

SYLLABUS FOR ET-CERAMIC

- Engineering Mathematics & Physics
- Engineering Chemistry & Basic Electronics
- Engineering Drawing and Computer Programming
- Fundamentals of Electrical and Manufacturing Practices
- Materials Thermodynamics and Phase Equilibria
- Ceramic Raw Materials and Characterization
- Particle Mechanics and Fluid Flow Processes
- Ceramic Fabrication Process and Unit Operations
- Structure and Phase Equilibrium in Ceramics
- Fuels, Furnaces, and Kilns
- Ceramics in Energy Sector
- High Temperature Processes in Ceramics
- Physical Ceramics (Structure and Properties)
- Glass Engineering and Technology
- Refractory Technology
- Whitewares and Heavy Clay Goods
- Cement and Concrete Technology
- Instrumental Characterization Techniques
- Electroceramics and Functional Devices
- Composite Materials and Bioceramics
- Nanoceramics and Energy Storage Materials
- Mechanical Behaviour of Ceramics
- Phase Transformation and Reaction Kinetics
- Waste Management of Ceramic Industries
- Ceramic Equipment Design

SYLLABUS FOR ET-CHEMICAL

a) FLUID AND PARTICLE DYNAMICS

Viscosity of Fluids. Laminar and turbulent flows. Equation of continuity and Navier-Stokes equation-Bernoulli's theorem. Flow meters. Fluid drag and pressure drop due to friction, Reynold's Number and friction factor- effect of pipe roughness. Economic pipe diameter. Pumps, water, air/steam jet ejectors, compressors, blowers and fans. Agitation and mixing of solids and pastes. Crushing and grinding- principles and equipment. Rittenger's and Bond's laws. Filtration and filtration equipment. Fluid-particle mechanics-free and hindered settling. Fluidisation and minimum fluidization velocity, concepts of compressible and incompressible flow. Transport of Solids.

b) MASS TRANSFER

Molecular diffusion coefficients, First and second law and diffusion, mass transfer coefficients, film and penetration theories of mass transfer. Distillation, simple distillation, relative volatility, fractional distillation, plate and packed columns for distillation. Calculation of theoretical number of plates. Liquid-liquid equilibria. Extraction- theory and practice: Design of gas-absorption columns. Drying. Humidification dehumidification. Crystallisation. Design of equipment.

c) HEAT TRANSFER

Conduction, thermal conductivity, extended surface heat transfer. Convection-free and forced. Heat transfer coefficients – Nusselt Number. LMTD and effectiveness. NTU methods for the design of Double Pipe and Shell & Tube Heat Exchange. Analogy between heat and momentum transfer. Boiling and condensation heat transfer. Single and multiple-effect evaporators. Radiation- Stefan-Boltzman Law, emissivity and absorptivity. Calculation of heat load of a furnace Solar heaters.

d) NOVAL SEPARATION PROCESSES

Equilibrium separation processes-ion-exchange, osmosis, electro-dialysis, reverse osmosis, ultra-filtration and other membrane processes. Molecular distillation. Super critical fluid extraction.

e) PROCESS EQUIPMENT DESIGN

Factors affecting vessel design of storage vessels-vertical, horizontal spherical, underground tanks for atmospheric and high pressure. Design of closures flat and elliptical head. Design of supports. Materials of construction-characteristics and selection.

f) PROCESS DYNAMICS AND CONTROL

Measuring instruments for process variables like level, pressure, flow, temperature pH and concentration with indication in visual/ pneumatic/ analog/digital signal forms. Control variable, manipulative variable and load variables. Linear control theory- Laplace, transforms. PID controllers. Block diagram representation transient and frequency response, stability of closed loop system. Advance control strategies.

a) MATERIAL AND ENERGY BALANCES

Material and energy balance calculations in processes with recycle/ bypass/purge. Combustion of solid/liquid gaseous fuels, stoichiometric relationships and excess air requirements. Adiabatic flame temperature.

b) CHEMICAL ENGINEERING THERMODYNAMICS

Laws of thermodynamics. PVT relationships for pure components and mixtures. Energy functions and inter-relationships – Maxwell's relations. Fugacity, activity and chemical potential. Vapour-liquid equilibria, for ideal/non-ideal, single and multi component equilibrium, equilibrium constant and equilibrium conversions. Thermodynamic cycles – refrigeration and power.

c) CHEMICAL REACTING ENGINEERING

Batch reactors – Kinetics of homogeneous reactions and interpretation of kinetic data. Ideal flow reactors – CSTR, plug flow reactors and their performance equations. Temperature effects and run-away reactions. Heterogeneous reactions – catalytic and non-catalytic and gas-solid and gas liquid reactions. Intrinsic kinetics and global rate concept. Importance of inter-phase and intraparticle mass transfer on performance. Effectiveness factor Isothermal and non-isothermal reactors and reactor stability.

d) CHEMICAL TECHNOLOGY

Natural organic products-Wood and wood-base chemicals, pulp and paper. Agro industries – sugar, Edible oils extraction(including tree based seeds), Soaps and detergents. Essential oils – Biomass gasification (including biogas). Coal and coal chemical. Petroleum and Natural gas- Petroleum refining(Atmospheric distillation/cracking/reforming) Petrochemical industries-Polyethylenes(LDPE/HDPE/LLDPE), Polyvinyl Chloride, Polystyrene and lime industries. Paints and varnishes. Glass and ceramics. Fermentation – alcohol and antibiotics.

e) ENVIRONMENT ENGINEERING AND SAFETY

Ecology and environment. Sources of pollutants in the air and water. Green house effect, ozone layer depletion, acid rain. Micrometeorology and dispersion of pollutants in environment. Measurement techniques of pollutant levels and their control strategies. Solid wastes, their hazards and their disposal techniques. Design and performance analysis of pollution control equipment. Fire and explosion hazards rating –HAZOP and HAZAN. Emergency planning, disaster management. Environmental legislations – water, air environment protection Acts, Forest(Conservation)Act.

f) PROCESS ENGINEERING ECONOMICS

Fixed and working capital requirement for a process industry and estimation methods. Cost estimation and comparison of alternatives. Net present value by discounted cash flow. Pay back analysis. IRR, Depreciation, taxes and insurance. Break-even point analysis. Project scheduling- PERT and CPM. Profit and loss account, balance sheet and financial statement. Plant location and plant layout including piping.

SYLLABUS FOR ET-COMPUTER & INFORMATION TECHNOLOGY

1. Theory of Computation: Regular languages and finite automata, context free languages and Push-down automata, Turing machines.
2. Digital Logic : Logic Functions, Minimization, Design and synthesis of Combinatorial and Sequential Circuits, Number Representation and Computer Arithmetic (Fixed and Floating Point).
3. Computer Organization: Machine Instructions and Addressing Modes, ALU and Data path, Hardwired and Microprogrammed Control, Memory Interface, I/O Interface (Interrupt and DMA Mode), Serial Communication Interface, Instruction Pipelining, Cache, Main and Secondary Storage.
4. Data Structures and Algorithms: The Notion of Abstract Data Types, Stacks, Queues, Linked Lists, Trees, Binary Search Trees, Heap, Graph, Tree and Graph Traversals, Connected Components, Spanning Trees, Shortest Paths, Hashing, Sorting, Searching, Design Techniques (Greedy, Dynamic, Divide and Conquer), Asymptotic Analysis (Best, Worst, Average Cases) on Times and Space, Upper And Lower Bounds, Interactability.
5. Programming Methodology: C Programming, Program Control (Iteration, Recursion, Functions), Scope, Binding, Parameter Passing, Elementary Concepts of Object Oriented Programming.
6. Operating Systems: Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Memory Management and Virtual Memory, File systems, I/O systems. Protection and security.
7. Information Systems and Software Engineering: Information Gathering, Requirement and Feasibility Analysis, Data Flow Diagrams, Process Specifications, Input/Output Design, Process Life Cycle, Planning and Managing the Project, Design, Coding, Testing, Implementation, Maintenance.
8. Database: Relational Mode, Database Design, Integrity Constraints, Normal Forms, Query Languages (SQL), Python ,File Structures (Sequential, Indexed), B-trees, Transaction and Concurrency Control.
9. Data Communication: Data Encoding and Transmission, Data Link Control, Multiplexing, Packet Switching, LAN Architecture, LAN Systems (Ethernet, Token Ring), Network Devices Switches, Gateways, Routers.
10. Networks: ISO/OSI Stack, sliding Window Protocols, Routing Protocols, TCP/UDP, Application Layer Protocols and Systems (HTTP, SMTP, DNS, FTP), Network Security.
11. Web Technologies: Three Tier Web Based Architecture; JSP, ASP, J2EE, NET Systems; HTML, XML.
12. Artificial Intelligence – Agentic AI , Generative AI and Concepts of AI
13. Software Engineering : concept of systems, Software development process modules, software project planning and management; cost estimation methods, scheduling requirement analysis, software testing strategies, Quality Assurance.

14. Compilers: Lexical analysis, Syntax analysis-different parsing techniques, semantic analysis, Error detection, Optimization and code generation.

Note- The above syllabus is indicative in nature and not exhaustive

SYLLABUS FOR ET- CIVIL ENGINEERING

1. BUILDING MATERIALS:

Timber: Different types and species of structural timber, density-moisture relationship, strength in different directions, defects, influence of defects on permissible stress, preservation, dry and wet rots, codal provisions for design plywood.

Bricks: Types, Indian standard classification, absorption, saturation factor, strength in masonry, influence of mortar strength on masonry strength.

Cement: Compound of different types, setting times, strength.

Cement Mortar: Ingredients, proportions, water demand, mortars for plastering and masonry.

Concrete: Importance of W/C Ratio, strength, ingredients including admixtures, workability, testing for strength, elasticity, nondestructive testing, mix design methods.

2. SOLID MECHANICS: Elastic constants, stress, plane stress, Mohr's circle of stress, strains, plane strain, Mohr's circle of strain, combined stress; elastic theories of failure; simple bending, shear; Torsion of circular and rectangular sections and simple members.

3. STRUCTURAL ANALYSIS: Analysis of indeterminate skeletal frames-moment distribution, slope-deflection, stiffness and force methods, energy methods, Muller-Breslau principle and application. Plastic analysis of indeterminate beams and simple-shape factors.

4. DESIGN OF STEEL STRUCTURES: Principles of working stress method.

Design of connections, simple members, Built-up sections and frames. Design of Industrial roofs, principle of ultimate load design. Design of simple member and frames.

5. DESIGN OF CONCRETE AND MASONRY STRUCTURES: Limit state design for bending, shear, axial compression and combined forces. Code provisions for slabs, beams, walls and footings. Working stress method of design of R.C. members. Principles of prestressed concrete design, materials, method of prestressing, losses. Design of simple members and determinate structures. Introductions to prestressing of indeterminate structures.

Design of brick masonry as per I.S. Codes.

6. CONSTRUCTION PRACTICE, PLANNING AND MANAGEMENT:

Concreting Equipment: Weight, batcher, mixer, vibrator, batching plant, concrete pump, cranes, hoists, lifting equipment.

Earthwork Equipment: Power shovel, hoe, dozer, dumper, trailers and tractor, rollers, sheep foot rollers, pumps.

Construction, Planning and Management: Bar chart, link bar chart, work-break down structures, activity on-arrow diagrams. Critical path, probabilistic activity durations; Event-based networks. PERT network; time-cost study, crashing; Resources allocation

1. **(a) FLUID MECHANICS, OPEN CHANNEL FLOW, PIPE FLOW:**

Fluid properties, pressure, thrust, buoyancy; flow Kinematics; integration of flow equations; flow measurement; relative motion; moment of momentum; viscosity, boundary layer and control, drag, lift; dimensional analysis, modelling, cavitation; flow oscillations; momentum and energy principles in open channel flow, flow controls, hydraulic jump, flow sections and properties; normal flow, gradually varies flow, surges; flow development and losses in pipe flows; measurements; siphons; surges and water hammer; delivery of power; pipe network.

(b) HYDRAULIC MACHINES AND HYDROPOWER: Centrifugal pumps, types, performance parameters, scaling, pumps in parallel, reciprocating pumps, air vessels, performance parameters; hydraulic ram; hydraulic turbines, types, performance parameters, controls, choice; power houses, classification and payout, storage, pondage, control of supply.

2. **(a) HYDROLOGY:** Hydrological cycle, precipitation and related data analysis, PMP, unit and synthetic hydrographs; evaporation and transpiration; floods and their management, PMF: streams and their gauging; river morphology; routing of floods; capacity of reservoirs.

(b) WATER RESOURCES ENGINEERING: Water resources of the globe; multipurpose uses of water; soil-plant-water relationship, irrigation systems, water demand assessment; storages and their yields, ground water yields and well hydraulics; waterlogging, drainage design; irrigation revenue; design of rigid boundary canals; Lacey's and Tractive force concepts in canal design; lining of canals; sediment transport in canals; non-overflow and overflow sections of gravity dams and their design, energy dissipaters and tail water rating; design of headworks, distribution works, falls, cross-drainage works, outlets; river training.

3. **ENVIRONMENTAL ENGINEERING:**

(a) Water Supply Engineering: Sources of supply, yields, design of intakes and conductors; estimation of demand; water quality standards; control of waterborne diseases; primary and secondary treatment, detailing and maintenance of treatment units, conveyance and distribution systems of treated water, leakage and control rural water supply; institutional and industrial water supply.

(b) Waste Water Engineering: Urban rain water disposal; systems of sewage collection and disposal; design of sewage systems, pumping; characteristics of sewage and its treatment, disposal of products of sewage treatment, stream flow rejuvenation; institutional and industrial sewage management; plumbing systems; rural and semi urban sanitation.

(c) SOLID WASTE MANAGEMENT: Sources, classification, collection and disposal; design and management of landfills.

- (d) AIR AND NOISE POLLUTION AND EXOLOGY:* sources and effects of air pollution, monitoring of air pollution; noise pollution and standards; ecological chain and balance, environmental assessment.
4. *(a) SOIL MECHANICS:* Properties of soils, classification and interrelationship; compaction behavior, methods of compaction and their choice; permeability and seepage, flow nets. Inverted filters, compressibility and consolidation; shearing resistance, stresses and failure, soil testing in laboratory and in-situ; stress path and applications; earth pressure theories, stress distribution in soil, soil exploration, samplers. Load tests, penetration tests.
- (b) FOUNDATION ENGINEERING:* Types of foundations, selection criteria, bearing capacity, settlement, laboratory and field tests; types of piles and their design and layout, foundations on expansive solid, swelling and its prevention, foundation on swelling soils.
5. *(a) SURVEYING:* Classification of surveys, scales, accuracy; measurement of distances-direct and indirect methods; optical and electronic devices; measurement of directions, prismatic compass, local attraction; theodolites-types; measurement of elevations-spirit and trigonometric leveling; relief representation; contours; digital elevation modeling concept; establishment of control by triangulations and traversing-measurements and adjustment of observations, computation of coordinates; field astronomy, concept of global positioning system; map preparation by plane tabling and by photogrammetry; remote sensing concepts, map substitutes.
- (b) TRANSPORTATION ENGINEERING:* Planning of highway system, alignment and geometric design, horizontal and vertical curves, grade separation; materials and construction methods for different surfaces and maintenance; principles of pavement design; drainage.

Traffic surveys; intersections, signaling; mass transit system. Accessibility, net working. Tunneling, alignment, methods of construction, disposal of muck, drainage, lighting and ventilation, traffic control, emergency management.

Planning of railway systems, terminology and designs, relating to gauge, track, controls, transits, rolling stock, tractive power and track modernization; maintenance; appurtenant works; containerization.

Harbours-layout, shipping lanes, anchoring, location identification; littoral transport with erosion and deposition; sounding methods; dry and wet docks, components and operations; tidal data and analysis.

Airport-layout and orientation; runway and taxiway design and drainage management; zoning laws; visual aids and air traffic control; helipads, hangers, service equipment.

SYLLABUS FOR ET- ELECTRICAL

1. EM THEORY:

Electrical and magnetic fields. Gauss's Law and Amperes Law. Fields in dielectrics, conductors and magnetic materials. Maxwell's equations. Time varying fields. Plane-wave propagation in dielectric and conducting media. Transmission lines.

2. ELECTRICAL MATERIALS:

Band theory, conductors, semi-conductors and insulators. Super-conductivity. Insulators for electrical and electronic applications. Magnetic materials. Ferro and Ferri magnetism. Ceramics, properties and applications. Hall effects and its applications. Special semiconductors.

3. ELECTRICAL CIRCUITS:

Circuits elements. Kirchoff's Laws. Mesh and Nodal analysis. Network Theorems and applications. Natural response and forced response. Transient response and steady state response for arbitrary inputs. Properties of networks in terms of poles and zeros. Transfer function. Resonant circuits. Three phase circuits. Two-port networks. Elements of two-element network synthesis.

4. MEASUREMENTS AND INSTRUMENTATION:

Units and standards. Error analysis. Measurement of current. Voltage, Power, Power-factor and energy. Indicating instruments. Measurement of resistance, inductance, capacitance and frequency. Bridge measurements. Electronic measuring instruments. Digital Voltmeter and frequency counter Transducers and their applications to the measurement of non-electrical quantities like temperature, pressure, flow-rate displacement, acceleration, noise level etc. Data acquisition systems. A/D and D/A converters.

5. CONTROL SYSTEMS:

Mathematical modeling of physical systems. Block diagrams and signal flow graphs and their reduction. Time domain and frequency domain analysis of linear dynamical system. Errors for different type of inputs and stability criteria for feedback systems. Stability analysis using Routh-Hurwitz array. Nyquist plot and Bode plot. Root Locus and Nicols chart and the estimation of gain and phase margin. Basic concepts of compensator design. State variable matrix and its use in system modeling and design. Sampled data system and performance of such a system with the samples in the error channel. Stability of sampled data system. Elements of nonlinear control analysis. Control system components, electromechanical, hydraulic pneumatic components.

1. ELECTRICAL MACHINES AND POWER TRANSFORMERS:

Magnetic circuits-analysis and design of power transformers. Construction and testing. Equivalent circuits losses and efficiency. Regulation auto-transformer. 3 phase to former. Parallel operation. Basic concepts in rotating machines. EMF, torque, basic machine types construction and operation, leakage, losses and efficiency.

B.C. Machines construction, excitation method, circuit models, Armature reaction and commutation, characteristics and performance analysis. Generators and motors.

Starting and speed control. Testing losses and efficiency.

Synchronous machines. Construction. Circuit model. Operating characteristics and performance analysis. Synchronous reactance. Efficiency. Voltage regulation, Salient-pole machine. Parallel operation. Hunting short circuit transients.

Induction machines. Construction. Principle of operation. Rotating fields. Characteristics and performance. Analysis. Determination of circuit model. Circle diagram. Starting and speed control. Fractional KW motors. Single phase synchronous and induction motors.

2. POWER SYSTEM: Types of Power Stations, Hydro Thermal and Nuclear Stations. Pumped storage plant. Economics and operating factors.

Power transmission lines, Modeling and performance characteristics. Voltage control. Load flow studies. Optimal power system operation. Load frequency control. Symmetrical short circuit analysis. Zbus formulation. Symmetrical components. Per Unit representation. Fault analysis. Transient and steady-state stability of power systems. Equal area criterion.

Power System Transients. Power systems protection circuit breakers. Relays HVDC transmission.

3. ANALOG AND DIGITAL ELECTRONICS AND CIRCUITS:

Semiconductor device physics, PN junctions and transistors, circuit models and parameters, FET, Zener, Tunnel, Schottky, photo diodes and their applications, rectifier circuits, voltage regulators and multiplier switching behavior of diodes and transistor.

Small signal amplifiers, biasing circuits, frequency response and improvement, multistage amplifiers and feedback amplifiers, D.C. amplifiers, oscillators, large signal amplifiers, coupling amplifier, push pull amplifier, operational amplifier, wave shaping circuits, multivibrators and flip-flops and their applications. Digital logic gate families, universal gates combinational circuits for arithmetic and logic operation, sequential logic circuits. Counters, registers RAM and ROMS.

4. MICRO PROCESSORS: Microprocessors architecture-instruction set and simple assembly language programming. Interfacing for memory and I/Q. applications of micro processors in power system.

5. COMMUNICATION SYSTEMS: Types of modulation. AM, FM and PM. Demodulation. Noise and bandwidth considerations. Digital communication systems. Pulse code modulation and demodulations. Elements of sound and vision broadcasting. Barrier communication. Frequency division and time division multiplexing, telemetry system in power engineering.

6. POWER ELECTRONICS: Power semiconductor devices. Thyristor. Power transistor, GTOs and MOS-FETs. Characteristics and operation. AC to DC converters: 1 phase and 3 phase DC to DC converters.

AC regulators. Thyristor controlled reactors, switched capacitor networks. Inverters: Single-phase and 3 phase. Pulse with modulation. Sinusoidal modulation with uniform sampling switched mode power supplies.

SYLLABUS OF ET- FINANCE

1. Accounting

- Accounting Standards, Introduction to Accounting Standards, Overview of Accounting Standard AS1: Disclosure of Accounting Policies, AS 2: Valuation of Inventories AS 3: Cash Flow Statements, AS 6: Depreciation Accounting, AS 7: Construction Contracts, AS 9: Revenue Recognition, AS 10: Accounting for Fixed Assets, AS 13: Accounting for Investments, AS 14: Accounting for Amalgamation - Financial statements of Company- Preparation of financial statements- Cash flow Statement (Profit and Loss Account, Balance Sheet and Cash Flow Statement)-Profit/Loss prior to incorporation- Accounting for Bonus Issue, Amalgamation and Reconstruction, Average Due Date and Account Current, Self-Balancing Ledgers, Financial Statements of Not-for-Profit Organizations, Accounts from Incomplete Records, Accounting for Special Transactions.
- Hire purchase and instalment sale transactions , Investment accounts , Insurance claims for loss of stock and loss of profit Issues in Partnership Accounts , Accounting in Computerized Environment.

2. Business Laws

- The Indian Contract Act, 1872
- The Negotiable Instruments Act, 1881
- The Payment of Bonus Act, 1965
- The Employees' Provident Fund and Miscellaneous Provisions Act, 1952
- The Payment of Gratuity Act, 1972

3. Company Law

- The Companies Act, 2013, Preliminary, Prospectus, Share and Share capital
- Appointment of Auditors
- Audit Committee
- Powers of Board of Directors
- Dividend/Bonus Shares

4. Cost Accounting

- Introduction to Cost Accounting, Materials, Labour, Overheads, Non-Integrated Accounts, Methods, Job and Batch, Contract, Operating, Process and Operation, Standard Costing, Marginal Costing, Budgets and Budgetary Control.

5. Financial Management

- Scope and Objectives of Financial Management, Time Value of Money, Financial Analysis and Planning, Financing Decisions, Types of Financing, Investment Decisions, Management of working capital.

6. Tax

- The Income-tax Act, 1961, Basic concepts, Residential status and scope of total income, Incomes which do not form part of total income (Sec 10), 5 Heads of income, Provisions of Clubbing, Set-off and carry forward of losses, Deductions from gross total income, Computation of total income and tax payable. Provisions concerning Advance tax and TDS, Provisions for filing of return of income.

GST: Concept of Supply under GST, Input Tax Credit under GST, Place of Supply, Concept of Inverted Duty Structure, GST TDS provisions, E- invoicing under GST, E-way Bill provisions, Invoice/Debit Note/Credit Note rules and timelines.

7. Advanced Accounting

- Conceptual Framework for Preparation and Presentation of Financial Statements Accounting standards,

AS 4: Contingencies and Events occurring after the Balance Sheet Date

AS 5: Net Profit or Loss for the Period, Prior Period Items and Changes in Accounting Policies

AS 11: The Effects of Changes in Foreign Exchange Rates

AS 12: Accounting for Government Grants

AS 16: Borrowing Costs

AS 19: Leases

AS 20: Earnings per Share AS 26: Intangible Assets

AS 29: Provisions, Contingent Liabilities and Contingent Assets

• Advanced Issues in Partnership Accounts, Company Accounts, Employee stock option plan and Buy back of securities, Amalgamation and Reconstruction, Underwriting of shares and debentures, Redemption of debentures, Accounting for Special Transactions, Insurance Companies, Banking Companies, Electricity Companies, Departmental accounts, Branch accounts including foreign branches.

8. Auditing and Assurance

• Auditing Concepts, Auditing and Assurance Standards, Preparation for an Audit, Internal Control, Vouching, Verification of Assets and Liabilities, Company Audit, Audit Report, Special Audit.

9. Managerial Accounting

- Accounting Principles and Standards, Preparation of Financial Statements
- Financial Statement Analysis – Ratio Analysis, Funds Flow and Cash Flow Analysis, DuPont Analysis
- Preparation of Cost Sheet, Marginal Costing, Cost Volume Profit Analysis
- Standard Costing & Variance Analysis
- Financial Management, Concept & Functions
- Capital Structure – Theories, Cost of Capital, Sources and Finance
- Budgeting and Budgetary Control, Types and Process, Zero base Budgeting
- Leverages – Operating, Financial and Combined Leverages, EBIT–EPS Analysis, Financial Breakeven Point & Indifference Level

10. Financial Management

- Value & Returns – Time Preference for Money, Valuation of Bonds and Shares, Risk and Returns;
- Capital Budgeting – Nature of Investment, Evaluation, Comparison of Methods;
- Risk and Uncertainly Analysis
- Dividend – Theories and Determination
- Mergers and Acquisition – Corporate Restructuring, Value Creation, Merger Negotiations, Leveraged Buyouts, Takeover
- Portfolio Management – CAPM, APT
- Derivatives – Options, Option Payoffs, Option Pricing, Forward Contracts & Future Contracts
- Working Capital Management – Determinants, Cash, Inventory, Receivables and Payables Management, Factoring
- International Financial Management, Foreign exchange market

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SYLLABUS OF ET- Human Resources

1- Principles and Practices of Management: Development of management Thought, • Contributions of Taylor, Fayol, Mayo, Mary Parker Follett and C.I. Barnard. • Behavioural Approach, • Systems Approach, • Quantitative Approach and • Contingency Approach. • Function of Management: Planning and Decision Making, Organising, Staffing, Directing, Controlling, Coordinating and communication.

2- HRM • Human Resource Management: Conceptual framework, Line and Staff, Human Resource Planning, Job Analysis, • Recruitment, Selection, • Placement, Induction, • Training and Development, • Performance Management, • Job Evaluation, • Compensation Management, • Employee Benefits and Incentives, Wage and Salary Administration, Methods of Wage payment linking wages with productivity • Managing Career. • Grievance handling and Disciplinary action • New Trends in HRM: Changing environment of HRM and contemporary challenges, Emerging HRM Concepts • Potential Assessment • Employee Engagement.

3- HRD and International HRM • Human Resource Development (HRD): Concepts, Assumptions, Values, • HRD Mechanisms, Action – research Model, • HRD Culture and Climate, HRD Interventions, • HR Accounting and Audit, • Knowledge Management, • Human Resource Information System. • International Human Resource Management (IHRM): Organisational context of IHRM, • IHRM and Sustainable Business, • Functions of IHRM, • Cross – Cultural Studies, Cultural Diversity, • Training and Development, Quality of work life, Career planning, Quality circles, Training programmes for workers, Management Development Programmes, Evaluation of training • Training Need assessment.

4- Organizational behaviour • Organisational Behaviour: Concept, Scope, Nature of human behaviour, • Personality, • Perception, • Learning, • Attitude, • Motivation, • Interpersonal Behaviour, • Group Dynamics, • Leadership, • Communication, • Power and Authority, • Stress, • Job satisfaction, Morale, fatigue and monotony • Organisational Change and Development, Organisational effectiveness.

5- Industrial Relations and Trade Unions • Industrial Relations: Concept, Scope, Evolution, Approaches, Actors and Models, • Conflict and cooperation, Bi-partitism, Tri-partitism, • Collective Bargaining, • Workers' Participation in Management, • Grievance Handling and Disciplinary Action, Code of Conduct, • Industrial Relations in changing scenario, • Employers' organisations. • Trade Unions: Concepts, Evolution, • Problems of trade unions in India, Recognition, • The Trade Unions Act, 1926. • Union Politics, Inter and Intra Union Rivalry • Emerging role of trade unions in India, Industrial relations and the new economic reforms.

6- Industrial Disputes: Concept, Scope, Approaches, Industrial Relations system • Causes, Effects, Trends, Prevention and Settlement, Methods and Machinery for the settlement of Industrial Disputes • Role of State and Central Labour Administration, • Strike and Lockout • The Industrial Employment (Standing Orders) Act, 1946. • The Industrial Disputes Act, 1947.

7- Labour Laws • Labour Legislation: Objectives, Principles, Classification and Evolution. • International Labour Organisation, • Social Justice and Labour Legislation, • Indian Constitution and Labour Laws. • The Factories Act, 1948. • The Mines Act, 1952. • The Contract Labour (Regulation and Abolition) Act, 1970. • Employee Compensation Act 1923 • RPwD Act-2016 • Maternity Benefit act 1961 • ESIC Act 1948 • Workmen's Compensation Act, 1923, Public Premises (Eviction of Unauthorized Occupants) Act, RTI Act 2005, CSR under Section 135 of Companies Act.

8- Labour Laws regarding Wages • Wages: Concept, Types, Factors influencing wages, Wage Theories and Wage Differentials • The Minimum Wages Act, 1948. • The Payment of Wages Act, 1936. • The Payment of Bonus Act, 1965. • The Equal Remuneration Act, 1976. • The Payment of Gratuity Act, 1972. • The Employees' Provident Fund and Miscellaneous Provisions Act, 1952, Coal Mines Provident Fund and Miscellaneous Provisions Act, 1948.

9- Labour Welfare • Labour Welfare: Concept, Scope, Types, Theories, Principles and approaches • Industrial Health and Hygiene, • Statutory and Non-statutory labour welfare: Intra- mural and extra- mural welfare • Industrial Accidents and Safety, • Occupational Diseases • Social Security: Concept and Scope, Social Assistance and Social assurance • Agencies of Labour Welfare: State, Employer, Trade Unions, Voluntary Agencies.

10- Wage Code- New Wage Code, The Code on Wages, 2019; the Industrial Relations Code, 2020; the Occupational Safety, Health and Working Conditions Code, 2020; and the Code on Social Security, 2020.

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SYLLABUS FOR ET-INSTRUMENTATION ENGINEERING

Section 1: Engineering Mathematics

Linear Algebra: Matrix algebra, systems of linear equations, consistency and rank, Eigenvalue and Eigenvectors. Calculus: Mean value theorems, theorems of integral calculus, partial derivatives, maxima and minima, multiple integrals, Fourier series, vector identities, line, surface and volume integrals, Stokes, Gauss and Green's theorems. Differential Equations: First order equation (linear and nonlinear), second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy's and Euler's equations, initial and boundary value problems, solution of partial differential equations: variable separable method. Analysis of Complex Variables: Analytic functions, Cauchy's integral theorem and integral formula, Taylor's and Laurent's series, residue theorem, solution of integrals. Probability and Statistics: Sampling theorems, conditional probability, mean, median, mode, standard deviation and variance; random variables: discrete and continuous distributions: normal, Poisson and binomial distributions. Numerical Methods: Matrix inversion, solutions of non-linear algebraic equations, iterative methods for solving differential equations, numerical integration, regression and correlation analysis.

Section 2: Electricity and Magnetism

Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium, Capacitance of simple configurations, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Lorentz force, Inductance, Magnetomotive force, Reluctance, Magnetic circuits, Self and Mutual inductance of simple configurations.

Section 3: Electrical Circuits and Machines

Voltage and Current Sources: Independent, dependent, ideal and practical; v-i relationships of resistor, inductor, mutual inductance and capacitor; transient analysis of RLC circuits with dc excitation. Kirchoff's laws, mesh and nodal analysis, superposition, Thevenin, Norton, maximum power transfer and reciprocity theorems. Peak-, average- and rms values of AC quantities; apparent-, active- and reactive powers; phasor analysis, impedance and admittance; series and parallel resonance, locus diagrams, realization of basic filters with R, L and C elements. transient analysis of RLC circuits with ac excitation. One-port and two-port networks, driving point impedance and admittance, open-, and short circuit parameters. Single Phase Transformer: Equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three phase induction motors: principle of operation, types, performance, torque-speed characteristics, no-load and blocked rotor tests, equivalent circuit, starting and speed control; Types of losses and efficiency calculations of electric machines.

Section 4: Signals and Systems

Periodic, aperiodic and impulse signals; Laplace, Fourier and z-transforms; transfer function, frequency response of first and second order linear time invariant systems, impulse response of systems; convolution, correlation. Discrete time system: impulse response, frequency response, pulse transfer function; DFT and FFT; basics of IIR and FIR filters.

Section 5: Control Systems

Feedback principles, signal flow graphs, transient response, steady-state-errors, Bode plot, phase and gain margins, Routh and Nyquist criteria, root loci, design of lead, lag and leadlag compensators, state-space representation of systems; time-delay systems; mechanical, hydraulic and pneumatic system components, synchro pair, servo and stepper motors, servo valves; on-off, P, PI, PID, cascade, feed forward, and ratio controllers, tuning of PID controllers and sizing of control valves.

Section 6: Analog Electronics

Characteristics and applications of diode, Zener diode, BJT and MOSFET; small signal analysis of transistor circuits, feedback amplifiers. Characteristics of ideal and practical operational amplifiers; applications of opamps: adder, subtractor, integrator, differentiator, difference amplifier, instrumentation amplifier, precision rectifier, active filters, oscillators, signal generators, voltage controlled oscillators and phase locked loop, sources and effects of noise and interference in electronic circuits.

Section 7: Digital Electronics

Combinational logic circuits, minimization of Boolean functions. IC families: TTL and CMOS. Arithmetic circuits, comparators, Schmitt trigger, multi-vibrators, sequential circuits, flipflops, shift registers, timers and counters; sample-and-hold circuit, multiplexer, analog-to-digital (successive approximation, integrating, flash and sigma-delta) and digital-to-analog converters (weighted R, R-2R ladder and current steering logic). Characteristics of ADC and DAC (resolution, quantization, significant bits, conversion/settling time); basics of number systems, Embedded Systems: Microprocessor and microcontroller applications, memory and input-output interfacing; basics of data acquisition systems, basics of distributed control systems (DCS) and programmable logic controllers (PLC).

Section 8: Measurements

SI units, standards (R, L, C, voltage, current and frequency), systematic and random errors in measurement, expression of uncertainty - accuracy and precision, propagation of errors, linear and weighted regression. Bridges: Wheatstone, Kelvin, Megohm, Maxwell, Anderson, Schering and Wien for measurement of R, L, C and frequency, Q-meter. Measurement of voltage, current and power in single and three phase circuits; ac and dc current probes; true rms meters, voltage and current scaling, instrument transformers, timer/counter, time, phase and frequency measurements, digital voltmeter, digital multimeter; oscilloscope, shielding and grounding.

Section 9: Sensors and Industrial Instrumentation

Resistive-, capacitive-, inductive-, piezoelectric-, Hall effect sensors and associated signal conditioning circuits; transducers for industrial instrumentation: displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure (including low pressure), flow (variable head, variable area, electromagnetic, ultrasonic, turbine and open channel flow meters) temperature (thermocouple, bolometer, RTD (3/4 wire), thermistor, pyrometer and semiconductor); liquid level, pH, conductivity and viscosity measurement. 4- 20 mA two-wire transmitter.

Section 10: Communication and Optical Instrumentation

Amplitude- and frequency modulation and demodulation; Shannon's sampling theorem, pulse code modulation; frequency and time division multiplexing, amplitude-, phase-, frequency-, quadrature amplitude, pulse shift keying for digital modulation; optical sources and detectors: LED, laser, photo-diode, light dependent resistor, square law detectors and their characteristics; interferometer: applications in metrology; basics of fiber optic sensing. UV-VIS Spectrophotometers, Mass spectrometer.

SYLLABUS FOR ET-MECHANICAL ENGINEERING

- 1. THEORY OF MACHINES:** Kinematic and dynamic analysis of planer mechanism. Gears, Gears and gear trains, Flywheels. Governors, balancing of rigid rotors and field balancing. Balancing of single and multicylinder engine. Linear vibration analysis of mechanical systems. Critical speeds and whirling of shafts automatic controls.
- 2. MACHINE DESIGN:** Design of Joints: Cotter, keys, splines, welded joints, threaded fasteners, joints formed by interference fits. Design of friction drives: Couplings and clutches, belt and chain drives, power screws. Design of power transmission systems: Gears and gear drives shaft and axle, wire ropes.
- 3. STRENGTH OF MATERIALS:** Stress and strain in two dimensions, principle stresses and strains, Mohr's construction, linear elastic materials, isotropy and anisotropy, stress-strain relations, uniaxial loading, thermal stresses. Beams: Bending moment and shear force diagram, bending stresses and deflection of beams. Shear stress distribution. Torsion of shafts, helical springs. Combined stresses, thick and thin-walled pressure vessels. Struts and columns. Strain energy concepts and theories of failure.
- 4. ENGINEERING MATERIAL:** Basic concepts on structures of solids. Crystalline materials. Defect in crystalline materials. Alloys and binary phase diagrams. Structure and properties of common engineering materials. Heat treatment of steel, plastics, ceramics and composite materials, common applications of various materials.
- 5. PRODUCTION ENGINEERING:** Metal Forming: Principles of forging, drawing and extrusion; high energy rate forming, powder metallurgy.
Metal Casting: Die casting, investment casting, sand moulding, centrifugal casting, gating and riser design, melting furnaces.

Fabricating Processes: Principles of gas, arc, shielded arc welding, advanced welding processes, weldability, metallurgy of welding.

Metal Cutting: Turning, methods of screw production, drilling, boring milling, gear manufacturing, production of flat surfaces, grinding and finishing processes, computer controlled manufacturing systems, CNC, DNC, FMS, automation and robotics, cutting tools materials, tool geometry, mechanism of tool wear, tool life and machinability, measurement of cutting forces. Economics of machining, unconventional machining processes. Jigs and fixtures. Fits and tolerance, measurement of surface texture, comparators alignment tests and reconditioning of machine tools.

- 6. INDUSTRIAL ENGINEERING:** Production Planning and Control: Forecasting moving average, exponential, smoothing, operations scheduling, assembly line balancing, product development, break-even analysis, capacity planning, PERT and CPM.

Control Operations: Inventory control-ABC analysis, EOQ model, materials requirement planning, job design, job standards, work measurement, Quality management-Quality analysis and control, operations research: Linear programming-Graphical and simplex methods, transportation and assignment models. Single server queuing model. Value Engineering: Value analysis for cost/value.

7. ELEMENTS OF COMPUTATION: Computer organization, flow charting, features of common computer language-FURTRAN. Base III, Lotus 1-2-3. C and elementary programming.

1. THERMODYNAMICS: Cycles and IC engines, basic concepts, open and closed systems. Heat and work. Zeroth, first and second law, application to non-flow and flow processes. Entropy, availability, irreversibility and Tds relations. Claperyron and real gas equations, properties of ideal gases and vapours. Standard vapour, gas power and refrigeration cycles. Two stage compressor. C-I and S.I engines. Pre-ignition, detonation and diesel-knock, fuel injection and carburetion, superogarging. Turbo-prop and rocket engines, engine cooling, emission and control, flue gas analysis, measurement of calorific values. Conventional and nuclear fuels, elements of nuclear power production. Heat transfer and refrigeration and air-conditioning. Modes of heat transfer. One dimensional steady and unsteady conduction, composite slab and equivalent resistance.

2. Heat dissipation from extended surfaces, heat exchangers, overall heat transfer coefficient, empirical correlations for heat transfer in laminar and trubulent flow and for free and forced convection, thermal boundary layer over a flat plate. Fundamentals of diffusive and connective mass transfer, black body and basic concepts in radiation, enclosure theory, shape factor, not work analysis. Heat pump and refrigeration cycles and systems, refrigerants. Condensers, evaporators and expansion devices, psyhtrometry, charts, and application to air conditioning, sensible heating and cooling effective temperature, confort, indices, load calculations, solar refrigeration, control, duct design.

3. FLUID MECHANICS: Properties and classification of fluids, manometry, forces on immersed surfaces, Center or pressure, Buoyancy, elements of stability of floating bodies. Kinematics and Dynamics.

Irrotational and incompressible, inviecid flow velocity potential, pressure field and forces on immersed bodies. Bernoulli's equation, fully developed flow through pipes, pressure drop calculations, measurement of flow rate and pressure drop. Elements of boundary layer theory, integral approach, laminar and turbulent flows, seorations, flow over weirs and notches. Open channel flows, hydraulic jump. Dimensionless numbers, dimensional analysis, similitude and lodelling. One dimensional isentropic flow, normal shock wave, flow through convergent-divergent ducts, oblique shock-wave, rayleigh and fanno lines.

4. FLUID MACHINERY AND STEAM GENERATORS: Performance, operation and control of hydraulic pump and impulse and reaction turbines, specific speed, classification. Energy transfer coupling, power transmission, steam generators fire-tubes and water-tube boilers. Flow of steam through nozzles and diffusers, wetness and condensation. Various types of steam and gas turbines, velocity diagrams. Partial admission, reciprocating, centrifugal and axial flow compressors, multistage compression, role of mach number, reheat, regeneration, efficiency, governance.

SYLLABUS FOR ET-METALLURGICAL ENGINEERING

Engineering Mathematics

Linear Algebra: Matrices and Determinants, Systems of linear equations, Eigen values and Eigen vectors.

Calculus: Limit, Continuity and Differentiability; Partial derivatives; Maxima and minima; Sequences and series; Test for convergence; Fourier series.

Vector Calculus: Gradient; Divergence and Curl; Line, Surface and volume integrals; Stokes, Gauss and Green's theorems.

Differential Equations: Linear and non-linear first order ODEs; Higher order linear ODEs with constant coefficients; Cauchy's and Euler's equations; Laplace transforms; PDEs – Laplace, one dimensional heat and wave equations.

Probability and Statistics: Definitions of probability and sampling theorems, conditional probability, Mean, median, mode and standard deviation; Random variables; Poisson, normal and binomial distributions; Analysis of experimental data; linear least squares method.

Numerical Methods: Solutions of linear and non-linear (Bisection, Secant, Newton-Raphson methods) algebraic equations; integration by trapezoidal and Simpson's rule; single and multi- step methods for differential equations.

Metallurgical Thermodynamics

Laws of Thermodynamics: First law – energy conservation, Second law - entropy; Enthalpy, Gibbs and Helmholtz free energy; Maxwell's relations; Chemical potential; Applications to metallurgical systems, solutions, ideal and regular solutions; Gibbs phase rule, phase equilibria, binary phase diagram and lever rule, free-energy vs. composition diagrams; Equilibrium constant, Activity, Ellingham and phase stability diagrams; Thermodynamics of point defects, surfaces and interfaces, adsorption and segregation phenomena.

Electrochemistry: Single electrode potential, Electrochemical cells, Nernst equation, Potential-pH diagrams.

Transport Phenomena and Rate Processes

Momentum Transfer: Concept of viscosity, shell balances, Bernoulli's equation, mechanical energy balance equation, flow past plane surfaces and through pipes.

Heat transfer: Conduction, Fourier's Law, 1-D steady state conduction. **Convection:** Heat transfer coefficient relations for forced convection.

Radiation: Black body radiation, Stefan-Boltzman Law, Kirchhoff's Law.

Mass Transfer: Diffusion and Fick's laws, Mass transfer coefficients.

Dimensional Analysis: Buckingham Pi theorem, Significance of dimensionless numbers.

Basic Laws of Chemical Kinetics: First order reactions, reaction rate constant, Arrhenius relation, heterogeneous reactions, oxidation kinetics.

Electrochemical Kinetics: Polarization.

Mineral Processing and Extractive Metallurgy

Comminution techniques, Size classification, Flotation, Gravity and other methods of mineral beneficiation; Agglomeration: sintering, pelletizing and briquetting.

Material and Energy balances in metallurgical processes; Principles and processes for the extraction of non-ferrous metals – aluminium, copper and titanium.

Iron and Steel Making: Material and heat balance in blast furnace; Structure and properties of slags and molten salts – basicity of slags - sulphide and phosphate capacity of slags; Production of metallurgical coke. Other methods of iron making (COREX, MIDRE)

Primary Steel Making: Basic oxygen furnace, process dynamics, oxidation reactions, electric arc furnace.

Secondary Steel Making: Ladle process – deoxidation, argon stirring, desulphurization, inclusion shape control, principles of degassing methods; Basics of stainless steel manufacturing.

Continuous Casting: Fluid flow in the tundish and mould, heat transfer in the mould, segregation, inclusion control.

Physical Metallurgy

Chemical Bonding: Ionic, covalent, metallic, and secondary bonding in materials, Crystal structure of solids – metals and alloys, ionic and covalent solids, and polymers.

X-ray Diffraction: Bragg's law, optical metallography, principles of SEM imaging.

Crystal Imperfections: Point, line and surface defects; Coherent, semi-coherent and incoherent interfaces.

Diffusion in Solids: Diffusion equation, steady state and error function solutions; Examples homogenization and carburization; Kirkendall effect; Uphill diffusion; Atomic models for interstitial and substitutional diffusion; Pipe diffusion and grain boundary diffusion.

Phase Transformation: Driving force, Homogeneous and heterogeneous nucleation, growth Kinetics Solidification in isomorphous, eutectic and peritectic systems, cast structures and macrosegregation, dendritic solidification and constitutional supercooling, coring and microsegregation.

Solid-state Transformations: Precipitation, spinoidal decomposition, ordering, massive transformation, discontinuous precipitation, eutectoid transformation, diffusionless transformations; Precipitate coarsening, Gibbs-Thomson effect.

Principles of heat treatment of steels, TTT and CCT diagrams; Surface hardening treatments; Recovery, recrystallization and grain growth; Heat treatment of cast iron and aluminium alloys. Electronic, magnetic and optical properties of materials.

Basic forms of corrosion and its prevention.

Mechanical Metallurgy

Strain tensor and stress tensor, Representation by Mohr's circle, elasticity, stiffness and compliance tensor, Yield criteria, Plastic deformation by slip and twinning.

Dislocation Theory: Edge, screw and mixed dislocations, source and multiplication of dislocations, stress fields around dislocations; Partial dislocations, dislocation interactions and reactions.

Strengthening Mechanisms: Work/strain hardening, strengthening due to grain boundaries, solid solution, precipitation and dispersion.

Fracture behaviour, Griffith theory, linear elastic fracture mechanics, fracture toughness, fractography, ductile to brittle transition.

Fatigue: Cyclic stress strain behaviour - low and high cycle fatigue, crack growth.

Mechanisms of high temperature deformation and failure; creep and stress rupture, stress exponent and activation energy.

Manufacturing Processes

Metal Casting: Mould design involving feeding, gating and risering, casting practices, casting defects.

Hot, Warm and Cold Working of Metals: Metal forming – fundamentals of metal forming processes of rolling, forging, extrusion, wire drawing and sheet metal forming, defects in forming.

Metal Joining: Principles of soldering, brazing and welding, welding metallurgy, defects in welded joints in steels and aluminium alloys.

Powder Metallurgy: production of powders, compaction and sintering.

Non-destructive Testing (NDT): Dye-penetrant, ultrasonic, radiography, eddy current, acoustic emission and magnetic particle inspection methods.