# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
# ANANTAPURAMU 515 002 A.P.

## FULL TIME / EXTERNAL RESEARCH PROGRAMMES (Ph.D./M.Phil./M.S.)- 2014
## SYLLABI FOR ENTRANCE TEST

**Objective**: To test the proficiency of students to do research in concerned area.
**Note**: The syllabus is framed on the lines of GATE/GPAT/NET examinations and of the level of Post Graduation and so as to cover different specializations. There will be sixty objective type questions spread over the syllabus given below: The entrance test will be of one hour duration.

## CIVIL ENGINEERING

**Strength of Materials :** Bending moment and shear force in statically determinate beam.Simple stress and strain relationship: Stress and strain in two dimensions, principal stresses, stress transformation Mohr's circle Simple bending theory flexural and shear stresses.
unsymmetrical bending, shear centre. Thin walled pressure vessels, uniform torsion,buckling of column, combined and direct bending stresses.

**Structural Analysis:** Analysis of statically determinate trusses, arches, beams, cables and frames, displacements in statically determinate structures and analysis of statically indeterminate structures by force / energy methods, analysis by displacement methods (slope deflection and moment distribution methods), influence lines for determinate and indeterminate structures. Basic concepts of matrix methods of structural analysis.

**Concrete Structures:** Concrete Technology- properties of concrete, basics of mix design –Special Concretes - Concrete design basic working stress and limit state design concepts,analysis of ultimate load capacity and design of members subjected to flexure, shear, compression and torsion by limit state methods. Basic elements of prestressed concrete, analysis of beam sections at transfer and service loads, IS Code provisions.

**Steel Structures:** Analysis and design of tension and compression members, beams andbeam-columns, column bases. Connections- simple and eccentric, beam-column connections, plate girders and trusses Plastic analysis of beams and frames, IS Code provisions.

**Soil Mechanics:** Origin of soils, soil classification, three - phase system, fundamental definitions; relationship and interrelationships, permeability and seepage, effective stress principle, consolidation, compaction, shear strength.

**Foundation Engineering:** Sub-surface investigations- scope, drilling bore holes, sampling, penetration test, plate load test. Earth pressure theories, effect of water table, layered soils. Stability of slopes- infinite slopes finite slopes. Foundation types-foundation design requirements. Shallow foundations- bearing capacity effect of shape, water table and other factors, stress distribution, settlement analysis in sands and clays. Deep foundations - pile types, dynamic and static formulae, load capacity of piles in sands and clays, negative skin friction.

**Fluid Mechanics and Hydraulics:** Properties of fluids, principle of conservation of mass, momentum, energy and corresponding equations, potential flow, applications of momentum and Bernoulli' s equation laminar and turbulent flow in pipes, pipe networks. Concept of boundary layer and its growth. Uniform flow, critical flow and gradually varied flow in channels, specific energy concept, hydraulic jump. Forces on immersed bodies, flow measurements in channels, tanks and pipes. Dimensional analysis and hydraulic modeling. Kinematics of flow, velocity triangles and specific speed of pumps and turbines.

**Hydrology:** Hydrologic cycle, rainfall, evaporation, infiltration, stage discharge relationships, unit hydrographs, flood estimation, reservoir capacity, reservoir and channel routing. Well hydraulics.

**Irrigation:** Duty, delta, estimation of evapo-transpiration. Crop water requirements. Design of: lined and unlined canals, waterways, head works, gravity dams and spillways. Design of weirs on permeable foundation. Types of irrigation system, irrigation methods. Water logging and drainage, sodic soils.

**Environmental Engineering**

**Water requirements:** Quality standards, basic unit processes and operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, sludge disposal, effluent discharge standards. Domestic wastewater treatment, quantity of characteristics of domestic wastewater, primary and secondary treatment Unit operations and unit processes of domestic wastewater, sludge disposal.

**Air Pollution:** Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

**Municipal Solid Wastes:** Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/recycle, energy recovery,treatment and disposal).

**Noise Pollution:** Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

**Transportation Engineering**

**Highway Planning:** Geometric design of highways, testing and specifications of paving materials, design of flexible and rigid pavements.

**Traffic Engineering:** Traffic characteristics, theory of traffic flow, intersection design, traffic signs and signal design, highway capacity.

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# ELECTRICAL ENGINEERING

## 1. Electric Circuits, Fields & Measurements:

**Electric Circuits:** Network elements – Ohm's law and Kirchhoff's laws – formation of mesh and nodal equations – topological description of networks – response of R, L and C elements to arbitrary excitations - Laplace transform method of analyzing networks. Network theorems – Superposition Thevenin's Norton's Maximum power transfer reciprocity theorems – applications – Two port parameters – Z, Y, ABCD, H parameters – their relationships - A.C. Circuits – single phase circuits – j-notation – calculations – resonance – Polyphase – circuits – measurements of polyphase power.
**Electromagnetic theory** – general relations in static fields – potential gradient and field intensity – flux density – Gauss's law – Poisson and Laplace equations – relations in electromagnetic fields – ampere's was – flux and flux density – divergence and curl – vector magnetic potential.
**Electrical measurements** – Types of measuring instruments – Principles of operation – extension of ranges – instrument transformers.

## 2. Control Systems and Electronics:

**Control Systems:** – Types of servo mechanisms – equations and models of linear systems block diagrams – time response of second order systems – stability criteria – root locus technique – frequency response – Nyquist criterion – Bode plots.
**Electronics**: Solid-state devices and circuits – small signal amplifier design – feedback amplifiers – Oscillators – FETS – Logic Circuits – 8086 Microprocessor – 8051 Micro Controller – their peripheral devices and interfacing

## 3. Electrical Machines:

**Principles of Electromechanical Energy Conversion**: Basic ideas of production of torque-concepts of generation of voltages – formulae for voltage and torque production.
**Three phase induction motors**: The revolving field theory – Principles of operation of induction motor – torque eqaution – Computation of performance – torque speed characteristics – motor starters – conventional and thyristor controllers for speed control of induction motors.
**Single phase motors**: Revolving field theory – types of single-phase motors –equivalent circuits – speed control – applications.
**Synchronous machines**: Generation of 3-phase voltages – types of synchronous machines – equivalent circuit – experimental determination of reactances – voltage regulation and efficiency –parallel operation – transient and sub transient reactances –synchronous motors – theory of operation – phase of diagram – equivalent circuit –performance and power factor control – applications.
**Special machines**: Two phase servomotors – stepper motors – methods of operation –metadyne and amplidyne – operating characteristics and applications.
**D.C. Machines** – Generators – emf equation – types of excitation – characteristics –efficiency – parallel operation – Motors – operation – torque equation – types –characteristics – speed control – losses – efficiency - testing
**Transformers**: Single phase transformers – construction – operation – equivalent circuit – regulation – efficiency – testing and parallel operation - accessories of transformers & cooling – three phase transformers – Auto transformers

## 4. Power Systems:

**Generation**: Methods of power generation – steam, hydro, nuclear, diesel – selection of site for each – general layout of each type – function of each component – economics and different types – base and peak load stations – pumped stations – simple calculations in hydro station design.
**Transmission**: A.C. Vs. D.C. transmission – criteria for selection of voltages – transmission line parameters – G.M.D. and G.M.R – concepts for short, medium and long lines – line calculations – A,B, C

and D constants – load flow analysis – surge impedance loading. Corona and insulators: production of corona – disruptive and visual corona – corona loss – methods to avoid corona – types of insulators – string efficiency.
**Fault analysis**: Per unit representation: fault analysis – Symmetrical and unsymmetrical faults – application of symmetrical components.
**Protection**: Switch gear – methods of arc extinction – classification of circuit breakers – definitions – calculations in switch gear – testing of circuit breakers – Relaying principles – primary and back up relaying – definitions – operation of different types of relays – applications to line, transformer and generator protection – protection of lines and equipment against voltage surges – traveling wave theory.

**5. Power Electronics:**

Thyristors – their characteristics – methods of triggering – rating – protection - Commutation - Controlled Rectifiers – AC & DC Choppers – Inverters – Cycloconverters.

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# MECHANICAL ENGINEERING

1. Engineering Mechanics: Free body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion, including impulse and momentum (linear and angular) and energy formulations; impact.

Strength of Materials: Stress and strain, stress-strain relationship and elastic constants, Mohr's circle for plane stress and plane strain thin cylinders shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts.

2. Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels.Vibrations: Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance, critical speeds of shafts.

3. Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints, shafts, spur gears, rolling and sliding contact bearings, brakes and clutches.

4. Fluid Mechanics: Fluid properties; fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum Bernoulli's equation viscous flow of incompressible fluids boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends.

5. Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, unsteady state heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes; radiative heat transfer, black and grey surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.

6 Thermodynamics: Zeroth, First and Second laws of thermodynamics; thermodynamic system and processes; Carnot cycle. irreversibility and availability; behaviour of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion.

7. Power Engineering: Rankine, Brayton cycles with regeneration and reheat. I.C. Engines:air-standard Otto, Diesel cycles. Turbo-machinery: Pelton-wheel, Francis and Kaplan turbines — impulse and reaction principles, velocity diagrams.

Refrigeration and air-conditioning: Vapour compression refrigeration cycle, heat pump, gas refrigeration, moist air: psychrometric properties, basic psychrometric processes.

8. Engineering Materials: Structure and properties of engineering materials, heat treatment, stress strain diagrams for engineering materials. Principles of powder metallurgy.

9. Metal Casting: Design of patterns, moulds and cores; solidification and cooling; riser and gating design, design considerations. Forming: Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; Joining: Physics of welding, brazing and soldering; adhesive bonding.

10. Machining and Machine Tool Operations: Mechanics of machining, single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-raditional machining processes; principles of work holding, principles of design of jigs and fixtures , Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools.

11. Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

12. Production Planning and Control: Forecasting models, aggregate production planning, scheduling. Operations Research:Linear programming, simplex and duplex method,transportation, assignment, network flow models, simple queuing models, PERT and CPM.

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## ELECTRONICS AND COMMUNICATIONS ENGINEERING

1. Kirchoff's laws and its applications-nodal & mesh analysis, network theorems transient analysis, two-port networks, network functions, network topologies-network synthesis.

2.Diode characteristics, rectifiers, filters and regulators, transistor and FET characteristics & applications, biasing and stabilization, small signal and large signal amplifiers, feedback amplifiers & oscillators, single-stage, multi-stage amplifiers, power & tuned amplifiers.

3.Linear wave shaping, non-linear wave shaping, multi vibrators, time-base generators, sampling gates, op-amps, characteristics and application, timers & phase locked loops, D to A and A to D converters, analog multipliers, network theorems, network types, transient analysis and filter design.

4.Modulation, AM,FM,PM,SSB,DSB, noise in analog modulation, transmitters and receivers, pulse modulation, Source coding techniques, base band & pass band digital modulation techniques, undamentals of mobile & wireless communications. Signal analysis, Fourier series representation of periodic signals, Fourier transforms, convolution and correlation of signals, sampling theorem and types, Laplace transforms and z-transforms, discrete Fourier series & transforms, realization of digital filters, IIR & FIR filters.

5.Boolean algebra and switching functions, minimization of switching functions, combinational and sequential circuits, logic design, CMOS logic, memories: ROM. RAM, SRAM, DRAM, IC technology. Overview of 8085, architecture of 8086 microprocessor, registers, addressing modes, instructions, directives, procedures and macro, interfacing devices 8237/8257, 8255, 8259, 8251, RS 232, 8051 MICROCONTROLLER, Interfacing, interrupts etc..

6.Fundamentals of electromagnetic fields, time invariant & time varying - Maxwell's equations, EM wave characteristics, guided waves, transmission lines, antenna fundamentals, antenna arrays, VHF, UHF and Microwaves Antennas, wave propagation, wave guides, microwave tubes, microwave solid state devices and measurements, radar systems, tracking radar, radar receivers.

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## COMPUTER SCIENCE AND ENGINEERING

1.**Theory of Computation:** Regular languages and finite automata, Context free languages and Push-down automata, Recursively enumerable sets and Turing machines.

2.**Digital Logic:** Logic functions, Minimization, Design and synthesis of combinational and, sequential circuits; Number representation and computer arithmetic (fixed and floating point).

3.**Computer Organization and Architecture:** Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface (Interrupt and DMA mode), Instruction pipelining, Cache and main memory, Secondary storage.

4.**Programming and Data Structures:** Programming in C; Functions, Recursion, Parameter passing, Scope, Binding, Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Priority queues, Binary search trees.

5.**Algorithms:** Analysis, Asymptotic notation, Notions of space and time complexity, Worst and average case analysis; Design: Greedy approach, Dynamic programming, Divide and conquer, Tree and graph traversals, Connected components, Spanning trees, Shortest paths, Hashing, Sorting, Searching.

6.**Compiler Design:** Lexical analysis, Parsing, Syntax directed translation, Runtime environments, Intermediate and target code generation, Basics of code optimization.

7.**Operating System:** Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems, I/O systems, Protection and security.

8.**Databases:** ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query languages (SQL),FileStructures (sequential files, indexing, B and B+ trees), Transactions and concurrency control, Recovery.

9.**Computer Networks:**Reference models, LAN technologies (Ethernet, Token ring), Flow and error control techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IP(v4), Application layer protocols (icmp, dns, smtp, pop, ftp, http), Basic concepts of hubs,switches, gateways, and routers.

10. **Software Engineering Methodologies :** Software process models – Software requirements management – Requirementengineering, Elicitation, Analysis, Requirements development and validation, Requirements testing – Object oriented analysis and design – Modular design, Architectural design, User interface design, Real time software design, System design, Data acquisition system – Software testing and quality assurance – SQA fundamentals, Quality standards, Quality metrics, Software testing principles, Defects, Test case design strategies, Software quality and reusability, Software project management, Software cost estimation, Function point models, Software configuration management, Software maintenance.

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# CHEMICAL ENGINEERING

**I. Process Calculations and Thermodynamics:**
Laws of conservation of mass and energy; use of tie components; recycle, bypass and purge calculations; degree of freedom analysis. First and Second laws of thermodynamics. First law application to close and open systems. Second law and Entropy Thermodynamic properties of pure substances: equation of state and departure function, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibria.

**II. Fluid Mechanics and Mechanical Operations:**
Fluid statics, Newtonian and non-Newtonian fluids Bernoulli's equation,Macroscopic friction factors, energy balance, dimensional analysis, shell balances, flow through pipeline systems, flow meters, pumps and compressors, packed and fluidized beds,elementary boundary layer theory, size reduction and size separation; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, mixing and agitation; conveying of solids.

**III.Heat Transfer:** Conduction, convection and radiation, heat transfer coefficients, steady and unsteady heat conduction, boiling, condensation and evaporation; types of heat exchangers and evaporators and their design.

**Mass Transfer:** Fick's law, molecular diffusion in fluids, mass transfer coefficients, film penetration and surface renewal theories; momentum, heat and mass transfer analogies; stage wise and continuous contacting and stage efficiencies; HTU & NTU concepts design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction,drying, humidification, dehumidification and adsorption.

**IV. Chemical Reaction Engineering:**
Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, non-ideal reactors; residence time distribution, single parameter model; non-isothermal reactors; kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis.

**V. Instrumentation and Process Control:** Measurement of process variables; sensors, transducers and their dynamics, transfer functions and dynamic responses of simple systems, process reaction curve, controller modes (P, PI, and PID); control valves; analysis of closed loop systems including stability, frequency response and controller tuning, cascade, feed forward control.

**VI. Chemical Technology:** Inorganic chemical industries; sulfuric acid, NaOH, fertilizers (Ammonia, Urea, SSP and TSP); natural products industries (Pulp and Paper, Sugar, Oil, and Fats); petroleum refining and petrochemicals; polymerization industries; polyethylene, polypropylene, PVC and polyester synthetic fibers.

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# PHARMACEUTICAL SCIENCES

I.**Pharmaceutical Analysis:** Principles, instrumentation and applications of the following: Absorption Spectroscopy (UV, visible & IR). Fluorimetry, Flame Photometry, Potentiometry, Conductometry and Plarography. Pharmacopoeial assays. Principles of NMR, ESR, Mass Spectroscopy, and different chromatographic methods. Concepts of qualitative and quantitative analysis, fundamentals of volumetric analysis concepts of GMP and GLP.

II.**Pharmaceutical Chemistry**: Structure, nomenclature, classification, synthesis, SAR and metabolism of the following category of drugs & Stereochemistry of drug molecules. Hypnotics and Sedatives, Analgesics, NSAIDS, Neuroleptics, Antidepressants, Anxiolytics, Anticonvulsants, Antihistaminics, Local Anaesthetics, Cardio Vascular drugs – Antianginal agents Vasodilators, Adrenergic & Cholinergic drugs, Cardiotonic agents, Diuretics, Antihypertensive drugs, Hypoglycemic agents, Antilipedmic agents, Coagulants, Anticoagulants, Antiplatelet agent. Chemotherapeutic agents – Antibiotics, Antibacterials, Sulphadrugs. Antiproliozoal drugs, Antiviral, Antitubercular, Antimalarial, Anticancer, Antiomoebic drugs. Diagnostic agents. Preparation and storage and used of official Vitamins and Hormones.

III.**Pharmacology:** General pharmacological principles including Toxicology. Drug interaction, Pharmacology of drugs acting on central nervous system, cardiovascular system, Autonomic nervous system, Gastro intestinal system and Respiratory system. Pharmacology of Autocoids, Hormones, Hormone antagonists, Chemotherapeutic agents including anticancer drugs. Bio assays, immuno Pharmacology. Drugs acting on the renal system. Drug – Drug interactions and Drug-Food interactions. Adverse drug reactions.

IV.**Pharmocognosy:** Pharmacognosy of crude drugs that contain the following constituents. Alkaloids, Glycosides, Terpenoids, Steroids, Bioflavanoids, Purines, volatile oils, resins, seponines. Chemistry, tests, isolation, Characterization and estimation of phyto pharmaceuticals belonging to the above groups. Study of mineral drugs like bentonite, kaolin, talc and kieselguhr. Standardization of raw materials and herbal products. Quantitative microscopy including modern techniques used for evaluation of crude drugs. Biotechnological principles and techniques for plant development, Tissue culture. Fermentation technology and its applications in pharmacy.

V. **Pharmaceutics:** Development, manufacturing standards Q.C. limits, labeling, as per the Pharmacopoeal requirements, Storage of different dosage forms like solid dosage forms, liquid dosage forms, semi-solid dosage forms and aerosols and of new drug delivery systems Biopharmaceutics and Pharmacokinetics and their importance in formulation. A details study of buffers and isotonic solutions, solubility of pharmaceuticals, interfacial phenomena, colloids, stability of colloids, rheology, thixotropy and its applications, micro meritics. A details study of the concept of chemical kinetics and their application in pharmacy.

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# MATHEMATICS

## UNIT – I

**REAL ANALYSIS :-** Limit of a Function – Continuity – Differentiation - Rolle's theorem, LaGrange's- Riemann Integration - Open and closed sets, Compact sets.

## UNIT – II

**COMPLEX ANALYSIS** : - Special functions -Functions of complex variable - Complex integration - Complex power series - Calculus of Residues - Argument principle and Rouches's theorem - Conformal mapping.

## UNIT – III

**DIFFERENTIAL EQUATIONS** :- Order and degree of a differential equation formation of D.E. - D.E. of first order and first degree - Linear D.E. with constant and variable coefficients - Formation of partial D.E. - Equations of first order.

## UNIT – IV

**NUMERICAL METHODS**: - Transcendental and polynomial equations - Regula falsi method - Newton Raphson method – Interpolation - Numerical diffferention - Numerical Integration - Runge Kutta method.

## UNIT – V

**MATRICES** :- Inverse of a matrix - Rank of a matrix - Solution of Linear equations -Eigen values, Eigen vectors and Cayley Hamilton theorem - Diagonalization and Quadratic forms.

## UNIT – VI

**VECTOR CALCULUS** :- Differential Operators - Directional derivative – Divergence – Curl - Vector Integration - Gauss Integration theorem - Green's theorem - Stoke's theorem

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# CHEMISTRY

**Unit-1**: **Chemistry of non- transition and transition elements**: General discussion on the properties of the non-transition elements; Allotropy of Carbon, Graphitic compounds, Carbides, Carboranes, Oxides and Oxy – acids of Phosphorous: Phosphazenes. Electronic structure and Oxidation states of Halogens; Interhalogen Compounds; Pseudo halogens and Pseudo halides; Chemistry of Xenon; Structure and Bonding in Xenon compounds. Co-ordination chemistry of transition metal ions, valence bond theory, Crystal field theory, splitting of d-orbitals, Jahn-Tellar effect, electronic spectra, Nephelauxetic effect, Zeeman and Stark effect, Spectral and magnetic properties of f-block elements.

**Unit-2: Catalysis**: Types of Catalytic Reagents; Types of Catalysis; Theory of Homogeneous catalysis; Theory of Heterogeneous catalysis; Kinetics of heterogeneous reactions. Specificity in Enzyme Catalyzed reactions; Michaelis- Menten mechanism; Influence of Concentration and temperature on Enzyme-Catalyzed reactions; Acid-base catalysis.

**Unit-3: Chemical Kinetics**: Introduction to Kinetics; first order, second order and third order reactions; Fast reactions; Rate constants of fast reactions; their determination. Ionic reactions; Influence of solvent on the rate of reactions; Primary salt effect; Secondary salt effect; Influence of frequency factor; Influence of ionic strength.

**Unit-4: Stereochemistry:** Classification of isomers into structural and stereo types-Optical Isomerism - Elements of symmetry and chirality - Configuration of optically active molecules - DL and RS notations - Relative and Absolute configurations- Resolution of Racemic mixtures. Absolute asymmetric synthesis - Asymmetric induction - Stereospecific and Regiospecific synthesis - Cram's rule - Optical Isomerism of Nitrogen compounds - Concept of dynamic enantiomerism. Cis-Trans isomerism; E-Z configuration - Interconversion of geometrical isomers and determination of their configuration; Stereo chemistry of oximes and Beckmann rearrangement - Conformational analysis of acyclic systems like ethane and n-butane and cyclic systems like cyclohexane.

**Unit-5: Reactive intermediates**: Classical and non-classical Carbocations-Carbanions-free radicals-radical anions, radical cations- Carbenes – Nitrenes and Arynes – general methods of generation, detection and reactivity – singlet oxygen – generation and reaction with organic substrates.

**Unit-6: UV-Visible and IR Spectroscopy:** Introduction; Absorption Laws; Theory of Electronic Spectroscopy; Chromophore concept; Auxochrome; Solvent effect; Instrumentation; Woodward – Fischer rules for calculating absorption maxima in dienes and $\alpha$, $\beta$-unsaturated carbonyl compounds; Steric hindrances and co-planarity; Estimation of ligand-metal ratio in complexes; Applications. IR Spectroscopy: IR spectrometer, Sampling techniques, Interpretation and applications of IR Spectra.

**Unit-7: Elimination and Substitution Reactions**: Classification $E_1$, $E_2$, $E_1CB$ and Pyrolytic mechanism – Orientation in elimination reaction – Hofmann and Zaitsev products. Substitution Reactions**:** substitution in benzene; formation of $\sigma$ and $\pi$ complexes; Orientation and Reactivity in benzene ring containing one and more than one substituent; Directing effect of substituent already on benzene ring; Effect of electrophile; Effect of leaving group ; Orientation and Reactivity in naphthalene, phenanthrene and Anthracene; Electrophilic aromatic substitution in activated benzene derivatives; Riemer-Tiemann reaction; Vilsmeier-Haack reaction; Houben-Hoesch reaction; Diazo-Coupling; Hofmann -Martius rearrangement.; $SN^1$, $SN^2$ and benzyne mechanisms; Reactivity and Orientation in nucleophilic aromatic substitution.

**Unit-8: Heterocyclic Chemistry**: General survey and nomenclature of five and six member heterocycles of O, N, and S – Chemistry of Pyrazole, Imidazole, Oxazole, Thiazole and study of azines such as pyridazine, pyrimidine and pyrazine: study of oxygen heterocycles such as chromones and coumarins.

**Unit-9: Molecular Rearrangements**: Classification and general mechanism of molecular reaarangements –Mechanism of the following rearrangements: Wagner-Meerwin, Pinacol- Pinacolone, Wolf, Hoffmann, Schmidt, Beckmann and Benzil-Benzilic acid rearrangements.

**Unit-10: NMR Spectroscopy**: Principles of NMR Spectroscopy; Characteristics of a PMR Spectrum such as number of signals, Chemical shift, Integration, Spin-Spin coupling etc. Ring current effects Aromaticity, Diamagnetic Anisotropic effects. Nuclear Magnetic Resonance – A closer look; Coupling constants; Karplus Equation; Vicinal, geminal, vinylic and aromatic protons. Protons bound to heteroatoms; Protons bound to Oxygen – Effect of hydrogen bonding & chemical exchange; Hindered rotation; Spectrum of Dimethyl formamide. Simplification of PMR spectrum; Higher Resolution NMR; Double Resonance technique; Lanthanide shift reagents. $^{13}C$ NMR Spectroscopy; CW & FT methods; Proton Noise Decoupled and Off-Resonance Spectra.

**Unit-11: Mass Spectroscopy**: Basic principles; Instrumentation – The electron –impact mass spectrometer; GC-MS and Double Focussing instruments; Types of ions in the mass spectrometer – Meta-stable peaks – Mass spectral fragmentation patterns of some select class of organic compounds such as hydrocarbons, alcohols, acids etc. - Mc Lafferty rearrangement:

**Unit-12: Macromolecules**: Organic polymers – Classification, Principles of polymerization, types of polymers. Elastomers – Natural rubber – processing, structure, compounding, Synthetic Rubbers. Plastics – definition, classification and types and their method of preparation. Fibers – natural and artificial and their methods of preparation and uses. Inorganic polymers – preparation, properties and uses of the inorganic polymers. Determination of molecular weight and size, Experimental methods of their determination.

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# PHYSICS

Differential equations – Complex analysis – Matrices- Lagrange equations – Hamiltonian – Central forces – Canonical Transformations –
Principle of Least action.

Schroedinger wave equation – Boundary conditions – Uncertainty Principle – General formalism of wave mechanism – Harmonic Oscillator – Hydrogen atom – Special theory of relativity.

Micro canonical, canonical & Grand canonical ensembles – Ideal gas – Maxwell velocity distribution – Gibbs paradox – Sackur Tetrode equation – Entropy and probability – Partition functions – Molecular, Translational, Rotational and Vibrational Partition function.

Maxwell's equations – Propagation of EM waves in different medium – Pointing theorem – TE, TM & TEM waves – Attenuation – Impedances – Rectangular and Circular wave guides.

Crystallography – Bragg's law – X-Ray Diffraction techniques – Optical, Magnetic & superconducting properties of solids.

Nuclear models – Fission & Fusion reactions – Nuclear reactor – Decay theories.

Physics of Semiconductor devices and their characteristics (BJT, JFET, MOSFET,.MESFET), Photonic devices (LED, Laser, Photo Conductors Detectors and Solar cells).

Principles and characteristics of laser – Einstein Coefficient – Laser rate equations –

Principles of Optical Fibers – Numerical aperture – Acceptance angle – Fibers in communication.

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# BIO TECHNOLOGY

**Introduction to Biotechnology:** Introduction to biotechnology Chronological development of industrial biotechnology, Range of biotechnology products.

**Chemical foundations of biology:** pH, pK, acids, bases, buffers, weak bonds and covalent bonds.

**Biochemistry:** Structure and functions of Carbohydrates, Lipids, Proteins, Amino acids and Nucleic acids.

**Separation techniques:** Electrophoretic and chromatographic techniques (Affinity, Ion-exchange, Gel filtration TLC and HPLC) for separation of different biomolecules.

**Enzymes:** Introduction to enzymes, kinetics, inhibition and allosteric enzymes.

**Microbiology :** Morphological, Structural and Biochemical characteristics of prokaryotes; Pure culture techniques; The definition of growth, mathematical expression of growth; Principles of microbial nutrition, construction of culture media; Culture collection and maintenance of cultures.

**Molecular biology:** DNA & RNA Structure, Replication: Transcription Translation; Recombination Plasmids, Transposable elements, TY Elements.

**Process engineering principles:** Role of process engineering principles in biotechnological industries, Brief overview of fundamentals of chemical engineering - concepts of unit operation & unit processes.

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# FOOD TECHNOLOGY

1. Chemical bonding
2. Co-ordination compounds – Introduction, Crystal field theory, nomenclature and Werner's theory.
3. Phase rule: Introduction, terms, phase diagram and detailed application to water.
4. Adsorption: Introduction, Types of adsorption and factors affecting adsorption
5. Solutions: Introduction, Types, Colligative properties, Lowering of Vapour pressure, Osmotic pressure, Elevation of boiling point, Depression freezing point and Van'thoff factor.
6. Thermodynamics: Introduction, Laws of thermodynamics
7. Electro chemistry: Introduction, Conductors, Electrolysis, Ohms and Faradays laws of electrolysis, theories of ionization and ionic equilibrium.
8. Chemical Kinetics: Introduction, Rate of reaction, order of reaction - Pseudo order, Zero, First and Second.
9. Errors : Introduction, types of errors
10. Structure and reactivity of organic compounds: Introduction, hybridization, types of fissions, Types of reagents, Polarization effects, Types of reactions.
11. Classification and nomenclature of organic compounds
12. Preparation, properties, and uses of alkanes, alkenes, alkynes, and aromatic compounds and heterocyclic compounds.
13. Preparation, properties and uses of various functional groups: Alkyl halides, alcohols, ethers, carboxylic acids, esters, Nitrogen compounds, Active methylene group compounds.
14. Stereo chemistry and spectroscopy of organic compounds.
15. Carbohydrates, oils and fats, amino acids and proteins, dyes, alkaloids and terpens.

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# MANAGEMENT SCIENCE

Unit I: *Research aptitude*: Meaning, characteristics and types of research, steps of research, methods of research, research ethics, Characteristics and format of Thesis. Meaning and relevance of paper, research article, workshop, seminar, conference and symposium. Analysis and Interpretation of research data using statistical tools comprising parametric and non-parametric tests.

Unit II *Managerial Economics*: Demand Analysis, production function, cost output relations, market structures, pricing theories and methods.

Unit III *Business Environment*: Economic and legal Environment as applicable to Business in India, WTO, TRIPs and TRIMs, Fiscal and Monetary Policy of Government of India.

Unit IV: *Organizational Behaviour*: skills and roles in an organization, contemporary organization structures, understanding and managing individual behaviour, personality, perception, values and attitudes, learning, motivation, Understanding and managing group behaviour, interpersonal and group dynamics, Managing conflicts.

Unit V: *Human Resource Management*: Human resource planning, Recruitment, selection, Induction, training and development, performance management, compensation management. Basics of Industrial relations management.

Unit VI:*Financial Management*: Valuation concepts, capital budgeting decisions, capital structure and cost of capital, dividend policy, long term and short term financing instruments, mergers and acquisitions.

Unit VII:*Marketing Management*: Demand measurement and forecasting, market segmentation, product mix, product life cycle, new product development, branding and packaging, pricing strategies, promotion mix, advertising and personal selling, channel management, CRM, marketing of services.

Unit VIII *Production Management:* Facility location, layout planning, PPC, Determinants of product mix, production scheduling, work measurement, Time and motion study, SQC, Linear programming, Transportation models, queuing theory, decision theory, PERT/CPM.

Unit IX: *Strategic Management:* Elements of Strategy, SWOT Analysis, strategy formulation and execution, core competence and competitive advantage, contemporary strategies for stability, growth, turnaround and expansion.
Unit X: *Management Information Systems*: Technology issues and data processing in organizations, MIS and Decision Making, System Analysis and Design, trends in Information technology, internet and internet based applications.

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# ENGLISH

The questions for the exam will be based on M.A., (English. Litt.,) level aimed at testing the candidates'

(a) Awareness and comprehensive understanding of English literature.
(b) Knowledge of literary criticism and theory
(c) Literary sensibility in analyzing the given topic
(d) Clarity of thought and expression
(e) Writing ability

**Unit I : The Age of Shakespeare**

His works – Shakespearean Theatre and Audience – Shakespearean comedy, Tragedy, Romance and Historical Plays – Chief Characteristics of his Dramas.
For Detailed Study: The Merchant of Venice

**Unit II: Literature of the 18th Century**

Neo-Classicism – Satire – Rise of the English Novel – Sentimental Comedy – Transition Poetry – Periodicals Essay –Elegy.
For Detailed Study:

Thomas Gray "Elegy Written in a Country Churchyard"
Honathan Swift Gulliver's Travels
Daniel Defoe: Robinson Crusoe
Samuel Johnson: Preface to Shakespeare

**Unit III: Literature of the 19th Century**

Romanticism – Fancy and Imagination – Dramatic Monologue – Lyric – Gothic - Historical Novel.
For Detailed Study:

Hohn Keats "Ode To Nightingale"
"Ode On a Grecian Urn"
Charles Lamb "Dream Children"
"Old China"
Hane usten "Pride and Prejudice"

**Unit IV: 20th Century British Literature**

Stream of Consciousness – Modernism and Post Modernism – Symbolism - Existentialism – Movement Poetry- Theatre of the Absurd.
For Detailed Study:

T.S. Eliot : The Wasteland
D : Lawrence "Sons and Lovers"
Virginia Woolf " Room of One's Own"

**Unit V: Theory of Literary Criticism**

Literary Criticism – Function of Criticism – Various Trends And Approaches – New Criticism – Principles Of Criticism.
For Detailed Study:

Matthew rnold " "The Study of Poetry"
T S Eliot "Tradition and individual Talent"

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