

SEMESTER-IV  
**MECHANICAL ENGINEERING**

**MATHEMATICS – IV (MA4105)**

**SPECIAL FUNCTIONS** :- Series solution of ordinary differential equations, Bessel and Legendre's equations and their series solution, Elementary properties of Bessel's function and Legendre's polynomial. **12 L**

**COMPLEX VARIABLE** : - Analytic function, Cauchy – Riemann equation. Complex integration, Cauchy's theorem and Cauchy Integral formula. Taylor and Laurent's expansion, Poles and residue, Residue theorem. Conformal transformation, Bilinear and Schwartz's transformations. **15L**

**PARTIAL DIFFERENTIAL EQUATION** : - Formulation of partial differential equation, Linear and non – linear partial differential equations of the first order, Lagrange's method and Charpit's method. Higher order Partial Linear differential equations with constant coefficients. Method of separation of variables. Equation of vibrating strings, heat flow, Laplace's two dimensional equation and simple problems. **15L**

**PROBABILITY AND STATISTICS (MA 4106)**

Probability: Classical and axiomatic definition, Addition law, Conditional probability, Multiplication law, Total probability, Baye's theorem and independence of events. Random variables: Discrete and continuous random variables, Probability mass, Probability density and commutative distribution functions. Mathematical expectation, Variance, Moment and moment generating function, Chebyshev's inequality. **10 L**

Regression Analysis: Linear and non-linear regression, Principle of least square, Correlation and coefficient of correlation and Rank correlation. **05L**

Distributions: Binomial, Hyper-geometric, Poisson and Normal distributions. **07L**

Sampling Distribution: Population, samples, sampling distribution, estimate for population mean and variance, point of estimation, confidence interval for mean and variance of normal population, testing of hypothesis, the critical and acceptance region, Chi-square, t-student, and F-distributions. **12 L**

Analysis of Variance: Completely randomized design and randomized block design, Quality control, control charts(X-chart, R-chart, P-chart and C-chart). **08 L**

**MANUFACTURING TECHNOLOGY – I(ME4109)**

**FOUNDRY PROCESSES & CASTING:** Types of patterns, pattern allowances, types of moulds, sand preparation and sand test, preparation of moulds. Furnaces – cupola.

Cores – uses of cores, chills, chaplets

Gating design – aspiration effect. Design of risers and gates. Shell mould casting, investment casting, gravity die casting, metal mould casting, die casting, centrifugal casting, CO<sub>2</sub> casting Casting defects, causes and remedies Finishing of casting and inspection.

**MECHANICAL WORKING OF METALS:** Hot working and cold working, its advantage, disadvantages and applications, rolling, forging, Wire drawing, extrusion, punching and blanking, piercing, spinning, coining, embossing.

**WELDING, BRAZING AND SOLDERING:** Principles, process, parameters and application of gas welding, arc welding, TIG, MIG welding, Thermit welding, Electron beam welding, Laser beam welding, Submerged arc welding. Fluxes for gas welding and for arc welding. Electrode classification and selection, atomic hydrogen welding, selection of welding technique, filler metal, welding for the following metals – cast iron, aluminum, and copper, resistance welding, defect in welding, inspection – destructive and non-destructive test, equipment, application of soldering and brazing.

**HEAT TREATMENT OF METALS:** Introduction of heat treatment, Heat treatment processes, heat treatment of carbon steel with reference to iron-carbon diagram and TTT (Time Transformation and Temperature) curve. Defect in heat treatment and their remedies. Austempering and Martempering. Surface hardening of steel.

**POWDER METALLURGY:** Principles, method of producing powder, pressing, sintering and finishing operations, applications.

## **FLUID MACHINES**

INTRODUCTION: application of the moment and moment of momentum equations to flow through hydraulic machinery. Euler's fundamental equation. Classification of machine.

WATER TURBINES: classification of turbines, impulse turbine. Constructional details. Velocity triangles. Power and efficiency calculations. Governing of pelton wheels. Reaction turbines: Francis and Kaplan turbines, constructional details, velocity triangles, power and efficiency calculations, degree of reaction, draft tube. Cavitation. Thoma's cavitation factor.

PRINCIPLE OF SIMILARITY: unit and specific quantities, performance characteristics. Testing of models and selection of water turbines.

RECIPROCATING AIR COMPRESSORS: P-V diagram. Calculation of isothermal and adiabatic work. Free air delivery. Slippage. Volumetric efficiency. Effect of clearance. Multi-stage compression, inter-cooling.

ROTARY COMPRESSORS: Introduction, rotary positive displacement compressors, static and total head values. Centrifugal compressors and their performance.

ROTODYNAMIC PUMPS: Classification, centrifugal pump. Vector diagram, specific speed. Head, power and efficiency calculation. Performance characteristics.

POSITIVE DISPLACEMENT PUMPS: Reciprocating pump, theory, indicator diagram, slip. Effect of friction and acceleration. Theory of air vessels.

OTHER MACHINES: Hydraulic accumulator, intensifier, Ram and press.

## **CAD G (COMPUTER AIDED DESIGN)**

### INTRODUCTION

CAD/CAM, Product cycle and CAD/CAM, Automation & CAD/CAM. Fundamental of CAD: The design process, Application of computers for design, creating a manufacturing data base, benefits of Computer Aided Design.

### HARDWARE IN COMPUTER AIDED DESIGN:

Introduction, The Design work station, the graphics terminal, Operator Input Devices, Plotters and other output Devices. The central processing unit, secondary storage.

### COMPUTER GRAPHICS SOFTWARE AND DATA BASE:

Software configuration of graphic system, Functions of a graphic package, Construction the geometry, Transformations, Data Base structure and content, wire-frame and solid modeling.

## **FLUID MECHANICS(ME 4107)**

### INTRODUCTION:

Concept of continuum, difference between fluid mechanics and solid mechanics, brief history of classical hydraulics, hydrodynamics and fluid mechanics.

Characteristic properties of fluids, ideal and real fluids, Newtonian and non-Newtonian fluids viscosity, surface tension, capillarity, compressibility, fluid statics and buoyancy.

### FLUID KINEMATICS:

Streamlines, path lines, streak lines, velocity potential functions and stream functions, laminar and turbulent flows, steady and unsteady flow, rotational and irrotational motion, circulation, vorticity, velocity and acceleration.

#### FLUID DYNAMICS:

Conservation of mass, principle of momentum and energy, moment of momentum, equation of motion, Euler's equation, and introduction to Navier-Stokes equation, energy equation, hydraulic and energy gradients.

#### LAMINAR FLOW:

Flow through pipes, frictional and other losses.

#### TURBULENT FLOW:

Fully developed flows, boundary layer theory, rough and smooth pipe flows.

#### DIMENSIONAL ANALYSIS:

Similitude of fluid flows, hydraulic modeling, non-dimensional parameters (Reynolds's, Froude's, Euler, Weber and Mach numbers)

#### FLOW MEASUREMENTS:

Piezometer, manometers, pressure gauges, pitot tube, orifices, notches and weirs, orifice meter, venturimeter.

#### FORCES ON IMMERSED BODIES:

Drag and lift aerofoil section.

## SEMESTER-IV

### ELECTRICAL ENGINEERING

#### MATHEMATICS – IV (MA4105)

**SPECIAL FUNCTIONS** :- Series solution of ordinary differential equations, Bessel and Legendre's equations and their series solution, Elementary properties of Bessel's function and Legendre's polynomial. **12 L**

**COMPLEX VARIABLE** : - Analytic function, Cauchy – Riemann equation. Complex integration, Cauchy's theorem and Cauchy Integral formula. Taylor and Laurent's expansion, Poles and residue, Residue theorem. Conformal transformation, Bilinear and Schwartz's transformations. **15L**

**PARTIAL DIFFERENTIAL EQUATION** :- Formulation of partial differential equation, Linear and non – linear partial differential equations of the first order, Lagrange's method and Charpit's method. Higher order Partial Linear differential equations with constant coefficients. Method of separation of variables. Equation of vibrating strings, heat flow, Laplace's two dimensional equation and simple problems. **15L**

#### PROBABILITY AND STATISTICS ( MA 4106)

Probability: Classical and axiomatic definition, Addition law, Conditional probability, Multiplication law, Total probability, Baye's theorem and independence of events. Random variables: Discrete and continuous random variables, Probability mass, Probability density and commutative distribution functions. Mathematical expectation, Variance, Moment and moment generating function, Chebyshev's inequality. **10 L**

Regression Analysis: Linear and non-linear regression, Principle of least square, Correlation and coefficient of correlation and Rank correlation. **05L**

Distributions: Binomial, Hyper-geometric, Poisson and Normal distributions. **07L**

Sampling Distribution: Population, samples, sampling distribution, estimate for population mean and variance, point of estimation, confidence interval for mean and variance of normal population, testing of hypothesis, the critical and acceptance region, Chi-square, t-student, and F-distributions. **12 L**

Analysis of Variance: Completely randomized design and randomized block design, Quality control, control charts(X-chart, R-chart, P-chart and C-chart). **08 L**

#### **POWER SYSTEM-I (EE 4104)**

Generation of Electric power: Introduction to thermal, hydro, nuclear, gas power plant and non conventional power plants

Transmission and distribution systems:-

DC 2 wire and 3 wire systems, AC single Phase, three phase and 4 wire systems, Comparison of copper efficiency.

Economics of Power System:

Overhead Transmission lines:-

Types of conductors, Line parameters, Calculation of Inductance and capacitance of single and double ckt transmission lines, three phase lines with stranded and bundle conductors, Generalized ABCD constants and equivalent ckts of short, medium and long lines, line performance- regulation and efficiency of short, medium and long lines, series & shunt compensation, Introduction to FACTS.

Overhead Line Insulators: - Type, String efficiency, Voltage distribution in string of suspended insulators, grading ring.

Mechanical design of Transmission Line: - Different types of tower sag. Tension calculation, string charts, corona losses.

Cables:- Types, Calculation of capacity of cables, charging current, stress, grading,

Problems of Long AC lines: - Ferranti effect, charging current,

Power Factor Improvement:-

Disadvantages of low pf, pf correction at power Stations, cost analysis of pf improving plants.

## INSTRUMENTATION-I (EE 4105)

Electrical measurements:-

Errors in measurement, Classification of errors, statistical analysis of errors, Probable error and limit errors, Calculation of limiting errors.

Potentiometer: DC and AC: Construction and Principle of operation.

Measuring Instruments:-

Fundamentals ,operation and construction of galvanometer(DC & AC), ammeter and voltmeters, wattmeters, extension of range of instruments, energy-meter, frequency meter and single phase reactive power measurements, single phase power factor meter, megger , multimeter , trivectormeter.

Instrument Transformer:-

CT & PT, ratio& phase angle errors.

Measurement of resistance, inductance and capacitance

High voltage measurement:-

Surge and impulse test and oil testing set

Magnetic measurement: ballistic galvanometer and flux-meters: Construction, principle of operation and their uses, separation of hysteresis and eddy current losses by using loyd, Fisher square.

Electronic Instruments:-

CRO and its uses, Special purpose CRO, VTVM,

## SIGNALS AND SYSTEMS (EE 4106)

Classification of Signals and Systems, Various System Representation Techniques-differential, difference and state space representation

Fourier transforms and series application to analysis of system

Laplace Transform-its Property and application to System analysis, Impulse response, step response and convolution Integral.

Z Transforms- its Property and application, difference equation.

Introduction to Random Variables and random Process,

## ANLOG ELECTRONICS (EC4103)

**Transistor Biasing and Thermal Stability:** The operating point of a BJT, fixed biasing, potential divider biasing, self biasing, stabilization against variation in  $I_{CO}$ ,  $V_{BE}$  and  $\beta$ , compensation technique, biasing technique for IC circuits, Thermal run away and thermal stability

**The transistor at low frequency:** Transistor hybrid model, analysis of transistor amplifier circuit using h-parameter, comparison of amplifier configuration on the basis of  $A_i$ ,  $A_v$ ,  $R_i$  and  $R_o$ , Miller's Theorem and its dual, cascading transistor amplifiers, simplified Common –Emitter hybrid model, simplified calculation for CE, CC and CB configuration, CE amplifier with emitter resistance, high input resistance transistor circuit .

Multi Stage Amplifiers: Frequency Response of an amplifier, step response of amplifier, band pass of cascade stages, low frequency response of RC coupled amplifier, effect of an emitter bypass capacitor on low frequency response. Current mirror, current repeaters etc.

**BJT at high frequency:** The hybrid pi ( $\pi$ ) CE transistor model, hybrid ( $\pi$ ) conductance, the CE short circuit current gain, current gain with resistive load, single stage CE amplifier response, the gain bandwidth product.

**Tuned Amplifier:** Introduction, Q-Factor, Single tuned amplifier, double tuned amplifier, Stagger tuned amplifier and class-C tuned amplifier

**Power Amplifiers:** Large signal amplifiers, harmonic distortion, the transformer coupled audio power amplifier, push pull amplifier, class B and class AB amplifier.

**Operational Amplifier:** The basic operational amplifier, the differential amplifier, the emitter-coupled differential amplifier, differential amplifier supplied with constant current, offset error voltages and currents. Applications of operational amplifier: Adder, difference circuit, level shifter, voltage to current converter, comparator, Schmitt trigger, Instrumentation amplifier, log and anti-log amplifier, sample and hold circuit, precision diode and rectifier, active peak detector.

6L **Multivibrator:** Monostable and astable operation using 555 timers.

**Oscillators:** Sinusoidal Oscillator, General Form of resonant circuit oscillators, Phase shift Oscillator, Wein Bridge Oscillator, VCO and Phase Locked Loop.

## SEMESTER-IV

### PRODUCTION ENGINEERING

#### MATHEMATICS – IV (MA4105)

**SPECIAL FUNCTIONS** :- Series solution of ordinary differential equations, Bessel and Legendre's equations and their series solution, Elementary properties of Bessel's function and Legendre's polynomial. **12 L**

**COMPLEX VARIABLE** :- Analytic function, Cauchy – Riemann equation. Complex integration, Cauchy's theorem and Cauchy Integral formula. Taylor and Laurent's expansion, Poles and residue, Residue theorem. Conformal transformation, Bilinear and Schwartz's transformations. **15L**

**PARTIAL DIFFERENTIAL EQUATION** :- Formulation of partial differential equation, Linear and non – linear partial differential equations of the first order, Lagrange's method and Charpit's method. Higher order Partial Linear differential equations with constant coefficients. Method of separation of variables. Equation of vibrating strings, heat flow, Laplace's two dimensional equation and simple problems. **15L**

#### PROBABILITY AND STATISTICS ( MA 4106)

Probability: Classical and axiomatic definition, Addition law, Conditional probability, Multiplication law, Total probability, Baye's theorem and independence of events. Random variables: Discrete and continuous random variables, Probability mass, Probability density and commutative distribution functions. Mathematical expectation, Variance, Moment and moment generating function, Chebyshev's inequality. **10 L**

Regression Analysis: Linear and non-linear regression, Principle of least square, Correlation and coefficient of correlation and Rank correlation. **05L**

Distributions: Binomial, Hyper-geometric, Poisson and Normal distributions. **07L**

Sampling Distribution: Population, samples, sampling distribution, estimate for population mean and variance, point of estimation, confidence interval for mean and variance of normal population, testing of hypothesis, the critical and acceptance region, Chi-square, t-student, and F-distributions. **12 L**

Analysis of Variance: Completely randomized design and randomized block design, Quality control, control charts(X-chart, R-chart, P-chart and C-chart). **08 L**

#### FLUID MACHINES

INTRODUCTION: application of the moment and moment of momentum equations to flow through hydraulic machinery. Euler's fundamental equation. Classification of machine.

WATER TURBINES: classification of turbines, impulse turbine. Constructional details. Velocity triangles. Power and efficiency calculations. Governing of pelton wheels. Reaction turbines: Francis and Kaplan turbines, constructional details, velocity triangles, power and efficiency calculations, degree of reaction, draft tube. Cavitation. Thoma's cavitation factor.

PRINCIPLE OF SIMILARITY: unit and specific quantities, performance characteristics. Testing of models and selection of water turbines.

RECIPROCATING AIR COMPRESSORS: P-V diagram. Calculation of isothermal and adiabatic work. Free air delivery. Slippage. Volumetric efficiency. Effect of clearance. Multi-stage compression, inter-cooling.

ROTARY COMPRESSORS: Introduction, rotary positive displacement compressors, static and total head values. Centrifugal compressors and their performance.

ROTODYNAMIC PUMPS: Classification, centrifugal pump. Vector diagram, specific speed. Head, power and efficiency calculation. Performance characteristics.

POSITIVE DISPLACEMENT PUMPS: Reciprocating pump, theory, indicator diagram, slip. Effect of friction and acceleration. Theory of air vessels.

OTHER MACHINES: Hydraulic accumulator, intensifier, Ram and press.

## FLUID MECHANICS (ME 4107)

### INTRODUCTION:

Concept of continuum, difference between fluid mechanics and solid mechanics, brief history of classical hydraulics, hydrodynamics and fluid mechanics.

Characteristic properties of fluids, ideal and real fluids, Newtonian and non-Newtonian fluids viscosity, surface tension, capillarity, compressibility, fluid statics and buoyancy.

### FLUID KINEMATICS:

Streamlines, path lines, streak lines, velocity potential functions and stream functions, laminar and turbulent flows, steady and unsteady flow, rotational and irrotational motion, circulation, vorticity, velocity and acceleration.

### FLUID DYNAMICS:

Conservation of mass, principle of momentum and energy, moment of momentum, equation of motion, Euler's equation, and introduction to Navier-Stokes equation, energy equation, hydraulic and energy gradients.

### LAMINAR FLOW:

Flow through pipes, frictional and other losses.

### TURBULENT FLOW:

Fully developed flows, boundary layer theory, rough and smooth pipe flows.

### DIMENSIONAL ANALYSIS:

Similitude of fluid flows, hydraulic modeling, non-dimensional parameters(Reynolds's, Froude's, Euler, Weber and Mach numbers)

### FLOW MEASUREMENTS:

Piezometer, manometers, pressure gauges, pitot tube, orifices, notches and weirs, orifice meter, venturimeter.

### FORCES ON IMMERSED BODIES:

Drag and lift, aerofoil section.

## **COMPUTER AIDED DESIGN (PE 4101)**

Basic concepts : Introduction, Integrated CAD/CAM, Designer Vs computer as a Design medium, system software's comparison of languages. Benefits and applications of CAD. Computer Graphics and Geometric Modeling : Introduction, point plotting techniques, line drawing displays, two and three dimensional transformations, Clipping And windowing, Segmentations. Wire frame modeling, surface modeling, Solid modeling and their applications. Three dimensional graphics, Curves and surfaces, hidden surface elimination, shading. Graphic input devices, Graphic input techniques, Input functions, Raster graphics fundamentals, Interactive raster graphics, Raster graphic Systems.

Computer Aided Drafting : Introduction, Drafting packages. Arrows and pointers, dimensioning, Text, Cross hatching, Drafting examples.

Introduction to CAD Packages

## **MANUFACTURING PROCESS-I (PE 4102)**

Machine tool classification, spectrum of machining operation performed on machine tools, Types of cutting tools, tool signature, cutting speed, feed, depth of cut. Cutting tool material. Use of coolants. Constructional features, specification, operations and drives of basic machine tools such as lathe, shaper, planer, slotter, drilling machine, boring and milling machine. Indexing in milling operations. Working principles of Capstan and turret lathes. Tool layout and operation of Capstan and turret lathes. Grinding and finishing operations : Cylindrical, surface and centerless grinding. Broaching, lapping, honing and buffing. Gear cutting by forming and generating methods.

## SEMESTER-IV

### METALLURGICAL ENGINEERING

#### MATHEMATICS – IV (MA4105)

**SPECIAL FUNCTIONS** :- Series solution of ordinary differential equations, Bessel and Legendre's equations and their series solution, Elementary properties of Bessel's function and Legendre's polynomial. **12 L**

**COMPLEX VARIABLE** :- Analytic function, Cauchy – Riemann equation. Complex integration, Cauchy's theorem and Cauchy Integral formula. Taylor and Laurent's expansion, Poles and residue, Residue theorem. Conformal transformation, Bilinear and Schwartz's transformations. **15L**

**PARTIAL DIFFERENTIAL EQUATION** :- Formulation of partial differential equation, Linear and non – linear partial differential equations of the first order, Lagrange's method and Charpit's method. Higher order Partial Linear differential equations with constant coefficients. Method of separation of variables. Equation of vibrating strings, heat flow, Laplace's two dimensional equation and simple problems. **15L**

#### PROBABILITY AND STATISTICS ( MA 4106)

Probability: Classical and axiomatic definition, Addition law, Conditional probability, Multiplication law, Total probability, Baye's theorem and independence of events. Random variables: Discrete and continuous random variables, Probability mass, Probability density and commutative distribution functions. Mathematical expectation, Variance, Moment and moment generating function, Chebyshev's inequality. **10 L**

Regression Analysis: Linear and non-linear regression, Principle of least square, Correlation and coefficient of correlation and Rank correlation. **05L**

Distributions: Binomial, Hyper-geometric, Poisson and Normal distributions. **07L**

Sampling Distribution: Population, samples, sampling distribution, estimate for population mean and variance, point of estimation, confidence interval for mean and variance of normal population, testing of hypothesis, the critical and acceptance region, Chi-square, t-student, and F-distributions. **12 L**

Analysis of Variance: Completely randomized design and randomized block design, Quality control, control charts(X-chart, R-chart, P-chart and C-chart). **08 L**

#### **MINERAL PROCESS ENGINEERING (ML 4103)**

Introduction---Present status and future scope of Mineral Beneficiation. Mineral resources of India.

Crushing And Grinding—Laws of Crushing & Grinding, Mechanism & Kinetics of size reduction. Principles and construction of Jaw Crusher, Gyratory Crusher, Cone Crusher, Roll Crusher, Rod Mill and Ball Mill.

Sizing and Classification. Hydrodynamics of movement of solids in fluid. Classification and important classifier like Cyclones and Hydrocyclones.

Concentration techniques, gravity separation methods, Heavy Media Separation, Jigging and Tabling, Magnetic Separation, Electrostatic Separation and Froth Flotation.

Dewatering—Qualitative discussion of Filtration and Drying. Qualification of concentrating operations.

#### **FUELS REFRACTORIES AND FURNACES (FRF) (ML4104)**

FUELS: Classification of fuels, Indian resources.

SOLID FUELS: Coal preparation, coal washing, carbonization of coal, Brief description of the manufacture of coke and recovery of products, specifications and testing of coal and coke. Indian standard specifications of Metallurgical coke to be used in the Blast Furnace.

LIQUID FUELS: Advantages of liquid fuels, liquid fuel furnaces, storage and handling of liquid fuels.

GASEOUS FUELS: Advantages of Gaseous Fuels, Manufacture of Producer Gas, Water Gas, By Products of Gaseous Fuels – Blast Furnace Gas, Coke Oven Gas.

FURNACES: Classification, Principles of Working and applications in Industry, Principles of Regenerators and Recuperators.

Introduction: Definition, properties of a good refractory material and factors affecting selection of refractories, Classification of refractories.

Alumino-Silicate Refractories: Types of Clay, Weathering, Use of Grog and Its Advantages, manufacture, Properties & application of Fireclay refractories, High Alumina Refractories.

Silica Refractories: Raw Materials, Bonding Agents & Mineralizers used Manufacture, Properties & Applications.

Dolomite, Magnesite and Chromite Base Refractories: Preparation of refractories, Bonding Agents and Mineralizers, Composition, Chrome-Magnesite & Magchrome Refractories, their properties and applications. Carbon Refractories: Characteristics of Carbon as refractory material, Manufacture, properties and applications.

### **Material Characterization (ML 4106)**

Thermal Characterization :

High temperature measurement and calibration, principles and techniques. Thermo couples and pyrometers. Specific heat, thermal conductivity and co-efficient of thermal expansion. Principles and application of thermal analysis such as TG, DTA, DSC.

**Optical Microscopy :**

Metallurgical microscope, optical power, lenses – objective and eyepiece and their common defects, polarized light, phase contrast and dark field microscopy. Use of hot stage and heating microscope, high temperature phase study and fusion behaviors.

**Electron Microscopy :**

Types, principles of operation, samples preparation for SEM & TEM, analytical use such as WDX, EDAX.

**Chemical Characterization :**

Chemical analysis, methods of sampling with special reference to ores, fuels, metal and alloys. Principles of operation of colorimeter, spectrophotometer, mass and atomic absorption spectrophotometer, spectroscopy.

### **METALLURGICAL THERMODYNAMICS AND KINETICS (ML 4107)**

Basic scope and Concept of Thermodynamics, Thermodynamics terminology and definition, Concept of Heat, Work and Energy. Discussion of First and Second Law of Thermodynamics, their development, formulation and application.

The Concept of Entropy and Free Energy, their importance, important Consequence of these laws and their application, Standard Free Energy and State of Equilibrium involving reactions in Solution and multi component system, Phase Equilibrium, illustration from Metallurgical System, Third Law of Thermodynamics.

Thermodynamics of Solutions, Ideal Solutions, Raoult's law, their deviation. Partial molar quantities, Integral Quantities, Gibb's Duhem Equations, Heterogeneous equilibria.

Ellingham diagram of Metal Oxide and Metal Sulphide Systems.

Kinetics – Kinetic reactions, Activated Complex Theory, heterogeneous Reaction and importance of rate controlling Steps, Adsorption and Reactions on Surfaces, Reaction Rule, thermodynamics of Electrolytes Concentration Cells.

## SEMESTER-IV

### CHEMICAL ENGINEERING

#### MATHEMATICS – IV (MA4105)

**SPECIAL FUNCTIONS** :- Series solution of ordinary differential equations, Bessel and Legendre's equations and their series solution, Elementary properties of Bessel's function and Legendre's polynomial. **12 L**

**COMPLEX VARIABLE** :- Analytic function, Cauchy – Riemann equation. Complex integration, Cauchy's theorem and Cauchy Integral formula. Taylor and Laurent's expansion, Poles and residue, Residue theorem. Conformal transformation, Bilinear and Schwartz's transformations. **15L**

**PARTIAL DIFFERENTIAL EQUATION** :- Formulation of partial differential equation, Linear and non – linear partial differential equations of the first order, Lagrange's method and Charpit's method. Higher order Partial Linear differential equations with constant coefficients. Method of separation of variables. Equation of vibrating strings, heat flow, Laplace's two dimensional equation and simple problems. **15L**

#### PROBABILITY AND STATISTICS ( MA 4106)

Probability: Classical and axiomatic definition, Addition law, Conditional probability, Multiplication law, Total probability, Baye's theorem and independence of events. Random variables: Discrete and continuous random variables, Probability mass, Probability density and commutative distribution functions. Mathematical expectation, Variance, Moment and moment generating function, Chebyshev's inequality. **10 L**

Regression Analysis: Linear and non-linear regression, Principle of least square, Correlation and coefficient of correlation and Rank correlation. **05L**

Distributions: Binomial, Hyper-geometric, Poisson and Normal distributions. **07L**

Sampling Distribution: Population, samples, sampling distribution, estimate for population mean and variance, point of estimation, confidence interval for mean and variance of normal population, testing of hypothesis, the critical and acceptance region, Chi-square, t-student, and F-distributions. **12 L**

Analysis of Variance: Completely randomized design and randomized block design, Quality control, control charts(X-chart, R-chart, P-chart and C-chart). **08 L**

#### INDUSTRIAL CHEMICAL CALCULATION (CL 4104)

1. Units and Dimensions, Stoichiometric and composition relations. Mathematical and Engineering Calculations, units, dimensions conversion of units, 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.
2. Behaviour of Ideal gases: Ideal gas law, Gage pressure, absolute pressure, density, specific gravity, molecular weight of gases, gas mixtures, Average molecular wt. of gas mixtures, Dalton's law, Amagat's law and their application, partial pressure, pure component volume, solving problems.
3. Vapour pressure: Liquefaction and liquid state, vaporization, condensation, dynamic equilibrium, equilibrium vapor pressure, superheat and quality, boiling point, effect of temperature on vapor pressures, Clausius-Clapeyron equation,
4. Humidity and saturation: Humidity, saturation, Relative saturation, percentage saturation, humid heat, Dew point, wet bulb and dry bulb temperature, humidity chart.
5. Material Balance: Input-output method, steady state, Key component, material balance with chemical reaction and without chemical reaction, simultaneous equations (distillation, absorption) Recycle, Bypass and Purge calculations, application of computer in solving material balance problems.

6. Energy Balance: Introduction to energy balance, Heat capacity, Mean heat capacity, entropy, specific heat, internal energy, First Law of Thermodynamics, Second law of Thermodynamics

### **FLUID AND PARTICLE OPERATIONS (CL 4105)**

1. Size reduction: Principles of crushing & Grinding, Grindability characteristics of materials for crushing, Type of crushers, grinders and Disintegrators for coarse, intermediate and fine grinding, open and close circuit grinding, laws of crushing.
2. Screening: Standard screens, Industrial screens, classification and performance of screens, Screen Analysis.
3. Classifiers: Dry and wet classifiers, spitz-kasten and other types Tabling, Jigging & Hydro cyclones.
4. Flotation: Principle and operation of flotation cells, Reagents used in flotation, flotation machines and Industrial applications.
5. Sedimentation: Theory of sedimentation, Design and operation of Batch & continuous thickeners.
6. Flow of solids through fluids: Free and hindered settling, stoke's law & Newton's Law used for separation of particles.
7. 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.

### **PROCESS ENGINEERING-1 (CL 4106)**

1. Sulphuric Acid: Different Raw Materials, methods of production.
2. Cryogenics: Oxygen and Nitrogen, production. Storage and handling.
3. Nitrogen Industry: Ammonia. Reaction equilibrium of ammonia synthesis, Ammonium sulphate, Nitric Acid, Ammonium Nitrate, Urea; Methods of production characteristic Specifications, Storage and handling.
4. Phosphorous Industry: Phosphorous, Phosphoric acid, sodium and Ammonium Phosphates, single and triple super phosphates, Methods of production, storage & handling.
5. Water: Industrial and municipal water, sewage treatment.
6. Chloral-Alkali Industry: Soda Ash, caustic soda, Bleaching powder, methods of production, storage & handling.
7. Marine Industry: Common salt, Magnesium compounds, potassium compounds and Bromine; production, storage and handling.
8. Cement and Lime Industry: Cement, special cements, lime, manufacture of cement & lime.
9. Electro chemical Industry: Aluminum, magnesium, sodium production & uses, primary and secondary class fuel cells.
10. Electro thermal Industry: Artificial abrasives:- Production & Uses of Aluminum carbide and calcium carbide, miscellaneous, electro thermal products: common types;

### **CHEMICAL ENGINEERING THERMODYNAMICS-II (CL 4107)**

1. 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 term of partial pressure
2. PHASE RULE AND PHASE EQUILIBRIA:  
Phase rule , Clausius-Claypron equation. VLE calculation – Bubble point, Dew point and Flash calculation. Phase Equilibrium VLE
3. EXCESS FREE ENERGY  
Concept of excess free energy of mixing and its Gibbs-Duhem equation, Gibbs/Duhem equation in relation to Raoult's Law, Henry's Law, Lewis/Randal Rule and Partial pressure. Gibbs/Duhem equation and its interacted form like, Porter Van Laar, Margules, Wilson and Redlich/Kister Equation. Excess function of non-ideal solution.
4. 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

SEMESTER-IV

**CIVIL ENGINEERING**

**MATHEMATICS – IV ( MA4105)**

**SPECIAL FUNCTIONS :-** Series solution of ordinary differential equations, Bessel and Legendre's equations and their series solution, Elementary properties of Bessel's function and Legendre's polynomial. **12 L**

**COMPLEX VARIABLE :-** Analytic function, Cauchy – Riemann equation. Complex integration, Cauchy's theorem and Cauchy Integral formula. Taylor and Laurent's expansion, Poles and residue, Residue theorem. Conformal transformation, Bilinear and Schwartz's transformations. **15L**

**PARTIAL DIFFERENTIAL EQUATION :-** Formulation of partial differential equation, Linear and non – linear partial differential equations of the first order, Lagrange's method and Charpit's method. Higher order Partial Linear differential equations with constant coefficients. Method of separation of variables. Equation of vibrating strings, heat flow, Laplace's two dimensional equation and simple problems. **15L**

**PROBABILITY AND STATISTICS ( MA 4106)**

Probability: Classical and axiomatic definition, Addition law, Conditional probability, Multiplication law, Total probability, Baye's theorem and independence of events. Random variables: Discrete and continuous random variables, Probability mass, Probability density and commutative distribution functions. Mathematical expectation, Variance, Moment and moment generating function, Chebyshev's inequality. **10 L**

Regression Analysis: Linear and non-linear regression, Principle of least square, Correlation and coefficient of correlation and Rank correlation. **05L**

Distributions: Binomial, Hyper-geometric, Poisson and Normal distributions. **07L**

Sampling Distribution: Population, samples, sampling distribution, estimate for population mean and variance, point of estimation, confidence interval for mean and variance of normal population, testing of hypothesis, the critical and acceptance region, Chi-square, t-student, and F-distributions. **12 L**

Analysis of Variance: Completely randomized design and randomized block design, Quality control, control charts(X-chart, R-chart, P-chart and C-chart). **08 L**

**FLUID MECHANICS (CE 4103)**

**Fluid Mechanics**

1. Fluid Properties: - Introduction of Fluids and **continuum of principle**, Difference between fluid & solids, Units of Measurement, physical properties of fluids: mass density, specific weight, specific volume, relative density, viscosity, ideal and real fluids, Newtonian and non-Newtonian fluids, surface tension. & capillarity, compressibility,
2. Fluid static's :- Pressure, density, pressure and height relationship, Manometers, Pressure on plane and curved surfaces Buoyancy and center of buoyancy, stability of immersed and floating bodies, met centre and Metacentric height, experimental determination of Metacentric height, measurement of pressure.
3. Kinematics of Fluid Flow :- steady and unsteady flow, uniform and non-uniform flow, Laminar and turbulent flow, one, two and three dimensional flows, stream lines, streak lines and path lines, continuity equation, rotation, circulation stream function and velocity potential functions, flow nets.
4. Dynamics of fluid flow :- Euler's Equation of motion along a stream line and its integration, Bernoulli's equation and applications, free and forced vortex, Momentum equation and application to stationary and moving vanes, pipe bends, Problems related to Combined application of energy and momentum equations.
5. Flow Measurement Pitot tube Rota meter, Venturimeter, Orifice Meter, Weir & Notches(Rectangular, Triangular, Trapezoidal, & Cipoletti)
6. Dimensional analysis and Hydraulic Similitude. :-Dimensional Analysis, Buckingham's theorem, Dimensionless numbers and their significance, similarity, Similitude of fluid flow, model studies.
7. Viscous Flow: Laminar flow through pipes, Darcy's Equation, losses of energy, HGL hydraulic gradient line and total TEL energy line, problem related with losses of energy and H.G.L and T.E.L.

## **ENGINEERING GEOLOGY (GE 4104)**

1. Minerals: Their physical properties and detailed study of certain rock forming minerals
2. Rocks: Their origin, structure, texture and classification of igneous, sedimentary and metamorphic rock and their suitability as Engineering materials, Building stones, engineering properties of rocks.
3. Stratification: Lamination bedding, dip and strike of bed, overlap.
4. Rock deformation: Folds, Faults, joints unconformity and their classification, causes and relation to engineering behaviour of rock mass.
5. Earthquake: its causes, classification, seismic zones of India and Geological consideration for construction of building.
6. Landslides: Its causes, classification and preventive measures.
7. Underground Water: Origin, Aquifer, Aquicludes, Artesian Wells, Underground provinces of India and its role as geological hazard.
8. Geological investigations: For site selection of Dams and Reservoirs, tunnels, Bridges and highways.
9. Principles of Geophysical explorations: Methods for subsurface exploration

### **Experiments:**

1. Study of rock forming and Economic minerals, study of different rocks
2. Methods of completing the outcrop of rocks on a map.
3. Drawing the geological sections of geological maps.
4. Inter-relation of geological maps and sections with respect to subsurface structure.
5. Problems of locating sites of projects like Dams, Tunnels, and Highways etc. in the geological sections.

## **STRUCTURAL ANALYSIS – I (ICE 4104)**

1. Fundamentals: Introduction to structural analysis and its concept. Equilibrium, Compatibility and force – Deformation equation with a simple example to illustrate their use ; Equation of condition ; Classification of Structures (based on availability of equations ) ; Load considerations for familiar structures and its types.
2. Trusses: General theory; classification; Solution of determinate plane trusses; Principle of virtual work and their applications for the determination of deflections of determinate plane trusses.
3. Three – Pinned Structures : Calculation of bending moment, shear force, Axial force for three- hinged arches and diagrams for the same ; Dead Load, stressed in three pinned determinate trusses,
4. Masonry Structures: Basic concept in gravity structures, stability check; calculation of stresses in case of dams and chimneys.
5. Influence Lines: Basic concept of moving load and influence line, Influence line for reactions; shearing forces and bending moments of determinate beams; absolute maximum shearing forces and bending moment, influence lines for three hinged arches.
6. Analysis of structures by unit load method and conjugate beams method.
7. Continuous and fixed beams: Theorem of three moments, Analysis of fixed beams, Settlement of support.

## **SURVEYING – II (CE 4105)**

1. Control Surveying :- Horizontal & Vertical control, Triangulation, methods strength of figure, Base line measurement Eccentricity of signals and station, Reduction to centre Measurement of horizontal angles , Trigonometrical leveling Effect of Refraction and curvature, Axis signal correction ,Different methods, Comparison of methods .
2. Measurement of distance by EDM, Principles, Measurement by transit time and phase comparison, Ambiguity Resolution Types of waves used in EDM. Types of EDM instruments.
3. Theory of errors and adjustment of figure: - Types of Errors, law of weights, weights & weighted observation, Theory of propagation of error, method to calculate most probable values: least square, Normal equation, method of correlate, Adjustment of plane and Geodetic figure.
4. Astronomy: - Definition of Astronomical terms Astronomical Co-ordinate systems. Astronomical Triangle, Determination of Azimuth, Declination, Hour Angles. Definition of time, LMT, ST. GMT and interdependence.
5. Traversing with Inertial surveying system: - Components of an inertial surveying system. platform stabilization , Running the traverse, Design of ISS, Principle and uses of Gyroscope & Accelerometer
6. Hydrographic Survey :- Introduction shore line survey sounding method of locating sounding, three point problems
7. Principle and use of Global position of system, Application in Civil Engineering.

SEMESTER-IV

**MINING ENGINEERING**

**MATHEMATICS – IV (MA4105)**

**SPECIAL FUNCTIONS :-** Series solution of ordinary differential equations, Bessel and Legendre's equations and their series solution, Elementary properties of Bessel's function and Legendre's polynomial. **12 L**

**COMPLEX VARIABLE :-** Analytic function, Cauchy – Riemann equation. Complex integration, Cauchy's theorem and Cauchy Integral formula. Taylor and Laurent's expansion, Poles and residue, Residue theorem. Conformal transformation, Bilinear and Schwartz's transformations. **15L**

**PARTIAL DIFFERENTIAL EQUATION :-** Formulation of partial differential equation, Linear and non – linear partial differential equations of the first order, Lagrange's method and Charpit's method. Higher order Partial Linear differential equations with constant coefficients. Method of separation of variables. Equation of vibrating strings, heat flow, Laplace's two dimensional equation and simple problems. **15L**

**PROBABILITY AND STATISTICS ( MA 4106)**

Probability: Classical and axiomatic definition, Addition law, Conditional probability, Multiplication law, Total probability, Baye's theorem and independence of events. Random variables: Discrete and continuous random variables, Probability mass, Probability density and commutative distribution functions. Mathematical expectation, Variance, Moment and moment generating function, Chebyshev's inequality. **10 L**

Regression Analysis: Linear and non-linear regression, Principle of least square, Correlation and coefficient of correlation and Rank correlation. **05L**

Distributions: Binomial, Hyper-geometric, Poisson and Normal distributions. **07L**

Sampling Distribution: Population, samples, sampling distribution, estimate for population mean and variance, point of estimation, confidence interval for mean and variance of normal population, testing of hypothesis, the critical and acceptance region, Chi-square, t-student, and F-distributions. **12 L**

Analysis of Variance: Completely randomized design and randomized block design, Quality control, control charts(X-chart, R-chart, P-chart and C-chart). **08 L**

**FLUID MECHANICS(ME 4107)**

**INTRODUCTION:**

Concept of continuum, difference between fluid mechanics and solid mechanics, brief history of classical hydraulics, hydrodynamics and fluid mechanics.

Characteristic properties of fluids, ideal and real fluids, Newtonian and non-Newtonian fluids viscosity, surface tension, capillarity, compressibility, fluid statics and buoyancy.

**FLUID KINEMATICS:**

Streamlines, path lines, streak lines, velocity potential functions and stream functions, laminar and turbulent flows, steady and unsteady flow, rotational and irrotational motion, circulation, vorticity, velocity and acceleration.

**FLUID DYNAMICS:**

Conservation of mass, principle of momentum and energy, moment of momentum, equation of motion, Euler's equation, and introduction to Navier-Stokes equation, energy equation, hydraulic and energy gradients.

**LAMINAR FLOW:**

Flow through pipes, frictional and other losses.

#### TURBULENT FLOW:

Fully developed flows, boundary layer theory, rough and smooth pipe flows.

#### DIMENSIONAL ANALYSIS:

Similitude of fluid flows, hydraulic modeling, non-dimensional parameters(Reynolds's, Froude's, Euler, Weber and Mach numbers)

#### FLOW MEASUREMENTS:

Piezometer, manometers, pressure gauges, pitot tube, orifices, notches and weirs, orifice meter, venturimeter.

#### FORCES ON IMMERSED BODIES:

Drag and lift, aerofoil section.

### **MINERAL PROCESS ENGINEERING (ML 4103)**

Introduction---Present status and future scope of Mineral Beneficiation. Mineral resources of India.

Crushing And Grinding—Laws of Crushing & Grinding, Mechanism & Kinetics of size reduction. Principles and construction of Jaw Crusher, Gyratory Crusher, Cone Crusher, Roll Crusher, Rod Mill and Ball Mill.

Sizing and Classification. Hydrodynamics of movement of solids in fluid. Classification and important classifier like Cyclones and Hydrocyclones.

Concentration techniques, gravity separation methods, Heavy Media Separation, Jigging and Tabling, Magnetic Separation, Electrostatic Separation and Froth Flotation.

Dewatering—Qualitative discussion of Filtration and Drying. Qualification of concentrating operations.

### **INTRODUCTION TO MINING TECHNOLOGY (MN 4101)**

Definition and scope of mining, mining as a basic industry, definition of mining terms.

Introduction to Basic unit operations : opening & development of mineral deposits, method of working, ventilation, transportation, hoisting and despatch.

Boring: Principle of boring and purpose of boreholes; methods of boring; borehole deflection and deviation.

Explosives and Blasting: Definition, classification, common composition and property of different types of explosives; detonator, detonating cord, nonel detonators.

Blasting Methods: Basic Layouts of underground and surface mine blasting. 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

### **ENGINEERING GEOLOGY – II (GE 4103)**

Stratigraphy – Principles of Stratigraphy ; Geological Time Scale ; Stratigraphic Correlation, Physiographic Divisions of India, Achaean, Vindhyan, Gondwana & Tertiary formations of India

Economic Geology :

Ore, Gangue, Tenors of Ores, Grade, Assay value, Cut Off grade ; Processes of formation of Mineral deposits - Magmatic Concentration, Hydrothermal Processes, Placer Deposits & Supergene Sulfide Enrichment deposits.

Distribution, mode of occurrence, genesis and uses of following deposits :

Iron, Copper, Aluminum, Manganese, Lead & Zinc, Radio active Minerals

Mica, Asbestos, Kyanite, Limestone and Gypsum

Mineral Exploration :

Geological, Geophysical and Geochemical Prospecting - principles and methodology.

Principles of Ore beneficiation.

Coal Geology – Introduction, Coal Petrography, Origin, Classification, Structural features of Coal seams, Distribution of Coal in India, Study of Jharia, Bokaro, Raniganj & Neyveli Coal Fields of India. Oil & Natural Gas – Introduction, Origin, Classification, Accumulation, Migration, Cap rocks, Traps, Distribution and Surface

indication of oil & gas, Study of important Indian Oil fields such as Digboi, Cambay & Bombay High.

**ELECTRONICS & COMMUNICATION ENGINEERING****MATHEMATICS – IV (MA4105)**

**SPECIAL FUNCTIONS** :- Series solution of ordinary differential equations, Bessel and Legendre's equations and their series solution, Elementary properties of Bessel's function and Legendre's polynomial. **12 L**

**COMPLEX VARIABLE** :- Analytic function, Cauchy – Riemann equation. Complex integration, Cauchy's theorem and Cauchy Integral formula. Taylor and Laurent's expansion, Poles and residue, Residue theorem. Conformal transformation, Bilinear and Schwartz's transformations. **15L**

**PARTIAL DIFFERENTIAL EQUATION** :- Formulation of partial differential equation, Linear and non – linear partial differential equations of the first order, Lagrange's method and Charpit's method. Higher order Partial Linear differential equations with constant coefficients. Method of separation of variables. Equation of vibrating strings, heat flow, Laplace's two dimensional equation and simple problems. **15L**

**PROBABILITY AND STATISTICS ( MA 4106)**

Probability: Classical and axiomatic definition, Addition law, Conditional probability, Multiplication law, Total probability, Baye's theorem and independence of events. Random variables: Discrete and continuous random variables, Probability mass, Probability density and commutative distribution functions. Mathematical expectation, Variance, Moment and moment generating function, Chebyshev's inequality. **10 L**

Regression Analysis: Linear and non-linear regression, Principle of least square, Correlation and coefficient of correlation and Rank correlation. **05L**

Distributions: Binomial, Hyper-geometric, Poisson and Normal distributions. **07L**

Sampling Distribution: Population, samples, sampling distribution, estimate for population mean and variance, point of estimation, confidence interval for mean and variance of normal population, testing of hypothesis, the critical and acceptance region, Chi-square, t-student, and F-distributions. **12 L**

Analysis of Variance: Completely randomized design and randomized block design, Quality control, control charts(X-chart, R-chart, P-chart and C-chart). **08 L**

**ANLOG ELECTRONICS (EC4103)**

**Transistor Biasing and Thermal Stability:** The operating point of a BJT, fixed biasing, potential divider biasing, self biasing, stabilization against variation in  $I_{CO}$ ,  $V_{BE}$  and  $\beta$ , compensation technique, biasing technique for IC circuits, Thermal run away and thermal stability **4L**

**The transistor at low frequency:** Transistor hybrid model, analysis of transistor amplifier circuit using h-parameter, comparison of amplifier configuration on the basis of  $A_i$ ,  $A_v$ ,  $R_i$  and  $R_o$ , Miller's Theorem and its dual, cascading transistor amplifiers, simplified Common –Emitter hybrid model, simplified calculation for CE, CC and CB configuration, CE amplifier with emitter resistance, high input resistance transistor circuit

Multi Stage Amplifiers: Frequency Response of an amplifier, step response of amplifier, band pass of cascade stages, low frequency response of RC coupled amplifier, effect of an emitter bypass capacitor on low frequency response. Current mirror, current repeaters etc. **8L**

**BJT at high frequency:** The hybrid  $\pi(\pi)$  CE transistor model, hybrid  $\pi(\pi)$  conductance, the CE short circuit current gain, current gain with resistive load, single stage CE amplifier response, the gain bandwidth product. **4L**

**Tuned Amplifier:** Introduction, Q-Factor, Single tuned amplifier, double tuned amplifier, Stagger tuned amplifier and class-C tuned amplifier **2L**

**Power Amplifiers:** Large signal amplifiers, harmonic distortion, the transformer coupled audio power amplifier, push pull amplifier, class B and class AB amplifier. 4L

**Operational Amplifier:** The basic operational amplifier, the differential amplifier, the emitter-coupled differential amplifier, differential amplifier supplied with constant current, offset error voltages and currents. Applications of operational amplifier: Adder, difference circuit, level shifter, voltage to current converter, comparator, Schmitt trigger, Instrumentation amplifier, log and anti-log amplifier, sample and hold circuit, precision diode and rectifier, active peak detector. 6L

**Multivibrator:** Monostable and astable operation using 555 timers. 2L

**Oscillators:** Sinusoidal Oscillator, General Form of resonant circuit oscillators, Phase shift Oscillator, Wein Bridge Oscillator, VCO and Phase Locked Loop. 4L

## INSTRUMENTATION-I (EE 4105)

Electrical measurements:-

errors in measurement, Classification of errors, statistical analysis of errors, Probable error and limit errors, Calculation of limiting errors.

Potentiometer: DC and AC: Construction and Principle of operation.

Measuring Instruments:-

Fundamentals, operation and construction of galvanometer(DC & AC), ammeter and voltmeters, wattmeters, extension of range of instruments, energy-meter, frequency meter and single phase reactive power measurements, single phase power factor meter, megger, multimeter, trivector meter.

Instrument Transformer:-

CT & PT, ratio & phase angle errors.

Measurement of resistance, inductance and capacitance

High voltage measurement:-

Surge and impulse test and oil testing set

Magnetic measurement: ballistic galvanometer and flux-meters: Construction, principle of operation and their uses., separation of hysteresis and eddy current losses by using loyd, Fisher square.

Electronic Instruments:-

CRO and its uses, Special purpose CRO, VTVM,

## COMMUNICATION SYSTEM & ENGG. (EC 4104)

1. Wave spectra: Introduction, spectral analysis of respective waves.

2. Noise: Introduction, Thermal noise, S/N ratio, Equivalent Noise Resistance, Noise Factor, Noise Temperature.

3. Modulation and demodulation of signals:

(i) Amplitude Modulation, Frequency spectrum, Average power, Diode envelope detection.

(ii) SSB modulation, Principles, FET Balanced Modulators, SSB Generation by Phase shift method.

(iii) FM and PM: Frequency spectra, Equivalence between FM and PM, FET Reactance Modulator, The Armstrong method, FM stereo Broad Transmitter, Foster seely Discriminator, Pre-emphasis and De-emphasis. Automatic Frequency control.

4. Performance of Communication Systems. Noise in Amplitude Modulated systems and Angle modulated systems.

5. Super heterodyne Receivers (Block diagram treatment) choice of IF and Oscillator frequency, Image rejection.

6. Sampling Theorem, Pulse Modulation, Pulse Amplitude Modulation, Pulse Time Modulation, TDM, FDM.

7. Digital Communication: Pulse code modulation, Delta Modulation, Quantization Noise in Binary PCM, Digital carrier systems: ASK, FSK, PSK, and DPSK.

8. Introduction to Information theory, Measure of information channel capacity, exchange of BW for S/N ratio.

## **SEMICONDUCTOR DEVICES (EC)**

### **CARRIER CONCENTRATIONS:**

*The Fermi level, Electron and Hole concentration at equilibrium, Direct and Indirect recombination of electrons and holes, Hall effect, Steady-state carrier generation, Quasi-Fermi levels.*

### **TRANSPORT PHENOMENA:**

*Drift and Diffusion of Carriers, Recombination, Continuity and Diffusion equations, Hynes-Shockley experiment.*

### **P-N JUNCTIONS:**

*The Contact Potential, Space Charge at a junction, Steady state condition, Current at a junction, Carrier injection, Junction breakdown, Time variation of stored charge, P-N junction capacitance, Graded junction.*

### **JUNCTION DIODES:**

*Varactor Diode, Concept of negative resistance, Tunnel Diode, Current and Voltage in an illuminated junction, Photo Diode, Photo detector, Solar Cells, Light Emitting Diode, Metal Semiconductor Junction.*

*Principle of PIN photo detector and Avalanche photodiode, Noise in photo detectors, Detector response time, Photodiode materials.*

### **Bipolar Junction Transistor (BJT):**

*Charge transport and current in a BJT, Current transfer ratio, Terminal currents, Generalised biasing, Charge control analysis, BJT switching, Turn-on and Turn-off transients, Base narrowing, Frequency limitations of a transistor.*

### **FET, MOSFET:**

*Principle of Operation and I-V Characteristics of FET, MESFET, MOSFET, MOS Capacitor, Threshold voltage in MOSFET.*

### **CCD & FABRICATION:**

*The basic CCD, Improved CCD p-n junction fabrication.*

**COMPUTER SCIENCE ENGINEERING & I.T**

**MATHEMATICS – IV (MA4105)**

**SPECIAL FUNCTIONS :-** Series solution of ordinary differential equations, Bessel and Legendre's equations and their series solution, Elementary properties of Bessel's function and Legendre's polynomial. **12 L**

**COMPLEX VARIABLE :-** Analytic function, Cauchy – Riemann equation. Complex integration, Cauchy's theorem and Cauchy Integral formula. Taylor and Laurent's expansion, Poles and residue, Residue theorem. Conformal transformation, Bilinear and Schwartz's transformations. **15L**

**PARTIAL DIFFERENTIAL EQUATION :-** Formulation of partial differential equation, Linear and non – linear partial differential equations of the first order, Lagrange's method and Charpit's method. Higher order Partial Linear differential equations with constant coefficients. Method of separation of variables. Equation of vibrating strings, heat flow, Laplace's two dimensional equation and simple problems. **15L**

**PROBABILITY AND STATISTICS ( MA 4106)**

Probability: Classical and axiomatic definition, Addition law, Conditional probability, Multiplication law, Total probability, Baye's theorem and independence of events. Random variables: Discrete and continuous random variables, Probability mass, Probability density and commutative distribution functions. Mathematical expectation, Variance, Moment and moment generating function, Chebyshev's inequality. **10 L**

Regression Analysis: Linear and non-linear regression, Principle of least square, Correlation and coefficient of correlation and Rank correlation. **05L**

Distributions: Binomial, Hyper-geometric, Poisson and Normal distributions. **07L**

Sampling Distribution: Population, samples, sampling distribution, estimate for population mean and variance, point of estimation, confidence interval for mean and variance of normal population, testing of hypothesis, the critical and acceptance region, Chi-square, t-student, and F-distributions. **12 L**

Analysis of Variance: Completely randomized design and randomized block design, Quality control, control charts(X-chart, R-chart, P-chart and C-chart). **08 L**

**Object Oriented Programming in JAVA**

1. Object Oriented Programming :

Introduction, Basics of OOPS, Fundamentals Characteristics of OOPS, Benefits of OOPS.

2. Introduction to Java:

Introduction, History of Java, Features of Java, The JVM (Java Virtual Machine)

3. Java Fundamentals :

Type of Java Programs, Application Program, Applets, Servlets, Java Architecture, JDK Tools and API

5. Java Programming

Building the first java program, compiling and running first java program, comments in a program, command line arguments, interactive inputs.

6. Data Type, Variables and Operators.

Java Tokens, character set, keywords, java reserved words, identifiers, constants, data types, operators, precedence of Operations

#### 7. Control Statement and Looping Structures :

Introduction, input and output statement, control flow statements, decision – making statements, switch, looping statements, break, continue, return, type casting.

#### 8. Classes and objects

What are classes, declaring a class, rules for naming classes, creating an object, methods, exploring new operator constructors, Types of Constructor, The final modifier.

#### 9. Exploring Methods & Inheritance

##### Introduction

Argument Passing , call by value characteristics of call by value , call by reference. Introduction to Inheritance , Subclasses , Overriding , Types of Inheritance, Inheritance using abstract classes.

#### 10. Packages And Interface

Structure of Java Program how to create a package what are packages what are nested packages creating an interface. Using interface-extending interface. Exhibiting multiple inheritance through interface.

#### 11. String , Arrays & Vector

Introduction to string. Substrings Usage of Various string functioning What is an array Definition, Declaration & initialization of a array types of array Vector.

#### 12. Exception Handling.

Syntax for exception handling, the try block, the catch block the finally block, exception types, throw, throws, user defined exception

#### 13. Multithreading

Multitasking and Multithreading, parallelism, thread, runnable, synchronized, characteristic of thread.

#### 14. APPLET

All about applet, without using HTML file to run an applet, the APPLET tag, paint(), update(), and repaint().

#### 15. Graphics

Introduction to graphics, drawing lines, drawing rectangles, drawing ovals, drawing arcs, drawing polygons, drawing polylines.

## DATABASE MANAGEMENT SYSTEMS (CS 5104)

Introduction

File & Data Base Concept, Overview of DBMS, Data Models, Database Administrator, Database Users, Schema. Data Independence

### *Entity-Relationship Model*

Basic concepts , Keys, Entity-Relationship Diagram, Cardinality ratios, Strong & Weak Entity Sets, Specialization, Generalization, Aggregation.

### *Relational Model*

Procedural & Non Procedural Languages, Relational Algebra, Extended Relational Algebra Operations, Views, Modifications Of the Database, Relational Calculus .

### *SQL*

Basic Concepts, Set operations, Aggregate Functions, Null Values, assertions, views, Nested Sub-queries, Cursors, Stored procedures and triggers.

### *Integrity Constraints & Introduction to RDBMS*

Domain Constraints, Referential Integrity Constraints, Codd's rule.

### *Functional Dependencies and Normalization*

Functional Dependency, Armstrong's axioms, Canonical Cover, Closure , Full and Partial Functional dependencies, Prime & Non Prime attribute , 1NF, 2NF, 3NF, BCNF, Multi valued Dependency , 4NF, 5NF, DKNF .

### *Transaction & Concurrency Control*

Transaction concept, ACID properties, Conflict & View serializability, Test for Conflict serializability, Concurrency Control, Lock base protocols, Two phase locking.

### *Storage Strategies*

Single-Level Index (primary, secondary, clustering), Multi-level Indexes, Dynamic Multi-level Indexes, Hashing Techniques, B tree and B+ tree .

### *Query Optimization*

Full Table scan, Indexed-based scan, Merge join, Nested loop join , Equivalence rules , Heuristic Optimization , Cost Based Optimization.

### *Backup & Recovery*

Physical & Logical Backup , Transaction logs, Causes of failures , Recovery techniques.

### *Distributed Databases*

Basic Concepts, Data Fragmentation, Replication and Allocation Techniques, Types of Distributed Database Systems, Query Processing, Overview of Client-Server Architecture and Its relationship to Distributed Databases.

## ANLOG ELECTRONICS (EC4103)

**Transistor Biasing and Thermal Stability:** The operating point of a BJT, fixed biasing, potential divider biasing , self biasing, stabilization against variation in  $I_{CO}$  ,  $V_{BE}$  and  $\beta$ , compensation technique, biasing technique for IC circuits , Thermal run away and thermal stability 4L

**The transistor at low frequency:** Transistor hybrid model, analysis of transistor amplifier circuit using h-parameter, comparison of amplifier configuration on the basis of  $A_i$ ,  $A_v$ ,  $R_i$  and  $R_o$  , Miller's Theorem and its dual, cascading transistor amplifiers, simplified Common –Emitter hybrid model, simplified calculation for CE, CC and CB configuration, CE amplifier with emitter resistance, high input resistance transistor circuit .

Multi Stage Amplifiers: Frequency Response of an amplifier, step response of amplifier, band pass of cascade stages, low frequency response of RC coupled amplifier, effect of an emitter bypass capacitor on low frequency response. Current mirror, current repeaters etc. 8L

**BJT at high frequency:** The hybrid  $\pi$  ( $\pi$ ) CE transistor model, hybrid ( $\pi$ ) conductance, the CE short circuit current gain, current gain with resistive load, single stage CE amplifier response, the gain bandwidth product.

4L

**Tuned Amplifier:** Introduction, Q-Factor, Single tuned amplifier, double tuned amplifier, Stagger tuned amplifier and class-C tuned amplifier

2L

**Power Amplifiers:** Large signal amplifiers, harmonic distortion, the transformer coupled audio power amplifier, push pull amplifier, class B and class AB amplifier.

4L

**Operational Amplifier:** The basic operational amplifier, the differential amplifier, the emitter-coupled differential amplifier, differential amplifier supplied with constant current, offset error voltages and currents. Applications of operational amplifier: Adder, difference circuit, level shifter, voltage to current converter, comparator, Schmitt trigger, Instrumentation amplifier, log and anti-log amplifier, sample and hold circuit, precision diode and rectifier, active peak detector.

6L **Multivibrator:** Monostable and astable operation using 555 timers.

2L

**Oscillators:** Sinusoidal Oscillator, General Form of resonant circuit oscillators, Phase shift Oscillator, Wein Bridge Oscillator, VCO and Phase Locked Loop.

4L

## **COMMUNICATION SYSTEM & ENGG**

1. Wave spectra: Introduction, spectral analysis of respective waves.
2. Noise: Introduction, Thermal noise, S/N ratio, Equivalent Noise Resistance, Noise Factor, Noise Temperature.
3. Modulation and demodulation of signals:
  - (i) Amplitude Modulation, Frequency spectrum, Average power, Diode envelope detection.
  - (ii) SSB modulation, Principles, FET Balanced Modulators, SSB Generation by Phase shift method.
  - (iii) FM and PM: Frequency spectra, Equivalence between FM and PM, FET Reactance Modulator, The Armstrong method, FM stereo Broad Transmitter, Foster seely Discriminator, Pre-emphasis and De-emphasis. Automatic Frequency control.
4. Performance of Communication Systems. Noise in Amplitude Modulated systems and Angle modulated systems.
5. Super heterodyne Receivers (Block diagram treatment) choice of IF and Oscillator frequency, Image rejection.
6. Sampling Theorem, Pulse Modulation, Pulse Amplitude Modulation, Pulse Time Modulation, TDM, FDM.
7. Digital Communication: Pulse code modulation, Delta Modulation, Quantization Noise in Binary PCM, Digital carrier systems: ASK, FSK, PSK, and DPSK.
8. Introduction to Information theory, Measure of information channel capacity, exchange of BW for S/N ratio.

## **NEW SYLLABUS AND STRUCTURE OF 4<sup>TH</sup> SEMESTER**

1. Mechanical Engineering
2. Electrical Engineering
3. Production Engineering
4. Metallurgical Engineering
5. Chemical Engineering
6. Civil Engineering
7. Electronics & Communication Engineering
8. Mining Engineering
9. Computer Science & Engineering
10. Information Technology