation Notes for Beginners"; The Mine Ventilation Society of South Africa.
- McPherson, M. J. (1993); Subsurface Ventilation and Environmental Engineering"; Chapman & Hall, London.
- Misra G.B. (1986); "Mine Environment and Ventilation"; Oxford University Press, Calcutta, India.
- Ramlu, M. A. (1991); "Element of Mine Ventilation"; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- Vutukuri, V. S. & Lama, R. D. (1986); "Environmental Engineering in Mines"; Cambridge University Press, Cambridge.
- Kejriwal,B.K,"ASurvey Of Accidents , Their Causes &Prevention''.
- Kaku L.C, "Fire In Coal Mine" ,Lovely Prakashan, Dhanbad, India.
- Ghatak S.,"Mine Ventilation"Vol. 1 & Vol. 2,Lovely Prakashan, Dhanbad, India.
- Banerjee S.P., "Prevention combating Mine Fires",Lovely Prakashan, Dhanbad, India.

Goals & Outcomes:

Upon successful completion of this course, the student will be able to:
(Knowledge based)

- Explain the meaning of mine ventilation system.
- Recognise the different types of damps and their causes and prevention techniques.
- Describe the various techniques of fan selection for a particular mine;
- Explain the laws of air flows, resistance of airways, equivalent orifice, distribution of air;
- Have complete understanding of the significant role of different flow control devices.

(Skills)
Use mine ventilation system to:

- Apply the techniques used in fan selection to solve real life problem in mining industry
- Develop skills sets for calculating natural ventilation pressure from air density etc.
- Formulate air quantity required to solve real life problem.
- Deal with fire dams in mine.
- Recognising the physiological properties of dust.
- Develop the prevention and suppression techniques of dust, dust formation sources.
- Develop methods of improving the cooling power of mine air.
- Determine the characteristics of mine airways.
- Maintain and monitor the mine fans.

MN502	MINING MACHINERY	3L:0T:0P	3 Credits

Pre-requisite: Engineering Mechanics, Mechanical Technology

Course Objectives:

This course introduces prime movers used for moving of mining machinery, Rails, Joints, Crossings, Plates for track laying, Locomotives used in mines, drills used for drilling in mines, mine winders, winding drums, man riding systems, cutter loaders, pumps, opencast machinery for mining to improve its output.

Syllabus:
Prime Mover for Mining Machinery: O.C. engine, hydraulic power, pneumatic power, elements of mechanical power transmission – gear, belt, chain, coupling, clutch and brake. Rope haulage: Construction of the wire ropes, rope haulages – gravity, direct, balanced direct, main & tail, endless, reversible endless. Suitability of these haulages and their limitations. Dimension of ropes, drums and pulleys, care and maintenance of ropes, changing of haulage ropes, rope splicing, safety appliances in haulage road, signaling, Statutory requirements of haulages. Track Laying: Rail, joints, crossings, plates, turn tables a curve, track extension, Aerial Ropeways: Types, construction, Application and operation. Mine Locomotives: Types, constructional features of compressed air, diesel, battery and electric trolley-wire locomotives, comparison of various locomotive haulages. Comparison of rope and locomotive haulages. Conveyors: Principle types and their operations, installation, shifting, maintenance and applicability, shuttle cars, stage loaders, bridge conveyors, capacity. Drills for Coal and Stone: Various types, their construction and maintenance, Jumbo drills. Mine Winders: Koepe and Drum winders and their applications, head gear, head gear pulley, shaft fitting – Keps, rope guides, shaft sinking and bells, capping and recapping, cage and suspension gear. Winding Drum-types and construction, Safety devices in winders-over speed and over wind preventers, slow breaking, depth indicator, Methods of counter balancing rope. Duty cycle. Mechanical and electrical braking. Winding from different levels in shaft. Man riding system in underground mines. Face Machinery: SDL & LHD – their applications, capacity, operation, fitting, control and maintenance. Cutter loaders – Shearers, Coal plough and Continuous Miners – their constructional features, applications, capacity and maintenance. Layout of faces with Power loader working under varied condition, Shuttle cars. Pumps: Types, Construction, operation, characteristics and application, Calculation of size, efficiencies and capacities. Layout of drainage system. Opencast Machinery: Blast Hole Drill, Ripper, Shovel, Dragline, Dumper, Bucket Wheel Excavator, Continuous Miners – their basic construction, applications and operation.

Modules:

Module 1: Prime Mover for Mining Machinery: O.C. engine, hydraulic power, pneumatic power, elements of mechanical power transmission – gear, belt, chain, coupling, clutch and brake.
Module 2: Rope haulage: Construction of the wire ropes, rope haulages – gravity, direct, balanced direct, main & tail, endless, reversible endless. Suitability of these haulages and their limitations. Dimension of ropes, drums and pulleys, care and maintenance of ropes, changing of haulage ropes, rope splicing, safety appliances in haulage road, signaling, Statutory requirements of haulages.

Module 3: Track Laying: Rail, joints, crossings, plates, turn tables a curve, track extension, Aerial Ropeways: Types, construction, Application and operation.
Module 4: Mine Locomotives: Types, constructional features of compressed air, diesel, battery and electric trolley-wire locomotives, comparison of various locomotive haulages. Comparison of rope and locomotive haulages. Conveyors: Principle types and their operations, installation, shifting, maintenance and applicability, shuttle cars, stage loaders, bridge conveyors, capacity.
Module 5: Drills for Coal and Stone: Various types, their construction and maintenance, Jumbo drills.
Module 6: Mine Winders: Koepe and Drum winders and their applications, head gear, head gear pulley, shaft fitting – Keps, rope guides, shaft sinking and bells, capping and recapping, cage and suspension gear.
Module 7: Winding Drum-types and construction, Safety devices in winders-over speed and over wind preventers, slow breaking, depth indicator, Methods of counter balancing rope. Duty cycle. Mechanical and electrical braking. Winding from different levels in shaft.
Module 8: Man riding system in underground mines. Face Machinery: SDL & LHD – their applications, capacity, operation, fitting, control and maintenance. Cutter loaders – Shearers, Coal plough and Continuous Miners – their constructional features, applications, capacity and maintenance.
Module 9: Layout of faces with Power loader working under varied condition, Shuttle cars. Pumps: Types, Construction, operation, characteristics and application, Calculation of size, efficiencies and capacities. Layout of drainage system.
Module 10: Opencast Machinery: Blast Hole Drill, Ripper, Shovel, Dragline, Dumper, Bucket Wheel Excavator, Continuous Miners – their basic construction, applications and operation.

Text/Reference Books:

1. Elements of Mining Technology Vol. III, D.J. Deshmukh, Denett & Company,
2. Coal Mining Series Vol. 1 & II, Ernest Mason, Virtue
3. Mine Transport – N.T. Karelin, Orient Longmans
4. Mining and Transport – S. C. Walker, Elsevier
5. Introduction to Mining Engineers – Hartman. H.L, John Wiley & Sons.
6. Pumps Focus Compressors Walkar wending & Transport, Cherkasky B.M.
7. Mine Mechanisation and Automation, Alemgren G, U. Kumar.

Course Outcomes:

Students can understand mechanism involved in heavy machinery, locomotives used in mines, track laying with different techniques. Different types of drills used in mines, winders applications, winding drum construction, face machinery, open cast machinery like blast hole drill, ripper, dumper, bucket wheel excavator, which will enhance the output of mines.

MN503	UNDERGROUND METAL MINING METHODS	3L:0T:0P	3 CREDITS

Syllabus:

Introduction to Metal Mining: Peculiarities of Metalliferous deposit. Scope and limitations of underground mining, Opening up of underground deposits, choice of entry shaft and combination and their applicability, limitations.
Mine Developments: Methods of developments, Factors effecting choice of level interval, Cross cuts, Drive, shape and size of drive, winzes, Raises, block size, shaft station, ore bin, ore pass and their position in relation to ore body and general scheme of its development. Division of mining area into working units and level pattern, dimensions of panels and blocks.
Stoping: Classification of stoping methods, applicability, limitations, merits and demerits, Factors affecting choice of stopping methods like depth, dip, Width grade / value of deposit, physio mechanical characteristics of the ore and wall rocks. Stope design and production planning in various methods of stoping. Production and cycle time estimates. Stope and development support, mining cycles, shift times, estimating equipment's requirements.
Stoping Methods: Stoping without supports: Open stopping, overhand, underhand, breast stoping. Stoping with Supports: shrinkage stopping cut and fill stopping, square set stopping. Caving methods: Top Slicing, sublevel caving and block caving.
Special Stoping methods: Sublevel stoping, long-hole stoping, blast hole stoping, raise stoping, V.C.R Stoping, in-situ leaching, bio-mineral engineering, hydraulic mining, blast hole stoping, underground bench blasting, Extraction of remnant pillars, shaft pillars and contiguous reefs, their supporting system and special precautions during extraction.
Deep mining: concept of deep mining, special problems of deep mining, , salt potash and Sulphur mining and their special problems, stoping practices in rock burst prone mines. Under sea mining, novel mining methods, application of tunnel and shaft boring machines and their applications.

Module

01. Introduction to Metal Mining: Peculiarities of Metalliferous deposit. Scope and limitations of underground mining, Opening up of underground deposits, choice of entry shaft and combination and their applicability, limitations.

2. Mine Developments: Methods of developments, Factors effecting choice of level interval, Cross cuts, Drive, shape and size of drive, winzes, Raises, block size, shaft station, ore bin, ore pass and their position in relation to ore body and general scheme of its development. Division of mining area into working units and level pattern, dimensions of panels and blocks.

3. Stoping: Classification of stoping methods, applicability, limitations, merits and demerits, Factors affecting choice of stopping methods like depth, dip, Width grade / value of deposit, physio mechanical characteristics of the ore and wall rocks. Stope design and production planning in various methods of stoping. Production and cycle time estimates. Stope and development support, mining cycles, shift times, estimating equipment’s requirements.

4. Stoping Methods: Stoping without supports: Open stopping, overhand, underhand, breast stoping. Stoping with Supports: shrinkage stopping cut and fill stopping, square set stopping. Caving methods: Top Slicing, sublevel caving and block caving.

5. **Special Stoping methods:** Sublevel stoping, long-hole stoping, blast hole stoping, raise stoping, V.C.R Stoping, in-situ leaching, bio-mineral engineering, hydraulic mining, blast hole stoping, underground bench blasting, Extraction of remnant pillars, shaft pillars and contiguous reefs, their supporting system and special precautions during extraction.

6. Deep mining: concept of deep mining, special problems of deep mining, salt potash and Sulphur mining and their special problems, stoping practices in rock burst prone mines. Under sea mining, novel mining methods, application of tunnel and shaft boring machines and their applications.

Goals and Outcomes:

On completion of the subject, students will be able to:

1. Explain various terminology and development of underground metal mines.
2. Compare between coal and metal mining.
3. Explain various raising methods in stope development.
4. Explain various stopping methods used in metal mines.
5. Describe about face mechanism.
6. Explain about deep mining.
7. Explain design and planning of various stoping methods for effective production.

Suggested Text books:

1. Introductory Mining Engg: Harman, John Wiley and sons;
2. EMT-D.J Deshmukh

Reference Books:

3. Deep Mining-jack Spalding, mining publications;
4. P. Darling:”SME Mining engineers hand book”Vol.I&II
5. U/G Mining Method-Hustrulid, society for mining, metallurgy & Exploration
6. Shevyalov:”Mining and mineral deposits”. MIR Publishers
7. Popov:”Working of mineral deposits”. MIR Publishers

PROFESSIONAL ELECTIVE I

MN504	OPERATION RESEARCH	3L:0T:0P	3 Credits

Overview:

Operation Research (OR) is application of scientific methods, techniques and tools of mathematical science to problems involving the operations of a system. OR provides the control in the system and its component with optimum solutions to the problems. It is a decision taking tool, which searches for the optimum results in coequality with the overall objectives within the constraints of the organization.

Thus, OR is to solve complex problems that involves management of large systems of men, machines, materials, and money in industry, business, government and defence. The distinctive approach is to develop a scientific model of the system incorporating measurement of factors such as chance and risk, to predict and compare the outcome of alternative decisions, strategies or controls.

Its purpose is to give administration, on the basis of predicting most effective quantitative results of an operation, under given set of variable conditions and thereby to provide a sound basis for “decision-making”. Though it is very clear that operation research never make decisions for the management, instead the method presents management with a careful scientific and quantitative analysis of problem so that the management will be in a better position to make sounder decisions.

In the more wide sense, operation research does not deal with the everyday problems such as output by the one worker or machine capacity; instead it is concerned with the overall aspect of business operation such as something as the relationship between inventory, sales, production and scheduling. It may also deal with the overall flow of goods and services from plants to consumers.

The team doing operation research may have, psychologists, labour specialists, mathematicians, analysts, statisticians and others depending upon the requirement for the problems.

Course Description:

This course is an introductory and practical course to the study of operations research application in mining projects. It is designed primarily for mining engineering students to replicate what is happening in the mining industry in classroom so as to be able to apply the knowledge and skills gained during and after course of study to real life situations they might face in the industry. It involves demonstration of principles and techniques of operations research using real life projects. Topics to be covered include operation research and model formulation, solution of the operation research model, phases of an 2 operation research study, techniques of operation research or operations research solution tools such as Linear Programming (LP) (Two phase (two variables) LP, Three phase (three variables) LP); Transportation models, Network models, Queuing systems (models) etc.

The objectives of this course are to:

- Introduce students to the techniques of operations research in mining operations
- Provide students with basic skills and knowledge of operations research and its application in mineral industry
- Introduce students to practical application of operations research in big mining projects

Syllabus:

Introduction: Objectives and scope of Quantitative methods; Classification or types of Quantitative methods; A brief history with particular reference to mining industry.

Linear Programming: Concepts, graphical solutions, simplex method, sensitivity analysis, transportation and assignment problems.

Network Analysis: CPM and PERT methods, their relative suitability vis-à-vis specific applications, time cost trading.

Dynamic Programming: Introduction, basic concept, Stage coach problem.

Stochastic Methods: Discrete and continuous probability distributions, Stochastic process and Markov chains.

Basic queuing models with constant arrival and service rates; inventory models.

Monte-Carlo method- Introduction.

Modules:

Module 1: **Introduction and course overview:** Definition of Operation Research, Objectives and scope of Quantitative methods.

Module 2: **Classification of Quantitative methods:** Different types of Quantitative methods.

Module 3: **History of OR:** A brief history with particular reference to mining industry.

Module 4: **Linear Programming Solving Techniques:** Concepts, Graphical solutions and Simplex methods.

Module 5: **Linear Programming Application:** Sensitivity analysis, Transportation and assignment problems.

Module 6: **Network analysis methods:** CPM and PERT methods.

Module 7: **Network analysis method's application and suitability:** Relative suitability vis-à-vis specific applications of CPM and PERT methods and Time cost trading.

Module 8: **Dynamic Programming:** Introduction, basic concept, Stage coach problem.

Module 9: **Stochastic approach to OR:** Discrete and continuous probability distributions, stochastic process and Markov chains.

Module 10: **Problems which involves queuing or waiting:** Basic queuing models with constant arrival and service rates.

Module 11: **Inventory models:** Mathematical models in determining optimum level of inventories.

Module 12: **Introduction to statistical simulation:** Introduction to Monte-Carlo method.

Text/Reference Books:

1. Handy A. Taha, An Introduction to Operation Research, University of Arkansas, Fayettiville. 8th Edition. Pearson Education Inc. London (2003). 81p.
2. Hiller, F.S. And L.J. Lieberman: Introduction to operation research, Holden Day, San Francisco (6th Ed.) (1995).
3. S. Kalavathy,Operations Research, 4th Edition, Vikas Publishing House
4. K.A. Stroud: Further Engineering Mathematics. Programmes and problems. 3rd Edition Macmillan Press Ltd (1996). 974p.
5. P. Herrison, Operational Research: Quantitative Decision Analysis; Mike Morris Publication (1983).
6. TaiwoOwoeye: Operation Research; Olugbenga Press Publication (2001). ISBN 987-2430. 60p
7. Wayne L. Winston. Operation Research Application. 415p

Goals & Outcomes:

Upon successful completion of this course, the student will be able to:
(Knowledge based)

- Explain the meaning of operations research
- Know the various techniques of operations research techniques;
- Apply the techniques used in operations research to solve real life problem in mining industry
- Select an optimum solution with profit maximization;
- Have complete understand of the significant role operation research play in mining
- Project completion at every stage of the mines

(Skills)
Use operations research to:

- Identify and develop operational research models from the verbal description of the real system. E.g. Solve transportation problems during the allocation of trucks to excavators
- Formulate operation research models to solve real life problem
- Proficiently allocating scarce resources to optimize and maximize profit
- Eliminate customers / clients waiting period for service delivery
- Turn real life problems into formulation of models to be solve by linear programming etc.
- Determine critical path analysis to solve real life project scheduling time and timely delivery
- Use critical path analysis and programming evaluation production and review techniques for timely project scheduling and completion and
- Conduct literature search on the internet in the use of operation research techniques in mining projects execution and completion.
- Understand the mathematical tools that are needed to solve optimization problems.
- Use mathematical software to solve the proposed models.
- Develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decision-making processes in Management Engineering.

MN505	MINE SYSTEM ENGINEERING	3L-0T-0P	3 CREDITS

Syllabus

Introduction to system engineering, system concept analysis, models in system analysis.
System approach to mine design, sub-system, engineering design phases of planning.
Economic considerations in planning of opencast and underground mining, optimal size, capacity and development parameters.
Tactical and strategic planning, project planning, project appraisal, prepration of project feasibility report.
Introduction to Statistical decision theory and its applications in the mineral industries, Technological forecasting
Introduction to operations research techniques, network analysis, application of PERT and CPM to mining projects.

Modules

1. Introduction to system engineering, system concept analysis, models in system analysis.
2. System approach to mine design, sub-system and engineering design phases of planning.
3. Economic considerations in planning of opencast mining, optimal size, capacity and development parameters.
4. Economic considerations in planning of underground mining, capacity and development parameters.
5. Tactical and strategic planning, project planning, project appraisal, prepration of project feasibility report.
6. Introduction to Statistical decision theory and its applications in the mineral industries, Technological forecasting
7. Introduction to operations research techniques, network analysis, application of PERT and CPM to mining projects.

Text/Reference Books:

1. Handy A. Taha, An Introduction to Operation Research, University of Arkansas, Fayettiville. 8th Edition. Pearson Education Inc. London (2003).
2. D. Biswas, Modern concepts of Surface Mining
3. W.Hustrulid, M.Kuchta and R.Martin, Openpit Mine Planning and Design.
4. S. Kalavathy,Operations Research, 4th Edition, Vikas Publishing House
5. Wayne L. Winston. Operation Research Application.
6. Surface Mining: Methods, Technologies and Systems. Volume-2
7. SME Mining Engineering Handbook, Third Edition
8. Handy A. Taha, An Introduction to Operation Research, University of Arkansas, Fayettiville. 8th Edition. Pearson Education Inc. London (2003).
9. S.K. Das, Surface Mining Operations.

Goals and Outcomes:
This course qualifies participants to apply an advanced body of knowledge in the area of mine system engineering and equips them with highly developed skills for research and enquiry. Students enrolled in this course will be able to apply the body of knowledge to a range of contexts within the mining industry enabling them to undertake professional or highly skilled work within the mining industry and allow them to undertake further study.

Knowledge:
1. Analyse mining systems used in surface operations
2. Identify and develop operational research models from the verbal description of the real system. E.g. Solve transportation problems during the allocation of trucks to excavators
3. Formulate operation research models to solve real life problem
4. Turn real life problems into formulation of models to be solve by linear programming etc.
5. Determine critical path analysis to solve real life project scheduling time and timely delivery

Skills:
1. Review, analyze, consolidate and synthesizes knowledge to identify and provide solutions to complex surface mining problems
2. Assess and evaluate complex ideas in mine system engineering and selection of the number required and the size of appropriate equipment
3. Apply specialized technical and creative skills using appropriate tools to solve problems in surface mining.

MN506	REMOTE SENSING & GIS	3L:0T:0P	3 Credits

Course Objectives:
Remote Sensing and GIS is a relatively young scientific discipline and is an area of emerging technology which has witnessed phenomenal growth over last three decades. In the recent past, there has been tremendous development in the field of Remote Sensing data collection, analysis and utilization. The science of Remote Sensing is no more an art of Map making from satellite image. The digital data handling led to the development of GIS (Geographical Information System) followed by another innovation of GPS (Global Positing System). Remote Sensing coupled with GIS and GPS techniques has dramatically enhanced human capability for resources exploration, mapping and monitoring on local and global scale.
The application of Remote Sensing techniques and Geographical Information System (GIS) in various activities including resources evaluation, environmental monitoring and Landuse/Landcover mapping etc, have grown considerably during the last three decades and Remote Sensing data products are being increasingly used for plan information at all levels. An essentials pre-requisite to partaking in these opportunities is the building of various indigenous capacities for the development and utilization of space science and technology. This has led to a spurt in the demand for qualified manpower.

This course is designed to address the following:

- Understanding the Geoinformatics approach
- Teach fundamental principles involved in RS and GIS
- Understand the Fundamentals of Remote sensing Products
- Know the Indian Remote Sensing Program
- Role of Remote Sensing for various surveys and information extraction
- Know about different software available in RS and GIS
- Learn fundamental procedures in RS and GIS
- Teach data integration and defining problems in digital format

Syllabus:

Definition & Scope of Remote Sensing: Electromagnetic energy & spectrum, Atmospheric windows. Remote Sensing Systems, Sensors & Scanners, Resolution of sensors, Multispectral, thermal & Radar data. Radiometers, spectral Signatures. Elements of Remote Sensing Systems: Terrestrial, airborne &spaceborne platforms, sunsynchronous & Geostationary satellites. Various earth resources satellites, Indian Remote sensing Programs. Remote Sensing Data products & their types: Analogue & Digital data Formats, errors. Interpretation Techniques: Elements & Methods of interpretation, Relief displacement and vertical exaggeration, Photogrammetric determination of elevation from Remote Sensing Data. Digital Image Processing: Image rectification & restoration, image enhancements, image classification; supervised & unsupervised, accuracy assessments. Geographical Information Systems: Raster & Vector Data, Components of GIS, concepts & basic characteristics of Vectorization, topology generation, attribute data attachment, editing and analysis. Buffer, Overlay and Interpolation techniques. Managing networks in GIS. Global Positioning Systems: Types and method. Applications: Integrated approach of RS & GIS application; Geotechnical investigations (soil studies, dam site studies), water resources management, environmental studies (EIA and Land Use Land cover studies), transportation planning, Urban Planning, E-Governance.

Modules

Module 1: **Definition & Scope of Remote Sensing:** Electromagnetic energy & spectrum, Atmospheric windows. Remote Sensing Systems, Sensors & Scanners, Resolution of sensors, Multispectral, thermal & Radar data. Radiometers, spectral Signatures.

Module 2: **Elements of Remote Sensing Systems:** Terrestrial, airborne &spaceborne platforms, sunsynchronous & Geostationary satellites. Various earth resources satellites, Indian Remote sensing Programs.

Module 3: **Remote Sensing Data products & their types:** Analogue & Digital data Formats, errors.

Module 4: **Interpretation Techniques:** Elements & Methods of interpretation, Relief displacement and vertical exaggeration, Photogrammetric determination of elevation from Remote Sensing Data.

Module 5: **Digital Image Processing:** Image rectification & restoration, image enhancements, image classification; supervised & unsupervised, accuracy assessments.

Module 6: **Geographical Information Systems:** Raster & Vector Data, Components of GIS, concepts & basic characteristics of Vectorization, topology generation, attribute data attachment, editing and analysis. Buffer, Overlay and Interpolation techniques. Managing networks in GIS.

Module 7: **Global Positioning Systems:** Types and method.

Module 8: **Applications:** Integrated approach of RS & GIS application; Geotechnical investigations (soil studies, dam site studies), water resources management, environmental studies (EIA and Land Use Land cover studies), transportation planning, Urban Planning, E-Governance.

Text/Reference Books:

1. M. Anji Reddy BS Publications Remote Sensing and Geographical Informatiotn Systems Third Edition.
2. C.P LO Albert KW Yeung, Concepts and techniqes of Geographic Infromation Systems Pritince Hall of India 2002.
3. John R Jensen Remote Sensing of the Environment ..an Earth Resource Perspective Pearson Education 2006.
4. Geographic Informaiton System and Enviornment Modeling Keith C. Clerk, Bradely O Parks, Michel P Crane Pritince Hall of India 2002.
5. Bhatta Remote Sensing and GIS Oxford University press First Edition.Surveying (Vol – 1,2 & 3), by B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain – Laxmi Publications (P) Ltd., New Delhi.

Goals & Outcomes:

Upon successful completion of this course, the student will be able to:
(Knowledge based)

- Know Understand the remote sensing process;
- Understand digital data in different and their formats
- Know about National and International RS Programs
- Know about various satellites and images
- Know about changing field practices in Survey
- Know how to generate different types of digital data
- Know about Application areas

(Skills)
Use operations of RS & GIS to:

- Geotechnical investigations (soil studies, dam site studies)
- Water resources management
- Environmental studies (EIA and Land Use Land cover studies)
- Transportation planning, Urban Planning, E-Governance.

MN507	NUMERICAL TECHNIQUES IN GEO-MECHANICS	3L:0T:0P	3 credits

Overview:
Numerical Techniques in Geo-Mechanics is the application of Numerical Methods in Geomechanics (i.e. Rock Mechanics and Soil Mechanics). The Course aims to introduce the extended evaluation of safety, regarding collapse or excessive settlement, for slopes, surface, and underground earth works using Numerical Simulation. The perception is to Practice Numerical Techniques in Rock and Geotechnical Engineering. The course is intended for sixth semester students of B. Tech degrees in Civil and Mining Engineering (Geotechnics, Mining Structures). Also, for professionals with an interest in the area of Geomechanics (like Geotechnical Engineers, Structural Foundation Designers and Geology Engineers) and people interested in research in applied numerical methods.

Since the Course is promoted by a Research Group in Computational Mathematics applied to Geomechanics, applications of different Numerical Methods and Techniques are particularly stressed.

Course Description:
This course starts with Principle of continuum mechanics and Numerical Methods. It will elaborate the different numerical methods for Mathematical Modelling and need of Numerical Modelling in designing excavation by analysing stresses around the excavation. The course will also explain different Numerical Techniques such FDM, FEM, BEM and introduction to some software's based on these techniques.

The objectives of this course are to:

- Introduce students to application of Numerical Methods in Mathematical Modelling
- Introduce students to practical application of Numerical Simulation in civil and mining industry
- Introduce students to different Numerical Techniques and software's based on this.

Syllabus:
Introduction: Principle of continuum mechanics, Numerical methods: Numerical Methods in general, Numerical Methods in Linear Algebra; Need for numerical modelling in design of excavation in mines, domain and boundary conditions, discretisation of domain and boundary, principal methods of numerical simulation for excavation in mining (FEM, FDM, & BEM; reference to geomechanics).
Finite Element Method: Basic principle, assembling elements to form a structural stiffness matrix, imposing boundary conditions, solving structural equations using plane truss, elements on assumed displacements, constant strain triangle, iso-parametric formulation.
Finite Difference Method: Basic principle, explicit finite difference method, finite difference equation, solution stability.
Boundary Element Method: Basic principle, introductory ideas of its application in mining excavations.
Introduction to numerical modelling packages: ANSYS, PLAXIS, FLAC etc.

Modules:

1. **Introduction:** Principle of continuum mechanics, Numerical Methods in general, Solution of Equations by Iteration, Interpolation.
2. **Numerical Integration and Differentiation:** Numerical Integration and Differentiation
3. **Numerical Methods in Linear Algebra:** Linear systems: Gauss Elimination, Solution by Iteration.
4. **Numerical Modelling:** Need for numerical modelling in design of excavation in mines, domain and boundary conditions and its application in Mathematical Modelling.
5. **Finite Element Method:** Basic principle, assembling elements to form a structural stiffness matrix, imposing boundary conditions, solving structural equations using plane truss, elements on assumed displacements, constant strain triangle, iso-parametric formulation.
6. **Finite Difference Method:** Basic principle, explicit finite difference method, finite difference equation, solution stability.
7. **Boundary Element Method:** Basic principle, introductory ideas of its application in mining excavations.

Text/Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th edition; John wiley & sons, Part E (Numerical Methods)
2. Debasis Deb, Finite Element Method: Concept and Applications in Geomechanics; Prentice Hall of India
3. J. B. Martins, Numerical Methods in Geomechanics; Springer
4. G. Swoboda, Numerical Methods in Geomechanics, 6th edition; CRC Press
5. http://vle.du.ac.in/course/view.php?id=562

Goals & Outcomes:

Upon successful completion of this course, the student will be able to:

(Knowledge based)

- Understand different Numerical Methods.
- Identify and apply different Numerical Methods in different kind of Modelling
- Understand working of different FEM/ FDM/ BEM based software's

(Skills)

Use Numerical Techniques in Geomechanics to:

- Analyse and evaluate different kind of Numerical Techniques (FEM) for different conditions
- Can use different software's for designing Civil and Mining structures

Able to write some programmes for various applications in Civil and Mining Industry

OPEN ELECTIVE I

MN508	MINERAL PROCESSING ENGINEEINRG	3L:0T:0P	3 Credits

Course Objectives:

This course introduces objectives of mineral processing, characteristics of minerals and coal, crushing methods, separation methods, methods of concentration, fields of application and limitations. Upon completion of the course, students will possess the knowledge needed to design a mineral processing operation that ensures maximum profitability for a mining company while achieving the required product quality specifications. Students will understand the methodology used to select the appropriate unit operations, determine the optimum operating conditions and select the required size of the unit. A knowledge of product quality assurance programs that includes the monitoring of plant efficiency will be demonstrated.

Syllabus:

Scope, objectives and limitations of mineral processing, liberation and beneficiation. Comminution: Theory and practices of crushing and grinding; different types of crushing and grinding equipment's – their applications and limitations. Laboratory size analysis and interpretation; settling of solids in fluids; industrial screens, mechanical classifiers and hydro cyclones. Gravity Concentration Methods: Jigging, Heavy media separation, flowing film concentrators–theory, applications and limitations. Physico-chemical principles, reagents, Machines, floatation of sulphides and oxides ores and coals. Magnetic methods of concentration Principles, Applications and limitations of magnetic concentration, Electric methods of concentration Principles, High tension and low-tension electric concentration, Ore sorters, Dewatering: Thickeners, filters, thermal drying. Simplified flow sheets for coal, zinc, iron, and manganese ores. Magnetic methods of concentration Principles, Fields of Application and Limitation.

Modules:

Module 1: Introduction: Scope, objectives and limitations of mineral processing, liberation and beneficiation.

Module 2: Comminution: Theory and practices of crushing and grinding; different types of crushing and grinding equipment's – their applications and limitations.

Module 3: Size Separation: Laboratory size analysis and interpretation; settling of solids in fluids; industrial screens, mechanical classifiers and hydro cyclones.

Module 4: Gravity Concentration Methods: Jigging, Heavy media separation, flowing film concentrators–theory, applications and limitations.

Module 5: Froth Floatation: Physico-chemical principles, reagents, Machines, floatation of sulphides, oxides and coal.

Module 6: Electrical and magnetic methods of concentrating technique: Magnetic methods of concentration Principles, Applications and limitations of magnetic concentration, Electric methods of concentration Principles, High tension and low-tension electric concentration, Ore sorters,

Module 7: Dewatering: Thickeners, filters, thermal drying.

Module 8: Flow Sheets: Simplified flow sheets for coal, copper, lead and zinc, gold, uranium, iron, manganese and lime stone ores, Laboratory sampling.

Module 9: Industrial lectures: Case studies of mineral processing plant projects by industry professionals, covering comprehensive planning to commission the same.

Module 10: Basics of Professionalism: Professional Ethics, Entrepreneurial possibilities in Mineral Processing Technology, Possibilities for creative & innovative working in this field,

Text/Reference Books:

1. Introduction to Mineral Processing – V. Malleswar Rao, Indian Academy of Geoscience
2. Mineral Processing – Barry A Wills, Elsevier.
3.Mineral Processing – S.K. Jain, CBS Publishers & Distributors
4. Mineral beneficiation a concise basic course by D.V. Subba rao
5. J. W. Leonard and B. C. Hardinge, Coal Preparation, Society for Mining, Metallurgy and Exploration, Inc., Littleton, CO, ISBN 0-87335-104-5, 1991.
6. N. L. Weiss, SME Mineral Processing Handbook, Volumes 1 and 2, Society for Mining, Metallurgy and Exploration, Inc., Littleton, CO, ISBN 0-89520-433-6, 1985.

Course goals and outcomes:

At the end of the course, students will be able to learn the following points which are given below:

1. Understand Scope, objectives and limitations of mineral processing and theory of Comminution
2. Understand basic concepts of Size Separation
3. Understand basic concepts Froth Floatation
4. Understand Applications and Limitations of Concentrating techniques
5. Understand various Flow Sheets
6.Develop processing flow sheets for the production of aggregates and mineral concentrates from raw ore material
7. Obtain the knowledge for the typical process circuits used to treat aggregates and ores containing one or more valuable minerals.
8. Conduct mass and water balances throughout the process flow sheet.
9. Predict solid-solid and solid-liquid separation performances based on known physical properties of the raw material and process unit models.
10. Determine the process unit, size and number needed to effectively achieve solid-solid separations and solid liquid separations.

MN 509	BULK MATERIAL HANDLING	3L:0T:0P	3 Credits

Course Objectives:
When the students enter the college to pursue a degree in Mining Engineering and as well pursue a career in Mining Engineering after graduation, they need to understand the breadth and depth available in this field for different bulk material handling system. When many alternative disciplines of engineering appear to offer apparently more glamorous avenues for advancement, the Mining Engineering student should realize the solid foundations available in this mother of all engineering disciplines. The students should understand the enormous possibilities available for creative and innovative works in this all-pervasive field of engineering. This course introduces material handling and transportation concept, Operation and maintenance of different conveying system, Design of transportation system and different storage systems etc.
This course is designed to address the following:

- To give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Mining Engineering
- To motivate the student to pursue a career in one of the many areas of Mining Engineering with deep interest and keenness.
- To expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects of public utility.

Syllabus:
Properties of the bulk material vis-à-vis different bulk handling operations. Classification of bulk material transportation system: Road transport system, Rail transport system, pipe line transport system, conveyor transport system. Design, operation and maintenance: Belt conveyors. High angle conveyors, Cable belt conveyors, Booster belt conveyors -their selection and application in the mining industry. Design and operation of slurry transport of minerals and mining wastes. Operation and maintenance of Stacker, Reclaimer and Spreader. Hydraulic and pneumatic conveying, stacking and blending, reclaiming of bulk materials. Automation and online monitoring of bulk material handling system, Storage systems: Silos, bins and bunkers. Rapid loading system, Merry-go-round system.

Modules:
Module 1: Introduction to Bulk Material Handling: Properties of the bulk material vis-à-vis different bulk handling operations
Module 2: Classification of Bulk Material transportation System: Road transport system, Rail transport system, pipe line transport system, conveyor transport system.
Module 3: Design, Operation and Maintenance of different types of Conveyor: Belt conveyors. High angle conveyors, Cable belt conveyors, Booster belt conveyors -their selection and application in the mining industry.
Module 4: Design, Operation and Maintenance of slurry transport system: Design and operation of slurry transport of minerals and mining wastes.
Module 5: Operation and Maintenance of material handling machines: Operation and maintenance of Stacker, Reclaimer and Spreader
Module 6: Hydraulic and pneumatic conveying system: Hydraulic and pneumatic conveying, stacking and blending, reclaiming of bulk materials.
Module 7: Automation and online monitoring: Automation and online monitoring of bulk material handling system,

Module 8: Storage System: Storage systems: Silos, bins and bunkers. Rapid loading system, Merry-go-round system.
Module 9: Industrial lectures: Case studies of large tunneling and shaft sinking engineering projects by industry professionals, covering comprehensive planning to commission the same.
Module 10: Basics of Professionalism: Professional Ethics, Entrepreneurial possibilities in Tunneling Engineering, Possibilities for creative & innovative working, Technical writing Skills enhancement; Facilities Management; Quality & HSE Systems in tunnel excavation method.

Text/Reference Books:

1. Design and Selection of Bulk Material Handling Equipment and Systems Vol II, Jayanta Bhattacharya
2. Design and Selection of Bulk Material Handling Equipment and Systems: Mining Mineral Processing Port Plant and Excavation Engineering: Vol. I, Jayanta Bhattacharya
3. Hand Book of Bulk Materials Handling, Fruchtbaum, Jacob
4. Material Handling – Principles and Practices by Allegri (Sr.), T.H CBS Publishers and Distributors, Delhi, 1987.
5. Kennedy, B.A., Surface Mining – 2nd Edition, SME, New York, 1990.
6. Peng, S.S., and Chiang, H.S., Longwall Mining, John Wiley and Sons, New York, 1984.
7. Hartman, H.L., (Ed.), SME Mining Engg. Handbook Vol. I and II,
8. Society for Mining, Metallurgy, and Exploration, Inc., Colorado, 1992.

Course Goals & Outcomes:
1. Introduction to what constitutes Bulk material handling system.
2. Highlighting the depth of engagement possible within each of these areas.
3. Exploration of the various possibilities of a career in this field.
4. Understanding the vast interfaces this field has with the society at large.
5. Providing inspiration for doing creative and innovative work in bulk material handling system.
6. Highlighting possibilities for taking up entrepreneurial activities in this field.
7. Providing a foundation for the student to launch off upon an inspired academic pursuit into this subject of engineering.
8. Know about material handling system, different material handling methods.
9. Student gets knowledge about design, operation and maintenance of different conveying system i.e. hydraulic, pneumatic, slurry transportation system etc.

MN510	CLEAN COAL TECHNOLOGY	3L:0T:0P	3 Credits

Course objectives:

The course outlines the current changes and developments in the coal combustion-related processes. The course objectifies with the aim of utilizing the energy from coal and its by-products efficiently, such that minimal amount of waste generation and disposal takes place. The course aims at stating the physical and chemical process working under the carbon capture, and sequestrations. Clean coal technology works around the foundation to create minimal impact on the environment.

Syllabus:

Definition and objectives. Classification of CCT's. Carbon sequestration and storage of CO_2, coal bed methane recovery and its utilization, underground coal gasification (in-situ and surface gasification), Coal production and utilization trends., Life cycle of coal, Status of coal utilization technology and related operating and environmental problems. coal characterization and qualities and their effect on selection of efficient methods for eco-friendly utilization of coal. classification system of coal, rank and grade of coal. Necessity, scope and limitations of pre-combustion coal cleaning technology. Wash ability characteristics and preparation problems related to coal quality. Principles, operations and selection of processes for coal preparation. Plant performance evaluation and forecasting of cleaning results. Environmental problems and related mitigating measures. Fluidized bed combustion techniques, integrated gasification combined cycle (IGCC) and their co – generation options. Necessity, scope and limitations of combustion and post-combustion clean coal technologies. Developments, basic principles, operating features of clean coal technologies. Selection, performance and related environmental problems and their control. Characterization, impacts, control, treatment and safe disposal of wastes and pollutants released from various stages of clean coal technologies. Utilization of wastes and pollutants.

Modules:

Module 1: Introduction to CCT: Definition and objectives. Classification of CCT's. Carbon sequestration and storage of CO2, coal bed methane recovery and its utilization, underground coal gasification (in-situ and surface gasification),
Module 2: Coal characterization and utilization: Coal production and utilization trends., Life cycle of coal, Status of coal utilization technology and related operating and environmental problems. coal characterization and qualities and their effect on selection of efficient methods for eco-friendly utilization of coal. classification system of coal, rank and grade of coal.
Module 3: Pre-combustion techniques: Necessity, scope and limitations of pre-combustion coal cleaning technology. Wash ability characteristics and preparation problems related to coal quality. Principles, operations and selection of processes for coal preparation. Plant performance evaluation and forecasting of cleaning results. Environmental problems and related mitigating measures.
Module 4: Combustion techniques: Fluidized bed combustion techniques, integrated gasification combined cycle (IGCC) and their co – generation options.
Module 5: Post combustion techniques: Necessity, scope and limitations of combustion and post-combustion clean coal technologies. Developments, basic principles, operating features

of clean coal technologies. Selection, performance and related environmental problems and their control.

Module 6: Waste management and Pollutants: Characterization, impacts, control, treatment and safe disposal of wastes and pollutants released from various stages of clean coal technologies. Utilization of wastes and pollutants.

Module 7: Industrial lectures: Case studies of coal preparation plant projects by industry professionals, covering comprehensive planning to commission the same.

Module 8: Basics of Professionalism: Professional Ethics, Entrepreneurial possibilities in Clean Coal Technology, Possibilities for creative & innovative working in this field to extend a practicable solution to coal industries.

Reference/text books:

1. Clean Coal Technologies for Power Generation by P Jayrama Reddy.
2. Clean Coal Engineering Technology by Bruce Granville Miller.
3. Clean Coal Technology and Sustainable Development from Proceedings of the 8th International Symposium on Coal Combustion. -**Yue**, Guangxi, **Li**, Shuiqing, (2016).
4. Clean Coal Engineering Technology: Bruce G Miller, Elsevier Publications.
5. Fuels and Combustion: Samir Sarkar, University Press (India) Pvt Limited, India.
6. The Chemistry and Technology of Coal: James G Speight, Marcel Dekker.

Course goals and outcomes:

1. After successful completion of the course the learner will be able to:
2. List the new technologies for coal-fired power generation.
3. Identify policy considerations and outline future aspects for coal use.
4. Examine new technologies for clean coal and analyze commercial viability of new technologies.
5. Assess technologies in clean coal to technologies in energy alternatives.

MN511	INTERNET OF THINGS (IoT)	3L:0T:0P	3 CREDITS

Course Objective

Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defense sectors. This course is designed to address the following: Similarly, for safety critical industry like of mining industry application of IoT has potential to open up the opportunities of enhancement of operational safety and productivity.

Purposes of this course is:

- To get the students acquainted with upcoming trend of using sensor networks in Mining Industry.
- To learn the basic concepts of IoT.
- To learn the different communication schemes and protocols used in IoT
- To lean the data management techniques in IoT.

Syllabus

Importance of sensor networking in mining and other safety critical industries.

Introduction to IoT: functional layers of IoT, Sensing, Actuation, data warehousing and analytics.

Basics of Networking, Communication Protocols, Networking Hardwares

Sensor Networks: Machine-to-Machine Communications, Interoperability in IoT.

SDN for IoT, Cloud Computing for IoT, Fog Computing in IoT context,

Industrial IoT: Impact in Security, Data Integrity, Ease of industrial operations management.

Modules

1. Importance of sensor networking in mining and other safety critical industries.
2. Introduction to IoT: functional layers of IoT, Sensing, Actuation, data warehousing and analytics.
3. Basics of Networking, Communication Protocols, Networking Hardwares
4. Sensor Networks: Machine-to-Machine Communications, Interoperability in IoT.
5. SDN for IoT, Cloud Computing for IoT, Fog Computing in IoT context,
6. Industrial IoT: Impact in Security, Data Integrity, Ease of industrial operations management.

Text/Reference Books:

1. Related Magazines and Research Articles
2. Online Blogs on IoT
3. NPTEL lecture Notes of Prof. Sudip Mishta

Goals & Outcomes:

- Making students aware of applications of IoT in Mining Industry scenario.
- Getting overall knowledge of IoT ecosystem.
- Making the students aware of different technical perspective of sensor networking.

PRACTICALS

MN 521P	MINE VENTILATION ENGINEERING LAB	0L:0T:3P	1 CREDITS

LIST OF EXPERIMENTS:

Sl. No.	Name of Experiment
1.	Study of whirling and fixed hygrometer and estimation of relative humidity.
2.	Study of whirling and fixed hygrometer and estimation of relative humidity.
3.	Study of kata thermometer and determination of cooling power in mine air.
4.	Determination of air velocity and air quantity measurement by vane anemometer.
5.	Determination of effective temperature using dry and wet bulb temperature.
6.	Study of co and h_2s detectors and determination of their percentage.
7.	Determination of inflammable gas percentage by MSA d6 Methanometer.
8.	Study of various types of flame safety lamps.
9.	Study of various types of fans and their characteristic curves and their use in locating efficient operating point.
10.	Determination of parallel and series operation of fan.
11.	Determination of air pressure by inclined tube manometer.

MN 522P	MINING MACHINERY LAB	0L:0T:3P	1 CREDITS

LIST OF EXPERIMENTS:

Sl. No.	Name of Experiment
1.	Study and sketch of various types of wire ropes construction.
2.	Study of friction props.
3.	Study and sketch of hydraulic props (close and open circuit).
4.	Study and sketch of safety devices in haulage roads.
5.	Study and sketch of coal drill and bits.
6.	Study and sketch of jack hammer drill.
7.	Study and sketch of side discharge loader and load haul dumper.
8.	Study and sketch of chain conveyor & belt conveyor.
9.	Study and sketch of suspension gear arrangements in friction and drum winders.
10.	Study and sketch of various safety hooks in winding.
11.	Study and sketch of safety devices used in winders.
12.	Study and sketch of face pumps and their operations.

MN 523P	INTERNET OF THINGS LAB (IoT LAB)	0L:0T:3P	1 CREDITS

LIST OF EXPERIMENTS:

Sl. No.	Name of Experiment
1.	Setting up a programming environment for Arduino Boards and programming in emulators.
2.	Handling Digital display and LED panels with Arduino
3.	Interfacing methods for digital and analog sensors and logging data with timestamp.
4.	Interfacing Gas Sensors with Arduino controllers.
5.	Serial, I2C and SPI communication.
6.	Wireless communication Modules.
7.	Introduction to IoT development boards with inbuilt wireless capability.
8.	Introduction to Embedded Computer and their programming.
9.	Introduction of designing Device schismatics with KiCad (Open Source)
10.	Introduction to custom PCB Design using KiCad (Open Source)
11.	Localization of Wireless Sensor Devices with RSSI data
12.	Setting up local servers for handling and storage of IoT sensors data.
13.	Use of cloud servers for developing IoT Platforms
14.	Data Analytics with IoT sensors acquitted data.
15.	Designing of user interfaces for IoT data visualization.
16.	Modelling Sensor Networks with Network Emulators.

MN 524P	MINE DESIGN - II LAB	0L:0T:3P	1 CREDITS

LIST OF EXPERIMENTS:

Sl. No.	Name of Experiment
1.	Study of bely conveyor and carrying capacity determination.
2.	Study of direct rope haulage capacity calculation.
3.	Determination of factor of safety of winding rope.
4.	Study of winding pulley and calculation of fleet angle.
5.	Study of torque - time diagram in friction and drum winder.
6.	Determination of load on longwall face and choice of suitable power support.
7.	Production design of mechanized longwall face (AFC & Shearer).
8.	Production design of mechanized B & P using continuous miner technology.
9.	Blast design for given production of an opencast mines.
10.	Design of open pit slope for stability.
11.	Study of bucket wheel excavator in an opencast mine.
12.	Study of Surface Miner in an opencast mine.

VIth SEMESTER

MINING ENGINEERING
B.Tech, Semester VI (Third year]
Course Structure

Sl. No.	Course Code	Course Title	Hours per week			Credit
			L	T	P	
THEORY						
1.	MN601	Mine Environmental Engineering	4	1	0	4
2.	MN602	Rock Mechanics	3	1	0	3
3.	MN603	Advanced Underground Coal Mining Methods	3	1	0	3
4.	**Professional Elective – II (Any One of the Following)**					
I.	MN604	Rock Excavation Engineering	3	1	0	3
II.	MN605	Rock Slope Engineering	3	1	0	3
III.	MN606	Mine Ventilation Planning	3	1	0	3
IV.	MN607	Advanced Mine Ventilation Engineering	3	1	0	3
5.	**Open Elective – II (Any One of the Following) ***					
I.	××××××	Electrical Engineering in Mines	3	1	0	3
II.	MN608	Data Analytics	3	1	0	3
III.	MN609	Reliability Engineering	3	1	0	3
IV.	MN610	Geostatistics	3	1	0	3
PRACTICALS						
1.	MN621P	Rock Mechanics Lab	0	0	3	1
2.	MN622P	Mine Environmental Engineering Lab	0	0	3	1
3.	MN623P	Data Analytics Lab	0	0	3	1
4.	××××××	Electrical Engineering in Mines Lab	0	0	3	1
5.	××××××	Internship/ Tour & Training/ Industrial Training	0	0	2	2
						22

PROFESSIONAL CORE

MN601	MINE ENVIRONMENTAL ENGINEERING	3L:1T:0P	4 CREDITS

Course objective

Assess environmental issues associated with air, land, and water systems and their accompanying human health and ecological impacts due to mining activities. Synthesize technical knowledge of engineering analysis and design to identify, formulate, and solve problems of professional interest and importance. This course streams into more specialised areas including: water quality engineering, air and noise pollution control, solid and hazardous waste management, environmental engineering design, and site remediation related to mining engineering.

Course content

Land environment: visual impacts, landscape analysis, land use, landscape planning, physical reclamation and subsidence management. Land reclamation principles and requirement; Topsoil management inventory, removal, preservation and redistribution; Ecological restoration technology –objectives and guidelines ;Technical reclamation – stability, drainage and erosion control; Factors effecting the development of vegetation cover in mine degraded areas; estimation of sediment load and design of sedimentation pond; Mine closure planning – environmental impacts of mine closure, development of closure plan, closure guidelines, mine closure activity, closure cost.

Water regime: Water quality – physical, chemical, biological, criteria and standards, Waste water management – sources characteristics, techniques of treatment. Acid mine drainage – occurrence, effects and treatment techniques. Groundwater hydrology: Measurement of yield, Laws of groundwater movement: Darcy`s law, Thiems equilibrium formula, Duipuits formula etc. CPCB standards.

Air pollution: sources of gaseous and particulate pollutants , their physical, chemical(special preference to greenhouse gases and ozone)physiological effects Classification of Air Pollutants, Particulates and Gaseous pollutants, Sources of air pollution, Effects of air pollution on Human Beings, Materials, Vegetation, Animals. Major Global and Regional impacts, monitoring and control.control of air borne respirable dust : ventilation , water spray, cyclone dust collector, dust filtration , dust scrubber. Control technologies of motor vehicle emissions and indoor air pollution.CPCB standards for air pollution control.

Noise pollution/ ground vibration: Fundamentals of Noise: Basics of Acoustics: Sound power, Sound intensity and Sound pressure levels; Plane, Point and Line sources, Multiple sources; Outdoor and indoor noise propagation; Effects of noise –noise induced deafness, presbycusis, acoustic trauma, other physiological and psychological effects; Noise standards and indices. Vibration problems in surface mines and control measures. Ground Vibration and Air Blast -Environmental impacts, strategic planning and abatement/ prevention.

Illumination*:* Cap lamps; Layout and organization of lamp rooms; Standards of illumination; Photometry and illumination survey.

Learning outcomes:

After successful completion of the course the learner will be able to:

- Identify, formulate, and solve complex mine environmental engineering problems in land degradation ,water and wastewater, air pollution, solid waste, and related areas by selecting and applying appropriate tools and techniques.
- Specify or design unit processes or systems associated with traditional areas of environmental engineering.
- Synthesize advanced technical knowledge in a traditional or emerging specialization area of mine environmental engineering.

References /textbooks

- Environmental Land use planning and Management, John Randolph, Island Press,
- Land Use in Mining Areas of India, Rekha Ghosh, Envis, ISM Dhanbad, ISSN 0972 4656.
- Eco restoration of the coalmine degraded lands- Subodh Kumar Maiti, Springer (2013).
- Air Pollution Control Equipment. H. Brauer and Y. B. G. Verma, Berlin Heidelberg, New York, latest edition.
- Environmental Impact of Mining – Down CG and Stocks J. Applied Science Publishers, London,1978.
- Best Practices Environmental Management in Mining" - EPA (Australia): 1997-2004.
- Environmental Management in Mining Areas– Saxena NC, Singh Gurdeep and Ghosh R, (Ed.), Scientific Publishers (India), Jodhpur 2003.
- Industrial Noise Control and Acoustics – Randall F Barron, Marcel Dekker, Inc., New York, 2003.
- Engineering Noise Control: Theory and Practice – David Bies et. al., Routledge Publishers, 2003.
- Vibrations – Balakumar Balachandran and Edward B. Magrab, Thomson Asia Pte. Ltd., Singapore, 2003.
- Noise control: Principles and Practice - Bruel & Kjaer, 2nd ed. B & K Pub., Denmark, 1986.

MN602	ROCK MECHANICS	3L: 0T: 0P	3. Credit

Course Objective

The course is designed to provide a better understanding to evaluate physico-mechanical properties of rocks, elastic and time dependent behavior, laboratory and field test procedure, rock mass characteristics. Theories of rock failure, Influence of water on rock and soil behavior. Dynamic characteristics of rocks. Concept of in - situ stress and post mining redistribution of stress.

Syllabus

Concept of stress and strain in rock: Analysis of stress, strain and constitutive relations in isotropic and anisotropic rocks. Physico-mechanical properties rocks: Determination of physical properties, strength, strength indices and static elastic constants, parameters influencing strength, abrasivity and its determination. Physico-mechanical properties of soil: Physico-mechanical properties including consistency and gradation, classification of engineering soils, engineering properties of soils- compressibility, consolidation, compaction and strength. Time dependent properties of the rock. Creep formation and strength behavior, creep test and simple rheological models. Behavior of Rock Mass: Rock mass structure, in-situ elastic properties and strength determination. Failure criteria for rock and rock mass: Theories of rock failure, Column, Mohr, Griffith and Empirical criteria. Pre-mining state of stress: Sources, methods of determination including over coring and hydro-fracturing methods. Ground water: Influence of water on rock and soil behavior, permeability of rocks, measurement of permeability, ground water flow in rock mass, measurement of water pressure. Dynamic property of the rock and rock mass: Propagation of elastic wave in rock media, determination of properties and elastic constants.

Modules

Module 1. Introduction to Stress and Strain:

Concept of stress and strain in rock, Analysis of stress, strain and constitutive relations in isotropic and anisotropic rocks.

Module 2. Physico-mechanical properties rocks:

Determination of physical properties, strength, strength indices and static elastic constants, parameters influencing strength, abrasivity and its determination.

Module 3.Time dependent properties of the rock:

Creep formation and strength behavior, creep test and simple rheological models.

Module 4. Behavior of Rock Mass:

Rock mass structure, in-situ elastic properties and strength determination.

Module 5. Rock mass Failure criteria:

Failure criteria for rock and rock mass. Theories of rock failure, Coulomb - Navier, Mohr, Griffith and Empirical criteria.

Module 6. Influence of water on rock and soil behavior:

Ground water: Influence of water on rock and soil behavior, permeability of rocks, measurement of permeability, ground water flow in rock mass, measurement of water pressure.

Module 7. Dynamic behavior of Rock and Rock mass:

Dynamic property of the rock and rock mass. Propagation of elastic wave in rock media, determination of properties and elastic constants.

Text/Reference Books:

1. Fundamental of Rock Mechanics by J.C Jaeger & N.G.W. Cook, Blackwell Publishing
2. Coal Mining ground Control by Syd S. Peng, West Virginia University.
3. Rock Mechanics for underground Mining– BHG Brady & E T Brown, George Allen & Unwin Ltd, 1992.
4. Introduction to Rock Mechanics, Second Edition, Richard E. Goodman
5. Fundamental and Applied Rock Mechanics, D. Deb, A.K. Verma

Course Outcome:

After completion of the course, students will be able to:

1. Understand mechanical properties of rock, different theories of rock failure.
2. Know Causes and impacts of rock failure, rock strength and stresses induced in rocks.
3. Understand the time dependent deformation in rock structure.
4. Understand the effect of water on rock structure and their stability.
5. Understand the dynamic characteristics of rock and rock mass.

MN603	ADVANCED UNDERGROUD COAL MINING METHODS	3L: 0T: 0P	3. Credit

Course Objective

After getting exposed to basics of mining engineering, students should get a dig into different types of mines. When it comes to coal mines, especially underground coal mines where there is relatively high risk compare to other mines, students should be well familiar with risks and challenges associated with them, thus requiring some case studies essentially. Advance Underground coal mining methods covers many working methods which are applicable within different and rare circumstances. Students, after going through this subject, will be benefitted with deep knowledge of underground coal mining, as they have some basics in earlier.

This course is designed to address the following:

- To expose the students with the knowledge of special working methods carried out for abnormal cases.
- To expose the students with modern methods being carried out across the globe.
- To encourage the students for some innovative works by the exposure of some case studies.

Syllabus

Thick Seam Mining: Concept of thick seam, problems of the mining thick seams, past experience of working thick seams by Bord & Pillar method in multi sections. Modern multi-slicing method - incline slicing, horizontal slicing, cross slicing in ascending and descending order. Equipments for thick seam mining. Case Studies. Advanced Underground Winning Methods: Sublevel Caving, Integral Caving, Blasting Gallery Method, Descending Shield Method, Hydraulic Mining, Bhaska and Tipong Method. Case Study. Steep Seam Mining: Mining technology of inclined and steep seams Thin Seam Mining: Problems in thin seam mining, equipment and methods for thin seam extraction. Case Study. Underground Coal Gasification and Coal Bed Methane: Basic concepts, applications and limitations of the methods with case studies.

Modules

1. **Thick Seam Mining:** Concept of thick seam, problems of the mining thick seams, past experience of working thick seams by Bord & Pillar method in multi sections.
2. **Modern multi- slicing method:** incline slicing, horizontal slicing, cross slicing in ascending and descending order. Equipments for thick seam mining. Case Study.
3. **Advanced Underground Winning Methods:** Sublevel Caving, Integral Caving, Blasting Gallery Method, Descending Shield Method,
4. **Hydraulic Mining:** Bhaska and Tipong Method. Case Study.
5. **Steep Seam Mining:** Mining technology of inclined and steep seams
6. **Thin Seam Mining:** Problems in thin seam mining, equipments and methods for thin seam extraction. Case Study.
7. **Underground Coal Gasification (UCG):** Basic concepts, applications and limitations of the methods with case studies.
8. **Coal Bed Methane:** Basic concepts, applications and limitations of the methods with case studies.

Text/Reference Books:

1. Principles and Practices & Modern Coal Mining, R.D. Singh,New Age International Publication.
2. Underground Mining & Coal, Singh, T.N. Singh – Oxford Publication.
3. Modern Coal Mining Technology, Das S.K. – Lovely Prakasan publication.
4. Longwall mining, Peng S.S., Chiang H/S. – John Willey Publication.
5. Mine Planning for Coal, Mathur S.P. – M.J Consultant Publications.
6. Winning and Working Coal in India Vol.II- R.T. Deshmukh and D.J.Deshmukh, Dhanbad Publishers
7. Underground Coal Mining Methods – J.G. Singh, Braj-Kalpa Publishers.

Goals & Outcomes:

After completion of the course, students will be able to:

1. Understand mine planning, opening of deposits, pillar development, pillar extraction, Layout required for out puts, long well mining, mechanized extraction of long wall panel.
2. Understand the concept of gasification, Technology involved in it, Non-mining methods of UCG, Gasification at great depth, merits and demerits, Future scope and Development.

PROFESSIONAL ELECTIVE II

MN604	ROCK EXCAVATION ENGINEERING	3L:0T:0P	3 Credits

Course Objectives:
When the students enter the college to pursue a degree in Mining Engineering and as well pursue a career in Mining Engineering after graduation, they need to understand the breadth and depth available in this field for different rock excavation methods. When many alternative disciplines of engineering appear to offer apparently more glamorous avenues for advancement, the Mining Engineering student should realize the solid foundations available in this mother of all engineering disciplines. The students should understand the enormous possibilities available for creative and innovative works in this all pervasive field of engineering.

This course is designed to address the following:

- To give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Mining Engineering
- To motivate the student to pursue a career in one of the many areas of Mining Engineering with deep interest and keenness.
- To expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects of public utility.

Syllabus:
Scope and importance: Rock excavation engineering in mining and construction industries; physico-mechanical and geotechnical properties of rocks Vis-à-vis excavation method; selection of excavation method.
Drilling: Mechanics of rock drilling; design and operating parameters of surface and underground drilling; evaluation of drill performance; drillability of rocks; mechanism of bit wear; bit selection; problems of drilling; economics of drilling.
Blasting: mechanics of rock fragmentation by explosives; advances in explosives and their selection criteria for rock excavation; blast design for surface excavations and optimization; advanced blast initiation systems; blast performance evaluation; cast blasting; techno-economic and safety aspects of surface and underground blasting; advances in blast design for underground excavations; contour blasting; computer aided blast designs; review of tunnel blasting techniques in recent advances.
Rock Cutting: theories of rock tool interaction for surface excavation machinery- rippers, bucket wheel excavators, continuous surface miners; theories of rock tool interaction for underground excavation machinery- ploughs, shearers, road headers, continuous miners and tunnel boring machines; selection criteria for cutting tools; Advanced rock cutting techniques- high pressure water jet assisted cutting.

Modules:
Module 1: Basic Understanding: What is Rock Excavation Engineering? Basics of Rock Excavation Engineering in mining and construction industries; Importance of Rock Excavation Engineering; Possible scopes for a career in Rock Excavation Engineering.
Module 2:. Selection Criteria for Rock Excavation: Physical and mechanical properties of rock materials; Geotechnical properties of rock materials in regard to method of excavation; Selection of excavation method.
Module 3: Drilling Mechanism, Performance and Problems: Mechanics of drilling; Design and operating parameters of surface drilling and underground drilling. Performance

parameters of drilling; Evaluation of drilling performance; Drillability of rock; Selection of drill bit. Drill bit wear; Mechanism of drill bit wear; Economics of drilling.

Module 4: Blasting Operation, Blast Design, Performance and Advance underground blast: Mechanism of rock fragmentation by explosives; Advances in explosives and their selection criteria for rock excavation. Blast design for surface excavation; Optimization of blast design; Initiation system; advanced blast initiation system; Powder factor; Calculation of powder factor; techno-economic aspects in surface and underground blasting; safety aspects in surface and underground blasting. New technology for underground blast design for excavation; contour blasting; computer aided blast design; recent advances in tunnel blasting.

Module 5: Rock cutting technology and Selection: Theories of rock cuttings; rock and tool interaction for surface and underground excavation. Criteria for selecting cutting tools; advanced rock cutting techniques; High pressure jet assisted cutting.

Module 6: Surface and Underground excavation machineries: Ripper; Bucket wheel Excavator; Surface continuous miner; Ploughs; Shearers; Road headers; Continuous miner and Tunnel boring machines.

Module 7: Computational Methods, IT in Rock Excavation Engineering: Typical software used in Rock Excavation Engineering- Finite Element Method, Computational Fluid Dynamics; Computational geotechnical methods; Highlighting typical available software system (FLAC 2D, FLAC 3D, PLAXIS 2D and PLAXIS 3D)

Module 8: Industrial lectures: Case studies of large tunneling and shaft sinking engineering projects by industry professionals, covering comprehensive planning to commission the same.

Module 9: Basics of Professionalism: Professional Ethics, Entrepreneurial possibilities in Rock Excavation Engineering, Possibilities for creative & innovative working, Technical writing Skills enhancement; Facilities Management; Quality & HSE Systems in excavation method.

Text/Reference Books:

1. Ratan Raj Tatiya, Surface and underground excavation method.
2. Principles of Rock fragmentation,Cark G.B-John Wiley & Sons
3. Diamond Drilling, Chugh C.P-Oxford Publication
4. Introduction to Mining Engineers – Hartman. H.L, John Wiley & Sons.

Course Goals & Outcomes:

* Introduction to what constitutes Rock Excavation Engineering.
* Identifying the various areas available to pursue and specialize within the overall field of Rock Excavation Engineering.
* Highlighting the depth of engagement possible within each of these areas.
*Exploration of the various possibilities of a career in this field.
*Understanding the vast interfaces this field has with the society at large.
*Providing inspiration for doing creative and innovative work in Rock Excavation Technology.
* Showcasing the many tunnel construction, vertical shaft and incline for accessing the deposits, nationally important infrastructure, and impressive projects to serve as sources of inspiration.
* Highlighting possibilities for taking up entrepreneurial activities in this field.
* Providing a foundation for the student to launch off upon an inspired academic pursuit into this subject of engineering.
* Know about rock excavation, excavation methods, drill bit wear and drillability to cut rocks.
* Optimize, safety aspects of surface and underground blasting.

MN605	ROCK SLOPE ENGINEERING	3L:0T:0P	3 Credits

Pre-requisite: Surface mining technology

Course Objectives:
To introduce the basic mechanics of rock slope failure to learn the types of rock failure and its influencing parameters

Syllabus:
Basic mechanics of rock slope failure: Rock slope economics, slope parameters, effect of water pressure, factor of safety of slopes, slope height vs. slope angle, design of slopes. Geological and strength properties: Geological parameters affecting slope stability; physico-mechanical properties affecting slope stability, shearing on incline plane, determination of shear strength of rock and rock discontinuities; Ground water flow in rock masses; field measurement of permeability; measurement of water pressure. Plane Failure: Plane failure analysis; graphical analysis of stability; influence of ground water on stability, Influence of tension crack; rock reinforcement; analysis of failure on a rough plane; case studies. Wedge Failure: Analysis of wedge failure; wedge analysis including cohesion and water pressure; case studies. Circular and toppling Failure: Conditions for circular failure; derivation of circular failure analysis; effect of ground water; Types of toppling failure; analysis of toppling failure; Influence of slope curvature on stability; slope depressurization: protection of slopes: control of rock falls. Slope Monitoring: Monitoring and instrumentation techniques of rock slopes. Investigations of failed slopes, Remedial Measure: Remedial and corrective measures. Remedial measures for slope stabilization. Numerical Analysis: Numerical analysis of slopes. Use of FLAC Software.

Modules:

Module 1: Basic mechanics of rock slope failure: Rock slope economics, slope parameters, effect of water pressure, factor of safety of slopes, slope height vs. slope angle, design of slopes. **Module 2: Geological and strength properties:** Geological parameters affecting slope stability; physico-mechanical properties affecting slope stability, shearing on incline plane, determination of shear strength of rock and rock discontinuities; Ground water flow in rock masses; field measurement of permeability; measurement of water pressure.
Module 3: Plane Failure: Plane failure analysis; graphical analysis of stability; influence of ground water on stability, Influence of tension crack; rock reinforcement; analysis of failure on a rough plane; case studies.
Module 4: Wedge Failure: Analysis of wedge failure; wedge analysis including cohesion and water pressure; case studies.
Module 5: Circular and toppling Failure: Conditions for circular failure; derivation of circular failure analysis; effect of ground water; Types of toppling failure; analysis of toppling failure; Influence of slope curvature on stability; slope depressurization: protection of slopes: control of rock falls.
Module 6: Slope Monitoring: Monitoring and instrumentation techniques of rock slopes. Investigations of failed slopes.
Module 7: Remedial Measure: Remedial and corrective measures. Remedial measures for slope stabilization.
Module 8: Numerical Analysis: Numerical analysis of slopes. Use of FLAC Software.

Text/Reference Books:

1. Hoek, E and Bray, J.W., Rock Slope Engineering, Institution of Mining and Metallurgy, 1991.
2. Goodman, R.E., Rock Mechanics, John Wiley and Sons, 1989
3. Singh, R.N. and Ghose, A.K., Engineered Rock Structures in Mining and Civil Construction, A.A. Balkema, Netherlands, 2006.
4. Rock Slope Engineering: Civil and Mining by Duncan C. Wyllie
5. Cumming A.B. & Given I &V. & SME Vol. I & II, Society of Mining Engineers, USA.
6. Introduction to Mining Engineering, Hartman H.L. – John Willey & Sons.
7. Soil Slope Instability and Stabilization, Bruce F. Walker, Robin Fell, Proceedings of an Extension Course on Soil Slope Instability and Stabilization, Sydney
8. Rock Mechanics by Alfreds R. Jumikis, Trans Tech Publications,
9. Rock Mechanics by BGH Brady, ET Brown/Springer Publishing

Course Outcomes:

At the end of the course, students will be able to,
1. Understand Basic mechanics of rock slope failure
2. Understand Geological parameters and physico-mechanical properties affecting slope stability
3. Understand basics of Plane failure
4. Understand basics of Wedge failure
5. Understand basics of Circular and toppling failure.
6. Understand about data interpretation for slope stability analysis
7. Understand about mechanism of failure of rock mass,
8. Understand about influence of ground water on slopes and techniques of depressurization,
9. Understand about instrumentation techniques of rock slopes, use of software like FLAC.

MN606	MINE VENTILATION PLANNING	3L:0T:0P	3 credits

Overview:

Mine Planning introduces you to key mine planning concepts. The mine planning process is complex and integrates several technical branches of the mining discipline including rock mechanics, rock breakage, ventilation and mine design. While mine planners should endeavour to design and implement plans that are safe, environmentally sustainable and socially acceptable, the overriding factor in the success of a mining operation and what ultimately determines whether it will proceed through feasibility studies and onto construction and development is the level of profitability. The drive to exploit a mineral resource such that it adds as much value as possible to the mining business requires a continual update of the mine plan and the rapid implementation of any value adding opportunities as they arise.

It is assumed that course participants have a good understanding of mining terms and descriptions, have been exposed to surface and underground mining methods, are familiar with mining development, operations and production and are keen to learn how to plan a mine for the purpose of maximizing value. Course participants are also expected to have a basic knowledge of rock mechanics, rock breakage, ventilation, typical mining equipment and other technical fundamentals which form the platform and constraints for generating mine plans.

Course Description:

This course applies ventilation principles to the design of underground mines and enables the ventilation requirements for underground mining methods to be met. Students work in groups for projects work that are focused on the ventilation requirements of the mine in question. The projects are structured in such a way as to lead each group through the processes that are required. In addition to the projects work, a site visit where ventilation techniques and data collection is practiced. A minor report completes this visit where the student provides a summary of the learnings from the visit. The visit is structured around a ventilation survey.

The objectives of this course are to:

- Apply ventilation principles to mine design
- Quantify ventilation requirements
- Identify risks associate with ventilation management
- Identify controls to manage ventilation.
- Determine fan / system performance and specification of requirements in complex coal and metalliferous ventilation systems, including trouble shooting and problem solving.
- Identify the requirements, and issues associated with, the application of appropriate ventilation monitoring systems in both coal and metalliferous mines.
- Develop ventilation designs for a coal mine and a metalliferous mine.
- Identify the requirements of appropriate management plans for the designed systems

Syllabus:

Ventilation planning: Objectives and steps in ventilation planning, system analysis of the planning procedure, desirable features of ventilation systems, ventilation plans.

Types of ventilation system, Central, Boundary and Combined ventilation systems, Air distribution with different mining methods: Board and Pillar method, Longwall methods, Shrinkage and Cut and Fill stopes, Open and Underhand stopes, Sublevel stopes. Top slicing and Sub-level caving, Block caving.

Air quantity requirement: Air quantity requirement in the workings, Strata gas, Diesel exhaust fumes, dust, heat, workshop and other ancillary areas, air requirements in drifts and tunnels, leakage of air, expansion in upcast, air velocities.

Pressure Requirement, Selection of fans, output control in fans, series and parallel combination of mine fans, forcing and exhaust, maintenance and monitoring of fans, booster fans, auxiliary ventilators, fan installations, diffuser and evasee.

Network Analysis: solution of complex ventilation network, solution by Hardy Cross Method of successive approximation, ventilation network analysis by digital computer, recent development in ventilation planning
Ventilation Economics: Analysis of ventilation cost, Interest payments, time value of money, present value, Equivalent annual cost, ventilation operating cost, optimum size of airway and shaft.

Modules:

1. **Introduction:** Objectives and steps in ventilation planning, desirable features of ventilation systems, ventilation plans.
2. **Types of ventilation system**: Central, Boundary and Combined ventilation systems
3. **Air distribution with different mining methods:** Bord and Pillar method, Longwall methods, Shrinkage and Cut and Fill stopes, Open and Underhand stopes, Sublevel stopes. Top slicing and Sub-level caving, Block caving.
4. **Air quantity requirement:** Air quantity requirement in the workings, Strata gas, Diesel exhaust fumes, dust, heat, workshop and other ancillary areas, air requirements in drifts and tunnels, leakage of air, expansion in upcast, air velocities.
5. **Pressure Requirement:** Selection of fans, output control in fans, series and parallel combination of mine fans, forcing and exhaust, maintenance and monitoring of fans, booster fans, auxiliary ventilators, fan installations, diffuser and evasee.
6. **Network Analysis:** solution of complex ventilation network, solution by Hardy Cross Method of successive approximation, ventilation network analysis by digital computer,
   recent development in ventilation planning.
7. **Ventilation Economics:** Analysis of ventilation cost, Interest payments, time value of money, present value, Equivalent annual cost, ventilation operating cost, optimum size of airway and shaft.

Goals & Outcomes:

Upon successful completion of this course, the student will be able to:

- *(Knowledge based)*

- To familiarize with the steps in ventilation planning.
- Know the various types of ventilation system.
- To get acquainted with the various air quality requirement in the working.
- To know the various causes of leakage of air.
- To have the knowledge of effects on various leakage of air.

(Skills)

Use operations research to:

- To apply the knowledge gained for solving problems related to mine ventilation planning.
- To make acquainted ventilation network.
- To have hands on the ventilation cost

Text/Reference Books:

1. Skochinsky, A. and Komarov, V., (1969) Mine ventilation, Mir Publisher, Moscow.
2. Roberts, A., (1960), mine ventilation, Clever Hume Press Ltd.
3. Graham, J.I., (1949-50), the methane content of unworked coal seams,ibid 109;2.
4. Penman, D and Penman, J.S., (1947), mine ventilation, Charles griffin &Co.
5. Ower. E., (1949), the measurement of air flow, 3rd., chapman and hall, London.
6. Rouse, H., (1956) elementary mechanics of fluids, Jhon willey and sons Inc.
7. Hinsely, F.B., (1950-51) ‘natural and mechanical ventilation ‘, Tr. I.M.E 110;67.
8. Hall,C.J.,(1953), thermodynamics of mine ventilation’, col.eng. 30; 66, 102, 158, 189 and 246.
9. Misra , G.B.,(1964) mine ventilation, thacker spink &Co.
10. Rouse,H., (1956), elementary of mechanis of fluids , Jhon wiley and Sons Inc.
11. Ower.E., (1949), the measurement of air flow, 3rd ed, Chapman and Hall, London.
12. ‘mine fans’, (1952), N.C.B bull.66.
13. Bromilow, J.G., (1962), ventilation of mechanised heading’, Jr. Min met. F. special issue.

MN507	**ADVANCED MINE VENTILATION ENGINEERING**	**3L:0T:0P**	**3 CREDITS**

Course Objectives:
To introduce advanced mine ventilation problems in underground coal as well metal mines. This course also gives exposures of various application of software in mine ventilation network analysis including recent developments in mine ventilation.

Syllabus:
Mine thermodynamics: Computation of thermodynamic properties of mine air; Basics of modes of heat transfer in mine roadways; Evaporation and consequent changes in mine air properties;

Thermal properties of rocks; Fourier and Biot numbers; Calculation of heat flow and temperature rise in mine airways; Sources of heat and moisture transfer in Bord and Pillar/Longwall and other workings.

Network analysis: Hardy Cross method of iterative analysis; Thermodynamic analysis of mine airflow in ventilation network without and with change in moisture content; Change in Darcy-Weisbach equation and square law due to variation of air density; Pseudo-pressure equation;

Leakage and recirculation; Application of thermodynamic network analysis for complete mine ventilation circuit; Application of software for solving real life ventilation problems in coal and metal mines.

Recent developments in mine ventilation; Air conditioning & ventilation in deep mines; Gas monitoring systems.

Modules:
1. **Mine thermodynamics:** Computation of thermodynamic properties of mine air; Basics of modes of heat transfer in mine roadways; Evaporation and consequent changes in mine air properties;
2. **Thermal properties of rocks;** Fourier and Biot numbers; Calculation of heat flow and temperature rise in mine airways; Sources of heat and moisture transfer in Bord and Pillar/Longwall and other workings.
3. **Network analysis:** Hardy Cross method of iterative analysis; Thermodynamic analysis of mine airflow in ventilation network without and with change in moisture content; Change in Darcy-Weisbach equation and square law due to variation of air density; Pseudo-pressure equation;
4. **Leakage and recirculation;** Application of thermodynamic network analysis for complete mine ventilation circuit;
5. **Software application:** Application of software for solving real life ventilation problems in coal and metal mines.
6. **Recent developments in mine ventilation;** Air conditioning & ventilation in deep mines; Gas monitoring systems.

Text/Reference Books:

1. Skochinsky, A. and Komarov, V., (1969) Mine ventilation, Mir Publisher, Moscow.
2. Roberts, A., (1960), mine ventilation, Clever Hume Press Ltd.
3. Graham, J.I., (1949-50), the methane content of unworked coal seams,ibid 109;2.
4. Penman, D and Penman, J.S., (1947), mine ventilation, Charles griffin &Co.
5. Ower. E., (1949), the measurement of air flow, 3rd., chapman and hall, London.
6. Rouse, H., (1956) elementary mechanics of fluids, Jhon willey and sons Inc.
7. Hinsely, F.B., (1950-51) 'natural and mechanical ventilation ', Tr. I.M.E 110;67.
8. Hall,C.J.,(1953), thermodynamics of mine ventilation', col.eng. 30; 66, 102, 158, 189 and 246.
9. Misra , G.B.,(1964) mine ventilation, thacker spink &Co.
10. Rouse,H., (1956), elementary of mechanis of fluids , Jhon wiley and Sons Inc.
11. Ower.E., (1949), the measurement of air flow, 3rd ed, Chapman and Hall, London.
12. 'mine fans', (1952), N.C.B bull.66.
13. Bromilow, J.G., (1962), ventilation of mechanised heading', Jr. Min met. F. special issue.

<u>OPEN ELECTIVE II</u>

MN608	DATA ANALYTICS	3L:0T:0P	3 Credits

Course Objectives:
Data Analytics is the science of analyzing data to convert information to useful knowledge. This knowledge could help us understand our world better, and in many contexts enable us to make better decisions. While this is broad and grand objective, the last 20 years has seen steeply decreasing costs to gather, store, and process data, creating an even stronger motivation for the use of empirical approaches to problem solving. This course seeks to present you with a wide range of data analytic techniques and is structured around the broad contours of the different types of data analytics, namely, descriptive, inferential, predictive, and prescriptive analytics.

This course will cover fundamental algorithms and techniques used in Data Analytics. The statistical foundations will be covered first, followed by various machine learning techniques Supervised, Unsupervised, Semi-supervised and data mining algorithms. In summary, this course will provide exposure to theory as well as practical systems and software used in data analytics.

After completing this course, you will learn how to:
1. Find a meaningful pattern in data
2. Graphically interpret data
3. Implement the analytic algorithms
4. Handle large scale analytics projects from various domains
5. Develop intelligent decision support systems

Syllabus:

Data Definitions and Analysis Techniques: Concept of Data Science, Why/When/What, application in real scenarios, Elements, Variables, and Data categorization, Levels of Measurement, Data management and indexing, Introduction to statistical learning and R-Programming. **Descriptive Statistics:** Measures of central tendency, Measures of location of dispersions, Practice and analysis with R. **Programming Tools for Data Science:** Basics of Python (file handling, case-folding, spell check, split, strip, Regex, find, replace, etc.); Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK; Visualizing Data: Bar Charts, Line Charts, Scatterplots. **Basic Analysis Techniques:** Basic analysis techniques, Statistical hypothesis generation and testing; Chi-Square test, t-Test, Analysis of variance, Correlation analysis, Maximum likelihood test, Practice and analysis with R. **Data analysis techniques:** Regression analysis, Classification techniques, Clustering, Association rules analysis, Practice and analysis with R. **Machine Learning:** Overview of Machine learning concepts – Bias/variance, overfitting and train/test splits. Types of Machine learning – Supervised, Unsupervised, Semi-supervised. **Classification and Regression algorithms-** Naïve Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decision trees and induction rules, Hidden Markov Models; Linear Regression-model assumptions; Regularization (lasso, ridge, elastic net) from both the statistical and Bayesian inference viewpoint; Analysis of Time Series; Unsupervised learning: KMeans and Hierarchical clustering; Reinforcement learning.

Modules:

Module 1: Data Definitions and Analysis Techniques: Concept of Data Science, Why/When/What, application in real scenarios, Elements, Variables, and Data categorization, Levels of Measurement, Data management and indexing, Introduction to statistical learning and R-Programming.

Module 2: Descriptive Statistics: Measures of central tendency, Measures of location of dispersions, Practice and analysis with R.

Module 3: Descriptive Statistics: Measures of central tendency Measures of location of dispersions, Practice and analysis with R Basic Analysis Techniques Basic analysis techniques;

Module 4: Programming Tools for Data Science: Basics of Python (file handling, case-folding, spell check, split, strip, Regex, find, replace, etc.); Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK; Visualizing Data: Bar Charts, Line Charts, Scatterplots.

Module 5: Basic Analysis Techniques: Basic analysis techniques, Statistical hypothesis generation and testing; Chi-Square test, t-Test, Analysis of variance, Correlation analysis, Maximum likelihood test, Practice and analysis with R.

Module 6: Data analysis techniques: Regression analysis, Classification techniques, Clustering, Association rules analysis, Practice and analysis with R.

Module 7: Machine Learning: Overview of Machine learning concepts – Bias/variance, overfitting and train/test splits. Types of Machine learning – Supervised, Unsupervised, Semi-supervised.

Module 8: Classification and Regression algorithms-Naïve Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decision trees and induction rules, Hidden Markov Models; Linear Regression-model assumptions; Regularization (lasso, ridge, elastic net) from both the statistical and Bayesian inference viewpoint; Analysis of Time Series; Unsupervised learning: KMeans and Hierarchical clustering; Reinforcement learning

Text/Reference Books:

1. Hastie, Trevor, et al. The elements of statistical learning. Vol. 2. No. 1. New York: springer, 2009.
2. Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John Wiley & Sons, 2010
3. Probability & Statistics for Engineers & Scientists (9th Edn.), Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Prentice Hall Inc.
4. The Elements of Statistical Learning, Data Mining, Inference, and Prediction (2nd Edn.), Trevor Hastie Robert Tibshirani Jerome Friedman, Springer, 2014
5. An Introduction to Statistical Learning: with Applications in R, G James, D. Witten, T Hastie, and R. Tibshirani, Springer, 2013
6. Software for Data Analysis: Programming with R (Statistics and Computing), John M. Chambers, Springer
7. Mining Massive Data Sets, A. Rajaraman and J. Ullman, Cambridge University Press, 2012
8. Advances in Complex Data Modeling and Computational Methods in Statistics, Anna Maria Paganoni and Piercesare Secchi, Springer, 2013
9. Data Mining and Analysis, Mohammed J. Zaki, Wagner Meira, Cambridge, 2012
10. Hadoop: The Definitive Guide (2nd Edn.) by Tom White, O'Reilly, 2014

11. Map Reduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems, Donald Miner, Adam Shook, O'Reilly, 2014
12. Beginning R: The Statistical Programming Language, Mark Gardener, Wiley, 2013
13. http://cse.iitkgp.ac.in/~dsamanta/courses/da/index.html

Course Outcomes:

At the end of this course, the students will be able to:

1. Analyse data to evaluate meaningful pattern.
2. Demonstrate understanding of the mathematical foundations needed for data science.
3. Collect, explore, clean, munge and manipulate data.
4. Implement models such as k-nearest Neighbours, Naive Bayes, linear and logistic regression, decision trees, neural networks and clustering.
5. Build data science applications using Python based toolkits.
6. Graphically interpret data using different statistical tool and hypothesis tests.
7. Implement the analytic algorithms.
8. Develop intelligent decision support systems for various mining operations.

MN609	RELIABILITY ENGINEERING	3L:0T:0P	3 credits

Overview:
This course introduces students to concepts and methods of modern statistical quality control. Students learn to apply standard quality control tools. They learn the theoretical statistical concepts that justify the use of particular quality control tools in particular situations. They learn theory and methods for analyzing the performance of different quality control tools.

Course Description:
Principles of statistical quality control including control by variable and by attribute, construction and use of control charts for variables, fraction defectives and number of defects and use of standard plans, reliability and life cycle testing.

The objectives of this course are to:

- To define and describe concept of system structures
- To apply the principles of reliability, quality and asset management to mechanical engineering processes, production and manufactured products
- The use of appropriate software for statistical and quality analysis is taught and is necessary for successful completion of some homework assignments. Issues of ethics and professional responsibility and their relation to product quality are discussed.

Syllabus:
Introduction to reliability concept.
System Structures: Status functions, series systems, parallel systems, and equivalent structures.
Reliability of System Structures: Series systems, parallel systems, equivalent structures.
Unit and system reliability- forward models, density and distribution functions, fault tree analysis, HAZOP analysis, risk and criticality analysis, maintainability analysis, calculation of maintainability parameters, availability calculations, maintenance management.
Introduction to product quality. Introduction to ISO 9000 series, concept of TQM and Business performance, HRD and quality management, organizing for TQM, CI.

Modules:

1. **Introduction to reliability concept:** Introduction to system and reliability
2. **System Structures:** Status functions, series systems, parallel systems, and equivalent structures
3. **Reliability of System Structures:** Series systems, parallel systems, equivalent structures
4. **Unit and system reliability:** forward models, density and distribution functions
5. **System Reliability Analysis:** fault tree analysis, HAZOP analysis, risk and criticality analysis
6. **System Reliability Analysis:** Maintainability analysis, calculation of maintainability parameters, availability calculations, maintenance management
7. **Introduction to product quality:** Introduction to ISO 9000 series, concept of TQM and Business performance
8. **Quality Management:** HRD and quality management, organizing for TQM, CI

Text/Reference Books:

6. Introduction to Quality and Reliability Engineering by Renyan Jiang, Springer, 2015
7. An Introduction to Reliability and Quality Engineering by John P. Bentley, Longman Scientific & Technical, 1993
8. Reliability Engineering, by E. Bala Guruswamy, Tata McGraw Hill, 1994.
9. Reliability Engineering, (3rd Edition), by LS Srinath, Affiliated East West Pvt Ltd, 1991.
10. Optimization &Variation Reduction in Quality, by W.A. Taylor, Tata McGraw Hill, 1991.

Goals & Outcomes:

Upon successful completion of this course, the student will be able to:

(Knowledge based)

- Understand and able to describe different system's structure
- Understand the concepts of reliability and maintainability
- Acquire basic knowledge of total quality management

(Skills)

Use reliability and quality engineering to:

- Use System structure concept to examine reliability of different systems
- Use different reliability analysis techniques to appraise and manage a system or process
- Describe standard control charts and use it to analyze and improve the product quality.

MN610	GEOSTATISTICS	3L:0T:0P	3 credits

COURSE OUTCOME
The course is designed to provide a better understanding to use the statistical tool in mining industries. It will give the idea of interpretation of reserve estimation using three-dimensional modelling software.

SYLLABUS
Geo - statistics: Introduction, Concept.
Basics of Probability and Statistics: Mean, Median, Mode, Probability Distribution (normal & log normal), Variance, Cumulative frequency and Cumulative probability.
Mineral Inventory: Prospecting, exploration, method to quantify the size, shape & distribution of the ore reserve. Ore reserve calculation.
Extension method and application of classical statistics, regionalized variables, variogram and semi – variogram modeling, regularization, auxiliary functions.
Kriging; Introduction, concept of development, types of kriging, linear kriging methodology, and their application in mining industries, common problems associated with the use of kriging.
Geo - statistics for quality control, basis of non-parametric geo - statistics and indicator kriging. Introduction to SURPAC, STATISTICA, SPSS/SYSTAC software.

MODULE 1. Geo - statistics: Introduction, Concept.

MODULE 2. Basics of Probability and Statistics
Mean, Median, Mode, Probability Distribution (normal & log normal), Variance, Cumulative frequency and Cumulative probability.

MODULE 3. Mineral Inventory
Prospecting, exploration, method to quantify the size, shape & distribution of the ore reserve. Ore reserve calculation

MODULE 4. Extension method and application of classical statistics
regionalized variables, variogram and semi – variogram modeling, regularization, auxiliary functions.

MODULE 5. Kriging
Introduction, concept of development, types of kriging, linear kriging methodology, and their application in mining industries, common problems associated with the use of kriging.

MODULE 6. Geo - statistics for quality control
basis of non-parametric geo - statistics and indicator kriging. Introduction to SURPAC, STATISTICA, SPSS/SYSTAC software.

Text/Reference Books:

6. Open Pit Mine Planning and Design, Two Volume Set, Second Edition by William A. Hustrulid (Author), Mark Kuchta (Author)
7. Mining Geostatistics by A. G Journel & Ch. J. Huijbregts.
8. Advanced Geostatistics in the Mining Industry: Proceedings of the NATO Advanced Study Institute held at the Istituto di Geologia Applicata of the ... 13–25 October 1975 (Nato Science Series C:) Paperback – Import, 26 Mar 2012 by M. Guarascio (Editor), C.J. Huybrechts (Editor), M. David (Editor)
9. Geostatistics, Rendu J.M
10. Surface Mining, Kennedy Wiley

Course Outcome:

After completion of the course, students will be able to:

6. Understand use of statistics tools to use in mining fields.
7. Know reserve estimation methods using statistics tool.
8. Understand and interpret the 3 – D model of reserve.
9. Understand the and use in mine modelling software like surpac minex.

PRACTICALS

MN621P	ROCH MECHANICS LAB	0L:0T:3P	1 CREDITS

LIST OF EXPERIMENTS:

Sl. No.	Name of Experiment
1.	Determination of uniaxial compressive strength of rock using compression testing machine/UTM.
2.	Indirect determination of uniaxial compressive strength of rock/coal using Protodyakonov strength index apparatus.
3.	Indirect determination of uniaxial compressive strength of coal using impact strength index apparatus.
4.	Determination of tensile strength of rock/coal by brazilian test.
5.	Determination of point load index of rock/coal and estimation of uniaxial compressive strength and tensile strength.
6.	Determination of shear strength of rock/coal using direct shear apparatus.
7.	Determination of cohesion and angle of internal friction of rock/coal using shear apparatus with normal loading.
8.	Determination of bulk density, dry density and specific gravity of rock sample.
9.	Determination of durability index of rock/coal using durability index apparatus.
10.	Determination of ultimate tensile strength of steel reinforcement rod using UTM.
11.	Determination of permeability of soil and rock under fixed head and variable head condition.

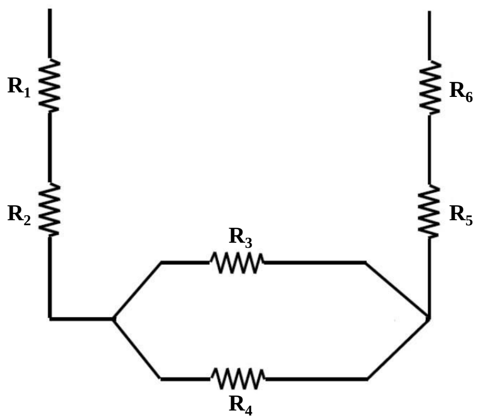
MN622P	MINE ENVIRONMENTAL ENGINEEIRNG LAB	0L:0T:3P	1 CREDITS

LIST OF EXPERIMENTS:

Sl. No.	Name of Experiment
1.	Determination of water quality and its suitability for industrial use.
2.	Determination of respirable particulate matter concentration by filtration method.
3.	Determination of particulate matter concentration by optical method.
4.	Determination of level of dust respirable exposure using personal dust sampler.
5.	Study and sketch of blastmate and micromate for measuring ground vibration.
6.	Study and sketch of radiationmeter.
7.	Study and sketch of weather monitoring station to measure local meteoroloical data.
8.	Study and sketch of haldane and orsat apparatus.
9.	Study and sketch of multi- gas detector.
10.	Determination of air velocity and quantity using digital anemometer.
11.	Study and sketch of lux meter.
12.	Study and sketch of sound level meters.

MN623P	DATA ANALYTICS LAB	0L:0T:3P	1 CREDITS

LIST OF EXPERIMENTS:

Sl. No.	Name of Experiment
1.	Find the Mean, Mode, Median, Variance, Skewness and Kurtosis for the given opencast blasting data using Excel.
2.	Find the Mean, Mode, Median, Variance, Skewness and Kurtosis for the given Mineral price data using C.
3.	Find the Mean, Mode, Median, Variance, Skewness and Kurtosis for the given average pull from the underground face data using C++.
4.	Find the Mean, Mode, Median, Variance, Skewness and Kurtosis for the given Mineral price data using python.
5.	Write a program in C or C++ or Python to predict the average pull from the underground face after the blast.
6.	Find the cohesion, angle of internal friction, failure angle and UCS from the given set of triaxial data (excel or other programming language).
7.	Write a program in C and C++ to determine the equivalent resistance of the mine, for the network given below (Fig 1).  *Mine Ventilation networks* (Resistance of air current network follows the same rule of addition as of Electrical current network.)
8.	Write a program in C, C++ and python to determine RQD of a core sample.
9.	Write a program in C, C++ and python to deduct Whole Circle Bearing (WCB) into Quadrantal Bearing (QB), with proper assumptions.
10.	Write a program in Python to predict the traffic on a new mode of transport for haul road for surface mine.

Course Structure for 5th and 6th Semester CSE

5^{th} Sem CSE

Sl. No	Course Code	Category	Subject	L	T	P	Credit
1		Professional Core-I	Computer Organization and Architecture	4	1	0	4
2		Professional Core-II	Compiler Design	3	1	0	3
3		Professional Core-III	Computer Graphics	3	1	0	3
4		Professional Electives-I	List of Professional Electives-I	3	1	0	3
5		Open Elective-1	List of Open Elective-1	3	1	0	3
Laboratory/Sessional							
1		Laboratory-I	Computer Organization and Architecture Lab.	0	0	3	1
2		Laboratory-II	Compiler Design Lab.	0	0	3	1
3		Laboratory-III	Computer Graphics Lab.	0	0	3	1
4		Laboratory-IV	Professional Electives-I Lab.	0	0	3	1
5		Laboratory-V	General Proficiency / Seminar	0	0	2	2
Total Credits (Theory + Sessional)							22

List of Electives 5th Semester CSE

Professional Elective-I	
Course No.	Subject Name
	Web Technology
	Linux Programming
	System Analysis and Design
	Semantics Web

Open Elective-I	
Course No.	Subject Name
	Data Science
	Computer Architecture*
	Data Base Management Systems*
	Data Communication

*These subjects are open for all the branches other than CSE and IT.

6th Semester, CSE

S. No	Course Code	Category	Subject	L	T	P	Credit
1		Professional Core-I	Computer Networks	4	1	0	4
2		Professional Core-II	Software Engineering	3	1	0	3
3		Professional Core-III	Image Processing	3	1	0	3
4		Professional Electives-II	List of Professional Electives-II	3	1	0	3
5		Open Elective-II	List of Open Elective-II	3	1	0	3
Laboratory/Sessional							
1		Laboratory-I	Computer Networks Lab.	0	0	3	1
2		Laboratory-II	Software Engineering Lab.	0	0	3	1
3		Laboratory-III	Image Processing Lab.	0	0	3	1
4		Laboratory-IV	Professional Electives-II Lab.	0	0	3	1
5		Laboratory-V	Internship/Tour & Training /Industrial Training	0	0	2	2
Total Credits (Theory + Sessional)							22

List of Electives 6th Semester, CSE

Professional Elective-II	
Course No.	Subject Name
	Soft Computing
	System Software
	Distributed System
	Natural Language Processing

Open Elective-II	
Course No.	Subject Name
	Information Retrieval
	AI and Machine Learning*
	Computer Network*
	Internet Of Things (IOT)

*These subjects are open for all the branches other than CSE and IT.

Course Structure for 5th and 6th Semester IT

5th Semester, IT

Sl. No	Course Code	Category	Subject	L	T	P	Credit
1		Professional Core-I	Computer Organization and Architecture	4	1	0	4
2		Professional Core-II	Information System	3	1	0	3
3		Professional Core-III	Computer Graphics	3	1	0	3
4		Professional Electives-I	List of Professional Electives-I	3	1	0	3
5		Open Elective-1	List of Open Elective-1	3	1	0	3
Laboratory/Sessional							
1		Laboratory-I	Computer Organization and Architecture Lab.	0	0	3	1
2		Laboratory-II	Information System Lab.	0	0	3	1
3		Laboratory-III	Computer Graphics Lab.	0	0	3	1
4		Laboratory-IV	Professional Electives-I Lab.	0	0	3	1
5		Laboratory-V	General Proficiency / Seminar	0	0	2	2
Total Credits (Theory + Sessional)							22

5th Semester, electives list IT

Professional Elective-I	
Course No.	Subject Name
	Web Technology
	Linux Programming
	Compiler Design
	Semantics Web
Open Elective-I	
Course No.	Subject Name
	Data Science
	Computer Architecture*
	Data Base Management Systems*
	Data Communication

*These subjects are open for all the branches other than CSE and IT.

6th Semester, IT

S. No	Course Code	Category	Subject	L	T	P	Credit
1		Professional Core-I	Computer Networks	4	1	0	4
2		Professional Core-II	Software Engineering	3	1	0	3
3		Professional Core-III	Image Processing	3	1	0	3
4		Professional Electives-II	List of Professional Electives-II	3	1	0	3
5		Open Elective-II	List of Open Elective-II	3	1	0	3
Laboratory/Sessional							
1		Laboratory-I	Computer Networks Lab.	0	0	3	1
2		Laboratory-II	Software Engineering Lab.	0	0	3	1
3		Laboratory-III	Image Processing Lab.	0	0	3	1
4		Laboratory-IV	Professional Electives-II Lab.	0	0	3	1
5		Laboratory-V	Internship/Tour & Training /Industrial Training	0	0	2	2
Total Credits (Theory + Sessional)							22

6th Semester, elective list IT

Professional Elective-II	
Course No.	Subject Name
	Soft Computing
	System Software
	Distributed System
	Natural Language Processing
Open Elective-II	
Course No.	Subject Name
	Information Retrieval
	AI and Machine Learning*
	Computer Network*
	Internet Of Things (IOT)

*These subjects are open for all the branches other than CSE and IT.

Detailed Syllabus

Computer Science & Engineering					
Code: CS	**Computer Organization and Architecture**	**L**	**T**	**P**	**C**
		4	**1**	**0**	**4**

This course open to all branch except CSE/IT.

Course Outcomes:

1. Ability to describe the organization of computer and machine instructions and programs
2. Ability to analyze Input / Output Organization
3. Analyze the working of the memory system and basic processing unit.
4. Ability to solve problems of multicores, multiprocessors and clusters.
5. Choose optical storage media suitable for multimedia applications.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	-	3	-	2	2	-	-	-	-	-	-	1
CO2	2	2	2	2	2	-	-	-	-	-	-	2
CO3	2	2	2	2	3	-	-	-	-	-	-	2
CO4	3	3	3	2	2	-	-	-	-	-	-	2
Average												

**3: high, 2: moderate, 1 low*

MODULE-I:

Basics of Digital Electronics: Multiplexers and De multiplexers, Decoder andEncoder, Codes, Logic gates, Flip flops, Registers.
Register Transfer and Micro Operations: Bus and Memory Transfer, Logic Micro Operations, Shift Micro Operations, Register transfer and register transfer language, Design of arithmetic logic unit.

MODULE II:

Basic Computer Organization: Instruction codes, Computer instructions, Timing and Control, Instruction cycle, Memory reference Instruction, Complete computer description, Design of basic computer, Input output and interrupt.

MODULE III:

Control Unit: Hardwired controls, Micro programmed controls.
Central Processing Unit : Program control, Reduced instruction set computer, Complex instruction set computer, Data Transfer, Manipulation, General register and stack organization, Addressing mode.

MODULE IV:

Computer Arithmetic: Addition and subtraction algorithm, Multiplication algorithm, Division algorithms.

MODULE V:

Input-Output Organization: Priority interrupt, Peripheral devices, Input output interface, Data transfer schemes, Program control and interrupts, Direct memory access transfer, Input/output processor.
Memory Unit: High speed memories, Memory hierarchy, Processor Vs Memory speed, Cache memory, Associative memory, Inter leave, Virtual memory, Memory management.

MODULE VI :

Introduction to Parallel Processing: Pipelining, Characteristics of multiprocessors, Interconnection structures, Inter processor arbitration, Inter processor communication, Synchronization.

Text Books:

1. Computer System Architecture by Morris Mano, Prentice hall, 3rd Edition, (2007)

References:

1. Computer Organization by Carl Hamacher, ZvonkoVranesic, SafwatZaky, Tata Mcgraw Hill, 5th Edition, (2011)

2. Computer Architecture : A Quantitative Approach by Hennessy, J. L, David A Patterson, and Goldberg, Pearson Education, 4th Edition, (2006)

Computer Science & Engineering					
Code: CS	**Compiler Design**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Pre-requisites: knowledge of automata theory, context free languages, computer architecture, data structures and simple graph algorithms, logic or algebra.

MODULE-I:

Introduction to compiler and Finite automata **14 lectures**

Compilers, Analysis of source programs, Tokens, patterns, lexemes, Phases of compilers, Parsing, Parse trees, Ambiguity, Associativity and precedence of operators, Top-down parsing, Bottom-up parsing, Left recursion, Syntax directed translation. Classification of grammars, NFA, DFA, Conversion of NFA to DFA, RE to NFA (Thompson's Construction), Optimization of NFA/DFA using FIRSTPOS, LASTPOS, FOLLOWPOS.

MODULE-II:

Context Free Grammar **4 lectures**

RE vs. CFG, Eliminating ambiguity and left recursion, Left factoring.

MODULE-III:

Compiler Parser **8 lectures**

Top down parsing-LL parser, LL grammars. Bottom up parsing- LR parser, SLR parser, CLR parser, LALR parser. Polishing expressions Operator precedence grammar. LR grammars. Comparison of parsing methods. Error handling.

MODULE-IV:

Run time environments **8 lectures**

Symbol tables, Language facilities for dynamic storage allocation, Dynamic storage allocation technique, Organization for non-block and block structured languages.

MODULE-V:

Intermediate code generation **4 lectures**

Intermediate languages, graphical representations, Synthesized and inherited attributes, Dependency graph, Syntax directed translation, S and L- attributed definitions, Polish notation, three address, quadruples, triples, indirect triples Flow of control statement.

MODULE-VI:

Code optimization and code generation **4 lectures**

Basic blocks and flow graphs, Optimization of basic blocks, Code optimization techniques, Issues in design of code generator, Target machine code and simple code generator.

Suggested Text Books

- Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Monica S. Lam, *Compilers: Principles, Techniques, and Tools*. Addison-Wesley, 2006 (optional).
- Thomas W. Parsons, *Introduction to Compiler Construction*. Computer Science Press,**1992.**

Suggested Reference books

- Compiler design in C, A.C. Holub, PHI.
- Compiler construction (Theory and Practice), A.Barret William and R.M. Bates, Galgotia Publication.
- Compiler Design, Kakde.
-

COURSE OUTCOMES

1	*Identify* the issue that arises in the design and construction of translator for programming language.
2	*Analyze* RE and CFG to specify the lexical and syntactic structure of programming language.
3	*Design* different parsers from given specification.
4	*Assess* the various program transformations.
5	*Design* a compiler for a programming language.

CO-PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
1	-	3	2	2	-	-	-	-	-	1	-	-
2	-	3	-	2	-	-	-	-	-	-	-	-
3	-	-	2	2	-	-	-	-	-	2	-	-
4	-	2	-	2	-	-	-	-	-	-	-	-
5	-	-	2	1	-	-	-	-	-	1	-	-

**3: high, 2: moderate, 1: low*

Computer Science & Engineering					
Code: CS	**Computer Graphics**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Objectives of the course:

This course covers basics of computer graphics. Computer graphics are pictures and films created using computers. Usually, the term refers to computer-generated image data created with the help of specialized graphical hardware and software. It is a vast and recently developed area of computer science. Computer graphics is responsible for displaying art and image data effectively and meaningfully to the consumer. It is also used for processing image data received from the physical world. Computer graphics development has had a significant impact on many types of media and has revolutionized animation, movies, advertising, video games, and graphic design in general.

Course Outcomes

After completing this course, the student will be able to:

CO1	Understand the basics of computer graphics, different graphics systems and applications of computer graphics.
CO2	Discuss various algorithms for scan conversion and filling of basic objects and their comparative analysis.
CO3	Use of geometric transformations on graphics objects and their application in composite form.
CO4	Extract scene with different clipping methods and its transformation to graphics display device.
CO5	Render projected objects to naturalize the scene in 2D view and use of illumination models for this

Module – I:
Introduction to computer graphics and graphics systems. Raster and vector graphics systems, video display devices, physical and logical input devices, simple color models.

Module – II:
Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.

Module – III:
2D Transformation : Basic transformations : translation, rotation, scaling ; Matrix representations & homogeneous coordinates, transformations between coordinate systems ; reflection shear ; Transformation of points, lines, parallel lines, intersecting lines.

Module – IV:
Viewing pipeline, Window to Viewport co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse.

Module – V:
Hidden Surfaces: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Printer's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods, fractal - geometry. Rendering of a polygonal surface; Flat, Gouraud, and Phong shading; Texture mapping, bump texture, environment map; Introduction to ray tracing; Image synthesis, sampling techniques, and anti-aliasing.

Text Books

1. Donald Hearn and Pauline Baker Computer Graphics, Prentice Hall, New Delhi, 2012

2. Steven Harrington, "Computer Graphics- A programming approach", McGraw 3. Hill, 2nd Edition, 1987.

Reference Book

3. Foley J.D., Van Dam A, "Fundamentals of Interactive Computer Graphics", Addison Wesley, 1990

Computer Science & Engineering					
Code: CS	**Web Technology**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective: The focus in this course is on the World Wide Web continues to provide a foundation for the developmentofabroadrangeofincreasinglyinfluentialandstrategictechnologies,supporting a large variety of applications and services, both in the private and public sectors. There is a growing need for management and decision makers to gain a clearer understanding of the application development process, from planning through to deployment and maintenance. In this course, you will learn about the HTTP communication protocol, the markup languages HTML, XHTML and XML, the CSS standards for formatting and transforming web content, interactive graphics, multimedia content on the web, client-side programming using Java script; an understanding of approaches to more dynamic and mobile content; and demonstrate how you can analyze requirements, plan, design, implement and test arrange of webapplications.

Course Prerequisite

- Programming for Problemsolving.
- Object Oriented Programming ThroughJava.
- Basic concept ofNetworking.

Course Outcomes

After Successful completion of course, the students will be able to

CO	Description
CO 1	**Describe** various web technology and application development issues and trends.
CO 2	**Design** static and dynamic web pages using HTML, CSS and Java Script.
CO 3	**Design** and implement web services from the server and client side.
CO 4	**Build** interactive Web applications using JSP and Servlet.
CO 5	**Identify** the engineering structural design of XML and parse construction tree model.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO 1	-	3	-	-	-	-	-	-	-	2	-	-
CO 2	3	2	3	2	3	1	-	-	-	-	-	-
CO 3	-	-	3	-	2		-	-	2	-	-	-
CO 4	2	2	3	-	2	1	-	-	-	-	-	-
CO 5	2	2	-	-	-	-	-	-	-	-	-	-
Avg	2.33	2.25	3	2	2.33	1			2	2		

Note- *3: high, 2: moderate, 1 low*

Module – I

Introduction to html: Fundamentals of HTML elements, Document body, Different tags, sections, text, hyperlink, lists, tables, color and images, frames, frameset, form.

Web Pages: types and issues, tiers; comparisons of Microsoft and java technologies; WWW: Basic concept, web client and web server, HTTP protocol (frame format), universal resource locator (URL).

Module – II

Dynamic web pages: The need of dynamic web pages; an overview of DHTML, Cascading Style Sheets (CSS), comparative studies of different technologies of dynamic page creation.
Active web pages: Need of active web pages; java applet life cycle.

Module – III

JavaScript: Data types, variables, operators, conditional statements, array object, date object, string object.

Java Servlet: Servlet environment and role, HTML support, Servlet API, the Servlet Life cycle, cookies and sessions.

Module – IV

JSP: JSP architecture, JSP servers, JSP tags, understanding the layout in JSP, Declaring Variables, methods in JSP, inserting java expressions in JSP, processing request from user and generating dynamic response for the user, inserting applets and java beans into JSP, using include and forward action, comparing JSP and CGI program, comparing JSP and ASP program; Creating ODBC data source name, introduction to JDBC, prepare statement and callable statement.

Module – V

J2EE:AnoverviewofJ2EEwebservices,basicsofEnterpriseJavaBeans,EJBvs.JavaBeans,basic of RMI,JNI.

XML: Basics XML, elements and attributes, document type definition, xml parsers, sequential and tree approach

Text Books:

1. ChrisBates,“WebProgramming:BuildingInternetApplications”,WileyDreamTech, 2nd Edition,2002.
2. Jeffrey C K Jackson, Web Technologies”, Pearson Education, 1stEdition,2006.
3. JasonHunter,WilliamCrawford—JavaServletProgramming‖O‘Reilly Publications, 2nd Edition, 2001.

References

1. W Hans Bergsten, “Java Server Pages”, O‟Reilly, 3rd Edition,2003.
2. D. Flanagan, “Java Script”, O‟Reilly, 6th Edition,2011.
3. Jon Duckett, “Beginning Web Programming”, WROX, 2nd Edition,2008.
4. Herbert Schildt, “Java the Complete Reference”, Hill - Osborne, 8th Edition,2011.

List of Open Source Software/learning website:

- Browsers like IE, Mozilla, Firefoxetc.
- Server softwareXAMPP/WAMP/LAMP.
- www.apachefriends.org
- www.w3.org
- www.w3schools.com
- www.php.net
- www.mysql.com
- www.phpmyadmin.net
- www.javatpoint.com

Computer Science & Engineering					
Code: CS	**Linux Programming**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**0**

Course objectives:

CO1: able to understand the basic commands of linux operating system and can write shell scripts.

CO2: able to create file systems and directories and operate them

CO3: Students will be able to create processes background and fore ground etc. by fork() system calls

CO4: able to create shared memory segments, pipes, message queues and can exercise inter process communication

CO PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO1	2	2	2	-	-	-		-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	1	-	-	-	-	-	-	-	-

Module - I:Linux Utilities:

File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking commands, Filters, Text processing utilities, Backup utilities Sed - Scripts, Operations, Addresses, Commands,,awk - Execution, Fields and Records, Scripts, Operations, Actions, Assocoative Array, Strings and Mathematical functions, System commands in awk, Applications. Shell programming with Bourne Again Shell (bash): Introduction, Shell responsibilities, Pipes and redirection, here documents, Running a shell script, Shell as a programming language, Shell meta characters, File-name substitution, Shell variables, Command substitution, Shell commands, The environment, Quoting, test command, Control structures, Arithmetic in shell, Shell script examples, Interrupt processing functions, Debugging shell scripts

Module-II:Files and Directories:

File concepts, File types File system structure, file metadata - Inodes, kernel support for files, System calls for the file I/O operations- open,create,read,wrirte,close,lseek,dup2,file status information-stat family, file and record locking-fcntl function, file permissions- chmod, fchmod, file ownership-chown, lchown, fchown, links-soft links and hard links- symlink, link, unlink. Directories: Creating,,removing and changing Directories-mkdir, rmdir,chdir, obtaining current working directory-getcwd, directorycontents, scanning directories- opendir, readdir, rewin functions.

Module- III:Process:

Process concept, Layout of a C program image in main memory, Process environment – environment list, environment variables, getenv, setenv, Kernel support for process, Process identification, Process control - Process creation, replacing a process image, waiting for process, Process termination, Zombie process, Orphan process, ,system call interface for process management – fork, vfork, exit, wait, waitpid, exec family, process groups, sessions and controlling Terminal, differences between threads and processes. Signals: Introduction to signals, Signal generation, Signal handling, Kernel support for signals, signal function, Unreliable signals, Reliable signals, and Signal functions: kill, raise, alarm, pause, abort, sleep.

Module- IV:Inter process Communication:

Introduction to IPC,IPC between processes on a single computer system, IPC between processes on different systems, Pipes-creationIPC between related processes using FIFOs(Named pipes), differences between unnamed and named pipes, popen and pclose library functions. Message Queues: Kernel support for messages, APIs for message queues, Client/Server example Semaphores: Kernel support for semaphores, APIs for semaphores, file locking with semaphores.

Module -V:Shared Memory:

Kernel support for Shared Memory, APIs for Shared Memory, Shared Memory example Sockets: Introduction to Berkley Sockets, IPC over a network, client – server model, Socket address structures (Unix domain and internet domain) , Socket system calls for connection oriented protocol and connectionless protocol, example- client/server programs- single server- client connection, multiple simultaneous clients, socket options- setsockopt and fcntl system calls, comparison of IPC mechanisms.

EXT BOOKS:-

1. Unix System Programming using C++, T. Chan, PHI,(UNIT III to UNIT VIII)
2. Unix concepts and Applications, 4th Edition, Sumitabha Das, TMH.
3. Beginning Linux Programming, 4th Edition, N.Matthew, R.Stones, Wrox, Willey India Edition.

REFERRENCE BOOKS:

1. Linux System Programming. Robert Love, O’Reilly, SPD.
2. Advanced Programming in the Unix environment, 2nd Edition, W.R.Stevens, Pearson Education.
3. Unix Network Programming, W.R.Steven, PHI.
4. UNIX for Programming and users, 3rd Edition, Graham Glass, King Ables, Pearson Edition.
5. UNIX and shell Programming, B.A.Forouzan and R.F.Koretsky, S.A.Sarawar, Pearson edition.
6. Unix The Text book, 2nd edition, S.M.Sarawar, Koretsky, S.A.Sarawar, Pearson Edition

Computer Science & Engineering					
Code: CS	**System Analysis and Design**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OUTCOMES:

CO 1	Identify the issue that arises in the design of systems as a whole
CO 2	Ability to understand the Software Development Life Cycle
CO 3	Students will be able to understand different types of system designing and Modelling
CO 4	Students will be able to understand Maintenance, Testing and structured Design
CO 5	Ability to understand the Security and Threats

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO 1	-	3	2	2	-	-	2	-	-	1	-	-
CO 2	-	3	-	2	-	-	-	-	-	-	-	-
CO 3	-	-	2	2	-	3	-	-	-	2	-	-
CO 4	-	2	-	2	-	-	-	-	-	-	-	-
CO 5	-	-	2	1	-	-	-	-	-	1	-	-

**3: high, 2: moderate, 1: low*

MODULE- I:

INTRODUCTION

System definition and concepts: Characteristics and types of system, Manual and automated systems

Real-life Business sub-systems: Production, Marketing, Personal, Material, Finance

Systems models types of models: Systems environment and boundaries, Real-time and distributed systems, Basic principles of successful systems

MODULE- II:

SYSTEMS ANALYST

Role and need of systems analyst, Qualifications and responsibilities, Systems Analyst as and agent of change,

Introduction to systems development life cycle (SDLC):

Various phases of development: Analysis, Design, Development, Implementation, Maintenance

Systems documentation considerations: Principles of systems documentation, Typesof documentation and their importance, enforcing documentation discipline in anorganization.

System Planning

Data and fact gathering techniques: Interviews, Group communication, Presentations, Sitevisits. Feasibility study and its importance, Types of feasibility reports System Selection plan and proposal Prototyping

Cost-Benefit and analysis: Tools and techniques

MODULE- III:

SYSTEMS DESIGN AND MODELING

Process modeling, Logical and physical design, Design representation, Systems flowcharts and structured charts, Data flow diagrams, Common diagramming conventions and guidelines using DFD and ER diagrams. Data Modeling and systems analysis, designing the internals: Program and Process design, Designing Distributed Systems.

Input and Output Classification of forms: Input/output forms design, User-interface design, Graphical interfaces

MODULE- IV:

MODULAR AND STRUCTURED DESIGN

Module specifications, Module coupling and cohesion, Top-down and bottom-up design

System Implementation and Maintenance

Planning considerations, Conversion methods, producers and controls, System acceptance Criteria, System evaluation and performance, Testing and validation, Systems quality Control and assurance, Maintenance activities and issues.

MODULE- V:

SYSTEM AUDIT AND SECURITY

Computer system as an expensive resource: Data and Strong media Procedures and norms for utilization of computer equipment, Audit of computer system usage,Audit trails

Types of threats to computer system and control measures: Threat to computer system and control measures, Disaster recovery and contingency planning

Object Oriented Analysis and design

Introduction to Object Oriented Analysis and design life cycle, object modeling: Class Diagrams, Dynamic modeling: state diagram, Dynamic modeling: sequence diagramming.

TEXT BOOKS: -

1. System Analysis and Design Methods, Whitten, Bentaly and Barlow, Galgotia Publication.

2. System Analysis and Design Elias M. Award, Galgotia Publication

REFERENCES

3. Modern System Analysis and Design, Jeffrey A. Hofer Joey F. George JosephS. Valacich Addison Weseley.

Computer Science & Engineering					
Code: IT522	**Semantic Web**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OUTCOMES:

CO1	*Understand* and *explain* the overall architecture of semantic web and to illustrate the overview of design principles and technologies in semantic web.
CO2	*Design and implement* a small ontology that is semantically descriptive of your chosen problem domain, implement applications that can access, use and manipulate the ontology, represent data from a chosen problem in XML with appropriate semantic tags obtained or derived from the ontology.
CO3	*Describe* the semantic relationships among these data elements using Resource Description Framework (RDF).
CO4	*Design and implement* a web services application that ―discovers‖ the data and/or other web services via the semantic web (which includes the RDF, data elements in properly tagged XML, and the ontology), discover the capabilities and limitations of semantic web technology for different applications.

CO-PO MAPPING:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	3	2	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	3	3	2	-	-	-	-	-	-	2	-
Avg.	1.5	1.5	1.5	1	-	-	-	-	-	-	1	-

**3: high, 2: moderate, 1 low*

DETAIL SYLLABUS:

MODULE-I:

INTRODUCTION

Introduction to the Syntactic Web and Semantic Web – Evolution of the Web – the Visual and Syntactic Web – Levels of Semantics – Metadata for Web Information – the Semantic Web Architecture and Technologies – Contrasting Semantic with Conventional Technologies– Semantic Modeling -Potential of Semantic Web Solutions and Challenges of Adoption Design Principles.

MODULE-2:

KNOWLEDGE REPRESENTATION AND ONTOLOGIES

Knowledge Representation and Reasoning - Ontologies- Taxonomies –Topic Maps – Classifying Ontologies - Terminological Aspects: Concepts, Terms, Relations Between Them – Complex Objects -Subclasses and Sub-properties definitions –Upper Ontologies – Quality – Uses - Types of Terminological Resources for Ontology Building – Methods and Methodologies for Building Ontologies – Multilingual Ontologies -Ontology Development Process and Life Cycle – Methods for Ontology Learning – Ontology Evolution – Versioning Ontologies in Semantic Web.

MODULE-3:

STRUCTURING AND DESCRIBING WEB RESOURCES

Structured Web Documents - XML – Structuring – Namespaces – Addressing – Querying – Processing - RDF – RDF Data Model – Serialization Formats- RDF Vocabulary –Inferencing RDFS – basic Idea – Classes – Properties- Utility Properties – RDFS Modelling for Combinations and Patterns- Transitivity.

MODULE-4:

WEB ONTOLOGY LANGUAGE

OWL – Sub-Languages – Basic Notions -Classes- Defining and Using Properties – Domain and Range – Describing Properties - Data Types – Counting and Sets- Negative Property Assertions – Advanced Class Description – Equivalence – OWL Logic.

MODULE-5:

SEMANTIC WEB TOOLS AND APPLICATIONS

State - of- the- Art in Semantic Web Community-Development Tools for Semantic Web – Jena Framework – SPARL –Querying Semantic Web- Semantic Desktop – Semantic Wikis - Semantic Web Services – Application in Science – Business

TEXTBOOKS:

1. LiyangYu,‖A Developer‘s Guide to the Semantic Web‖, Springer, First Edition, 2011.

2. John Hebeler, Matthew Fisher, Ryan Blace and Andrew Perez-opez, ―Semantic Web Programming‖, First Edition, Wiley, 2009.

3. Grigoris Antoniou, Frank van Harmelen, ―A Semantic Web Primer‖, Second Edition, MIT Press, 2008. 4. Robert M.Colomb, Ontology and the Semantic Web‖, Frontiers in Artificial Intelligence and Applications, IOS Press, 2007.

5. Dean Allemangand James Hendler, Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL‖, Second Edition, Morgan Kaufmann, 2011.

6. Pascal Hitzler, Markus Krotzsch, Sebastian Rudolph, ―Foundations of Semantic Web Technologies, CRC Press, 2009.

REFERENCES:

1. Michael C. Daconta, Leo J.Obrst and Kevin T. Smith, ―The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management‖, First Edition, Wiley, 2003

2. Karin Breitman, Marco Antonio Casanova and Walt Truszkowski, ―Semantic Web: Concepts,TechnologiesandApplications(NASAMonographsinSystemsandSoftware Engineering) Springer, 2010.

3. Vipul Kashyap, Christoph Bussler and Matthew Moran, The Semantic Web: Semantics for Data and Services on the Web(Data-Centric Systems and Applications), Springer, 2008.

Computer Science & Engineering					
Code: CS532	**Computer Architecture***	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

***This course open to all branch except CSE/IT.**

Course Outcomes:

1. Ability to describe the organization of computer and machine instructions and programs
2. Ability to analyze Input / Output Organization
3. Analyze the working of the memory system and basic processing unit.
4. Ability to solve problems of multicores, multiprocessors and clusters.
5. Choose optical storage media suitable for multimedia applications.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	-	3	-	2	2	-	-	-	-	-	-	1
CO2	2	2	2	2	2	-	-	-	-	-	-	2
CO3	2	2	2	2	3	-	-	-	-	-	-	2
CO4	3	3	3	2	2	-	-	-	-	-	-	2
Average												

**3: high, 2: moderate, 1 low*

MODULE-I:

Basics of Digital Electronics: Multiplexers and De multiplexers, Decoder andEncoder, Codes, Logic gates, Flip flops, Registers.

Register Transfer and Micro Operations: Bus and Memory Transfer, Logic Micro Operations, Shift Micro Operations, Register transfer and register transfer language, Design of arithmetic logic unit.

MODULE-II:

Basic Computer Organization: Instruction codes, Computer instructions, Timing and Control, Instruction cycle, Memory reference Instruction, Complete computer description, Design of basic computer, Input output and interrupt.

MODULE-III:

Control Unit: Hardwired controls, Micro programmed controls.

Central Processing Unit : Program control, Reduced instruction set computer, Complex instruction set computer, Data Transfer, Manipulation, General register and stack organization, Addressing mode.

MODULE-IV:

Computer Arithmetic: Addition and subtraction algorithm, Multiplication algorithm, Division algorithms.

MODULE-V:

Input-Output Organization: Priority interrupt, Peripheral devices, Input output interface, Data transfer schemes, Program control and interrupts, Direct memory access transfer, Input/output processor.

Memory Unit: High speed memories, Memory hierarchy, Processor Vs Memory speed, Cache memory, Associative memory, Inter leave, Virtual memory, Memory management.

MODULE-VI:

Introduction to Parallel Processing: Pipelining, Characteristics of multiprocessors, Interconnection structures, Inter processor arbitration, Inter processor communication, Synchronization.

Text Books:

1. Computer System Architecture by Morris Mano, Prentice hall, 3rd Edition, (2007)

References:

1. Computer Organization by Carl Hamacher, ZvonkoVranesic, SafwatZaky, Tata Mcgraw Hill, 5th Edition, (2011)
2. Computer Architecture : A Quantitative Approach by Hennessy, J. L, David A Patterson, and Goldberg, Pearson Education, 4th Edition, (2006)

Semester – VI

Computer Science & Engineering					
Code: CS	**Computer Network**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Course Objective:

This course includes learning about computer network organization and implementation. Students are introduced to computer network design and its operations, and discuss the topics of OSI communication model; error detection and recovery; LANs; network naming and addressing; and basics of cryptography and network security.

Course Outcome:

CO1	Describe and analyze the importance of data communications and the layered protocol model
CO2	Describe, analyze and evaluate a number of data link, network, and transport layer protocols and network devices.
CO3	Have a basic knowledge of the use of cryptography and network security;
CO4	Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance and implementing new technologies

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO1	1	1	-	2	-	-	-	1	1	-	-	2
CO2	2	2	1	1	3	-	-	-	1	-	1	2
CO3	-	1	3	2	-	2	2	3	-	-	-	3
CO4	3	2	2	2	2	-	-	2	1	1	2	2

Course Description:

MODULE 1:

Data communication Components**:** Representation of data and its flow in Networks, Various Connection Topology, Protocols and Standards, OSI model.Physical Layer: LAN technologies (Ethernet), Multiplexing, Transmission Media, Switching Techniques.

MODULE 2:

Data Link Layer: Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, and Sliding Window. Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA. Error Detection and Error Correction - Fundamentals, Block coding, CRC, Hamming Code.

MODULE 3:

Network Layer: Internetworking Devices. IP Addressing and Subnetting, Network Layer Protocols: IPV4, IPV6 and ICMP. Address Mapping: ARP, RARP and DHCP. Routing algorithms (link state and distance vector).

MODULE 4:

Transport Layer: Process to Process Delivery: UDP and TCP, Congestion Control and Quality of Services.

MODULE 5:

Application Layer: Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Basics of Wi-Fi.

MODULE 6:

Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

Text Books:

1. "Data Communication and Networking", Behrouz Forouzan, McGraw Hill Education.

Reference Books:

1. "Computer Networks", Andrew S Tanenbaum, Pearson Edition
2. "Data and Computer Communications " , W. Stallings, PHI/ Pearson Education

Computer Science & Engineering					
Code: IT	**Data Science**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Course Objective:

The main objective of this course is to train the student to do theoretical with practical data science work, Career-wise, we expect our students to be able to develop into skilled data science researchers or software developers.

Course Outcome:

1. To enable students with data analytics skill
2. To develop knowledge of fundamentals of data science
3. To empower students with hands-on for data science
4. To make students experience with theoretical data science and programming

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO5**	**PO9**	**P11**	**P12**
CO1	-	3	2	-	1	3	3
CO2	3	2	-	-	2	2	2
CO3	-	2	3	3	3	3	-
CO4	2	-	2	3	3	2	2

MODULE-I

INTRODUCTION: -

Introduction to data science, Different sectors of using data science, Purpose and components of Python, Data Analytics processes, Exploratory data analytics, Quantitative technique and graphical technique, Data types for plotting.

MODULE-II

STATISTICAL ANALYSIS: -

Introduction to statistics, statistical and non-statistical analysis, major categories of statistics, population and sample, Measure of central tendency and dispersion, Moments, Skewness and kurtosis, Correlation and regression, Theoretical distributions – Binomial, Poisson, Normal

MODULE-III

INTRODUCTION TO MACHINE LEARNING: -

Machine learning, Types of learning, Properties of learning algorithms, Linear regression and regularization, model selection and evaluation, classification: SVM, kNN and decision tree, Ensemble methods: random forest, Naive Bayes and logistic regression, Clustering: k-means, feature engineering and selection, Dimensionality reduction: PCA

MODULE-IV

PYTHON SETUP FOR MATHEMATICAL AND SCIENTIFIC COMPUTING: -

Anaconda installation process, data types with python, basic operators and setup, introduction to numpy, mathematical functions of numpy, introduction to scipy, scipy packages, data frame and data operations, data visualisation using matplotlib

Text Books:

1. N.G.Das , Statistical Methods (combined edition Vol.I and Vol.II) – McGraw Hill
2. Roger D. Peng, Elizabeth Matusi, The Art of Data Science: A Guide for Anyone who work with data - Leanpub
3. AurelienGeron, Hands-On Machine Learning with Scikit – Learn &TensorFlow – O'reilly

Reference Books:

1. AndriyBurkov, The Hundred Page Machine Learning Book – Xpress Publishing
2. James, G., Witten, D., Hastie, T., Tibshirani, R. An introduction to statistical learning with applications in R. Springer.
3. Murphy, K. Machine Learning: A Probabilistic Perspective. - MIT Press
4. Jan Erik Solem, Programming Computer Vision with Python – O' Reilly

Computer Science & Engineering					
Code: CS	**Image Processing**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Pre-requisite(s)

Knowledge ofData Structures, Computer Graphics required for this course.

Objectives of the course

Course Outcomes:

After completing this course, students will be able to:

CO1	To study the image fundamentals and image transforms necessary for image processing
CO2	To study the image enhancement techniques.
CO3	To study the image restoration procedures and segmentation tools.
CO4	To study the wavelet tools and the image compression procedures.

Mapping of course outcomes with program outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	2	-	-	-	-	-	-	-	-	
CO2	3	2	2	3	-	-	-	-	-	-	-	-
CO3	2	-	3	2	-	-	-	-	-	-	-	-
CO4	1	2	3	-	-	-	-	-	-	-	-	-

MODULE-I:

INTRODUCTION AND DIGITAL IMAGE FUNDAMENTALS

Introduction: Origin, Steps in Digital Image Processing, Components. Digital Image Fundamentals: Elements of Visual Perception, Image Sampling and Quantization, Some Basic Relationships between pixels, Color Models.

MODULE-II:

IMAGE TRANSFORM

Introduction to the Fourier Transform, The Discrete Fourier Transform, Discrete Cosine Transform, Singular Value Decomposition and Principal Component Analysis.

MODULE-III:

IMAGE ENHANCEMENT

Spatial Domain: Some Simple Intensity Transformations, Histogram processing, Basics of Spatial Filtering, Smoothing and Sharpening Spatial Filtering. Frequency Domain: Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters.

MODULE-IV:

IMAGE RESTORATION AND SEGMENTATION

Image Restoration: Noise models, Mean Filters, Order Statistics, Adaptive filters, Band reject Filters, Band pass Filters, Notch Filters, Optimum Notch Filtering, Inverse Filtering, Wiener filtering. Segmentation: Thresholding.

MODULE-V:

WAVELETS AND IMAGE COMPRESSION

Wavelets: Background, Sub-band Coding, Multi-resolution Expansions. Compression: Fundamentals, Image Compression Models, Error Free compression- Variable Length Coding, Bit-Plane Coding, Lossless Predictive Coding, Lossy Compression, Lossy Predictive Coding, Transform Coding and Wavelet Coding.

TEXT BOOK:

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.

REFERENCES:

1. S. Jayaraman, S Essakirajan, "Digital Image Processing", Second Edition, Tata McGraw Hill, 2009
2. Khalid Sayood, "Introduction to Data Compression", Third Edition, Elsevier, 2006.
3. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata McGraw Hill Pvt. Ltd., 2011.
4. https://cse19-iiith.vlabs.ac.in/index.html

Computer Science & Engineering					
Code:	**System Software**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Objectives of the course

To introduce the student to key concepts in Phase transformations and enable an understanding of the steps involved in several important phase transformations.

Course Outcomes

After completing this course, the student should be able to:

CO1	Explain the organization of basic computer, its design and the design of control unit.
CO2	Understand the organization of memory and memory management hardware.
CO3	Distinguish between Operating Systems software and Application Systems software.
CO4	Identify the primary functions of an Operating System.
CO5	Master attributes and assessment of quality, reliability and security of software.

Detailed Syllabus:

MODULE-I

INTRODUCTION: System Software, Application Software, components of a programming system: Assembler, Loader, Linker, Macros, Compiler, Program Development Cycle, Evolution of Operating Systems, Functions of Operating System, Machine Structure: General Machine Structure, Approach to a new machine, Memory Registers, Data, Instructions, Evolution of Machine Language: Long Way, No looping, Address Modification, Looping, Introduction to Assembly LanguageProgram.

MODULE –II

ASSEMBLERS: Review of Computer Architecture – Machine Instructions and Programs – Assemblers –Basic Assembler Functions – Assembler Features – Assembler Design Options. LOADERS AND LINKERS: Loaders and Linkers – Basic Loader Functions – Machine-Dependent Loader Features – Machine-Independent Loader Features– Loader Design Options-Dynamic Linking and Loading- Object files- Contents of an object file – designing an object format – Null object formats- Code sections- Relocation – Symbols and Relocation – Relocatablea. out-ELF.

MODULE-III

MACROPROCESSORS AND EMULATORS: Microprocessors – Basic Macro Processor Functions – Machine-Independent Macro Processor Features – Macro Processor Design Options - Introduction to Virtual Machines (VM) - Emulation - basic Interpretation – Threaded Interpretation – Interpreting a complex instruction set – binary translation.

MODULE-IV

VIRTUAL MACHINES: Pascal P-Code VM – Object-Oriented VMs – Java VM Architecture – Common Language Infrastructure – Dynamic Class Loading. ADVANCED FEATURES: Instruction Set Issues – Profiling – Migration – Grids – Code optimizations- Garbage Collection - Examples of real-world implementations of system software.

TEXT BOOKS:

1. Leland L. Beck, “System Software”, 3rd ed., PearsonEducation.
2. John R. Levine, “Linkers & Loaders”, MorganKauffman.
3. James E Smith and Ravi Nair, “Virtual Machines”,Elsevier.

REFERENCES:

1. Srimanta Pal, “ Systems Programming “ , Oxford UniversityPress.
2. John J.Donovan, “ “Systems Programming”, Tata McGraw-Hill.
3. Systems Programming by John J Donovan (McGraw-HillEducation)
4. Operating System and System Programming – Dhamdhere (McGraw-HillEducation)

Computer Science & Engineering					
Code:	**Distributed System**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course objective:

This course covers the basic understanding of distributed computing system. The course aims to provide an understanding of the principles on which the Internet and other distributed systems are based; their architecture, algorithms and how they meet the demands of contemporary distributed applications. The course covers the building blocks for a study of distributed systems, and addressing thecharacteristicsandthechallengesthatmustbeaddressedintheirdesign:scalability,heterogeneity, securityandfailurehandlingbeingthemostsignificant.Distributedcomputingisafieldofcomputerscience that studies distributed systems. A distributed system is a system whose components are located on different networked computers, which communicate and coordinate their actions bypassingmessagestooneanother.Thecomponentsinteractwithoneanotherinordertoachieve a common goal. Three significant characteristics of distributed systems are: concurrency of components, lack of a global clock, and independent failure ofcomponents.

Course Outcomes:

At the end of this course the students will be able to:

CO1	Demonstrate knowledge of the basic elements and concepts related to distributedsystem technologies.
CO2	Demonstrate knowledge of the core architectural aspects of distributed systems
CO3	Demonstrate knowledge of details the main underlying components of distributed systems (such as RPC, file systems);
CO4	Use and apply important methods in distributed systems to support scalability and fault tolerance;
CO5	Demonstrate experience in building large-scale distributed applications.

Detailed Syllabus:

MODULE-I.

Introduction to distributed computing system, evolution different models, gaining popularity, definition, issues in design, DCE, message passing –introduction, desirable features of a good message passing system, issues in IPC, synchronization, buffering, multigram messages, encoding and decoding of message data, process addressing, failure handling, group communication.

MODULE-II.

Introduction, model, transparency, implementation mechanism, stubgeneration, RPC messages, marshalling arguments and results, server management, parameter - passing semantics, call semantics, communication protocols for RPCs, client – server binding, exception handling, security, mini project using Java RMI.

MODULE-III.

General architecture of DSM systems, design and implementation issues of DSM systems, granularity, structure of shared memory space, consistency model, replacement strategy, thrashing, advantages of DSM, clock synchronization DFS and security- Desirable features of good DFS, file models, file accessing Models, file sharing semantics, file catching schemes, file replication, fault Tolerance, atomic transaction, potential attacks to computer system, cryptography, authentication, access control.Digital signatures, DCE securityservice.

MODULE-IV.

Operating Systems, Client-Server Model, Distributed Database Systems, Parallel Programming Languages and Algorithms. Distributed Network Architectures- Managing Distributed Systems. Design Considerations.

MODULE-V.

For development, implementation & evaluation of distributed information systems, workflow, software processes, transaction management, and data modeling, infrastructure e.g. middle-ware to glue heterogeneous, autonomous, and partly mobile/distributed data systems, such as e.g. client/server-, CORBA-, and Internet- technologies. Methods for building distributed applications.

Text / Reference

1. Pradeep K. Sinha, "Distributed Operating Systems: Concepts Design", 2007
2. Crichlow Joel M, "An Introduction to Distributed and Parallel Computing", PHI, 1997
3. Black Uyless, "Data Communications and Distributed Networks", PHI, 5thEdition,1997

Computer Science & Engineering					
Code:	**Software Engineering**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course objectives –

1. To develop basic Knowledge in Software Engineering and its applications.

2. To understand software Engineering layered architecture and the process frame work.

3. To analyze software process models such as the waterfall, spiral, evolutionary models and agile method for software development.

4. To design software requirements and specifications of documents.

5. To understand project planning, scheduling, cost estimation, risk management.

6. To describe data models, object models, context models and behavioral models.

7. To learn coding style and testing issues.

8. To know about the quality checking mechanism for software process and product.

Course outcomes –

CO.1 Identifythe principles of large scale software systems, and the processes that are used to build them.

CO.2 Ableto use tools and techniques for producing application software solutions from informal and semi-formal problem specifications.

CO.3 Develop an appreciation of the cost, quality, and management issues involved in software construction.

CO.4 Implement design and communicate ideas about software system solutions at different levels.

CO.5 Establish the relation with other people in a team, communicating computing ideas effectively in speech and in writing.

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO.1	2	2	-	3	-	-	-	-	-	-	-	1
CO.2	-	3	-	2	1	-	-	-	-	-	-	-
CO.3	-	3	3	-	-	-	-	-	-	-	-	-
CO.4	1	2	-	1	-	-	-	-	-	1	-	-
CO.5	-	-	-	-	-	1	-	1	1	1	2	3

MODULE-I:

SOFTWARE PROCESS AND AGILE DEVELOPMENT

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models –Introduction to Agility-Agile process-Extreme programming-XP Process.

MODULE-II:

REQUIREMENTS ANALYSIS AND SPECIFICATION

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management Classical analysis: Structured system Analysis, Petri Nets- Data Dictionary.

MODULE-III:

SOFTWARE DESIGN

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design - Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

MODULE-IV:

TESTING AND MAINTENANCE

Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging –Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering.

MODULE-V:

PROJECT MANAGEMENT

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan-CASE TOOLS

TEXT BOOKS:

1. Roger S. Pressman, ―Software Engineering – A Practitioner‟s Approach‖, Seventh Edition, McGraw-Hill International Edition, 2010.

2. Rajib Mall, ―Fundamentals of Software Engineering‖, Third Edition, PHI Learning PrivateLimited, 2009.

REFERENCE BOOKS:

1. Ian Sommerville, ―Software Engineering‖, 9th Edition, Pearson Education Asia, 2011.

2. PankajJalote, ―Software Engineering, A Precise Approach‖, Wiley India, 2010.

3. Kelkar S.A., ―Software Engineering‖, Prentice Hall of India Pvt Ltd, 2007.

4. Stephen R.Schach, ―Software Engineering‖, Tata McGraw-Hill Publishing Company Limited,2007.

Computer Science & Engineering						
Code:	**Distributed System**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course objective:

This course covers the basic understanding of distributed computing system. The course aims to provide an understanding of the principles on which the Internet and other distributed systems are based; their architecture, algorithms and how they meet the demands of contemporary distributed applications. The course covers the building blocks for a study of distributed systems, and addressing thecharacteristicsandthechallengesthatmustbeaddressedintheirdesign:scalability,heterogeneity, securityandfailurehandlingbeingthemostsignificant.Distributedcomputingisafieldofcomputerscience that studies distributed systems. A distributed system is a system whose components are located on different networked computers, which communicate and coordinate their actions bypassingmessagestooneanother.Thecomponentsinteractwithoneanotherinordertoachieve a common goal. Three significant characteristics of distributed systems are: concurrency of components, lack of a global clock, and independent failure ofcomponents.

Course Outcomes:

At the end of this course the students will be able to:

CO1	Demonstrate knowledge of the basic elements and concepts related to distributedsystem technologies.
CO2	Demonstrate knowledge of the core architectural aspects of distributed systems
CO3	Demonstrate knowledge of details the main underlying components of distributed systems (such as RPC, file systems);
CO4	Use and apply important methods in distributed systems to support scalability and fault tolerance;
CO5	Demonstrate experience in building large-scale distributed applications.

Detailed Syllabus:

MODULE-I:

Introduction to distributed computing system, evolution different models, gaining popularity, definition, issues in design, DCE, message passing –introduction, desirable features of a good message passing system, issues in IPC, synchronization, buffering, multigram messages, encoding and decoding of message data, process addressing, failure handling, group communication.

MODULE-II:

Introduction, model, transparency, implementation mechanism, stubgeneration, RPC messages, marshalling arguments and results, server management, parameter - passing semantics, call semantics, communication protocols for RPCs, client– server binding, exception handling, security, mini project using Java RMI.

MODULE-III:

General architecture of DSM systems, design and implementation issues of DSM systems, granularity, structure of shared memory space, consistency model, replacement strategy, thrashing, advantages of DSM, clock synchronization DFS and security- Desirable features of good DFS, file models, file accessing Models, file sharing semantics, file catching schemes, file replication, fault Tolerance, atomic transaction, potential attacks to computer system, cryptography, authentication, access control.Digital signatures, DCE securityservice.

MODULE-IV:

Operating Systems, Client-Server Model, Distributed Database Systems, Parallel Programming Languages and Algorithms. Distributed Network Architectures- Managing Distributed Systems. Design Considerations.

MODULE-V:

For development, implementation & evaluation of distributed information systems, workflow, software processes, transaction management, and data modeling, infrastructure e.g. middle-ware to glue heterogeneous, autonomous, and partly mobile/distributed data systems, such as e.g. client/server-, CORBA-, and Internet- technologies. Methods for building distributed applications.

Text / Reference

1. Pradeep K. Sinha, "Distributed Operating Systems: Concepts Design", 2007 2.Crichlow Joel M,

"An Introduction to Distributed and Parallel Computing", PHI, 1997

3. Black Uyless, "Data Communications and Distributed Networks", PHI, 5thEdition,1997

Computer Science & Engineering					
Code:	**Artificial Intelligence & Machine Learning**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course objectives -

The aim of Artificial Intelligence & Machine Learning course is to prepare students for career in computer science & engineering where knowledge of AI & ML techniques leading to the advancement of research and technology. Artificial Intelligence and Machine Learning are the terms of computer science. Machine Learning is the learning in which machine can learn by its ownwithoutbeingexplicitlyprogrammed.ItisanapplicationofAIthatprovidesystemtheability to automatically learn and improve fromexperience.

Course Outcomes: After completing this course the student will be able to:

CO1	Demonstrate fundamental understanding of artificial intelligence (AI) and expert systems.
CO2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
CO3	Demonstrate proficiency in applying scientific method to models of machine learning.
CO4	Discuss the basics of ANN and different optimizations techniques.

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	2	2	-	-	-	-	-	-	-
CO2	2	-	3	2	-	-	-	-	-	-	-	-
CO3	3	2	-	3	-	-	-	-	-	-	-	-
CO4	2	-	1	-	3	-	2	-	-	-	-	-

Course Detail -

MODULE-I:

Overview and Search Techniques: Introduction to AI, Problem Solving, Statespacesearch,Blindsearch:Depthfirstsearch, Breadthfirstsearch,Informedsearch: Heuristic function, Hill climbing search, Best first search, A* & AO* Search, Constraint satisfaction problem; Game tree, Evaluation function, Mini-Max search, Alpha-beta pruning, Games of chance.

MODULE-II:

Knowledge Representation (KR): Introduction to KR, Knowledge agent, Predicate logic, Inference rule & theorem proving forward chaining, backward chaining, resolution;Propositionalknowledge,Booleancircuitagents;RuleBasedSystems,Forward reasoning: Conflict resolution, backward reasoning: Structured KR: Semantic Net - slots, inheritance, ConceptualDependency.

MODULE-III:

Handling uncertainty and Learning: Source of uncertainty, Probabilistic inference, Bayes' theorem, Limitation of naïve Bayesian system, Bayesian Belief Network (BBN); Machine learning, Basic principal, Utility of ML Well defined learning system, Challenges in ML, Application of ML.

MODULE-IV:

Learning and Classifier: Linear Regression (with one variable and multiple variables), Decision Trees and issue in decision tree, Clustering (K-means, Hierarchical, etc), Dimensionality reduction, Principal Component Analysis, Anomaly detection, Feasibility of learning, Reinforcement learning.

MODULE-V:

Artificial Neural Networks: Introduction, Artificial Perceptron's, Gradient Descent and The Delta Rule, Adaline, Multilayer Networks, Back-propagation Rule back-propagation Algorithm- Convergence; Evolutionary algorithm, Genetic Algorithms – An Illustrative Example, Hypothesis Space Search, Swarm intelligence algorithm.

Text Book:

1. Artificial Intelligence by Elaine Rich and Kevin Knight, Tata MeGrawHill
2. Understanding Machine Learning. ShaiShalev-Shwartz and Shai Ben-David. Cambridge University Press.
3. Artificial Neural Network, B. Yegnanarayana, PHI,2005

Reference Book:

1. Christopher M. Bishop. Pattern Recognition and Machine Learning(Springer)
2. IntroductiontoArtificialIntelligenceandExpertSystemsbyDanW.Patterson,Prentice Hall ofIndia

Computer Science & Engineering					
Code :	**Internetworking**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Outcomes:

CO 1: Students will be able to classify the routing protocols and analyse how to assign the IP addresses for the given network.
CO 2: Students will be able to understand the architecture of different internet servers.
CO 3: Students will be able to configure the firewall in the network.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO 1	2	2	2	2	-	2	-	-	1	-	3	1
CO 2	2	-	3	-	-	-	-	-	2	-	1	2
CO 3	1	2	3	2	2	-	-	-	3	-	1	2

**3: high, 2: moderate, 1: low*

MODULE-I:

AN OVERVIEW ON INTERNET

The need for an Internet, The TCP/IP Internet, Internet services, Internet protocols and standardization, Review of Networktechnologies.

INTERNETWORKING CONCEPTS

Architectural model introduction, Application level interconnection, Network level interconnection, Properties of the Internet, Internet Architecture, Interconnection through IP Gateways or routers, Internet andIntranet.

MODULE-II:

INTERNET ADDRESS

Introduction, Universal identifiers, Three primary classes of IP addresses, Classless IP address, Network and Broadcast addresses, Mapping internet addresses to physical addresses (ARP), ARP protocol format, Transport Gateways and subnet addressing, Multicastaddressing.

MODULE-III:

INTERNET PROTOCOL

Internet Architecture and Philosophy, The concept of unreliable delivery, Connectionless delivery system, The Internet Datagram, Routing direct and indirect delivery, Table driven IP routing, Protocol layering, Reliable stream transport, TCP performance, Bootstrap protocol(BOOTP).

MODULE-IV:

ROUTING

The origin of Gateway routing tables, Original Internet Architecture and Cores, Core Gateways, Automatic route propagation, Vector distance (Bellman-Ford), routing, Gateway to Gateway Protocol (GGP), Autonomous system concept, Exterior Gateway Protocol (EGP), Interior Gateway Protocol (RIP, OSPF, HELLO), Routing Information Protocol (RIP), Combining RIP, HELLO, and EGP, Routing with partial information.

MODULE-V:

ENTERPRISE NETWORKING AND INTERNET SERVERS

Corporate networking, Broadband at the Metropolitan area level, High speed dedicated WAN services and switched WAN services, ISDN, BISDN and ATM services, Frame relay technology and services, Virtual private network concepts PPTP protocol. DNS, DHCP Servers, FTP, TELNET, E-Mail.

MODULE-VI:

FIREWALL & NETWORKING

Introduction, Implementation of Firewall, Activities of Firewall, Configuration of firewall, Firewalls & SSL, SSL implementation, Bit implementation of SSL, Use ofSSL.

REFERENCE BOOKS

1. Computer Networks and Internets - Douglas E. Comer;PE.
2. Communication Networks - Leon-Garcia-Widjaja;TMH.
3. Internet working withTCP/IP -Douglas E.Comer;PE.
4. TCP/IP protocol suite- ForouzanBehrouz A;TMH.
5. Computer Networks – Andrew S. Tanenbaum;PHI.
6. Data and Computer Communication - William Stallings; PHI.
7. The Complete reference of Networking -CraigZacker;TMH.
8.

Computer Science & Engineering					
Code:	**Soft Computing**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course objective:

This course will cover fundamental concepts used in Soft computing. Soft Computing refers to a partnership of computational techniques in computer science, artificial intelligence, machine learning and some engineering disciplines, which attempt to study, model, and analyze complex phenomena. The concepts of Artificial Neural Networks (ANNs) will be covered first, followed by Fuzzy logic (FL) and optimization techniques using Genetic Algorithm (GA). Applications of Soft Computing techniques to solve a number of real-life problems will be covered to have hands on practices. In summary, this course will provide exposure to theory as well as practical systems and software used in soft computing.

Course outcomes:

At the end of the course students will be able to:

CO1	**Present** the feasibility of applying a soft computing methodology for specific problem.
CO2	**Identify** and describe soft computing techniques and their roles in building intelligent machines.
CO3	**Apply** neural networks to pattern classification and regression problems.
CO4	**Apply** fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
CO5	**Apply** genetic algorithms to combinatorial optimization problems.

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO 1	3	3	3	2	3	-	-	-	-	1	-	2
CO 2	3	3	2	2	-	-	-	-	2	-	-	-

CO 3	3	2	2	2	2	-	-	-	-	-	-	2
CO 4	3	3	2	2	2	-	-	-	-	-	-	-
CO 5	3	2	2	2	2	-	-	-	-	-	-	2
Avg	3	2.6	2.2	2	2.25				2	1		2

Detailed Syllabus

MODULE-I:

INTRODUCTION TO SOFT COMPUTING: Soft computing: Soft computing concepts, soft computing versus hard computing, various types of soft computing techniques, applications of soft computing.

MODULE-II:

ARTIFICIAL NEURAL NETWORKS: Neural Networks: History, overview of biological Neuro-system, Mathematical Models of Neurons, ANN architecture, learning rules, Learning Paradigms- Supervised, Unsupervised and reinforcement Learning, ANN training, Algorithms-perceptions; Training rules, Delta, Back Propagation Algorithm, Multilayer PerceptronModel.

MODULE-III:

SPECIAL LEARNING NETWORK: Competitive learning networks, Kohonen Self-organizing networks, Hebbian learning, Hopfield Networks, Associative memories, The Boltzman machine**,** Applications of Artificial Neural Networks.

MODULE-IV:

FUZZY LOGIC: Fuzzy Logic: Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function, Fuzzy rule generation. Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations. Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations. Fuzzy Logic: Classical Logic, Multivalued Logics, Fuzzy Qualifiers, Linguistic Hedges, Introduction & features of membership functions.

MODULE-V:

FUZZY RULE BASED SYSTEM: Fuzzy rule base system: Fuzzy Propositions, implications and inferences, Fuzzy reasoning, Defuzzification techniques, Fuzzy logic controller design, Fuzzy decision making & Applications of fuzzy logic.

MODULE-VI:

GENETIC ALGORITHMS: Genetic Algorithms: An Overview of Genetic algorithm (GA), Evolution strategies (ES), Evolutionary programming (EP), Genetic programming (GP); GA operators: Encoding, Selection, Crossover, Mutation, schema analysis, analysis of selection algorithms; convergence; optimization, of travelling salesman problem using genetic algorithm approach; Markov & other stochastic models. Other Soft Computing Techniques: Simulated annealing, Tabu search, Ant colony-based optimization (ACO),etc.

Text Book:

1. P. R. Beeley, Foundry Technology, Newnes- Buttterworths, 2001.
2. P. D. Webster, Fundamentals of Foundry Technology, Portwillis press, Red hill, 1980.

SupplementaryReading:

1. P. C. Mukherjee, Fundamentals of Metal casting Technology, Oxford IBH,1980.
2. R. W. Hein, C. R. Loper and P. C. Rosenthal, Principles of Metal casting, McGraw Hill, 1976.

Computer Science & Engineering					
Code:	**Information Retrieval**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES: To provide an overview of Information Retrieval systems. Expose them to various retrieval models with emphasis on pros and cons of these models. Discuss mechanisms of web search along with the details of ranking algorithms. Introduce basic concepts of text categorization and recommender systems.

MODULE-I

Introduction to Information Retrieval: The nature of unstructured and semi-structured text. Inverted index and Boolean queries. Text Indexing, Storage and Compression Text encoding: tokenization; stemming; stop words; phrases; index optimization. Index compression: lexicon compression and postings lists compression. Gap encoding, gamma codes, Zipf's Law. Index construction. Postings size estimation, dynamic indexing, positional indexes, n-gram indexes, real-world issues.

MODULE -II

Information Retrieval Models: Boolean; vector space; TFIDF; Okapi; probabilistic; language modeling; latent semantic indexing. Vector space scoring. The cosine measure. Efficiency considerations. Document length normalization. Relevance feedback and query expansion. Rocchio algorithm.

MODULE -III

Web Information Retrieval: Hypertext, web crawling, search engines, ranking, link analysis, PageRank, HITS. Retrieving Structured Documents: XML retrieval, semantic web.

Performance Evaluation of IR systems: Evaluating search engines. User happiness, precision, recall, F-measure. Creating test collections: kappa measure, interjudge agreement.

MODULE -IV

Text Categorization and Filtering: Introduction to text classification. Naive Bayes models. Spam filtering. Vector space classification using hyperplanes; centroids; k Nearest Neighbors. Support vector machine classifiers. Kernel functions. Boosting.

MODULE -V

Advanced Topics: Summarization, Topic detection and tracking, Personalization, Question answering, Cross language information retrieval (CLIR). Recommender System.

COURSE OUTCOMES:

Students will get:

CO1: The understanding of different Information retrieval models

CO2: To know about evaluation methods of the information retrieval model

CO3: Exposures of implementing retrieval models on text data

CO4: To know about text categorization and its implementation

CO5: To know the challenges associated with each topics on new domain of retrieval and classification

CO-PO mapping table

	PO1	PO2	PO3	PO4	PO5
CO1	3	2			
CO2		1	2	3	
CO3			3	2	2
CO4	3	2	3		
CO5			2	3	

TEXT BOOKS:

1. Manning, Raghavan and Schutze, “Introduction to Information Retrieval”, Cambridge University Press, 2009.
2. Baeza-Yates and Ribeiro-Neto, “Modern Information Retrieval”, Addison Wesley.

REFERENCES:

1. Charles L. A. Clarke, Gordon Cormack, and Stefan Büttcher, “Information Retrieval: Implementing and Evaluating Search Engines”, MIT Press Cambridge, 2010.
2. Baeza-Yates / Ribeiro-Neto, “Modern Information Retrieval: The Concepts and Technology behind Search”, Pearson Education India, 2010.

Computer Science & Engineering					
Code:	**Cloud Computing**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Objectives of the course:

The aim this course to understand the basics and importance of cloud computing. Cloud computing is a general term for anything that involves delivering hosted services over the Internet. These services are broadly divided into different categories: Infrastructure-as-a-Service (IaaS), Platform- as-a-Service (PaaS) and Software-as-a-Service (SaaS). The name cloud computing was inspired by the cloud symbol that's often used to represent the Internet in flowcharts and diagrams. Cloud computing is the on-demand availability of computer system resources, especially datastorageandcomputingpower,withoutdirectactivemanagementbytheuser.Thetermisgenerally used to describe data centers available to many users over the Internet. Large clouds, predominant today, often have functions distributed over multiple locations from central servers.

Course Outcomes:

At the end of the course, the student should be able to:

CO1	To identify the appropriate cloud services for a given application and perform cloud- oriented analysis.
CO2	To design the composition of a cloud services.
CO3	To analyze authentication, confidentiality and privacy issues in Cloud computing environment.
CO4	To Determine financial and technological implications for selecting cloud computing platforms.

Mapping of course outcomes with program outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	-	3	2	-	-	-	-	-	-	-
CO2	2	-	3	2	-	-	-	-	-	-	-	-
CO3	3	1	-	2	-	-	-	-	-	-	-	-
CO4	2	-	2	-	3	-	2	-	-	-		-

Detailed syllabus:

MODULE – I:

Introduction to cloud computing: Emergence of cloud computing in distributed computing; Cloud computing Definition, Architecture, Cloud-Based Services, Benefits of using a Cloud Model, Key Characteristics of Cloud Computing, Understanding- Public & Private cloud environments, The Evolution of CloudComputing – Hardware & Internet Software Evolution, SPI framework.

MODULE – II:

Cloud services: Communication-as-a-Service (CAAS), Infrastructure-as- a-Service (IAAS), Monitoring-as-a Service (MAAS), Platform-as-a-Service (PAAS), Software-as-a-Service (SAAS).

MODULE – III:

Cloud security challenges: Security Management People, Security Governance, Security Portfolio Management, Security Architecture Design, Identity Access Management (IAM), Data Security. Cloud computing threats, Case studies- Amazon EC2, Google App engine, IBM clouds.

MODULE – IV:

The MSP Model: Evolution from the MSP Model to Cloud Computing and Software-as-a-Service, The Cloud Data Center, Basic Approach to a Data Center-Based SOA, Open Source Software, Service- Oriented Architectures as a Step Toward Cloud Computing.

MODULE – I:

Virtualization concepts & Smartphone: virtualization benefits,Hardware & Software Virtualization, Memory Virtualization, Storage Virtualization, Data Virtualization, Network Virtualization, Virtualization Security Recommendations, Introduction to Various Virtualization OS VMware, KVM, Virtual Machine Security, Smartphone, Mobile Operating Systems for Smartphone’s (iPhone, Windows Mobile), Google(Android).

Course outcomes:

At the end of this course

1. Student will be able to identify the appropriate cloud services for a given application and perform cloud-oriented analysis.
2. Students will be able to design the composition of a cloud services.
3. Student will be able to analyze authentication, confidentiality and privacy issues in Cloud computing environment.
4. Determine financial and technological implications for selecting cloud computing platforms.

Text Book:

1. Toby Velte, Anthony Vote and Robert Elsenpeter, "Cloud Computing: A Practical Approach", McGraw Hill, 2002
2. Gautam Shroff, Enterprise Cloud Computing, Cambridge,2010.

Reference Book:

1. Tim Matherm, Subra Kumara swamy and ShahedLatif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", O'Reilly Media, 2005.
2. Ronald Krutz and Russell Dean Vines, Cloud Security, 1st Edition, Wiley