



**OFFICE OF THE DIRECTORATE OF ADMISSIONS
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
KUKATPALLY, HYDERABAD – 500 085, TELANGANA**

**Full Time Ph.D. Admissions for the Academic Year 2019-20
Under TEQIP-III & Research Centers at Affiliated Institutions under JNTUH**

Entrance Examination Syllabus

CIVIL ENGINEERING

SECTION -I

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 and beam-columns, column bases. Connections- simple and eccentric, beam-column connections, plate girders and trusses Plastic analysis of beams and frames, IS Code provisions.

SECTION II

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.

SECTION-III

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, 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.

SECTION –IV

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.

SECTION V:

TRANSPORTATION ENGINEERING & SURVEING

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.

Surveying & Geomatics: Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying, Principles of levelling- booking and reducing levels; differential, reciprocal levelling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses; areas and volumes. *Triangulation and Trilateration*, Elements of simple and compound curves; Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station. *Remote Sensing (9 Hours):* Introduction Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image\ interpretation

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ELECTRICAL AND ELECTRONICS ENGINEERING

Circuit Theory: Single phase RC, RL, and RLC circuits, resonance, Three phase circuits, Network topology, Network theorems, RC, RL, RLC transients, ABCD, Z and Y parameters, two port networks.

Electromagnetic Fields:

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.

Electrical Machines:

Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three phase transformers: connections, parallel operation; Auto-transformer, Electromechanical energy conversion principles, DC machines: separately excited, series and shunt, motoring and generating mode of operation and their characteristics, starting and speed control of dc motors; Three phase induction motors: principle of operation, types, performance, torque-speed characteristics, no-load and blocked rotor tests, equivalent circuit, starting and speed control; Operating principle of single phase induction motors; Synchronous machines: cylindrical and salient pole machines, performance, regulation and parallel operation of generators, starting of synchronous motor, characteristics; Types of losses and efficiency calculations of electric machines.

Power Systems:

Power generation concepts, ac and dc transmission concepts, Models and performance of transmission lines and cables, Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Per-unit quantities, Bus admittance matrix, Gauss-Seidel and Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential and distance protection; Circuit breakers, System stability concepts, Equal area criterion.

Control Systems :

Mathematical modeling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs, Transient and Steady-state analysis of linear time invariant systems, Routh-Hurwitz and Nyquist criteria, Bode plots, Root loci, Stability analysis, Lag, Lead and Lead-Lag compensators; P, PI and PID controllers; State space model, State transition matrix.

Electrical and Electronic Measurements

Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers, Digital voltmeters and multimeters, Phase, Time and Frequency measurement; Oscilloscopes, Error analysis.

Power electronics: Converters and Inverters and Choppers. AC voltage regulators, control of DC motors using single phase and three phase converters and choppers. Control of induction motors with voltage source and current source inverters.

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MECHANICAL ENGINEERING

Applied Mechanics and Design

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; Euler's theory of columns; strain energy methods; thermal stresses.

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.

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.

Fluid Mechanics and Thermal Sciences

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 etc.

Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, unsteady 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; thermal boundary layer; effect of turbulence; radiative heat transfer, black and grey surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.

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.

Applications: *Power Engineering:* Steam Tables, Rankine, Brayton cycles with regeneration and reheat. *I.C. Engines:* air-standard Otto, Diesel cycles. *Refrigeration and air-conditioning:* Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air: psychrometric chart, basic psychrometric processes. *Turbomachinery:* Pelton-wheel, Francis and Kaplan turbines – impulse and reaction principles, velocity diagrams.

Manufacturing and Industrial Engineering

Engineering Materials: Structure and properties of engineering materials, heat treatment, stress- strain diagrams for engineering materials.

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; principles of powder metallurgy.

Joining: Physics of welding, brazing and soldering; adhesive bonding; design considerations in welding.

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-traditional machining processes; principles of work holding, principles of design of jigs and fixtures.

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.

Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools.

Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials requirement planning.

Inventory Control: Deterministic and probabilistic models; safety stock inventory control systems.

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 COMMUNICATION ENGINEERING

MICRO ELECTRONICS

Semi conductor physics, semiconductor Devices, single and multistage amplifiers, feedback amplifiers, oscillators, high frequency transistor circuits, and power amplifiers, linear and non-linear wave shaping circuits, differential amplifiers, operational amplifiers, linear and nonlinear applications of op-amp, PMOS, NMOS, CMOS, Bi-MOS technologies, VLSI technology, VLSI circuit design process, gate-level design using PLAs, FPGAs, CPLDs and PALs-design approach.

DIGITAL SYSTEM DESIGN

Logic families, Bipolar Logic & Interfacing, Digital ICs: Standard 74xx & CMOS 40xx series, Boolean Algebra, Combinational Circuits and their design, Design using VHDL, Sequential circuits and their design, Threshold Logic, 8085 & 8086 microprocessors-architecture, instruction set, addressing modes, 8051 microcontroller- architecture, modes of operation, interrupt structure, memory and I/O interfacing. Embedded systems-general purpose processors, state machine and concurrent process models, RTOS.

COMMUNICATIONS

Need for modulation, FDM, Analog modulation, AM and FM transmitters and receivers. Sampling, TDM, PCM, DM and ADM systems. Comparison of PSK, FSK, ASK and QPSK with reference to BW and Probability of error, matched filter, optimum filter, coherent and non-coherent reception, average information, Shannon's theorem, channel capacity, error detecting and error correcting codes, fundamentals of optical communication, types of fibers, attenuation, losses, dispersion, light sources and detectors. OSI and TCP/IP Models, network services, switching concepts, congestion, routing, error control, flow control and security. ISDN channels, services, ATM fundamentals, Multiple access techniques, co-channel interference, cell splitting Handoff mechanism, frequency response concept, basics of satellite communication, Spread Spectrum.

DIGITAL SIGNAL AND IMAGE PROCESSING

Linear Time invariant Systems, Analysis of signals and systems using Fourier transforms, z-transforms and Laplace transforms, DFT, FFT, multirate signal processing, power spectral estimation, and finite word length effects. Image processing fundamentals, enhancement in spatial and frequency domains. Lossless and Lossy compression methods, Image coding methods, compression standards, Edge detection using derivation operators, transformation, segmentation based on region growing methods.

ELECTRO MAGNETIC FIELDS, ANTENNAS AND MICROWAVES

Electrostatic and Magneto static fields, Maxwell's equations, EM wave characteristics, Guided waves, wave guides, Transmission lines, Antenna Fundamentals, Antenna Arrays, Low Frequency and High frequency antennas and Antenna Measurements wave propagation, Microwave tubes, solid state devices and components, microwave measurements.



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COMPUTER SCIENCE ENGINEERING

1. C/C++/Java Programming and Data Structures

Algorithm, Flowchart, C Language: Control Statements, Functions, Structures, Union and Files, Pointers, Concepts covering all aspects. Object Oriented Programming: Classes and Objects, Other object-oriented features, C++ & Java Programming. Data Structures: Simple and Abstract Data Types, Stacks, Queues, Linked Lists, Trees, Balanced Trees, Graphs, Searching and Sorting.

2. Discrete Structures, and Design & Analysis of Algorithms

Discrete Structures: Concepts of Propositional & Predicate Logic, Sets, Functions, Sequences, Sums, Matrices and Relations, Equivalence Relations, Partial Orderings, Induction, Recursion, Recurrence Relations. Algorithms: Complexity of Algorithms, Divide and Conquer, Greedy Method, Dynamic Programming, Searching and Traversal Techniques, Backtracking, Branch & Bound, NP Hard & NP Complete Problems.

3. Computer Organization and Advanced Architectures

Data representation and Arithmetic, Microprocessor Basics, E.g. 8085/86, CPU Organization, Memory Organization, I/O Organization, Interrupts, Micro Programming, Nano Programming, Memory Hierarchy, Cache, and Virtual Memory Concepts. Parallel Processing: Parallel Processing in Uniprocessor, Pipelining, SIMD and Vector Processing, Multi Programming, Data Flow Computing, and VLSI Computing.

4. Data Communication & Networks, Socket Programming & Distributed Systems:

Data Communication and Networks: Transmission Fundamentals, Signals, Media, Encoding And Modulation, Switching Techniques. OSI & TCP/IP Models, Functions, Concepts and Performance Details of all Layers. Network Programming: Sockets, TCP Client, Server, Multiplexing and Socket options, UDP Sockets, IPC and Remote Login. Distributed Systems: Communication, Synchronization, Distributed Deadlocks, Distributed File Systems, and Distributed Shared Memory.

5. Operating Systems and Systems Programming.

Process, CPU Scheduling, Process Synchronization, Deadlocks, Memory Management, File System Concepts, I/O Scheduling, UNIX Utilities, UNIX Internals, Threads and Signals, & Inter Process Communication. Systems Programming: Assemblers, Macros and Macro Processors, Loaders, and Linkers.

6. Automata Theory and Compiler Design

Chomsky Hierarchy, Grammars, Machines and their Designs, NP Hard and NP Complete Problems, Lexical, Syntax and Semantic Analysis, Top down & Bottom up Parsing, Intermediate Code Forms & Code Generation. Principles of Programming Languages: BNF Notation, Functional Programming, LISP, Scope & Extent, Overloading, and Concurrency & Natural Language Processing.

7. DBMS, Distributed Database Systems, and Mining

File Systems, Various Data Models, Relational Algebra and Calculus, Query Optimization and Evaluation, Database Design, Concurrency Control and Recovery, Storing and Indexing. Distributed Database: Distributed Database Design, Distributed Transaction Management, Concurrency Control, Recovery, and Reliability. Data Mining: Mining Primitives, Languages and System Architectures, Mining Association Rules, Classification and Prediction, and Cluster Analysis.

8. Software Engineering and UML

Generic View of Process, Process Models, Software Requirements, Requirement Engineering Process, System Models, Design Engineering, Object-Oriented Design, Performing User Interface Design, Testing Strategies, Plans for Testing, Preparing for the Tests, Management of Software Engineering, Software Engineering Tools and Environments, & UML Concepts.

9. Computer Graphics and Image Processing

Raster Scan Graphics, 2D & 3D Transformations, Viewing, Projection, Variable Surface Detection, Shading, Animation, Digital Image Processing: Fundamentals, Image Enhancement Techniques, Morphological Image Processing, Image Segmentation,

10. Miscellaneous Topics

Concepts of Cryptography & Network Security, and Communication Security. Cloud Computing. HTML, JavaScript/Jscript, Dynamic HTML, XML and Multimedia Systems. AI: Knowledge Representation, Reasoning Techniques, Game Playing and Learning.



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BIOTECHNOLOGY

1. Microbiology: Methods in microbiology, microbial nutrition, pure culture, isolation techniques, preservation, microbial growth, fermentation, process variables and production of r-DNA based food and allied products.
2. Molecular biology & Genetic engineering: DNA, RNA structure, replication, transcription, protein synthesis, plasmids, transposable elements, regulation of gene expression in Prokaryotes and Eukaryotes.

Molecular tools in r-DNA technology, cloning of DNA and RNA fragments, genomic and cDNA libraries, PCR, RT-PCR, DNA sequencing methods, analysis of gene expression, analysis of DNA polymorphism.

3. Cell biology & Immunology: Organization of structure and functions of Prokaryotic and Eukaryotic cells. Organization and function of cell organelles, organization of genome, cell division and cell cycle, apoptosis, cell transformation and cancer. Cellular communication.

Innate and adaptive immune system, cells and molecules involved in it. Structure and function of antibody molecules, monoclonal antibodies, MHC molecules, primary and secondary immune modulation, complement system, hypersensitivity, autoimmunity and Vaccines.

4. Biochemistry: Bioenergetics, metabolism and regulation of biomolecules (Amino acids, proteins, carbohydrates, nucleic acids and lipids). Protein structure, concept of pH, ionic structure and buffers. Photosynthesis.
5. Bioinformatics: Major Bioinformatics resources, Database search (ENTREZ, SRS, BLAST, FASTA), sequence analysis, multiple sequence alignments and its applications, applications in taxonomy and phylogeny. CATH, SCOP, FSSP, comparison of protein 3D structure, applications.

6. Plant and Animal biotechnology: Totipotency, plant tissue culture media, micropropagation, somatic hybridization, production of secondary metabolites, production of transgenic plants for agronomic and quality traits.

Animal cell culture medium, its components and significance, basic techniques of mammalian cell culture, engineering animal cells, applications of animal cell culture.

7. **Basic Chemical Engineering**: Process Calculations, Unit Operation, Fluid Mechanics, Thermodynamics, Heat Transfer, Mass Transfer.
8. **Enzyme Engineering**: Introduction to Enzymes, Enzyme Kinetics, Pre-Steady-State and Multi-Substrate Enzyme Kinetics, Factors Affecting Enzyme Activity, Active Site Studies, Enzyme Immobilization & Kinetics of Immobilization;
9. **Microbial Process Engineering**: Material Balances, Energy Balances, Media Optimization and Sterilization, Unstructured Model for Microbial growth, structured model for Microbial growth.
10. **Bioreactor Engineering**: Introduction to various types of Bioreactors, Mass transport in Bioreactors, Mass transfer correlation in Bioreactors, Momentum transport in stirred tank bioreactors, Non ideal reactors & Scale up scale down of Bioreactors,.
11. **Downstream Processing**: Scope of Downstream Processing, Solid-Liquid separation, Refolding, separation and purification, Product Crystallization and Drying, Scale up and scale down of downstream processing.

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Chemical Science & Technology

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-Teller 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 α,β -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 E₁, E₂, E₁CB and Pyrolytic mechanism – Orientation in elimination reaction – Hofmann and Zaitsev products.

Substitution Reactions: substitution in benzene; formation of σ and π 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.; Aryl halides; Low reactivity of aryl and vinyl halides; S_N¹, S_N² and benzyne mechanisms; Reactivity and Orientation in nucleophilic aromatic substitution; Von-Richter rearrangement and Sommelet- Hauser rearrangement.

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 rearrangements –Mechanism of the following rearrangements: Wagner-Meerwin, Pinacol-Pinacolone, Wolf, Tiffenov-Demjanov, Hoffmann, Curtius, Lossen, 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.Mechanics of Measurement; Instrumentation for Continuous wave PMR; 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; Spectrum of ethanol; Protons bound to Nitrogen; Effect of nuclear quadrupole moment; D₂O exchange process; Hindered rotation; Spectrum of Dimethyl formamide. Simplification of PMR spectrum; Higher Resolution NMR; Double Resonance technique; Lanthanide shift reagents. ¹³C NMR Spectroscopy; CW & FT methods; Proton Noise Decoupled and Off-Resonance Spectra; 2D – NMR spectroscopy; NOESY & COESY Techniques.

Unit-11: Mass Spectrometry and ESR 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:

Instrumentation of ESR, Quantitative analysis; Study of free radicals; Structure determination; Analytical applications.

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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ENVIRONMENT

UNIT-I Ecology and Environment

Definition, scope and principles of ecology, Physical, chemical, environmental factors and their relation to organisms; Climatic factors; Topographic (Physiographic) factors; Edaphic factors (Soil Science); Ecological adaptations; Population ecology; Ecological pyramids; Structure and functions of an ecosystem; Biomes and biodiversity. Ecological energetics - Energy flow in ecosystem; Food chains - role of producers and consumers. Nutrient cycles in ecosystem - biogeochemical cycles; Environmental management and pollution; Sustainable development; Environmental Impact Assessment; Environmental audits; Environmental laws: Water (P&P) and Air acts. Energy resources - renewable and non-renewable; Major ecosystems and ecosystem modeling.

UNIT-II Environmental Chemistry

Basic concepts and scope of environmental chemistry; Environmental segments- Atmosphere - Structure and composition of atmosphere, temperature inversion, Atmosphere photo-chemistry, Ozone depletion, Greenhouse effect, CFC's, SMOG, Acid rain. Environmental toxicology-Toxic chemicals in the environment and their biochemical effects.

UNIT-III Environmental Microbiology

Diversity of microorganisms; General characters, important uses and harmful effects of a) Protozoa, b) Algae, c) Fungi, d) Bacteria, e) Virus; Microbial nutrition, macronutrients, micronutrients, trace elements and growth factors; Nutrient media (selective, differential, enriched and enrichment) and growth conditions, Nutritional types; Bacterial growth curve, diversity, growth and nutritional requirements; Control of microorganisms- Inhibition of growth and killing, sterilization and disinfections; Characteristics of an antimicrobial agent; mode of action and factors affecting antimicrobial agent.

UNIT-IV Environmental Geology, Remote Sensing and GIS

Origin and age of earth, internal constitution of earth, geological processes, basic principles of structural geology, geomorphic cycle, definition and types of weathering, erosion cycle, denudation. Map terminology and map reading, map projections, evolution of map projection, explanations of reference lines on earth, developable projection surfaces- cylindrical, conical, azimuthal; map classifications. Aerial photogrammetry, classification of aerial photographs, air photo interpretation key elements. Basics and fundamental concepts of remote sensing, Electromagnetic radiation, Electromagnetic spectrum, Remote Sensing Platforms and Sensors, Image processing methods. Basic concepts of GIS, components of GIS, GIS categories, Fundamental operations of GIS, Theoretical framework of GIS, Basic spatial analysis in GIS. Introduction & components of GPS.

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UNIT-V Air Pollution and Control Technologies

Air pollution - types and sources; Air pollutants - classification and properties; Meteorological aspects of air pollution; Air pollution - sampling and measurement; Control methods-particulate and gaseous emissions; Automobile pollution; Air pollution laws and standards; Air quality modeling, data requirements for air quality modeling, modeling procedures.

UNIT-VI Water and Wastewater Treatment Technologies

Water resources - availability and use; Water management and conservation; Water pollution-types, sources and impacts; Water pollutants-types and measurement/analysis; Instrumental methods of analysis. Water treatment processes - Layout of treatment plant. Characterization and degree of treatment of wastewater, primary treatment, sedimentation, flotation, secondary (biological) treatment, design principles in biological treatment facilities, activated sludge process, trickling filters, sludge treatment and disposal; advanced wastewater treatment. Wastewater treatment for specific industries- sugar, paper and pulp, tannery etc.

Recommended Books:

1. Ecology, E.P. Odum, 1983, Holt-Saunders International Edition
2. Environmental Chemistry, A.K. De, New Age Intt. Pub. Co., New Delhi, 1990
3. Environmental Chemistry, B.K.Sharma S.H.Kaur Goel Publishing House, Meerut, 1992.
4. Waste Water Treatment, Metcalf & Eddy
5. Remote Sensing and GIS, M. Anji Reddy
6. Microbiology, Pelczar Reid & Chan, Tata Mc Graw Hill Publishing Company Ltd., 1996
7. Remote sensing and image interpretation, T.M. Lillesand and R.W. Keifer
8. Environmental Impact Assessment, Canter, L.W., 1977, McGraw Hills New York.
9. Hofmann wellenhof, B. Lichtenegger, H. and Collins, J. Global positioning system, Springer - Verlag, New york, 1994.
10. A text book of Geology by P.K. Mukharjee
11. EIA Theory and Practice by M.Anji Reddy , 2016, B.S. Publications

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Full Time Ph.D. Admissions for the Academic Year 2019-20
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Entrance Examination Syllabus

NANO SCIENCE & TECHNOLOGY

1. PHYSICAL CHEMISTRY

ATOMIC STRUCTURE : HYDROGEN SPECTRUM, PLANK'S QUANTUM THEORY
Bohr's theory of hydrogen atom, Energy levels and explanation of hydrogen spectra, limitations of Bohr's Theory. Quantum numbers, wave nature of electron and uncertainty principle – Schrodinger wave equation Dependence of probability functions on distance from nucleus and directions – shapes of atomic orbitals (Calculation involving frequency and Rydberg's constants), Concept of chemical bonding ionic bonding and covalent bonding.

CHEMICAL EQUILIBRIUM : Reversibility – Dynamic nature of equilibrium K_p , K_c and their interrelation, derivation of quantitative expression for equilibrium constants for a few typical reactions, factors effecting the equilibrium constants.

GASEOUS STATE: Kinetic theory of gases – Derivation of kinetic equation and deduction of gas laws – Mean free path, collision number and collision diameter – principles of equipartition of energy – Heat capacities for mono, di and tri atomic molecules deviation from gas laws – Vander wall's equation Critical phenomena – Isotherms of carbon dioxide – Determination of critical constants – Derivation of relation between Vander wall's constants and critical constants – law of corresponding states and its usefulness / applications.

2. SOLID STATE DEVICES & QUANTUM MECHANICS

Semiconductors: Intrinsic semiconductors, electrons and holes, Fermi level. Temperature dependence of electron and hole concentrations. Doping; impurity states, n and p type semiconductors, conductivity, mobility, Hall effect, Hall coefficient.

Origin of the quantum theory: Failure of classical physics to explain the phenomena such as black-body spectrum, photoelectric effect, Ritz combination principle in spectra, stability of an atom. Planck's radiation law, Einstein's explanations of photoelectric effect, Bohr's quantization of angular momentum and its applications to hydrogen atom, limitations of Bohr's theory.

Wave-particle duality and uncertainty principle: De Broglie's hypothesis for matter waves; the concept of wave and group velocity evidence for diffraction and interference of 'particles'.

Consequences of De Broglie's concepts; quantization in hydrogen atom; energies of a particle in a box, wave packets, Heisenberg's uncertainty relation for p and x , its extension to energy and time.

Consequences of the uncertainty relation: Gamma ray microscope, diffraction at a slit, particle in a box, position of electron in Bohr orbit.

Quantum Mechanics : Schrodinger's equation. Postulatory basis of quantum mechanics; operators, expectation values, transition probabilities, applications to particle in a one and three dimensional boxes, harmonic oscillator, reflection at a step potential, transmission across a potential barrier.

3. NANO TECHNOLOGY

Synthesis of Nano materials – various methods; Thin film fabrication methods; Biological building blocks, Nucleic acids – DNA double Nano wires, genetic code; MEMS & NEMS, Nano biosensors, DNA computing and quantum computing, size effects and properties of nano materials; various methods of Nano materials characterization, Molecular electronics quantum electronic devices, short channel M O S Transistor, RTD, RTBT multiplexer; Spintronics, spatial computing as molecular electronics, carbon nano tubes synthesis and types, fullerenes, applications.

4. NANO MATERIALS FOR ENERGY AND ENVIRONMENT AND NANO ETHICS:

Energy characteristics – Fundamentals of environment, Environmental impact assessment of nano materials used in energy and environmental applications and their properties. Device applications, Energy – Hydrogen storage and production – Fuel cells – Solar energy conversion; Nano materials in Automobiles. Nano ethics, Impact on society and environment.

5. MATERIALS SCIENCE:

Atomic structure and bonding in materials. Crystal structure of materials, crystal systems, unit cells and space lattices, miller indices of planes and directions, ionic and covalent solids. Concept of amorphous, single and polycrystalline structures and their effect on properties of materials.

Diffusion: Fick's laws and application of diffusion. Metals and Alloys: Solid solutions, solubility limit, phase rule, binary phase diagrams, intermediate phases, inter-metallic compounds, recrystallization and grain growth. Microstructure, properties and applications of ferrous and non-ferrous alloys.

6. ELECTRONICS & CONTROL SYSTEMS:

POWER SUPPLY : Diode as a circuit element, load line concept, rectification, ripple factor, zener diode, voltage stabilization, IC voltage regulation, characteristics of a transistor in CB, CE and CC mode, graphical analysis of the CE configuration, low frequency equivalent circuits, h-parameters, bias stability, thermal runaway.

System concept – mathematical models of physical systems – block diagram algebra – feedback characteristics – reduction in parameter variations by use of feed back – PID controllers – time response analysis – concept of stability – frequency response analysis.

References:

1. Introduction to Nano Technology by Charles. P. Poole Jr & Frank J. Owens. Wiley India Pvt. Ltd.
2. Solid State physics by Pillai; Wiley Eastern Ltd.
3. Nano Technology and Nano Electronics – Materials, devices and measurement Techniques by WR Fahrner – Springer.
4. Nano: The Essentials – Understanding Nano Science and Nanotechnology – by T.Pradeep; Tata Mc.Graw Hill.
5. Bio Nano Technology by Good Sell – Wiley Liss.
6. A text book of Quantum Mechanics by P.M.Mathews and K.Venkatesan, Tata McGraw.
7. Modern quantum mechanics By Sakurari addition.Wesly Longman inc. Hill.
8. Inorganic material synthesis and fabrication by JN Lalena etall John Welly and Sons inc.
9. James J Allen Micro Electro Mechanical System Design, CRC Press
10. K. Subramanyam – Micro Electro Mechanical system – A design Approach. Springer 2008
11. Tai – Ran HSW – MEMS & Micro systems design and manufacture Tata McGraw, New Delhi.
12. Thin Film Phenomenon by K.L Chopra McGraw Hill
13. Renewable energy sources by JJ.Twidell and Tweir E&F Spon Ltd.,
14. Fuel Cell Technology Hand book by Hoogers, CRC Press.
15. Characterization of nao Structured materials by ZL Wang.
16. Textbook of Nanoscience and Nanotechnology – B.S.Murthy,P.Shankar, Baldev Raj,B.B.Rath and James Murday, University Press-IIM Series in Metallurgy and Materials Science.



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Entrance Examination Syllabus
WATER RESOURCES

1. ECOLOGY & ENVIRONMENT:

Nature of Ecosystems, Energy flow in Ecosystems, Energy Fixation by Autotrophs, Energy beyond the Producers, Biogeochemical cycles and ecosystems, Population growth, Dynamics of ecological communities, National water Resources problems with reference to the environment of major river valley projects, global climate, Indian monsoon systems, Climate change its impact on water and Environment.

Suggested Reading Material: 1. Concepts of Ecology by E.J.Kormondy.

2. WATER POLLUTION AND WASTEWATER TREATMENT:

Water Quality requirements for drinking, Agricultural and Industrial uses, Surface and Groundwater Pollution problems with reference to BOD, COD and suspended matter in the surface water, Fluoride, Nitrate, Arsenic and Iron pollution problems in ground water of India. Water Treatment process, Sedimentation, Coagulation and Filtration, Advanced water treatment technologies- Reverse Osmosis, ultra filtration, microfiltration, secondary treatment and tertiary treatment.

Suggested Reading Material:

1. Elements of Public Health Engineering by K.N.Duggal
2. Environmental Engineering by G.S.Birdie
3. Wastewater Treatment and Disposal by Metcalf and Eddy

3. FUNDAMENTALS OF SURFACE HYDROLOGY:

Hydrologic Cycle- Precipitation: Different types and forms of precipitation and their mechanism. Rain Gauges, Evaporation and Transpiration: Concepts, measurements and factors affecting evaporation and transpiration. Infiltration-Concept, measurement and factors affecting infiltration, runoff, definition and factors affecting runoff, stream gauging – computation of runoff, rainwater harvesting, soil moisture measurement and management, methods of irrigation – Furrow, border strip, drip, Sprinkler, Soil and water conservation techniques.

Suggested Reading Material:

1. A Text book of Hydrology by P.Jayarami Reddy
2. Hydrology by H.M.Raghunath
3. Water Resources Engineering by Larry W. Mays.

4. FUNDAMENTALS OF GROUNDWATER HYDROLOGY:

Occurrence of groundwater in consolidated and unconsolidated formations – Types of aquifers, Properties – porosity, Specific Yield, Storativity, Hydraulic Conductivity and Transmissivity- Darcy's Law, Groundwater Management – Artificial recharging methods, geological and geophysical exploration of groundwater, well logging techniques, Types of wells, open wells, tube wells, construction of wells, groundwater modeling techniques.

Suggested Reading Material:

1. Groundwater Hydrology by D.K.Todd
2. Groundwater by H.M.Raghunath.



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Entrance Examination Syllabus

PHARMACEUTICAL SCIENCES

- I. **Pharmaceutical Analysis:** Principles, instrumentation and applications of the following: Absorption Spectroscopy (UV, visible & IR). Fluorimetry, Flame Photometry, Potentiometry, Conductometry and Polarography. Pharmacopoeial assays. Principles of NMR, ESR, Mass Spectroscopy, and different chromatographic methods (TLC, Column, Paper, HPLC, HPTLC, GC). 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, Antilipidemic agents, Coagulants, Anticoagulants, Antiplatelet agent. Chemotherapeutic agents – Antibiotics, Antibacterials, Sulphadugs. Antiprotozoal drugs, Antiviral, Antitubercular, Antimalarial, Anticancer, Antiamoebic 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. **Pharmacognosy:** Pharmacognosy of crude drugs that contain the following constituents. Alkaloids, Glycosides, Terpenoids, Steroids, Bioflavonoids, 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. Evaluation of Crude drugs, Adulteration of Crude drugs and their detection by various methods.

- V. **Pharmaceutics:** Development, manufacturing details of solids dosage forms, liquid dosage forms, Semi solid dosage form along with standards of 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.

- VI. A details study of buffers and isotonic solutions, solubility of pharmaceuticals, interfacial phenomena, colloids, stability of colloids, rheology, thixotropy and its applications, micro merits. A details study of the concept of chemical kinetics and their application in pharmacy. Advanced drug delivery systems.

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Entrance Examination Syllabus

MANAGEMENT SCIENCE

Objective: To test the proficiency of students to do research in Business Management.

Note: The syllabus is framed on the lines of UGCNET examination.

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. Leadership, Communications.

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

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. Working Capital Management.

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. Digital Marketing.

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. Supply Chain Management.

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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. Cultural Diversity, Managing International Business.

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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