DAV UNIVERSITY, JALANDHAR

PhD Entrance Test Syllabus-2017

(Section A and B)

Section A

Research Methodology (Mechanical Engineering)

Introduction to Research: Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India.

Defining the Research Problem: What is a Research Problem?, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, factors affecting RDs, Relation among RDs, Developing a Research Plan.

Sampling design and Procedures: Sample or Census, The Sampling Design Process, A Classification of Sampling Techniques, Choosing Nonprobability Versus Probability Sampling, Uses of Non probability Versus Probability Sampling.

Measurement and Scaling: Non-comparative Scaling Techniques, Continuous Rating Scale, Itemized Rating Scale, Non-comparative Itemized Rating Scale Decisions, Multi-item Scales, Scale Evaluation, Choosing a Scaling Technique.

Methods of Data Collection: Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection.

Questionnaire & form design: questionnaire & observation forms, questionnaire design process.

Data analysis: tests of significance based on t, f and z distribution chi-square test; cross tabulation

Multiple Regression: Overview of Multiple Regression, Statistics Associated with Multiple Regression, Conducting Multiple Regression, Stepwise Regression, Multicollinearity

Discriminant Analysis: Discriminant Analysis Model, Statistics Associated with Discriminant Analysis, Conducting Discriminant Analysis

Reference Books:

1. Bajpai Naval, *Business Research Methods*, Pearson Publications.
2. Malhotra, Naresh K. (2007), *Marketing Research: An Applied Orientation*, 5th Edition. Pearson/Prentice-Hall.
3. Proctor Tony, *Essentials of Marketing Research*, Prentice Hall, 4th Edition
4. Beri G. C., *Marketing research*, Mcgrawhill, 4th Edition
5. C.R Kothari, *Research Methodology*, New Age Publishers

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Research Methodology (Physics)

Unit - I

Scientific Research: nature and objectives of research; methods of research: historical, descriptive and experimental, study and formulation of research problem, scope of research and formulation of hypothesis, feasibility, preparation and presentation of research proposal.

Statistical Analysis: measures of central tendency and dispersion; mean, median, mode, range, mean deviation and standard deviation.

Unit - II

Amorphous and crystalline materials, lattice, basis, unit cell, miller indices, reciprocal lattice, types of lattices, Brillouin Zones.

Relativity: Frames of reference, Inertial frames; Galilean transformations; Galilean invariance, Special theory of relativity, Lorentz transformation, length contraction, time dilation, mass variation with velocity, Mass energy equivalence.

Unit - III

Fundamentals of plasma, occurrence, Debye theory and shielding, Criteria for Plasmas.

Nanoscience, Nanotechnology, Nanomaterial's and their size-dependent properties.

Optical fibers-Principle, structure of optical fibers, acceptance angle and cone, numerical aperture and acceptance angle

Nonlinear Optics, Kerr effect, Raman Nathan effect.

Nuclear Physics: Nuclear forces, nuclear spin, magnetic moment, Liquid drop and shell models, fission and fusion, Radioactivity, Detectors and Accelerators.

Unit - IV

Computer basics: Fundamentals of computer basics, hardware and software, internet, computer languages, low level languages, high level languages, FORTRAN language, Review of fundamental FORTRAN commands and programming structures, Basic Operations of Mat lab.

Research Methodology (Mathematics)

Scientific Research: Nature and Objectives of research; Methods of research: historical, descriptive and experimental. Study and formulation of research problem. Scope of research and formulation of hypothesis; Feasibility, preparation and presentation of research proposal.

Descriptive statistics: Definition and relevance in research; Measures of Central Tendency: Arithmetic Mean, median, mode, quartiles and percentiles; Measures of Dispersion: Range, variance, standard deviation, coefficient of variation; Skewness and Kurtosis.

Inferential statistics: Hypothesis testing, Errors in Hypothesis Testing- Null Hypothesis, Alternative Hypothesis, Type I and Type II errors, Confidence Limits. Setting up of level of significance. One tailed and Two- tailed tests.

Data Analysis: Correlation coefficient (r), properties, interpretation of r, partial and multiple correlations, linear regression: Fitting of lines of regression, regression coefficient, Bivariate and Multiple Regression.

Parametric and Non-Parametric Statistics: Definition, Advantages, Disadvantages, Assumptions; Parametric Tests: Student's t-test, One Way Analysis of Variance, Two Way Analysis of Variance; Non-Parametric Tests: Analysis of Variance, Chi square and Kendall Rank Correlation.

Design of Experiments: Basic principles and significance of research design; Randomized Block Designs (RBD), Completely Randomized Designs (CRD). Copyright act; Academic frauds; Plagiarism; Softwares to check plagiarism

Research Methodology (Life Sciences)

Descriptive statistics: Definition and relevance in biological research; Measures of Central Tendency: Arithmetic Mean, median, mode, quartiles and percentiles; Measures of Dispersion: Range, variance, standard deviation, coefficient of variation; Skewness and Kurtosis. Probability Theory. Inferential statistics: Hypothesis testing, Errors in Hypothesis Testing- Null Hypothesis, Alternative Hypothesis, Type I and Type II errors, Confidence Limits. Setting up of level of significance. One tailed and Two- tailed tests. Correlation and Regression: Correlation coefficient (r), properties, interpretation of r, partial and multiple correlations, linear regression: Fitting of lines of regression, regression coefficient, Bivariate and Multiple Regression.

Parametric and Non-Parametric Statistics: Definition, Advantages, Disadvantages, Assumptions; Parametric Tests: Student's t-test, One Way Analysis of Variance, Two Way Analysis of Variance; Non-Parametric Tests: Analysis of Variance, Chi square and Kendall Rank Correlation. Basic principles and significance of research design; Randomized Block Designs (RBD), completely randomized designs (CRD); Latin square design; Split plot design and Factorial design. Data collection, organization and interpretation. Research articles, research papers, popular research articles and reviews; difference between periodicals; journals; monographs, magazines; proceedings. Science citation index; H-index, i10 index, Impact factor calculation, Impact factor of a journal; Eigen factor, Major journal search engines. Copyright act; Academic frauds; Plagiarism; Software's to check plagiarism.

Research Methodology (CSA)

Scientific Research: Nature and Objectives of research; Methods of research: historical, descriptive and experimental. Study and formulation of research problem. Scope of research and formulation of hypothesis; Feasibility, preparation and presentation of research proposal.

Statistical Analysis: Introduction to statistical analysis: Measures of central tendency and dispersion; mean, median, mode, range, mean deviation and standard deviation.

Regression and Correlation Analysis.

Random Variables and Probability Distribution: Probability and probability distributions; Binomial, Poisson, Geometric, Negative binomial, Uniform, Exponential, Normal and Log-normal distribution.

Test of Hypothesis: Basic ideas of testing of hypothesis; Tests of significance based on normal, t and Chi-square distributions. Analysis of variance technique.

Design of Experiments: basic principles, study of completely randomized and randomized block designs.

Introduction to Thesis report writing

Presentation: Edition and tabulation of results, presentation of results using figures, tables and text, quoting of references and preparing bibliography.

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Section B

Mechanical Engineering:

Engineering Materials: Structure and properties of engineering materials and their applications; effect of strain, strain rate and temperature on mechanical properties of metals and alloys; heat treatment of metals and alloys, its influence on mechanical properties.

Applied Mechanics: Engineering mechanics – equivalent force systems, free body concepts, equations of equilibrium; strength of materials – stress, strain and their relationship, Mohr's circle, deflection of beams, bending and shear stress, Euler's theory of columns.

Theory of Machines and Design: Analysis of planar mechanisms, cams and followers; governers and fly wheels; design of elements – failure theories; design of bolted, riveted and welded joints; design of shafts, keys, spur gears, belt drives, brakes and clutches.

Thermal Engineering: Fluid mechanics – fluid statics, Bernoulli's equation, flow through pipes, equations of continuity and momentum; thermodynamics – zeroth, first and second law of thermodynamics, thermodynamic system and processes, calculation of work and heat for systems and control volumes; air standard cycles; basics of internal combustion engines and steam turbines; heat transfer – fundamentals of conduction, convection and radiation, heat exchangers.

Metal Casting: Casting processes – types and applications; patterns – types and materials; allowances; moulds and cores – materials, making, and testing; casting techniques of cast iron, steels and nonferrous metals and alloys; solidification; design of casting, gating and risering; casting inspection, defects and remedies.

Metal Forming: Stress-strain relations in elastic and plastic deformation; concept of flow stress, deformation mechanisms; hot and cold working – forging, rolling, extrusion, wire and tube drawing; sheet metal working processes such as blanking, piercing, bending, deep drawing, coining and embossing; analysis of rolling, forging, extrusion and wire /rod drawing; metal working defects.

Metal Joining Processes: Welding processes – manual metal arc, MIG, TIG, plasma arc, submerged arc, electro slag, thermit, resistance, forge, friction, and explosive welding; other joining processes – soldering, brazing, braze welding; inspection of welded joints, defects and remedies; introduction to advanced welding processes – ultrasonic, electron beam, laser beam; thermal cutting.

Machining and Machine Tool Operations: Basic machine tools; machining processes-turning, drilling, boring, milling, shaping, planing, gear cutting, thread production, broaching, grinding, lapping, honing, super finishing; mechanics of machining – geometry of cutting tools, chip formation, cutting forces and power requirements, Merchant's analysis; selection of machining parameters; tool materials, tool wear and tool life, thermal aspects of machining, cutting fluids, machinability; principles and applications of nontraditional machining processes – USM, AJM, WJM, EDM and Wire cut EDM, LBM, EBM, PAM, CHM, ECM.

Tool Engineering: Jigs and fixtures – principles, applications, and design; press tools – configuration, design of die and punch; principles of forging die design.

Metrology and Inspection: Limits, fits, and tolerances, interchangeability, selective assembly; linear and angular measurements by mechanical and optical methods, comparators; design of limit gauges; interferometry; measurement of straightness, flatness, roundness, squareness and symmetry; surface finish measurement; inspection of screw threads and gears; alignment testing of machine tools.

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Powder Metallurgy: Production of metal powders, compaction and sintering.

Polymers and Composites: Introduction to polymers and composites; plastic processing – injection, compression and blow molding, extrusion, calendaring and thermoforming; molding of composites.

Computer Integrated Manufacturing: Basic concepts of CAD, CAM, CAPP, cellular manufacturing, NC, CNC, DNC, Robotics, FMS, and CIM.

Product Design and Development: Principles of good product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, concurrent engineering.

Facility Design: Facility location factors and evaluation of alternate locations; types of plant layout and their evaluation; computer aided layout design techniques; assembly line balancing; materials handling systems.

Production Planning and Inventory Control: Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; aggregate production planning; master production scheduling; MRP and MRP-II; order control and flow control; routing, scheduling and priority dispatching; push and pull production systems, concept of JIT manufacturing system; logistics, distribution, and supply chain management; Inventory – functions, costs, classifications, deterministic and probabilistic inventory models, quantity discount; perpetual and periodic inventory control systems.

Operation Research: Linear programming – problem formulation, simplex method, duality and sensitivity analysis; transportation and assignment models; network flow models, constrained optimization and Lagrange multipliers; simple queuing models; dynamic programming; simulation – manufacturing applications; PERT and CPM, time-cost trade-off, resource leveling.

Quality Management: Quality – concept and costs, quality circles, quality assurance; statistical quality control, acceptance sampling, zero defects, six sigma; total quality management; ISO 9000; design of experiments – Taguchi method.

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Physical Sciences

I. Mathematical Methods of Physics

Dimensional analysis; Vector algebra and vector calculus; Linear algebra, matrices, Cayley Hamilton theorem, eigenvalue problems; Linear differential equations; Special functions (Hermite, Bessel, Laguerre and Legendre); Fourier series, Fourier and Laplace transforms; Elements of complex analysis: Laurent series-poles, residues and evaluation of integrals; Elementary ideas about tensors; Introductory group theory, SU(2), O(3); Elements of computational techniques: roots of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, solution of first order differential equations using Runge-Kutta method; Finite difference methods; Elementary probability theory, random variables, binomial, Poisson and normal distributions.

II. Classical Mechanics

Newton's laws; Phase space dynamics, stability analysis; Central-force motion; Two-body collisions, scattering in laboratory and centre-of-mass frames; Rigid body dynamics, moment of inertia tensor, non-inertial frames and pseudoforces; Variational principle, Lagrangian and Hamiltonian formalisms and equations of motion; Poisson brackets and canonical transformations; Symmetry, invariance and conservation laws, cyclic coordinates; Periodic motion, small oscillations and normal modes; Special theory of relativity, Lorentz transformations, relativistic kinematics and mass–energy equivalence.

III. Electromagnetic Theory

Electrostatics: Gauss' Law and its applications; Laplace and Poisson equations, boundary value problems; Magnetostatics: Biot-Savart law, Ampere's theorem, electromagnetic induction; Maxwell's equations in free space and linear isotropic media; boundary conditions on fields at interfaces; Scalar and vector potentials; Gauge invariance; Electromagnetic waves in free space, dielectrics, and conductors; Reflection and refraction, polarization, Fresnel's Law, interference, coherence, and diffraction; Dispersion relations in plasma; Lorentz invariance of Maxwell's equations; Transmission lines and wave guides; Dynamics of charged particles in static and uniform electromagnetic fields; Radiation from moving charges, dipoles and retarded potentials.

IV. Quantum Mechanics

Wave-particle duality; Wave functions in coordinate and momentum representations; Commutators and Heisenberg's uncertainty principle; Matrix representation; Dirac's bra and ket notation; Schroedinger equation (time-dependent and time-independent); Eigenvalue problems such as particle-in-a-box, harmonic oscillator, etc.; Tunneling through a barrier; Motion in a central potential; Orbital angular momentum, Angular momentum algebra, spin; Addition of angular momenta; Hydrogen atom, spin-orbit coupling, fine structure; Time independent perturbation theory and applications; Variational method; WKB approximation; Time dependent perturbation theory and Fermi's Golden Rule; Selection rules; Semi-classical theory of radiation; Elementary theory of scattering, phase shifts, partial waves, Born approximation; Identical particles, Pauli's exclusion principle, spin-statistics connection; Relativistic quantum mechanics: Klein Gordon and Dirac equations.

V. Thermodynamic and Statistical Physics

Laws of thermodynamics and their consequences; Thermodynamic potentials, Maxwell relations; Chemical potential, phase equilibria; Phase space, micro- and macrostates; Microcanonical, canonical and grand-canonical ensembles and partition functions; Free Energy and connection with thermodynamic

quantities; First- and second-order phase transitions; Classical and quantum statistics, ideal Fermi and Bose gases; Principle of detailed balance; Blackbody radiation and Planck's distribution law; Bose-Einstein condensation; Random walk and Brownian motion; Introduction to nonequilibrium processes; Diffusion equation.

VI. **Electronics**

Semiconductor device physics, including diodes, junctions, transistors, field effect devices, homo and heterojunction devices, device structure, device characteristics, frequency dependence and applications; Optoelectronic devices, including solar cells, photodetectors, and LEDs; High-frequency devices, including generators and detectors; Operational amplifiers and their applications; Digital techniques and applications (registers, counters, comparators and similar circuits); A/D and D/A converters; Microprocessor and microcontroller basics.

VII. **Experimental Techniques and data analysis**

Data interpretation and analysis; Precision and accuracy, error analysis, propagation of errors, least squares fitting, linear and nonlinear curve fitting, chi-square test; Transducers (temperature, pressure/vacuum, magnetic field, vibration, optical, and particle detectors), measurement and control; Signal conditioning and recovery, impedance matching, amplification (Op-amp based, instrumentation amp, feedback), filtering and noise reduction, shielding and grounding; Fourier transforms; lock-in detector, box-car integrator, modulation techniques. Applications of the above experimental and analytical techniques to typical undergraduate and graduate level laboratory experiments.

VIII. **Atomic & Molecular Physics**

Quantum states of an electron in an atom; Electron spin; Stern-Gerlach experiment; Spectrum of Hydrogen, helium and alkali atoms; Relativistic corrections for energy levels of hydrogen; Hyperfine structure and isotopic shift; width of spectral lines; LS & JJ coupling; Zeeman, Paschen Back & Stark effect; X-ray spectroscopy; Electron spin resonance, Nuclear magnetic resonance, chemical shift; Rotational, vibrational, electronic, and Raman spectra of diatomic molecules; Frank – Condon principle and selection rules; Spontaneous and stimulated emission, Einstein A & B coefficients; Lasers, optical pumping, population inversion, rate equation; Modes of resonators and coherence length.

IX. **Condensed Matter Physics**

Bravais lattices; Reciprocal lattice, diffraction and the structure factor; Bonding of solids; Elastic properties, phonons, lattice specific heat; Free electron theory and electronic specific heat; Response and relaxation phenomena; Drude model of electrical and thermal conductivity; Hall effect and thermoelectric power; Diamagnetism, paramagnetism, and ferromagnetism; Electron motion in a periodic potential, band theory of metals, insulators and semiconductors; Superconductivity, type – I and type - II superconductors, Josephson junctions; Defects and dislocations; Ordered phases of matter, translational and orientational order, kinds of liquid crystalline order; Conducting polymers; Quasicrystals.

X. **Nuclear and Particle Physics**

Basic nuclear properties: size, shape, charge distribution, spin and parity; Binding energy, semi-empirical mass formula; Liquid drop model; Fission and fusion; Nature of the nuclear force, form of nucleon-nucleon potential; Charge-independence and charge-symmetry of nuclear forces; Isospin; Deuteron problem; Evidence of shell structure, single- particle shell model, its validity and limitations; Rotational spectra; Elementary ideas of alpha, beta and gamma decays and their selection rules; Nuclear reactions, reaction

mechanisms, compound nuclei and direct reactions; Classification of fundamental forces; Elementary particles (quarks, baryons, mesons, leptons); Spin and parity assignments, isospin, strangeness; Gell-Mann Nishijima formula; C, P, and T invariance and applications of symmetry arguments to particle reactions, parity non-conservation in weak interaction; Relativistic kinematics.

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Mathematics

UNIT – 1

Analysis: Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, and derivative as a linear transformation, inverse and implicit function theorems. Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms

UNIT – 2

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

Algebra: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements. Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder Theorem, Euler's Ø- function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions, Galois Theory.

Topology: basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

UNIT – 3

Ordinary Differential Equations (ODEs): Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

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Partial Differential Equations (PDEs): Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis : Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods. Calculus of Variations: Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations. Linear Integral Equations: Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Classical Mechanics: Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

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Chemistry

Organic Chemistry

1. IUPAC nomenclature of organic molecules including regio- and stereoisomers.
2. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.
3. Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions.
4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.
5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.
6. Common named reactions and rearrangements – applications in organic synthesis.
7. Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereoselective transformations.
8. Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.
9. Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Resolution – optical and kinetic.
10. Pericyclic reactions – electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.
11. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).
12. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.
13. Structure determination of organic compounds by IR, UV-Vis, ^{1}H & ^{13}C NMR and Mass spectroscopic techniques.

Inorganic Chemistry

1. Chemical periodicity
2. Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory).
3. Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.
4. Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds.

5. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.
6. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
7. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.
8. Cages and metal clusters.
9. Analytical chemistry- separation, spectroscopic, electro- and thermoanalytical methods.
10. Bioinorganic chemistry: photosystems, porphyries, metalloenzymes, oxygen transport, electron-transfer reactions; nitrogen fixation, metal complexes in medicine.
11. Characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-vis, NQR, MS, electron spectroscopy and microscopic techniques.
12. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

Physical Chemistry:

1. Basic principles of quantum mechanics: Postulates; operator algebra; exactly- solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling.
2. Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.
3. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.
4. Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π-electron systems.
5. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.
6. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance.
7. Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.
8. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities – calculations for model systems.
9. Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye- Huckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.

10. Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.
11. Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.
12. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.
13. Polymer chemistry: Molar masses; kinetics of polymerization.
14. Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

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Computer Science and Applications

Programming Languages: Programming in C; Functions, Recursion, Parameter passing, Scope, Binding, Classes concepts, File handling, Basic Java Concepts, AWT, Swing, Java Database connectivity, Java RMI, Socket Programming, Introduction to C# programming, ADO.Net Architecture, Introduction to ASP.NET Architecture.

Data Structure and Algorithms: Advanced Sorting Methods, Algorithm Design Paradigms, Complexity of Algorithm, Depth-first and Breadth-first Algorithms, Kinetic Data Structures, Asymptotic notation, Worst and average case analysis; Design: Greedy approach, Dynamic programming, Divide-and conquer; Tree and graph traversals, Connected components, Spanning trees, Shortest paths; Hashing, Sorting, Searching. Asymptotic analysis (best, worst, average cases) of time and space, upper and lower bounds, Basic concepts of complexity classes P, NP, NP-hard, NP-complete.

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

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

Digital Image Processing: Image Acquisition, Spatial Domain, Frequency Domain, Filters, Image Compression, Restoration, Segmentation, Morphing, Wavelets and Multi-resolution Processing, Object Recognition, Pattern Recognition.

Soft Computing: Genetic Algorithms, Fuzzy Logic, Artificial Neural Network, Supervised and Unsupervised learning.

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

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

Data Mining and Data Warehousing: Concept of Data Mining, Data Warehousing Architecture, Data Mart, OLAP and OLTP Systems.

Software Engineering: information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project, design, coding, testing, implementation, maintenance.

Computer Networks: ISO/OSI stack, LAN technologies (Ethernet, Token ring), Flow and error control techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IP(v4), Application layer protocols (icmp, dns, smtp, pop, ftp, http); Basic concepts of hubs, switches, gateways, and routers. Network security basic concepts of public key and private key cryptography, digital signature, firewalls.

Computer Graphics: Elementary Drawing Algorithms, Geometric Transformations, Viewing Transformations, Three-dimensional concepts, Hidden line/surface Removal, Surface Rendering techniques.

Web technologies: HTML, XML, basic concepts of client-server computing.

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Numerical Methods: Iterative Methods, Solution of simultaneous Linear equation Numeric Differentiation and Integration, Numerical Solution of Ordinary Differential equations, Finite Differences, Numerical Integration, Numerical Solutions of Linear and Non-Linear Algebraic Equations.

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Biotechnology

1. Cell Biology

Cell theory, General organization and diversity of prokaryotic and eukaryotic cells. Assembly of macromolecules, mechanism of assembly, evolutionary steps in the origin of cells. Structural organization and function of intracellular organelles, Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility. Membrane structure and function. Membrane protein diffusion, osmosis, ion channels, active transport, mechanism of sorting and regulation of intracellular transport. Targeting proteins to endoplasmic reticulum, Protein sorting and export from Golgi apparatus, Protein import into Mitochondria, Import and sorting of chloroplast protein. Cell division and Cell cycle & its regulation, the role of the cyclins and cyclin-dependent kinases, cell cycle checkpoints. Mechanism of signal transduction: Cell signaling - Modes of cell signaling, steroid hormone receptors, plant hormones, G-protein coupled receptors; regulation of signaling pathways, Ras, Raf , MAP kinase pathway.

2. Genetics

Molecular organization of chromosomes, Genome size and complexity, structure of eukaryotic and prokaryotic chromosome, polytene chromosomes, euchromatin and heterochromatin, satellite DNA, centromere and telomere structure, chromosomal staining. Structure of chromatin and chromosomes, heterochromatin, euchromatin, transposon. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Mendelian principles: Dominance, segregation, independent assortment. Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy. Polygenic inheritance, QTL mapping, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

Extrachromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance, Split genes, overlapping genes and pseudo genes. Spontaneous and induced mutation, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis, site directed mutagenesis, molecular basis of mutagenesis, test for mutagenicity, mutation frequency, transformation, transduction, conjugation, transposable elements and transposition. Microbial viruses: Diversity, classification, characteristics and applications of bacteriophages, and general account on algal, fungal and protozoan viruses. Virus-like agents: Prions, satellite DNAs and RNAs, satellite viruses; defective interfering particles and virophages.

3. Recombinant DNA Technology

Introduction and scope of Recombinant DNA Technology. DNA modifying enzymes, Linker, Adaptor, Homopolymer tailing, Restriction Endonucleases. Isolation and Purification of nucleic acid: Basic techniques and criteria of purity. Characteristics of cloning and expression vectors, plasmid, phage and cosmid vectors, multipurpose cloning vectors, shuttle vectors, bacterial, yeast, plant, viruses and mammalian expression vectors. Preparation of genomic and cDNA libraries, criteria for selection of cloning vectors - plasmid, bacteriophage and cosmid, transformation and transfection, electroporation, screening of gene library and selection of clone. Nucleic acid Blotting, Protein-Protein interactions, Polymerase chain reaction, site directed mutagenesis and protein engineering. Applications of r-DNA technology in industry, agriculture and forensic science.

4. Tools in Biotechnology

Quantitative and real time PCR, Nucleotide sequencing, Protein DNA interaction assays, Radioimmunoassay, ELISA, Flow cytometery, Overview of Chemical and Physical cell disruption techniques for biomolecules. Methods of separation of peptides and proteins, oligonucleotides and DNA by electrophoresis and chromatography. Advanced techniques of separation: 2D gel electrophoresis, HPLC and GC. Detection of molecular mass by MALDI, ESI-MS and structure of molecules by Nuclear Magnetic Resonance spectroscopy, 1H NMR, 13C NMR, Magnetic Resonance Imaging. Methods of virus diagnosis, detection, assays and comparison of their sensitivities. Techniques employed for structural and functional genomics of viruses. Transcriptomics: Microarray, EST, SAGE. Bioinformatical methods in transcriptomics. Genome sequencing projects: technology of sequencing and assembly. Next generation sequencing using new technologies. Protien-DNA interaction, DNA microarray for cancer profiling.

5. Nano-Biotechnology

Science of Nanobiotechnology, type of nanoparticles and nanomaterials. Nanoparticles in biological labeling and cellular imaging, functionalizated protein-based nanostructures, Nanomotors. Interaction of Nano-Materials with Cell/ Biosystems: Proteins, Lipids, RNA and DNA. Nanobiosensors: From Natural to Artificial Structures, Nano Printing of DNA, RNA and Proteins, Nano Scale Detection Lab-on-a-chip Devices (LOC). Nanostructures in Drug discovery, delivery, and controlled release, Nanotechnology for tissue engineering, in regenerative therapy. Nanoparticles for the detection and treatment of cancer, Nano-targeted delivery systems: Collodial drug carriers, nanoparticles and liposomes. Role of nanotechnology in biological therapy, nano devices in medicine and surgery.

6. Plant Biotechnology

Plant tissue culture, cellular totipotency, conventional breeding. Tissue culture media, sterilization techniques, callus and suspension cultures, single cell clones, nurse culture technique, differentiation, organogenesis & somatic embryogenesis, artificial seeds. Micropropagation, Clonal propagation, production of virus-free plants, propagation by direct and indirect organogenesis. In situ and ex situ rooting & difference. Changes during hardening of micropropagated plants. Somaclonal and gametoclonal variations and their practical application. Protoplast culture, somatic hybridization and regeneration of hybrid plants, symmetric and asymmetric hybrids, cybrids, haploid production, anther, pollen culture, monoploid production, hybrid embryo culture/embryo rescue and ovary culture, endosperm culture, production of triploids. Role of folllowing in agriculture improvement. Germplasm conservation techniques. Transgenic Plants Technology, Molecular mechanism of Agrobacterium mediated transformation, selection and reporter markers, Selection of transgenic and marker free transgenics. Role of viruses in plant biotechnology, gene transfer, plant virus and viroid induced diseases in economically important trees and agricultural crops and their control

7. Computational Biology & Bioinformatics

Bioinformatics databases, Type of databases, Nucleotide sequence databases, Primary nucleotide sequence databases, Protein structure databases, Sequence motif databases, Sequence, structure and function relationship. Analysis and submission of EST and GSS data, clustering of ESTs. Whole Genome annotation strategies: Basic overview of whole genome annotation strategies, strategies for Human and Arabidopsis genomes. Introduction to DNA and Protein sequencing, Human Genome Project.

8. Molecular Biology

DNA as genetic material, Structure of DNA, RNA, their types. Replication of DNA in prokaryotes and eukaryotes: Semi conservative nature of replication, Bi-directional replication, DNA polymerases. The replication complex: Pre-priming proteins, primosome, replisome, rolling circle replication, unique aspects of eukaryotic chromosome replication, Fidelity of replication. DNA damage and mechanism of repair. Homologous recombination: models and mechanism. Transcription in prokaryotes and eukaryotes: Prokaryotic RNA polymerase, Eukaryotic RNA polymerases, sigma factor, transcription factors, promoter, enhancers, initiation, elongation and termination of RNA chains. RNA splicing and processing of pre-mRNA. Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics. Virus replication Strategies: Principal events involved in replication: Adsorption, penetration, uncoating nucleic acid and protein synthesis, intracellular trafficking, assembly, maturation and release, viral-host interaction, Host response to viral infection. Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation. Post-translational modifications of proteins.

9. Research Methodology

Descriptive statistics, relevance in biological research, Measures of Central Tendency: Arithmetic Mean, median, mode. Measures of Dispersion: Range, variance, standard deviation, coefficient of variation. Probability: Type of events, their calculation for probability, theorem of addition and multiplication and calculations. Hypothesis testing, Errors in Hypothesis Testing- Null Hypothesis, Alternative Hypothesis, Type I and Type II errors, Confidence Limits. Setting up of level of significance. One tailed and Two- tailed tests. Correlation and Regression: Correlation coefficient (r), properties, interpretation of r. Parametric and Non-Parametric Statistics: Definition, Advantages and Disadvantages. Parametric Tests: Student's t-test, One Way Analysis of Variance, Two Way Analysis of Variance; Non-Parametric Tests: Analysis of Variance, Chi square. Research articles, research papers, difference between periodicals, journals, monographs, magazines and proceedings. Science citation index, H-index, i10 index, Major journal search engines. Copyright act and Plagiarism.

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Botany

UNIT-I:

Algae:classification, Salient features of major divisions; Ecological and economic importance of Algae.

Fungi:Classification of fungi; general characters, Fungal associations and their significance; Agricultural significance of Fungi.

Bryophyta:Classification and general characters; economic importance Pteridophyta: Classification and general characters of Pteridophytes Gymnosperms: General characteristic features of Gymnosperms and their affinities with pteridophytes and angiosperms; classification of Gymnosperms; Distribution of Gymnosperms in India.

UNIT II:

Introduction to the Angiosperms: Taxonomic History; classification; Keys for identification of plants; Basal angiosperms and Magnoliids; Basal monocots; Petaloid monocots; Commelinids; Basal eudicots and Caryophyllids; Rosids; Asterids.

Botanical Nomenclature: Kinds of names; ICBN, Names according to rank; Citation of authors; Priority; Type method; Naming a new species; Legitimacy; Synonyms.

Phylogenetics: The nature of phylogeny; How we depict phylogeny? The importance of homology, Polarizing characters of homology; The problem of homoplasy.

Salient Features and Economic Importance ofMonocot/Dicot Families:Apocyanaceae; Verbenaceae; Chenopodiaceae; Capparidaceae; Caryophyllaceae; Myrtaceae; Apiaceae; Acanthaceae; Moraceae; Rubiaceae; Amaranthaceae; Musaceae; Cannaceae; Commelinaceae.

Origin and economic significance of the following:Medicinal and aromatic plants; Fiber yielding plants, Spices and condiments; cereals, pulses, Rubber yielding plant; tea, coffee, Oil yielding plants; source and uses of plant based insecticides

UNIT-III

Plant Cell and Tissue Culture: Principles,Cellular totipotency; Somatic embryogenesis and synthetic seeds, Somatic hybridization; Application in biotechnology

Plant Breeding:Objectives,domestication and centres of origin of cultivated plants.Hybridization: Role and methods, Back-cross breeding. Pedigree method; Bulk method; Single-seed descent method;Heterosis, Inbreeding depression.Breeding for resistance: Breeding for biotic and abiotic stresses, physical and chemical mutagens; Gamma gardens;Heritability and its Methods of estimation; Reciprocal recurrent selection; Reciprocal recurrent selection based on test cross of half-sib families; Reciprocal recurrent selection based on half-sib progenies of prolific plants; Reciprocal full-sib recurrent selection.

Phytopathology:process of infection and pathogenesis, Defense mechanism in plants, Diseases in plants: Symptoms, etiology and disease cycle. Wheat- rust, smut; Rice-sheath blight; Cucurbits-Powdery mildew; Sugarcane-red rot; Potato-late and early blight; Crucifers-white rust; dieback disease of grasses. Chemical and biological means of disease control

UNIT-IV

Genome: Genome organization in prokaryotes and eukaryotes, Nuclear DNA content; law of DNA constancy and C-value paradox; Cot curves, chromosomes, linkage and genetic mapping, gene mapping methods, transposons Prokaryotic & eukaryotic DNA replication, Prokaryotic and eukaryotic transcription, Protein synthesis and processing, Control of gene expression at transcription and translation level,

Transgenic Plants, recombinant DNA technology, Gene Transfer Methods in Plants (direct gene transfer methods; restriction endonucleases, ligases, applications of genetic engineering; floral-dip

UNIT-V

Biomolecules: biomolecules (composition, structure and function), stablizing interactions, conformation of proteins; conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA); stability of proteins and nucleic acids.

Physiology: Water and Plant Cells; Mineral Nutrition, photosynthesis in higher plants; plant respiration, Phytochromes and cryptochromes; Photoperiodism., Plant Hormones, principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes; Stress physiology, Nitrogen metabolism, Physiology of flowering, seed germination, senescence

UNIT-VI

Ecology and Environment: Definition, history and scope of ecology, sub divisions of ecology, ecology vs environmental science. Interdisciplinary nature of environmental science. Evolution and Natural Selection, Ecological succession, Ecosystem organization: Structure and functions; primary production; energy dynamics; global biogeochemical cycling and ecosystem nutrient cycles, primary and secondary productivity, food chains, food webs, ecological pyramids, energy flow and nutrient cycles.

Environment Protection: Conservation of Soil, Agriculture, Biodiversity, aquatic systems; Bioremediation, Phytoremediation, Endangered and threatened species. International concern and efforts for environmental protection, Earth Summits. Global warming; Climate change

Phytogeography:Climate, vegetation and botanical zones of India, Application of remote sensing invegetation classification,

UNIT-VII

Techniques:Microscopy, Chromatographic techniques, Centrifugation, Electrophoresis and Isoelectric focusing, Molecular techniques: Random Fragment Length Polymorphism (RFLP); Fluorescence In-Situ Hybridization (FISH), Genomic In-Situ Hybridization (GISH), Fiber-FISH, Q-FISH; Flow FISH: Flow Cytogenetics, Flow karyotyping; Random amplified polymorphic DNA. Proteomics, Separation and identification of cellular proteins, Genomics, genome sequencing strategies

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Biochemistry

1. General Biochemistry: Classification and function of carbohydrates, proteins, lipids and nucleic acids; Carbohydrate metabolism; Lipid metabolism; Metabolism of amino acids; Enzymes. Role of major hormones and their physiology.

2. Molecular Biology: Structure and function of DNA and RNA; Replication; Transcription; Translation; Regulation of gene expression (Operon model); Genetic code; Recombinant DNA technology- R-M system, restriction endonucleases, vector systems, cDNA libraries. DNA Sequencing technologies, Polymerase Chain Reaction and its variants.

3. Cell biology: Cellular organelles- Plasma membrane, cell wall, their structural organization Mitochondria, Chloroplast; Nucleus and other organelles and their organization; Transport of nutrients, ions and macromolecules across membrane; Cell cycle – molecular events and regulation; major signaling pathways – Insulin signaling, G-protein signaling, Ras, Akt, MAP Kinases.

4. Immunology: Overview of the immune system; Cells and organs of the immune system, Antibodies; Major histocompatibility complex; T-cell receptor; The complement system.

5. Genetics: Cell division; Basic principles of inheritance; Structure of Chromosome; Chromosomal basis of mendelism; Linkage, Crossing over and chromosome mapping; Genetics of bacteria; Mutation and DNA repair; Mitochondrial and chloroplast DNA.

6. Bioanalytical techniques: Basic principles of sedimentation, preparative centrifugation, analytical centrifugation; Adsorption chromatography, Ion-exchange chromatography, Molecular exclusion chromatography, Thin-layer chromatography, Gas chromatography, HPLC; Electrophoresis of proteins and nucleic acids, UV-Vis spectroscopy, Fluorescence spectroscopy, Circular dichroism spectroscopy, X-ray spectroscopy, ESR, NMR; Immuno precipitation, Immuno blotting; light microscope, electron microscope.

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Environmental Science

Unit 1: Fundamentals of Environmental Science, Definition, principles and scope of Environmental Science., Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere. Mass and Energy transfer across the various interfaces, material balance. First and Second law of thermodynamics, heat transfer processes. Scale of Meteorology, pressure, temperature, precipitation, humidity, radiation and wind. Atmospheric stability, inversions and mixing heights, wind roses, Natural resources, conservation and sustainable development.

Unit – II: Ecology and Biodiversity

Definition, Principles and scope of ecology, Evolution, Origin of life and speciation, Ecosystems, Biodiversity, uses, threats and its conservation measures

Unit – III: Environmental Geosciences

Fundamental Concept of Environmental Geosciences, Energy budget of the earth. Earth's thermal environment and seasons. General relationship between landscape, biomes and climate. Climates of India, Indian Monsoon, El Nino, Droughts. Tropical cyclones and Western Disturbances, Earth's Processes and various Geological Hazards, Principles of Remote sensing and its application of Environmental Sciences, Application of GIS in Environmental Management.

Unit – IV: Energy Resources

Solar energy, Fossil fuels Hydroelectric power, Tidal, Ocean Thermal Energy Conversion, wind, geothermal energy; nuclear energy – fission and fusion; magneto hydrodynamic power, bio-energy-energy from biomass and biogas, anaerobic digestion; energy use pattern in different parts of the world.

Environmental implication of energy use; C02 emissions, global warming; air and thermal pollution; radioactive waste and radioactivity from nuclear reactors; impacts of large-scale exploitation of Solar, Wind, Hydro and Ocean energy. Principles of Analytical Methods: Titrimetry, Gravimetry, Colourimetry, Spectrophotometry, Chromatography, Gas Chromatography, Atomic Absorption Spectrophotometry, GLC, HPLC, Electrophoresis. X – ray fluorescence, X – ray diffraction, Flame photometry.

Unit – V: Pollution

Types, sources and consequences of Air and Water pollution, Methods of monitoring and control of air pollution SOz, NOx, CO, SPM., Acid Rain, Air Quality Standards, Physico – chemical and Bacteriological sampling and analysis of water quality. Standards, sewage and waste water treatment and recycling. Water quality standard; Physico – chemical as bacteriological sampling as analysis of soil quality.

Soil Pollution Control. Industrial waste effluents and heavy metals, their interactions with soil components. Soil micro – organisms and their functions, degradation of different insecticides, fungicides and weedicides in soil. Different kinds of synthetic fertilizers (NP & K) and their interactions with different components of soil; Sources of noise pollution, measurement of noise and Indices, effect of meteorological parameters on noise propagation. Noise exposure levels and standards. Noise control and abatement measures. Impact of noise on human health. Sources of marine pollution and control. Criteria employed for disposal of pollutants in marine system-coastal management. Radioactive and Thermal Pollution.

Unit – VI: Current Social issues

Introduction to environmental impact analysis. Environmental impact Statement and Environmental Management Plan.EIA guidelines 1994, Notification of Government of India.

Impact Assessment Methodologies. Generalized approach to impact analysis. Procedure for reviewing Environmental impact analysis and statement. Guidelines for Environmental audit. Introduction to Environmental planning. Base line information and predictions (land, water, atmosphere, energy, etc.). Restoration and rehabilitation technologies. Landuse policy for India. Urban planning for India. Rural planning and landuse pattern. Concept and strategies of sustainable development. Cost-Benefit analysis.

Environmental priorities in India and sustainable development. Environmental Education and Awareness. Environmental Ethics and Global imperatives. Global Environmental problems-ozone depletion, global warming and climatic change. Current Environmental issue in India. Context : Narmada Dam, Tehri Dam, Almetti Dam, Soil Erosion, Formation and reclamation of Usar, Alkaline and Saline Soil. Waste lands and their reclamation. Desertification and its control. Vehicular pollution and urban air quality. Biodiversity conservation and Agenda – 21. Waste disposal, recycling and power generation, Fly ash utilization. Water Crises-Conservation of water. Environmental Hazards. Eutrophication and restoration of Indian lakes. Rain water harvesting. Wet lands conservation. Epidemiological issues (e.g., Goitre, Fluorosis, Arsenic).

Unit – VII: Solid Waste Management and Environmental Laws

Sources and generation of solid wastes, their characterization, chemical composition and classification. Different methods of disposal and management of solid wastes (Hospital Wastes and Hazardous Wastes) Recycling of waste material. Waste minimization technologies. Hazardous Wastes Management and Handling Rules, 1989, Resource Management, Disaster Management and Risk analysis.

Environment protection-issues and problems, International and National efforts for Environment Protection, Provision of Constitution of India regarding Environment (Article 48A and 58A).

Environmental Policy Resolution, Legislation, Public Policy Strategies in Pollution Control, Wildlife Protection Act, 1972 amended 1991, Forest Conservation Act, 1980, Indian Forests Act (Revised) 1982, Air (Prevention and Control of Pollution) Act, 1981 as amended by Amendment Act, 1987 and Rule 1982, Motor Vehicle Act, 1988, The Water (Prevention and Control of Pollution) Act, 1974 as amended up to 1988 and Rules 1975, The Environment (Protection) Act, 1986 and Rules 1986.

Scheme of labelling of environmentally friendly products (Eco mark), Public Liability Insurance Act, 1991 and Rules 1991.

Unit – VIII: Statistical Analysis

Basic elements and tools of statistical analysis; Probability, sampling, measurement and distribution of attributes; Distribution-Normal, t and x* Poisson and Binomial; Arithmetic, Geometric and Harmonic means; moments; matrices, simultaneous linear equations; tests of hypothesis and significance.

Introduction to environmental system analysis; Approaches to development of models; linear simple and multiple regression models, validation and forecasting. Models of population growth and interactions – Lotka – Volterra model, Leslie's matrix model, point source stream pollution model, box model, Gaussian plume model.

MOLECULES AND THEIR INTERACTION RELAVENT TO BIOLOGY: Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins). Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties). Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy

transducers, Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes, Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds)., Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA), Stability of proteins and nucleic acids., Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins. CELLULAR ORGANIZATION

Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport,electrical properties of membranes.

Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

Organization of genes and chromosomes: Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons.

Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.

FUNDAMENTAL PROCESSES

DNA replication, repair and recombination: Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination.

RNA synthesis and processing: transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport.

Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post-translational modification of proteins.

Control of gene expression at transcription and translation level: regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing.

Cell communication and cell signaling

Host parasite interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.

Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways.

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Zoology

Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

Innate and adaptive immune system: Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines.

DEVELOPMENTAL BIOLOGY

Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development

Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Morphogenesis and organogenesis in animals : Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, amphibia and chick; organogenesis – vulva formation in Caenorhabditis elegans, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.

Programmed cell death, aging and senescence

ANIMAL PHYSIOLOGY

Blood and circulation: Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.

Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

Respiratory system: Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

Nervous system: Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Sense organs: Vision, hearing and tactile response.

Excretory system: Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance. Thermoregulation: Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization. Stress and adaptation, Digestive system: Digestion, absorption, energy balance, BMR. Endocrinology and reproduction: Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation

INHERITANCE BIOLOGY

Mendelian principles: Dominance, segregation, independent assortment. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.

Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.

Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes. Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping. Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Recombination: Homologous and non-homologous recombination including transposition.

DIVERSITY OF LIFE FORMS:

Principles & methods of taxonomy: Concepts of species and hierarchical taxa, biological nomenclature, classical & quantititative methods of taxonomy of plants, animals and microorganisms. Levels of structural organization: Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Comparative anatomy, adaptive radiation, adaptive modifications. Outline classification of animals: Important criteria used for classification in each taxon. Classification of animals. Evolutionary relationships among taxa. Natural history of Indian subcontinent: Major habitat types of the subcontinent, geographic origins and migrations of species. Comman Indian mammals, birds. Organisms of health & agricultural importance: Common parasites and pathogens of humans, domestic animals and crops. Organisms of conservation concern: Rare, endangered species. Conservation strategies.

ECOLOGICAL PRINCIPLES

The Environment: Physical environment; biotic environment; biotic and abiotic interactions.

Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.

Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax. Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

Applied Ecology: Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.

Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

EVOLUTION AND BEHAVIOUR

Emergence of evolutionary thoughts: Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.

Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiement of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.

Paleontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo.

Molecular Evolution: Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.

The Mechanisms: Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

Brain, Behavior and Evolution: Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior;

Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.

APPLIED BIOLOGY:

Application of immunological principles, vaccines, diagnostics. Tissue and cell culture methods for animals. Transgenic animals Genomics and its application to health, including gene therapy. Bioresource and uses of biodiversity.

METHODS IN BIOLOGY

Molecular Biology and Recombinant DNA methods:Isolation and purification of RNA , DNA (genomic and plasmid) and proteins, different separation methods, Analysis of RNA, DNA and proteins by one and

two dimensional gel electrophoresis, Isoelectric focusing gels, Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems, Expression of recombinant proteins using bacterial, animal and plant vectors, Isolation of specific nucleic acid sequences, Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors, In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms.

Protein sequencing methods, detection of post translation modification of proteins, DNA sequencing methods, strategies for genome sequencing, Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques, Isolation, separation and analysis of carbohydrate and lipid molecules, RFLP, RAPD and AFLP techniques, Histochemical and Immunotechniques: Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, fluocytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.

Biophysical Methods: Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy Molecular structure determination using X-ray diffraction and NMR, Molecular analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

Statisitcal Methods: Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; Analysis of variance; X2 test;; Basic introduction to Muetrovariate statistics, etc.

Radiolabeling techniques: Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.

Microscopic techniques: Visulization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze- fracture methods for EM, image processing methods in microscopy.

Electrophysiological methods: Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT .

Methods in field biology: Methods of estimating population density of animals and plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization: ground and remote sensing methods.

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Economics

Micro – Economic Analysis

Demand Analysis – Marshallian, Hicksian and Revealed preference approaches Consumer behaviour under conditions of uncertainty. Theory of Production and Costs. Pricing and output under different forms of market structure. Different models of objectives of the firm – Baumol, Morris and Williamson. Factor Pricing analysis. Elements of general equilibrium and new welfare economics.

Macro – Economic Analysis

Determination of output and employment – Classical approach, Keynesian approach, Consumption hypotheses. Demand for Money – Fisher and Cambridge versions, Approaches of Keynesian, Friedman, Patinkin, Baumol and Tobin. Supply of Money, Determinants of money supply, High – powered money, Money multiplier. Phillips Curve analysis. Business cycles – Models of Samuelson, Hicks and Kaldor. Macro – economic Equilibrium – Relative roles of monetary and fiscal policies Fleming – Mundell open economy model.

Development and Planning

Economic Growth, Economic Development and sustainable Development – Importance of institutions – Government and markets – Perpetuation of underdevelopment – Vicious circle of poverty, circular causation, structural view of underdevelopment – Measurement of development conventional, HDI and quality of life indices. Theories of growth and development – Models of growth of Joan Robinson and Kaldor; Technical Progress – Hicks, Harrod and learning by doing, production function approach to the determinants of growth : Endogenous growth : role of education, research and knowledge – explanation of cross country differentials in economic development and growth.

Theories of Development – Classical, Marx and Schumpeter; Economic Growth – Harrod – Domar model, instability of equilibrium, Neoclassical growth – Solow's model, steady state growth. Lewis model of development, Ranis – Fei model, Dependency theory of development.

Approaches to development: Balanced growth, critical minimum effort, big push, unlimited supply of labour, unbalanced growth, low income equilibrium trap. Indicators and measurement of poverty.

Indian Economy

Basic Economic indicators – National income, performance of different sectors Trends in prices and money supply. Agriculture – Institutional and technological aspects, new agricultural policy Industry – New industrial policy and liberalization. Money and banking – Concepts of money supply, inflation, monetary policy and financial sector reforms.

Public finance – Trends in revenue and expenditures of the Central and State Governments, Public debt; analysis of the Union Budget. Foreign trade – Trends, Balance of payments and trade reforms. Poverty, unemployment, migration and environment.

Quantitative Methods

Measures of Central tendency, dispersion, skewness and kurtosis. Elementary theory of probability – Binomial, Poisson and Normal distributions. Simple correlation and regression analysis. Statistical inferences – Applications, sampling distributions (t, x2 and F tests) sampling of attributes, testing of Hypothesis. Index numbers and time series analysis.Sampling and census methods, types of sampling and errors.

DAV UNIVERSITY, JALANDHAR

PhD Entrance Test Syllabus-2017

Commerce & Business Management

PART–I

RESEARCH METHODOLOGY

(50 Questions)

Business Research Methods: Introduction to Research-Basic, Applied and Business Research Methods, Road Map to Learn Business Research Methods, Business research methods: A Decision Making Tool, Use of Software in Data Preparation and Analysis, Introduction and Business Research Process Design, Introduction and Scales of Measurement, Four Levels of Data Measurement, The Criteria for Good Measurement, Factors in selecting an appropriate Measurement Scale, Questionnaire: Introduction and Design Process

Introduction to Sampling- Importance and Sampling Design Process, Random Sampling Methods and Non-Random Sampling, Central Limit Theorem and Sampling distribution. Classification of Secondary Data Sources, Road Map to Use Secondary Data, Survey and Observation: Classification of Survey Methods, Observation Techniques and Classification of Observation Methods

Hypothesis Testing for Single Population: Introduction, Hypothesis Testing Procedure, Two-Tailed Test of Hypothesis and One - Tailed Test of Hypothesis, Type- I and Type-II Error

Hypothesis Testing for a Single Population Mean Using the Z and T statistic, Hypothesis Testing for a Population Proportion, Hypothesis Testing for Two Populations, Hypothesis Testing for the Difference Between Two Population Means Using the z and t-Statistic

Statistical Inference About the Difference between the means of Two Related Population, One way ANOVA Introduction and Application in Business Research

Hypothesis testing for Categorical data (Chi-square test), Non-parametric statistics, Correlation- Karl Pearson and Spearman's Rank Correlation, Introduction of Simple Linear Regression and Determining the Equation of a Regression Line

Report Writing, Organization of Written Report, Tabular and Graphical Representation of Data, Oral Presentation

PART–II

Commerce / Management

(50 Questions)

Business Environment, The concept and significance of organisational behaviour – Skills and Roles in an organisation – Classical, Neo – Classical and Modern Theories of Organisational Structure – Organisational Design – Understanding and Managing individual behaviour personality – Perception – Values – Attitudes – Learning – Motivation. Understanding and Managing Group Behaviour, Processes – Inter – personal and group dynamics – Communication – Leadership – Managing change – Managing conflicts.

Organisational Development. Concepts and perspectives in HRM; HRM in changing environment. Human Resource Plarming – Objectives, Process and Techniques. Job analysis – Job Description. Selecting Human Resources. Induction, Training and Development. Exit policy and Implications. Performance Appraisal and

Evaluation. Potential Assessment. Job Evaluation. Wage Determination. Industrial Relations and Trade Unions. Dispute Resolution and Grievance Management. Labour Welfare and Social SecurityMeasures. Financial Management – Nature and Scope. Valuation Concepts and Valuation of Securities. Capital Budgeting Decisions – Risk Analysis. Capital Structure and Cost of Capital. Dividend Policy – Determinants. Long – Term and Short – Term Financing Instruments. Mergers and Acquisitions. Marketing Environment and Environment Scanning; Marketing Information Systems and Marketing Research; Understanding Consumer and Industrial Markets; Demand Measurement and Forecasting; Market Segmentation – Targeting and Positioning; Product Decisions, Product mix, Product Life Cycle; New Product Development; Branding and Packaging; Pricing Methods and Strategies. Promotion Decisions – Promotion mix; Advertising; Personal Selling; Channel Management; Vertical Marketing Systems; Evaluation and Control of Marketing Effort; Marketing of Services; Customer Relation Management; Uses of Internet as a Marketing Medium – Other related issues like branding, market development, Advertising and retailing on the net. New issues in Marketing. Role and Scope of Production Management; Facility Location; Layout Planning and Analysis; Production, Planning and Control – Production Process Analysis; Demand Forecasting for Operations; Determinants of Product mix; Production Scheduling; Work measurement; Time and Motion Study; Statistical Quality Control. Role and Scope of Operations Research; Linear Programming; Sensitivity Analysis; Duality; Transportation Model; Inventory Control; Queueing Theory; Decision Theory; Markov Analysis; PERT / CPM. Use of Computers in Managerial applications; Technology issues and Data processing in organizations; Information systems; MIS and Decision making; System analysis and design; Trends in Information Technology; Internet and Internet – based applications. Concept of Corporate Strategy; Components of Strategy Formulation; Ansoffs Growth Vector; BCG Model; Porter's Generic Strategies; Competitor Analysis; Strategic Dimensions and Group Mapping; Industry Analysis; Strategies in Industry Evolution, Fragmentation, Maturity, and decline. Competitive strategy and Corporate Strategy; Global Entry Strategies; Managing International Business; Competitive Advantage of Nations; IMF, World Bank, WTO. Concepts – Types, Characteristics; Motivation; Competencies and its development; Innovation and Entrepreneurship; Small business – Concepts Government policy for promotion of small and tiny enterprises; Process of Business Opportunity Identification;Detailed business plan preparation; Managing small enterprises; Planning for growth; Sickness in Small Enterprises; Rehabilitation of Sick Enterprises; Intrapreneurship (Organisational Entrepreneurship). Ethics and Management System; Ethical issues and Analysis in Management; Value based organisations; Personal framework for ethical choices; Ethical pressure on individual in organisations; Gender issues; Ecological consciousness; Environmental ethics; Social responsibilities of business; Corporate governance and ethics. Managerial Economics – Demand Analysis, Production Function,Cost – Output Relations, Market Structures, Pricing Theories, Advertising, Macro – Economics, National Income Concepts, Infrastructure – Management and Policy, Capital Budgeting, Basic accounting concepts, capital and revenue, financial statements. Cost and management accounting, ratio analysis, fund flow analysis, cash flow analysis, marginal costing and break even analysis, standard costing, budgetary control, responsibility accounting. Stock Markets and SEBI