**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**KUKATPALLY, HYDERABAD - 500 085, TELANGANA STATE, INDIA**

# EXTERNAL (PART TIME) Ph.D. PROGRAM 2025-26

## SYLLABII FOR ENTRANCE TEST

## 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, displace- ments 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.

**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, 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 unlinedcanals, 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 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.

Electro mechanical energy conversion, performance analysis of all types of DC generators and DC motors. Single phase transformers, equivalent circuit efficiency regulation parallel operation.

Induction motor torque calculations slip torque characteristic, equivalent circuit, performance analysis and speed control.

Synchronous generator emf calculation armature reaction regulation calculation using emf, mmf and ZPF methods. Synchronizing torque, parallel operation and effect of change of excitation and mechanical power input. Steady state, transient and subtransient reactances. Synchronous motor torque calculation V and inverted V curves.

Control Systems: Time domain analysis, Routh stability criterion and Root locus technique and frequency domain analysis compensation techniques and state variable method.

Power Systems: Transmission line parameters, performance of short, medium and long lines surges, traveling wave phenomenon, carona, insulators and cables. Power flow studies, economic operation, load frequency control symmetrical and unsymmetrical fault analysis and power system stability. Principles of over current, differential, impedance mho relays and their application. Different types of circuit breakers. Arc quenching methods, restriking voltage rate of restriking voltage.

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

1. **Thermodynamics.** Laws. Properties of ideal and real gases and vapors, Power Cycles, Gas Power Cycle, Gas Turbine Cycles, Fuels and Combustion.

2. **I. C. Engine.** C.I and S.I. Engines, Detonation. Fuel injection and carburetion. Performance and Testing. Turbo prop. Engines, Rocket Engines. Elementary knowledge of Nuclear Power Plants and Nuclear Fuels.

3. Steam Boilers, Engines, Nozzles and Steam Turbines. Modern boilers. Steam Turbines, Types. Flow of steam thorough nozzles. Velocity diagrams for Impulse and Reaction Turbines. Efficiencies and Governing.

4. **Compressors, Gas Dynamics and Gas Turbines.** Reciprocating, centrifugal and axial flow compressors. Energy transfer equation. Velocity diagrams. Efficiency and Performance. Gas Turbine Cycle with multistage compression. Reheating and Regeneration.
5. **Heat Transfer, Refrigeration and Air Conditioning.** Conduction. Convection and Radiation. Heat Transfer, Heat Exchangers, Boiling and condensation. Refrigeration and heat pump cycles. Refrigeration systems. Coefficient of performance. Psychometric and psychometric chart. Comfort indices. Cooling and dehumidification methods. Industrial Air-conditioning Processes. Cooling and heating loads calculations.

6. **Fluid Mechanics and Machines.** Fluids-Properties, Pressure. Forces, Buoyancy and stability. Laminar and turbulent flow, equation of continuity. Energy and momentum equation. Bernoulli's Theorem. Dimensional analysis. Critical Reynolds number Layer concepts. Film lubrication. Incompressible flow through pipes, critical velocity. Friction loss due to sudden enlargement and contraction. Compressible flow through nozzles.

7. **Theory of Machines.** Velocity and acceleration of moving bodies; in machines. Inertia forces in machines. Cams; Gears and Geartrains, Flywheels and Governors. Balancing of Rotating and Reciprocating Masses. Free and Forced vibrations of systems. Critical speeds and whirling of shafts.

8. **Machine Design. Design of :** Joints-Threaded fasteners and Power Screws-Keys, Cotters, Couplings-Welded Joints. Transmission system :-Belt and chain drives-wire ropes-shafts. Gears-Sliding and Rolling bearings.

9. **Engineering Mechanics.** Forces and moments-Equilibrium and analysis of force systems-friction-centre of gravity, moment of Innertia-Kinetics.

10. **Strength of Materials.** Stress and strain in two dimension ; **Mohr's** circles ; Relations between Elastic Constants. **Beams-** Bending Moments, Shear forces and deflection. **Shafts-** Combined bending, Direct and torsional stresses. **Thick-** Walled cylinders and spheres under Pressure, Spring, Struts and Columns. Theories of failure.

11. **Engineering Materials.** Alloys and Alloying Materials, Heat treatment ; Composition Properties and uses. Plastics and other newer engineering materials.

12. **Metallurgy.** Phase diagrams of Alloy systems, Iron carbon system, Solidification, Heat treatment Processes.

13. **Production Engineering.** Metals Machining :-Cutting tools ; Tool Materials, Wear and Machinability, Measurement of cutting forces.
    **Process :-** Machining-Grinding, Boring, Gear Manufacturing, Metal forming, Metal Casting and Joining, Basic special purpose Programme and Numerically controlled machine Tools, Jigs and Fixtures (locating elements).

14. **Welding Proceres.** Gas welding, Arc welding, resistance welding-welding equipment.

15. **Industrial Engineering.** Work study and work measurement. Wage incentive. Design of Production Systems and Product Cost. Principals of plant Layout. Production Planning and Control. Material Handling. Operations Research. Linear Programming. Queuing Theory. Value Engineering. Network Analysis. CPM and PERT. Use of Computers.

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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. Programming and Data Structures:**
Algorithm, flowchart, C Language, Control Statements, Functions, Structures, union and files, pointers in C, C programming covering all aspects. Simple and abstract data types and data structures stacks, queues, linked list, Trees balanced trees, Graphs, classes and objects, complexity of algorithms, divide and conquer, greedy, dynamic programming searching and traversal techniques, backtracking, Branch & Bound, NP Hard and NP complete problems.

**2. Computer Organization and Architecture:**
Processor basics, CPU organization, Data representation, Arithmetic representation, ALU's control design, Micro Programming, Nano programming. Memory Heirarchy, Cache and Virtual memory concepts. Parallel processing: PP in Uniprocessor, pipelining, SIMD and Vector processing, Multi programming, Data Flow computing. Introduction to VLSI computing.

**3. Computer Networks:**
Evolution of Data Communication and Networks, Transmission fundamentals, signals, media, encoding and modulation, switching techniques. OSI & TCP/IP models, functions and performance details of all layers. Network Security and communication security. Network programming, Sockets, TCP client server, Multiplexing and Socket options. UDP Sockets. IPC and Remote login.

**4. Operating Systems and system Programming.**
Process, CPU scheduling, Process synchronization, deadlocks, memory management, file system interface I/o systems assembles, Macros and MACRO Processors, Linkers. Distributed systems communication, synchronization, deadlocks, filesystems, shared memory Unix Utilities, Problem solving approaches in Unix, Unix Internals, Unix process, Threads and signals and Inter Process Communication.

**5. Automata, compilers and OOPS:**
Chomsky Heirarchy of languages, Grammers, machines and their designs. NP Hard and NP complete problems, Lexical, Syntax and Semantic analysis. Top down, Bottomup parsing. Intermediate code forms and code generation. Principles of Programming Languages, BNF motation, functional programming, LISP. Scope & Extent overloading, concurrency. Object oriented programming and features. C++ and Java programming.

**6. Data Base Management Systems:**
File systems, various data models, Relational algebra and calculus, Query optimization and evaluation, Database design, Concurrency control and recovery, Storing and Indexing Distributed data base design, Distributed Transaction Management, Reliability, Data Mining primitives, Languages and system Architectures, Mining association rules, classification and prediction, Cluster Analysis.

**7. Software Engineering:**
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. Introduction to UML Concepts.

**8. Computer Graphics and Image Processing.**
Raster Scan Graphics, 2D & 3D Transformations, Viewing, Projection Variable surface detection, Shading, Animation. Digital Image processing fundamentals, Image enchancement techniques, Morphological Image processing, Image Segmentation, Knowledge representation. Reasoning Techniques, Gameplaying, Learning and Natural language Processing. HTML, Javascript/j script, Dynamic HTML, AJPs, XML and Multimedia systems.

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## METALLURGICAL ENGINEERING

**Thermodynamics and Rate Processes:** Laws of thermodynamics, activity, equilibrium constant, applications to metallurgical systems, solutions, phase equilibria, Ellingham and phase stability diagrams, thermodynamics of surfaces, interfaces and defects, adsorption and segregation; basic kinetic laws, order of reactions, rate constants and rate limiting steps; principles of electro chemistry- single electrode potential, electro-chemical cells and polarizations, aqueous corrosion and protection of metals, oxidation and high temperature corrosion - characterization and control; heat transfer - conduction, convection and heat transfer coefficient relations, radiation, mass transfer - diffusion and Fick's laws, mass transfer coefficients; momentum transfer - concepts of viscosity, shell balances, Bernoulli's equation, friction factors.

**Physical Metallurgy:** Crystal structure and bonding characteristics of metals, alloys, ceramics and polymers, structure of surfaces and interfaces, nano-crystalline and amorphous structures; solid solutions; solidification; phase transformation and binary phase diagrams; principles of heat treatment of steels, cast iron and aluminum alloys; surface treatments; recovery, recrystallization and grain growth; industrially important ferrous and non-ferrous alloys; elements of X-ray and electron diffraction; principles of scanning and transmission electron microscopy; industrial ceramics, polymers and composites; electronic basis of thermal, optical, electrical and magnetic properties of materials; electronic and opto-electronic materials.

**Mechanical Metallurgy:** Elasticity, yield criteria and plasticity; defects in crystals; elements of dislocation theory - types of dislocations, slip and twinning, source and multiplication of dislocations, stress fields around dislocations, partial dislocations, dislocation interactions and reactions; strengthening mechanisms; tensile, fatigue and creep behaviour; super-plasticity; fracture - Griffith theory, basic concepts of linear elastic and elasto-plastic fracture mechanics, ductile to brittle transition, fracture toughness; failure analysis; mechanical testing - tension, compression, torsion, hardness, impact, creep, fatigue, fracture toughness and formability.

**Manufacturing Processes:** Metal casting - patterns and moulds including mould design involving feeding, gating and risering, melting, casting practices in sand casting, permanent mould casting, investment casting and shell moulding, casting defects and repair; hot, warm and cold working of metals, Metal forming - fundamentals of metal forming processes of rolling, forging, extrusion, wire drawing and sheet metal forming, defects in forming; Metal joining - soldering, brazing and welding, common welding processes of shielded metal arc welding, gas metal arc welding, gas tungsten arc welding and submerged arc welding; welding metallurgy, problems associated with welding of steels and aluminium alloys, defects in welded joints; powder metallurgy; NDT using dye-penetrant, ultrasonic, radiography, eddy current, acoustic emission and magnetic particle methods. 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.

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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. Biophysical & Biochemical techniques: Chromatography, electrophoresis, UV/Vis spectrophotometry, fluorescence spectroscopy. CD, IR and Raman spectroscopy, centrifugation, microscopy, separation of different biomolecules.

6. 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.

7. 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.

8. Chemical engineering: Material and energy balance, biofluid mechanics, transport phenomena. Heat transfer, mass transfer and thermodynamics in biological systems.

9. Bioprocess engineering: Principles of microbial growth, growth kinetics and substrate utilization in batch, fed batch and continuous systems. Introduction to bioreactors, sterilization, mass transfer operations in bioprocess engineering, downstream processing and bioprocess plant design.

10. Enzyme Engineering: Enzymes, enzyme kinetics, enzyme mechanism, factors that affect enzymatic reactions and enzyme immobilization.

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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.; Aryl halides; Low reactivity of aryl and vinyl halides; $SN^1$, $SN^2$ 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 reaarangements –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; $D_2O$ exchange process; 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; 2D – NMR spectroscopy; NOESY & COESY Techniques.

**Unit-11: Mass Spectroscopy 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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## ENVIRONMENTAL SCIENCES & TECHNOLOGY

**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. 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. Hydrosphere- Water resources, hydrological cycle, unique physical and chemical properties of water, complexation in natural and wastewater, role of microorganisms in aquatic chemical reactions, redox reactions. Lithosphere- Composition of lithosphere, soil, inorganic and organic compounds in soil, micro and macro nutrients, ion exchange in soils, soil pH, trace elements in soil, organic matter in soil, macro- nutrients in soil, nitrogen pathways and NPK in soil. 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.

**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.

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## MATHEMATICS

### BASICS AND ADVANCES UPTO P.G. LEVEL IN FOLLOWING TOPICS

Real Analysis, Linear Algebra, Complex Analysis, Algebra, Topology, Functional Analysis, Ordinary Differential Equations, Partial Differential equations, Calculus of Variations, Integral transforms, Z-Transformations, Linear Integral Equations, Numerical Analysis, Discrete Mathematics.

Probability theory : Random Variables (univariate and multivariate), Probability Distributions, Estimation, Random sampling, Testing of Hypothesis, Linear Programming, Assignment and Transportation problems, Queuing theory.

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## SYLLABII FOR ENTRANCE TEST

## 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 EQUILIBRUM : Reversibility – Dynamic nature of equilibrium Kp, Kc 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, Heiesnberg's uncertaintity 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; Thinfilm 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 al computing as molecular electronics, carbon nano tubes synthesis and types, fullerenes, applications.

**4. NANO MATERIIALS 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 Automoibiles. Nano ethics, Impact on society and environment.

**5. PROGRAMMING IN C, DATA STRUCTURES & DISCRETE MATHEMATICS:**

Data types, Operators and Expressions, Input Output Statements, Control Statements, Functions, Arrays, Pointers, Structures & Unions, Preprocessors, Programming in C. Searching and Sorting Techniques, Expression, Evaluation, Stacks, Queues, Linked Lists, Trees, Graphs and applications. Sets and relations, Fundamentals of prepositional logic, inference, elementary combinatories, Probability, Mathematical Induction.

**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.

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# EXTERNAL (PART TIME) Ph.D. PROGRAM 2025-26

## SYLLABII FOR ENTRANCE TEST

## 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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# EXTERNAL (PART TIME) Ph.D. PROGRAM 2025-26

## SYLLABII FOR ENTRANCE TEST

## CENTER FOR 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.

### 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.

### 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.

### 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.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**KUKATPALLY, HYDERABAD - 500 085, TELANGANA STATE, INDIA**

# EXTERNAL (PART TIME) Ph.D. PROGRAM 2025-26

## SYLLABII FOR ENTRANCE TEST

## 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 (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, 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. Evaluation of Crude drugs, Adulteration of Crude drugs and their detection by various methods.

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.

VI.

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. Advanced drug delivery systems.

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# EXTERNAL (PART TIME) Ph.D. PROGRAM 2025-26

## SYLLABII FOR ENTRANCE TEST

## MANAGEMENT SCIENCE (MBA)

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.

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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# EXTERNAL (PART TIME) Ph.D. PROGRAM 2025-26

**SYLLABII FOR ENTRANCE TEST**

## ENGLISH

The Entrance Examination Question paper will be objective type in nature with multiple choice type questions. Duration of the exam will be **Two Hours** and the maximum marks are **100**. 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"
- Jonathan 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:

- John Keats : "Ode To Nightingale"
  - "Ode On a Grecian Urn"

- Charles Lamb: "Dream Children"
    - "Old China"
- Jane Austen: "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.H. Lawrence "Sons and Lovers"
- Virginia Woolf : "A 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 Arnold " "The Study of Poetry"
- T.S.Eliot : "Tradition and Individual Talent"

# FORMAT OF THE MODEL QUESTION PAPER

Time: 2 Hrs Max Marks: 100

**(Objective Type Questions)**

I. Choose the right alternative:

1. The remark "Shakespeare has only heroines and no heroes" was made by
   (a) Releigh (b) Gordon (c) Ruskin (d) Albert

2. Who is the author of "Robinson Crusoe"?
   (a) Horace (b) Arnold (c) Tennyson (d) Daniel Defoe

3. The Phrase "Fancy and Imagination" was used in Biographia Literaria by
   (a) Coleridge (b) Wordsworth (c) Shelley (d) Keats

4. The concept of "Stream of Consciousness" was formulated by
   (a) Edward (b) William James (c) Albert (d) None

5. Which of Jane Austen's novels begins with this sentence?
   "It is truth universally acknowledge that a single man in possession of a good fortune, must be in want of life."
   (a) Pride and Prejudice (b) Emma (c) Mansfield Park (d) None

And so on…..

*END*