1.

Faculty of Science

MATHEMATICS

Mathematics (50 MCQs – 01 mark each)

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.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, Linear equations. Eigen values and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis.

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.

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, variationof parameters, Sturm-Liouville boundary value problem, Green's function.

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.

Linear Programming Problems: The linear programming problem, mathematical formulation of problem, types of solutions, linear programming in matrix notation, the two phase method, duality, transportation and assignment problems.

Special Functions And Integral Transform: Gauss hypergeometric function and its properties, integral representation, linear and quadratic transformation, formulas, contiguous function relations, integral representation, Legendre functions, Pn(X) and Qn(X) and their properties, Bessel functions, In(X), Laplace Transform, Fourier Transform.

Faculty of Science

ZOOLOGY

Zoology (50 MCQs – 01 mark each)

Unit 1. Biomolecular Interaction:

A. Structure and function of molecules:Atoms, molecules and chemical bonds. Structure of carbohydrates, lipids, proteins, nucleic acids and vitamins.Van der Waals, electrostatic, hydrogen bonding, and hydrophobic interaction.

B. Principles of biophysical chemistry:pH, buffer, reaction kinetics, thermodynamics and glycolysis,Structure and Types of enzymes.

C. Protein and Nucleic Acid:Structure of proteins, Primary, secondary, tertiary and quaternary structure, structure of A, B & Z-DNA.

Unit 2. Cellular Organization:

A. Membrane structure and function: Structure of membrane, lipid bilayer and diffusion, osmosis, active transport.

B. Structural organization and function of intracellular organelles: Plasma membrane, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, structure & function of cytoskeleton and its role in motility.

C. Organization of genes and chromosomes: Operon, interrupted genes, structure of chromosomes, heterochromatin, euchromatin and transposons.

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

Unit 3. Molecular Biology:

A.DNA replication, repair and recombination:DNA replication,unit of replication enzymes involved, replication origin and replication fork, extra chromosomal replicons, DNA repair mechanisms.

B.RNA synthesis and processing: Transcription factors, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, structure and function of different types of RNA.

C. Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation, termination and genetic code.

Unit 4. Cell Communication And Cell Signaling:

A.Cellular communication:General principles of cell communication, gap junctions, extracellular matrix, neurotransmission and its regulation.

B.Concept of oncogenes & its regulation: interaction of cancer cells with normal cells, apoptosis, and therapeutic interventions of uncontrolled cell growth.

C.Innate and adaptive immune system: Cells and molecules involved in innate and adaptive immunity, antigen-antibody reaction. B and T cells, structure and function of antibody, humoral and cell-mediated immune responses, primary and secondary immune response, hypersensitivity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, vaccines.

Unit 5. Developmental Biology:

A.Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate, stem cells.

B.Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; zygote formation, cleavage, blastula formation, gastrulation and formation of germ layers in animals.

C.Morphogenesis and Organogenesis in animals: Cell aggregation and differentiation, axes and pattern formations in amphibian and chick; organogenesis; post embryonic development-larval, metamorphosis; sex determination. Programmed cell death, aging and senescence.

Unit 6. Inheritance Biology:

A. Mendelian Principles: Dominance, segregation, independent assortment, deviation from Mendelian inheritance, Concept of geneAllele, pseudo allele.Co-dominance, incomplete dominance, gene interaction, pleiotropy, genomic imprinting, phenocopy, linkage and crossing over and sex linkage.

B. Gene mapping methods: Linkage maps, mapping with molecular markers.Inheritance of mitochondrial and maternal inheritance.

C. Human genetics: Pedigree analysis, karyotypes, genetic disorders. Mutation's causes and mutation's, loss of function, gain of function.

D. Structural and numerical alteration of chromosomes:Structure of chromosomes, Deletion, duplication, inversion and translocation,

Homologous and Non-Homologous recombinationand transposition.

Unit 7. Diversity of Life Forms:

A. Principles and methods of taxonomy: Concepts of species and hierarchical taxa, biological nomenclature, classical and quantitative methods of taxonomy of animals.

B. Levels of structural organization: unicellular, colonial and multicellular forms; levels of organization of tissues, organs and systems.

C. Outline classification of animals: Important criteria used for classification in each taxon; classification, evolutionary relationships among taxa.

Unit 8. Ecological Principles:

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

B. Population and Community ecology: Characteristics of a population; population growth curves; r and K selection and Community structure.

C. Species interactions: Types of interactions, intraspecific and interspecific interaction, competition andsymbiosis.

D. Ecosystem: Structure and function; energy flow and mineral cycling; primary production; structure and function of ecosystems; terrestrial (forest, desert, grassland) and aquatic (fresh water, marine) and Ecological succession**.**

E. Biogeography: Major terrestrial biomes; theory of island biogeography; bio geographical zones of India.

F. Applied ecology: Environmental pollution; global environmental change; major drivers of biodiversity change; biodiversity management approaches.

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

Unit 9. Evolution And Behaviour:

A. Emergence of evolutionary thoughts: Lamarck; Darwin-concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutation.

B. Origin of basic biological molecules:Abiotic synthesis of organic monomers and polymers; concept of Oparin and Haldane; experiment of Miller (1953); evolution 'of prokaryotes and origin of eukaryotic cells.

C. Paleontology and evolutionary history:The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; stages in primate evolution including Homo.

D. The Mechanisms: Population genetics- populations, gene pool, gene frequency; Hardy- Weinberg Law; migration and genetic drift; adaptive radiation and modifications; isolating mechanisms; speciation; allopatric and sympatric; convergent &sexual selection; co-evolution.

E. Brain, Behavior and Evolution: Approaches and methods in study of behavior; altruism and evolution-group selection, kin selection, reciprocal altruism; memory; socialcommunication; use of space and territoriality; mating systems, parental investment and reproductive success; parental care; aggressive behavior.

Unit 10. Applied Biology:

A. Microbial fermentation and production of small and macro molecules.

B. Application of immunological principles (vaccines, diagnostics). Tissue and cell culture methods for animals. Transgenic animals.

Unit 11. Methods in Biology:

A. Molecular biology and recombinant DNA methods: Isolation and purification of RNA, DNA and proteins, gel electrophoresis, isoelectric focusing gels; c-DNA Libraries.Immune techniques, using in ELISA test,southern and western blot.

C. Microscopic techniques: Visualization of cells by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and different fixation and staining techniques for EM.

Unit 12. Invertebrate Structure And Functions:

A.Organization of coelom: Acoelomates, Pseudo-coelomates, Coelomates:Protostomia and Deuterostomia, Locomotion:Flagellary and ciliary movement in Protozoa, Hydrostatic movement in Coelenterate, Annelida and Echinodermata.

B. Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan, feeding in Annelida, Arthropod, Mollusca and Echinodermata.

C. Respiration &Excretion: Organs of respiration: Gills, and trachea; respiratory pigments; Mechanism of respiration; Organs of excretion: Coelom, coelom ducts, nephridia and malphigian tubules, coxal gland, Kaber's organ, Bojanus organ: Mechanisms of excretion and

osmoregulation.

D. Nervous system: Primitive nervous system: Coelenterate and Echinodermata; Advanced nervous system: Annelida; Arthropoda (Crustacean and Insecta) and Mollusca (Cephalopoda).

E. Invertebrate larvae: Larval forms of free-living invertebrates; larval forms of parasites; Strategies and Evolutionary significance of larval forms

Unit 13. Vertebrate Physiology:

A. Digestion & Respiration:Biochemical process of food digestion, absorption and assimilation. Kind of respiratory pigments, mechanism of respiration and gaseous exchange.

B. Circulatory System:Composition and functions of blood and lymph. Cardiac cycle and heart beat; Clotting factors and blood clotting mechanism.

C. Excretory System:Structure and types of nephrons, mechanism of urine formation and elimination; arginine – ornithine cycle; Osmoregulation, Structure and physiology of eye.

D. Muscle structure & endocrine glands:Types of muscle, their ultra-structure and physiology of contraction; function and structure of various endocrine glands, hormonal abnormalities.

E. Nerve conduction:Types of neurotransmitters and their mode of action; Thermoregulation, hibernation, bioluminescence, chromatophore and colour change.

Faculty of Science

BOTANY

Botany (50 MCQs – 01 mark each)

Unit 1: Concept of cell and cell theory: Structural organization of plant cell. Specialized plant cell types. Chemical foundation: Covalent and non-covalent bonds. Structure of proteins, lipids and carbohydrates. Biochemical energetics: Various forms of energy and their interrelationships in living systems. Cell Wall: biochemistry and molecular biology of cell wall biogenesis. Nature of cell wall. Growth and its function. Macromolecules.

Unit 2: Plant vacuole: Tonoplast membrane transporters and storage organelle. Ribosomes: structure, siteof protein synthesis; mechanism of translation, initiation, elongation and termination; structure and role of tRNA. Structure and function of Endoplasmic Reticulum (ER), Plasmodesmata: Composition and structure; signaling and movement of molecules and macromolecules; other functions; comparison with gap junctions.

Unit 3: Endosymbiosis theory and ancestry of plastids: Division and development of plastids. Nature,organization and functioning of plastome. Mitochondria – Structure, division, biogenesis anddevelopment to mitochondria. Genome organization. Nucleus: Ultra structure, nuclear pores, mechanism of export and import of macromolecules,molecular structure of DNA, DNA replication and DNA polymerases. Transcription factors, promoters and splicing. DNA damage and repair cytokinesis and cell plate formation; retinoblastoma and E2F proteins. Apoptosis, mechanism of programmed cell death in plants and its importance.

Unit 4: Plasma membrane: structure, models and functions, sites for ATPases, ion carriers, channels,pumps and receptors. Cell shape and motility: Protein sorting: Targeting of proteins to organelles. Flow Cytometry. Principles of microscopy and optics (light, fluorescence, electron, confocal and atomic force microscopy).

Unit 5: Genome organization: Chromosome structure and packaging of DNA, molecular organization ofcentromere and telomere; euchromatin and heterochromatin; types of chromosomes; polytene, lampbrush, B-and sex chromosome. Molecular basis of chromosome pairing. Structural and

	numerical alterations in chromosomes: origin, meiosis and breeding behaviour of duplications, deficiency, inversion and translocation heterozygotes. Origin and occurrence of haploids, meiosis in haploids. Polyploids (aneuploids, euploids, autopolyploids and allopolyploids). **Unit 6: Genetics of prokaryotes and eukaryotes:** Genetic recombination of phage genome; genetictransformation, conjugation and transduction in bacteria. Fine structure of prokaryotic and eukaryotic genes. Regulation of gene expression in prokaryote: initiation of transcription, RNA polymerases, lac operon, tryptophan operon. Regulation of gene expression in eukaryotes: transcription; RNA polymerases, regulator binding sites, post transcription, translation and post translation modifications/regulations. Introns and their significance, RNA splicing. **Unit 7: Genetic recombination and genetic mapping:** Independent assortment, crossing over, linkagegroups and chromosome mapping. Correlation of genetic and physical maps. Molecular mechanism of recombination: ss DNA and ds DNA breakage models, role of RecA and RecBCD enzymes; site-specific recombination. Mutations: spontaneous and induced mutations, molecular mechanisms of physical and chemical mutagens; repair mechanisms, reverse genetics. Transposable elements in prokaryotes and eukaryotes; mutation induced by transposons, site directed mutagenesis. **Unit 8: Genetics, evolution and breeding of major crop plants:** Wheat, Rice, Cotton, Sugarcane, Potato, Brassica and Groundnut; Transfer of whole genome (examples frorm wheat, Arachis and Brassica); transfer of individual chromosomes and chromosome segments methods for detecting alien chromatin, characterization and utility of alien addition and substitution lines, Genetic basis of inbreeding and heterosis, exploitation of hybrid vigor, Male sterility and its application on crop improvement. **Unit 9: Microbiology:** General account of Archaebacteria, Eubacteria, Actinomycetes, Cyanobacteria,Mycoplasma, Phytoplasma and yeast. Ultrastructure of Bacteria. Viruses: morphology, isolationand purification, transmission and genetics of viruses. General account of AIDS. General characters and classification of fungi. General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina. Fungi in industry; Mycorrhizae; General concepts of

	plant pathology. **Unit 10: Phycology:** Algae in diversified habitats; thallus organization; cell ultrastructure; reproduction;criteria for classification of algae. Classification and salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta. Algal blooms, algal biofertilizers; algae as food, feed and uses in industry. **Unit 11: Bryophyta:** Morphology, structure, reproduction and life history; distributions; classifications;general account of Marchantiales, Junger-maniales, Anthocerotales, Sphagnales, Funariales andPolytrichales; economic and ecological importance. **Unit 12: Pteridophyta:** Classification; evolution of stele; heterospory and origin of seed habit; generalaccount of fossil pteridophyta; morphology, anatomy and reproduction: introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida. **Unit 13: Gymnosperms:**General characters and classification of Gymnosperms. Structure andreproduction in Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales and Gnetales. Diversity and evolution of male and female gametophytes of Gymnosperms. Diversity and distribution of Gymnosperms of India.Geological Time Scale. Evolution of Gymnosperms- a general account. General characters, classification and evolutionary significance of Pteridospermales (Lyginopteridaceae, Medullosaceae, Caytoniaceae and Glossopteridaceae), Cycadeoidales and Cordaitales. **Unit 14: Angiosperms:** Plant Taxonomy-principles and significance. Nomenclature: InternationalCode of Botanical Nomenclature (2012)-Taxonomic hierarchy-concept of species, genus, family and other categories; typification, rule of priority, effective and valid publication. Angiosperm classifications: Phenetic versus phylogenetic systems; cladistics in taxonomy. Classification, relative merits and demerits of major systems of classifications-Bentham and Hooker, Cronquist, Takhtajan, Angiosperm Phylogeny Group (III).Plant explorations. Herbarium methodology-collection and preservation of plant specimens. World and Indian herbaria. Plant identification-taxonomic keys; floras and taxonomic journals. Taxonomic evidence: Morphology, Anatomy, Palynology, Embryology, Cytology, Phytochemistry, Nucleic acid

	hybridization as a tool in taxonomy; DNA Barcoding. Study Of Selected Angiosperm Orders: Salient features, floral diversity, diversity of families and phylogeny of the following orders: Ranales, Centrospermae, Amentiferae, Tubiflorae, Helobieae and Glumiflorae. **Unit 15: Biosystematics And Phytogeography:** Biosystematic categories-Ecotype: nature, origin and their significance, different types of ecotypes, ecospecies, coenospecies, comparium; phenotype, genotype, biotype; deme concept. Infra specific and Inter specific variations. Genecotypes and phenecotypes. Plasticity of phenotypes; factors affecting phenotype variations and their significance, role of biosystematics in evolution. Principles of phytogeography: Static and dynamic concepts. Continental drift theory and Endemism. Invasions and introductions; Local plant diversity and its socio-economic importance. **Unit 16: Fundamentals of Enzymology:** General aspects, allosteric mechanism, regulatory and active sites, isozymes. Membrane transport and translocation of water and solutes: Plant-water relations, mechanism of water transport through xylem, root-microbe interactions in facilitating nutrient uptake, comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport proteins. **Unit 17: Photochemistry And Photosynthesis:** General concepts and historical background, evolution of photosynthetic apparatus, photosynthetic pigments and light harvesting complexes, photooxidation of water, mechanisms of electron and proton transport, carbon assimilation-the Calvin cycle, photo respiration and its significance, the C4 cycle, the CAM pathway. Regulation of C3 cycle. Biosynthesis of starch and sucrose, physiological and ecological considerations.Respiration and lipid metabolism: Overview of plant respiration, glycolysis, the TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, glyoxylate cycle, alternative oxidase system,fatty acids and their metabolism. **Unit 18: Plant Growth Regulators:** Physiological effects and general mechanism of action of plant hormones. Specific mode of actions of auxins (cell enlargement), gibberellins (de novo alpha amylasesecretion), cytokinins (delaying senescence, cell division), ethylene (fruit ripening,

	vase life) and abscisic acid (environmental stress). The flowering process: Photoperiodism and its significance, endogenous clock and its regulation. Vernalization. **Unit 19: Nitrogen Fixation, Nitrogen And Sulphur Metabolism:** Overview, biological nitrogen fixation, nodule formation and Nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation, sulfate uptake, transport and assimilation. Stress physiology- Plant responses to biotic and abiotic stress, general mechanisms of abiotic stress tolerance, HR and SAR, water deficit and drought resistance, salinity stress, metal toxicity, freezing and heat stress, oxidative stress and antioxidants system in plants. **Unit 20: Plant Development:** Unique features of plant development, differences between animal and plant development. Seed germination and seedling development. Concept of stem cells in plants. Hormonal and environmental signalling and plant development. Shoot apical meristem (SAM) and development of shoot. Cell to cell communication. Cell fates and lineages. Regulation of tissue differentiation with special reference to xylem and phloem, secretory ducts and laticifers. Bud dormancy. Wood development in relation to environmental factors. Nodal anatomy of angiosperms. **Unit 21: Differentiation and development of Leaf:** Phyllotaxy. Differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll. Metabolic changes associated with senescence and its regulation; influence of hormones and environmental factors on senescence. Root apical meristem (RAM) and development of root(s), lateral roots and root hairs. Hormonal control of root development. **Unit 22: Reproduction:** Vegetative options and sexual reproduction; flower development; genetics of floral organ differentiation; homeotic mutants in Arabidopsis and Antirrhinum; sex determination in plants. Male gametophyte: Structure of anthers; microsporogenesis, role of tapetum; pollen development and gene expression; sperm dimorphism and hybrid seed production; pollen germination, pollen tube growth and guidance; pollen storage; pollen allergy; pollen embryos. **Unit 23: Female gametophyte:** Ovule development; megasporogenesis; organization of the embryo sac, structure of the embryo sac cells.

	Pollination, pollen-pistil interaction and fertilization: Floral characteristics, pollination mechanisms and vectors; breeding systems; commercial considerations; structure of the pistil; pollen-stigma interactions, sporophytic and gametophytic self-incompatibility in plants. Double fertilization and in vitro fertilization in plants. **Unit 24: Endosperm development:**Developmentduring early, maturation and desiccation stages; embryogenesis, ultrastructure and nuclear cytology; cell lineages during late embryo development; storage proteins of endosperm and embryo; polyembryony; apomixis; embryo culture. Seed development and fruit growth: dynamics of fruit growth; biochemistry and molecular biology of fruit maturation. Seed dormancy: Importance and types. Basics of seed technology. **Unit 25: Climate, Vegetation and Population Biology:** Introduction to Concept, developments in ecology. Atmosphere, Hydrosphere and Biosphere- Life zones, major biomes, vegetation types of the world. Vegetation Organization: Concepts of community, analytical and synthetic characters, communitycoefficients, interspecific associations, ordination. Concept of habitat, coexistence and niche. Population Biology: Concepts and Growth models. Ecosystem: Structure and function. Energy dynamics- flow models and efficiencies. Productivity: Primary productivity-measurements, global pattern and controlling factors. Succession (Ecosystem development): Concept, mechanisms and models, changes in ecosystem properties during succession. **Unit 26: Soils and Mineralization:** Soils: Characters, formation, classification and major soil types of the world. Soil quality assessment and factors affecting soil quality. Mineralization: Litter fall and decomposition- litter quality, climatic factors, soil microorganisms affecting mineralization. Nutrient synchronization and biological management of soil fertility. **Unit 27: Origin of agriculture:** World centres of primary diversity of domesticated plants: The Indo-Burmese centre; plant introductions and secondary centres. Green revolution: History of agriculture revolution, Wheat revolution in India, Impact of green revolution, green revolution phase II. Regimes of WTO and plant genetic resources of India.Important fire-wood and timber yielding plants with special reference to Rajasthan

	desert. Non-wood forest products (NWFPs). Bamboos: distribution, cultivation and economic uses Rattans. Raw materials for paper making. Gums, resins, dyes and tannins from natural plant resources. **Unit 28:Basic statistics:** Central tendency, dispersion, standard error, coefficient of variation;Probability distributions (normal, binomial of Poission), Confidence limits, Test of statisticalsignificance (t-test; Chi-square). Analysis of variance. RBD and its application in plant breedingand genetics; Correlation and Regression. **Unit 29:Strategies for conservation:**'In situ' conservation: International efforts and Indian initiatives, protected areas in India- sanctuaries, national parks, biosphere reserves, wetlands, mangroves and coral reefs for conservation of wild biodiversity. Strategies for conservation- ex situ conservation: Principles and practices, botanical gardens, field gene banks, seed banks, in vitro repositories, cryobanks; **Unit 30: Biotechnology:** Basic concepts, principles and scope. Plant Cell and Tissue Culture: General introduction, history, scope, concept of cellular differentiation, totipotency. Fundamental of Plant Morphogenesis, plant regeneration, cultured cell/tissue through somatic embryogenesis and organogenesis. Production of hybrids in plants and somatic hybridization: Protoplast isolation, fusion and culture, hybrid selection and regeneration. Recombinant DNA technology: Extraction, purification and quantification of genomic and plasmid DNA; enzymes for cutting and joining of DNA and their mode of action. Cloning vectors: based on plasmids, bacteriophages, yeast, and plants. c-DNA libraries. Oligonucleotide synthesis. Sequencing of DNA: Chain termination, capillary electrophoresis and pyrosequencing. PCR: designing of primers, optimization, and applications. DNA fingerprinting and their applications. **Unit 31: Genetic engineering of plants:** Aims, strategies for development of transgenics. Agrobacterium – the natural genetic engineer, T-DNA and transposon mediated gene tagging. Production of transplastomic plants and their utilization. Microbial genetic manipulation: transformation, transfection and selection of recombinant bacteria and bacteriophages. Introduction of DNA in yeast, fungi and plant. Genetic improvement of industrial microbes and nitrogen fixers. Fermentation technology: fundamentals and industrial applications. Clonal propagation, artificial

	seed, production of hybrids and somaclones, production of secondary metabolites/natural products, cryopreservation and germplasm storage. Applications of recombinant DNA technology. Intellectual property rights. **Unit 32: Genomics and proteomics:** Genetic and physical mapping of genes. Molecular markers and their applications in characterization of genes/germplasm and for introgression of useful traits. Artificial chromosomes and their uses. Bioinformatics and its applications. Functional genomics and microarrays. Proteomics-Protein profiling and its significance.

Faculty of Science

CHEMISTRY

Chemistry (50 MCQs – 01 mark each)

Unit-I Inorganic Chemistry:

1.Main group elements and their compounds: Allotropy,synthesis, structure and bonding, industrial properties ofcompounds.

2. Transition elements and co-ordination compounds: Types oftransitions, selection rules for electronic transitions, groundstates, correlation diagrams, Orgel and Tanabe suganodiagrams for d1 to d9 states in Transition metal complexes.

Calculation of Dq. B and ß parameters. Change transferspectra, spectroscopic method for assigning absoluteconfiguration (ORD and CD based on cotton effect)

3. Inner-transition elements: Electronic configuration,Lanthanide contraction, spectral and magnetic properties of M3+ions, colour of M3+ & M4+ ions, redox chemistry of lanthanidesand actinides. Applications in analytical chemistry of thefollowing compounds-Cede sulphate Ce (SO4)2; eerie ammoniumsulphate (NH4) [Ce (S04) 2H20; Thorium nitrate Th (NO3)4;Uranylacetale UO2 (CH3COO)2.2H2O

4. Organometallic compounds:- Synthesis, bonding andstructure, and reactivity. organometallics in homogeneouscatalysis.

5. Cages and metal clusters: Metal carbonyl and halide typeclusters, chevrel phases, Zinti ions or naked clusters Borazinesand phosphazenes, Metalloboranes compounds with metalmetalmultiple bonds.

Unit-IIOrganic Chemistry:

1. IUPAC nomenclature of organic molecules including region and stereoisomers

2. Principals of stereochemistry: Configurational andconformational isomerism in acyclic and cyclic and cycliccompounds; stereogenicity, enantioselectivity. Diasteroselectivityand asymmetric induction.

3. Organic reactive intermediates: generation, stability andreactivity of carbocations, carbanions. free radicals, carbenebenzyne and nitrenes.

4. Organic reaction mechanism: addition, elemination andsubstitution reaction with electrophilic, nucleophilic or radicalspecies. Determination of reaction pathways.

	5. Common name reactions and rearrangements- applicationsin organic synthesis 6. Concepts in organic synthesis: Retrosynthesis, disconnection,synthons, linear and convergent synthesis, umpolung ofreactivity and protecting groups. 7. Asymmetric synthesis: Chiral auxiliaries, methods ofasymmetric induction-substrare, reagent and catalyst controlledreactions; determination of enantiomeric and disteromericexcess; enantiodiscrimination. Resolution-optical and kinetic. 8. Pericyclic reaction: electrocyclisation, cycloaddtion,sigmatropic rearrangements **Unit-IIIPhysical Chemistry:** 1. Basic principles of quantum mechanics: postulates;operators, particle in a box; harmonic oscillator and thehydrogen atom, orbital and spin angular momenta; tunning. 2. Chemical Thermodynamics: Laws, state and path functionsand their applications; thermodynamic description of varioustypes of processes; Maxwell's relations; spontaneity andequilibria; temperature and pressure dependence ofthermodynamic quantities; Le Chatelier principle elementary description of phase transitions; phase equilibria and phase rule.Thermodynamics of ideal and non ideal gases and solutions. 3. Statistical Thermodynamics: Boltzmann distribution;kinetic theory of gases; partition functions and their relation tothermodynamic quantities. 4. Electrochemistry: Nernst equation, redox system;electrochemical cells; Deby-Huckel theory; electrolyticconductance-Kohlrausch's law and its applications; ionicequilibria; conductometric and potentiometric titrations. 5. Colloids and Surfaces: Stability and properties of colloids;isotherms and surface area; heterogeneous catalysis 6. Solid state: Crystal structure:; Bragg's law and applications;band structure of solids 7. Polymer Chemistry: Molar masses; kinetics of polymerization. **Unit-IVAnalytical Chemistry:** 1. Data analysis: Mean and standard deviation: absolute andrelative errors; linear regression; covariance and correlationcoefficient. 2. Solvent extraction: Quantitative and Qualitative treatment ofsolvent

extraction; Organic reagents dithiols. diketones. oxine,dithizone, cuproin. cupferron, dimethylglyoxime anddithiocarbamates in solvent extraction; Synergistic Extraction,Crown ethers for Ion association complexes.

3. 1on Exchange: Action of ion exchange resins. Ion Exchangecapacity. Ion Exchange Chromatography, Chelating ionexchange resins. Liquid ion exchangers

4. Separation Techniques: TLC, Size Exclusion Chromatography.Gel Filiations and Gel Permeation Techniques; Electrophoresis.GC. HPLC. GC-MS. Super Critical Fluid Chromatography.

5. Nuclear Chemistry: nuclear reactions, fission and fusion,radio-analytical techniques and activation analysis

6. Thermo-analytical methods: Thermo-gravimetric Analysis(TGA): Differential Thermal Analysis (DTA): Principle.Methodology and interpretation of Data; Aapplication in PolymerCharacterization

7. Electroanalytical Chemistry: Basic principles of polarography, cyclic voltametry. Differential Pulse voltametry and stripping voltametry

Unit-VSpectroscopy:

1. UV- Visible Spectroscopy: Electromagnetic Radiation. Variouselectronic transitions Beer-Lambert law, effect of solvent onelectronic transitions, ultraviolet bands for carbonylcompounds, unsaturated carbonyl compounds, dienes.conjugated polyenes. Fieser-Woodward rules for conjugateddienes and carbonyl compounds, ultraviolet spectra of aromaticand heterocyctic compounds. Steric effect in biphenyls, Absorption by inorganic anions, transition metals andlanthanides. effect of ligands on absorption maxima associatedwith d-d transition.

2. Infrared (IR) absorption spectroscopy: Molecular vibrations.Hooke's law, selection rules, intensity and position of IR bands,measurement of IR spectrum, fingerprint region, characteristicabsorptions of alkanes, alkenes. alkynes, aromatic compounds,alcohols, ethers, phenols and amines. Detailed study ofvibrational frequencies of carbonyl compounds (ketones,aldehydes, esters, amides, acids, anhydrides and conjugatedcarbonyl compounds). Effect of hydrogen bonding and solventeffect on vibrational frequencies, overtones, combination bandsand Fermi resonance. FT IR.and interpretation of IR spectra ofsimple organic compounds.

	3. Raman Spectroscopy: Quantum Mechanical and classicaltheories of Raman spectroscopy. Rotational and VibrationalRaman sectra, rule of mutual exclusion. 4. Mass Spectrometry:Introduction, ion production - El, Cl, FDand FAB. factors affecting fragmentation, ion analysis, ionabundance. Mass spectral Fragmentation of organiccompounds, common functional groups, molecular ion peak,metastable peak, McLafferty rearrangement. Nitrogen rule. Highresolution mass spectrometery. Mass spectral fragmentation of Simple organic compounds. 5. Nuclear Magnetic Resonance Spectroscopy:Generalintroduction and definition. chemical shift, spin-spininteraction, shielding mechanism, mechanism of measurement,chemical shift values and correlation for protons bonded tocarbon (aliphatic, olefmic, aldehydic and aromatic) and othernuclei (alcohols, phenols, enols, carboxylic acids, amines,amides & mercapto), chemical exchange, effect of deuteration,complex spin-spin interaction between two, three, four and fivenuclei (first order spectra), virtual coupling. Simplification ofcomplex spectra-nuclear magnetic double resonance, contactshift reagents, solvent effects. Fourier transform technique,nuclear Overhauser effect (NOE). Resonance of other nuclei-F, P. 6. Carbon-13 NMR Spectroscopy: General considerations,chemical shift (aliphatic, olefmic, alkyne, aromatic,heteroaromatic and carbonyl carbon), coupling constants. 7. Characteriztion of inorganic compounds by IR. Raman.NMR.EPR. Mossbauer. UV-vis, NQR, MS. electron spectroscopyand microscopic techniques.

Faculty of Science

PHYSICS

Physics (50 MCQs – 01 mark each)

Classical Mechanics:

Newtonian mechanics and its limitations. Constrained motion. Constraints and their classication. Principle of virtual work. D' Alembert's principle. Generalised coordinates.Deduction of Lagrange's equations from D' Alembert's Principle. Generalised momenta and energy. Cyclic or ignorable coordinates. Rayleigh's dissipation function. Integrals of motion. Symmetries of space and time with conservation laws.Central force. Definition and properties of central force. Two-body central force problem. Stability of orbits. Conditions for closure. General analysis of orbits. Kepler's laws. Kepler's equation. Articial satellites. Rutherford scattering. Principle of least action. Hamilton's principle. The calculus of variations. Derivation of Hamilton's equations of motion for holonomic systems from Hamilton's principle. Hamilton's principle and characteristic functions.Canonical Transformations. Generating functions. Poisson bracket (PB). Poisson'sTheorem. Invariance of PB under canonical transformations. Angular momentum PBs. Hamilton-Jacobi equation. Connection with canonical transformation. Small Oscillations. Normal modes and coordinates.

Quantum Mechanics:

Mathematical tools: Brief introduction to origins of quantum Physics. Wave packets. Dirac notation. Operators, their eigenvalues and eigenfunctions, orthonormality, completeness and closure. Generalized Uncertainty Principle. Unitary transformations, change of basis. Matrix Representation of operators. Continuous basis, position and momentum representation and their connection. Parity operator. Fundamental Concepts of Quantum Mechanics: Basic postulates of quantum mechanics. Measurement. Time evolution of system's state. Discrete and continuousspetra in 1-D. Solution of 1-D harmonic oscillator using matrix mechanics. Angular Momentum: Orbital, Spin and total angular momentum operators. Pauli spin matrices, their Commutation relations. Eigenvalues and eigenfunctions of L2 and Lz. Identical Particles : Many particle systems, systems of identical particles, exchange degeneracy, symmetrization postulate, construction of

symmetric and anti-symmetric wave functions from unsymmetrized functions. The Pauli exclusion principle.

Mathematical Physics:

Review of Basic Methods: Real and complex numbers; Euclidean space; Dierentiability; Series and convergence. Function of a complex variable; Analytic functions; Cauchy's theorem; calculus of residues and applications. Advanced vector calculus; multiple integrals. Linear Dierential Equations & Special Functions : Series solutions of ordinary differential equations; ordinary, regular and irregular singular points; Gamma function; Special functions (Legendre, Bessel, Laguerre, Hermite); Hypergeometric and conuent hypergeometric functions. Partial Dierential Equations and Green Function Method : Classication of PDE's and boundary conditions; method of separation of variables; Green function method for Laplace, Poisson, wave, Klein-Gordon and heat equations; solutions of boundary value problems using Fourier series and Bessel functions. Elements of Group Theory : Definitions and examples of a group; subgroup, cosets, conjugate classes, invariant subgroups and factor group; isomorphism andhomomorphism; Permutation groups; Representations of a group, Reducible and irreducible representations, orthogonality relations; Topological groups and Lie groups,SO(2), SO(3), Lorentz group, Generators of U(n) and SU(n), SU(2), SU(3).

IntegralEquations: Homogeneous and Inhomogeneous equations, Method of successiveapproximations, Hilbert-Schmidt method.

Electronics:

Semiconductor Devices I : Semiconducting Materials, conduction in semiconductors, Charge densities in a semiconductors, PN junction, space charge and electric field distribution at junctions, forward and reverse biased conditions, Space charge capacitance, varactor diode, Zener and avalanche breakdowns, zener diodes, Schottky barrier, tunnel diode, photodiode, LED, p-n-p-n devices and their characteristics, SCR. Semiconductor Devices II Transistors : Bipolar junction Transistor (BJT), Ebers Moll Model, Analysis of CE amplier using h-parameters, The T-network equivalent circuit,constants of CB and CE amplier using emitter, base, collector resistance, Biasing technique to BJT, stabilization factor, temperature stabilization, operating point, fixed bias, emitter feedback

bias, voltage feedback bias. Field-Eect Transistors (FET) and MOSFET: Structure, Working, Derivations of the equations for I-V characteristics under dierent conditions. Feedback Principle : Negative feedback, effect of negative feedback on input/output resistances and voltage gain, gain stabilization, effect of negative feedback on band width, voltage series feedback, voltage shunt feedback applied to BJT. Microwave Electronics : Microwaves, Principle of velocity modulation and bunching of electrons, Basic principles of two cavity klystrons and Reflex Klystrons, operation of magnetrons, characteristics of microwave diode.

Condensed Matter Physics:

Bonding in crystals: covalent, ionic, metallic, hydrogen bond, van der Waal's bond and the Madelung constant. Crystalline solids, unit cell, primitive cell, Bravais lattices, Miller indices, closed packed structures. Atomic radius, lattice constant and density. Connection between orbital symmetry and crystal structure. Scattering from periodic structures, reciprocal lattice, Brillouin Zones. Free electrons in solids, density of states, Fermi surface, Fermi gas at T=0 K, Fermi statistics, specific heat capacity of electrons in metals, thermionic emission of electrons from metals. Electronic band structure in solids, Electrons in periodic potentials, Bloch's Theorem, Kronig-Penney model, Nearly free electron model, Tight-binding model: density of states, examples of band structures. Fermi surfaces of metals and semiconductors. Transport properties: Motion of electrons in bands and the eective mass, currents in bands and holes, scattering of electrons in bands, Boltzman equation and relaxation time, electrical conductivity of metals, thermoelectric effect, the Wiedemann-Franz Law. Lattice dynamics of atoms in crystals, vibrations of monoatomic and diatomic linear chains, acoustic and optical phonon modes, density of states, thermal properties of crystal lattices, thermal energy of the harmonic oscillator, specic heat capacity of the lattice, Debye theory of specic heats.

Electrodynamics:

Maxwells equations. Continuity Equation. Lorentz force. Poynting theorem. Conservation of energy and momentum. Scalar and vector potentials. Gauge transformations. Coulomb and Lorentz gauge.Generalized functions. Green's functions for Poisson, Helmholtz and Wave equations.

	Retarded and Advenced solutions for Maxwell's equations. Jemencko formulas for fields for charge and current distriubutions. Lienard-Wiechert Potentials. Electromagnetic fieldof a moving point charge. Feynman formulas. Review of Special Theory of Relativity. Lorentz transformations. Energy and momentum. Covariant formulation of electrodynamics. Transformation of electromagnetic fields. Lorentz group. Infinitesimal generators. Lie algebra of Lorentz group. Action Principle. Stess-energy tensor. Equations of motion of a point charge in electromagnetic fields. Radiations emitted by an accelerated charge. Energy radiation formula and radiative reaction. **Atomic And Molecular Physics:** Review of Solution of Schroedinger's equation for Coulomb field and Hydrogen atom, dipole approximation, spectroscopic terms and selection rules, intensities of spectral lines. Fine structure of Hydrogen like atoms: spin-orbit interaction, relativistic correction, Lamb shift. Interaction with external fields: Zeeman, Paschen-Back and Stark effect. The LS-coupling approximation, J-J coupling, hyperfine structures. The central field approximation: the central field, Thomas Fermi-potential, alkali atom spectra, Na doublet. Born-Oppenheimer Approximation, Rotational, Vibrational, Rotational-Vibrational and Electronic spectra of Di-atomic molecules, Selection rules, Frank-Condon principle, Raman spectra, NMR, ESR. Lasers : Spontaneous and stimulated emission, optical pumping, population inversion, rate equations, properties of laser beams: temporal and spatial coherence, simple description of Ammonia maser, C02 and He-Ne lasers. **Nuclear And Particle Physics:** Basic Nuclear Concepts Mass, Charge, and Constituents of the nucleus, Nuclear size and distribution of nucleons, Energies of nucleons in the nucleus, Angular momentum, Parity and symmetry, Magnetic dipole moment and electric quadrupole moment, Energy levels and mirror nuclei. Nuclear Forces Characteristics of nuclear forces -Range and strength, Simple theory of two nucleon system -deuterons, Spin states of two nucleon system, effect of Pauli's exclusion principle, Magnetic dipole moment and electric quadrupole moment of deuteron -The tensor forces. Experimental Methods of Nuclear & Particle Physics Interaction of charged

	particles withmatter. Stopping power and range. Detectors for energetic charged particles; Solid State or Semiconductor detector. Particle Accelerators Need for accelerator of charged particles, Classification of types of accelerators, Proton Synchrotron, Betatron; Alternating gradient accelerator, Colliding beam accelerator. Elementary particles Classication and properties of elementary particles -Leptons,Baryons, mesons particles and antiparticles excited states and resonances. Various types of interactions gravitational, electromagnetic, weak and strong interactions and their mediating quanta, Conservation rules in fundamental interactions. Chargesymmetry and charge independence, Parity and charge conjugation, Conservation of parity and its violation in dierent types of interactions. Strange particles, associated production, strangeness and decay modes of charged Kaons, Isospin and its conservation. Idea of eightfold way and quarks. **Statistical Mechanics:** Statistical basis of thermodynamics The macroscopic and the microscopic states, phase space, trajectories and density of states, Liouville's theorem, ensemble theory, the principle of maximum entropy, contact between statistical mechanics and thermodynamics, classical ideal gas, entropy of mixing and Gibb's paradox. Canonical and grand-canonical ensembles Classical canonical ensemble, partition function, calculation of statistical quantities, Energy uctuations. The grand canonical ensemble, particle number uctuation. Entropy in grand canonical ensemble,thermodynamic potentials. Quantum Statistical Mechanics Postulates of quantum statistical mechanics, density matrix, statistics of ensembles. Statistics of indistinguishable particles, Maxwell- Boltzmann, Fermi-Dirac and Bose Einstein statistics, properties of ideal Bose and Fermi gases, Bose-Einstein condensation. Phase transitions Type of phase transitions, rst and second order phase transitions. Ising model, mean-eld theories of the Ising model in two and three dimensions, exact solution in one dimension. Connection of Ising model to lattice gas and binary alloy models. Landau theory of phase transition, Landau free energy for second and rst order transitions, critical exponents and universality classes.

Faculty of Science

PUBLIC HEALTH

Public Health (50 MCQs – 01 mark each)

Unit-I Basics of Public Health and Determinants of disease:

History, Context and Concepts of Public Health.Healthcare versus Medical Care, Approaches to Public Health.History of public health in India.

Different Systems of Medicine.Historical and Modern Perspective, Interdisciplinary nature of Public Health.Basic Concepts and Definition, Disease Control and Levels of Prevention. Social and other types of health determinants in a public health context. Indicators of Health, Health situation and Trends in India. Nutrition-based physiology and its relationship to health and disease.Gender and Equity as determinants of Health.

Unit-II Behavioral and Social Sciences:

Public Health, concept of Mental Health, Stress, Well being and quality of life.Development of Psychology as a Science,methods used in study of Psychology,Foundations of Behavior, Biological inheritance, influence of environment,Personality development and its effect on health, Methods of Study in cultural anthropology, Scope in understanding health and Disease, Social psychology in understanding health and disease,Different Social Theories, Social Organizations, structures, Social Controls, & Methods of study in sociology, Process of social change, Community Ecology .

Unit-III Basics of Epidemiology:

Introduction, Data sources for Epidemiology.Epidemiological concept of disease, Measures of disease frequency.Epidemiological methods: Descriptive Epidemiology and Analytical Epidemiology.Measures of association.Outbreak investigation. Communicable Diseases: Concepts and Principles, Prevention and Control: Vector born diseases, Leprosy, Influenza,Concepts and Principles, Prevention and Control TB, water borne disease , AIDS and others STD.Non-Communicable Diseases: Concepts and Principles, Prevention and Control:Cardiovascular diseases, Stroke, Hypertension, Diabetes.Concepts and Principles, Prevention and Control: Cancer, obesity and accidents, blindness.National health programs.

Unit-IV: Basics of Biostatistics:

	and Data Presentation: Types of data, simple, compound, percentage,bar chart,Histogram, Frequency Polygon, Frequency curve, Normal curves, Skewed diagram.Numerical Description of Data: Measures of central tendency, Mean Median, Mode,Geometric mean, Harmonic mean, Measures of dispersion: range, Mean Deviation,Standard Deviation, quartile deviation, Co-efficient of variation, Standard ErrorScientific research: Nature and Scope, Basic Principles of scientific research, Steps involvedin a scientific study/ investigation, Formulation of Hypothesis, sources, qualities of a workable hypothesis.Sample, sampling methods, estimation of sample size, non parametric tests, Basic Principlesof sample surveyBiases in sampling, Data collection tools. **Unit-V: Health care systems and Global health:** Introduction and history of Healthcare systems.Systems and Indices.Concept of Primary Healthcare.Regionalization of care, Comparison of world systems of healthcare.Disease patterns around the world, Regions of the world according to WHO and theiroverall health status, effect of climate, politics and society on health.International health agencies, activities & other actors.Nutrition and global health, Water & sanitation. Disease control priorities in low income countries, Global Health and Ethics.Maternal and child health, Technology and Global Health. **Unit-VI : Health Education and Health Promotion and Communication:** Introduction to health education: Definition, concept, goals and objective of health education, role of health educator. Introduction to health promotion: Definition, concept and charters of health promotion. Theories of Health Behaviour: Stages of Change Model,Social learning/social cognitive theory,Health Belief Model, Diffusion of Innovations Theory.Methods and Approaches to health education: IEC, Individual and group approach-Medical or Preventive, Behaviour Change, Educational, Empowerment, Social Change;Mass media, Social marketing.

Faculty of Science

COMPUTER SCIENCE

Computer Science (50 MCQs – 01 mark each)

Data Structures

- Advanced Sorting Methods
- Algorithm Design Paradigms
- Complexity of Algorithm
- Depth-first and Breadth-first Algorithms
- Kinetic Data Structures

Algorithms

- Asymptotic analysis
- Asymptotic notation
- Basic concepts of complexity classes
- Connected components
- Dynamic programming
- Notions of space and time complexity
- Tree and graph traversals
- Worst and average case analysis
- Computational Geometry
- Growth of Functions
- Heuristic Methods

Computation Theory

- Regular Languages and Finite Automata
- Languages and Pushdown Automata
- Recursively Enumerable sets and Turing Machines

Operating Systems

- Agreement Protocols for handling Processor Failures
- Comparative Performance Analysis
- Distributed Mutual Exclusion
- Distributed Operating Systems
- Local and Global states
- Process Deadlocks
- Resource Models
- Synchronization Mechanisms
- Coordination of Processes and related Algorithms
- Failure Handling and Recovery Mechanisms
- Multiprocessor Operating Systems and related Thread Handlings
- Token and Non-token based Algorithms

Database Systems

- Database design
- Indexing and Hashing

- Relational model
- Storage and File Structures
- Extended Relational Model
- Mobile Databases and Web-enabled Database Systems
- Transactions and Concurrency control

Computer Organization and Architecture

- Cache and main memory
- CPU control design
- Design and synthesis of combinational and sequential circuits
- Instruction pipelining
- Machine instructions and addressing modes
- Number representation and computer arithmetic
- Secondary storage
- Structured Memory Design for Parallel Systems

Software Engineering

- Team Software Process
- Systems Modeling Language
- Requirement and feasibility analysis
- Process Models- Iterative
- Planning and managing the project
- Domain specific modeling
- Software architecture and design patterns
- Software reliability and Advanced testing techniques
- Aspect oriented programming

Computer Networks

- LAN technologies
- Application layer protocols
- Flow and error control techniques
- Introduction to intelligent networking
- Performance analysis of networks

In addition to these, candidates are advised to refer topics such as Compiler Design, Computer Graphics and Web technologies. Questions will be asked from the topics prescribed to MCA and M.Sc in Computer Science.

Faculty of Science

BIOTECHNOLOGY

Cell Signaling, Cell Death, Cell Renewal and Cancer: Cell Signaling pathways, apoptosis, role of cell survival factors, development and causes of cancer, tumour viruses, oncogenes, tumour suppressor genes, application of molecular biology for cancer prevention and treatment.

Genome Organization, Mutation and Site-Specific Recombination: Genome size and complexity, Gene organization, Multigene families, Pseudogenes, Repetitive DNA, Hot spots, Signature Tagged Mutagenesis (STM), Gene trap vector, Gene conversion, Recombinases and their function,

DNA Replication, DNA Repair, RNA and Protein Synthesis and Processing: Prokaryotic transcription, Eukaryotic transcription: RNA polymerases and transcription factors, RNA processing and turnover, Protein folding and processing

Transcription Regulation in Prokaryotes and Eukaryotes: Positive and negative control of transcription, Repression and activation, Organization and regulation of Lac, Trp and Ara operon in *E. coli.,* Eukaryotic activators, DNA binding domains, Transcriptional repressors, Gene silencing, Epigenetic gene regulation

Recombinant DNA Technology: Tools and techniques- Restriction Endonucleases, DNA manipulating enzymes, Cloning vectors, Gene libraries, Screening strategies, DNA amplification (PCR and its types-RT-PCR, Real Time PCR), DNA markers for genetic mapping (RAPD, RFLP, SSCP, SNPs, STS), Manipulation of Gene expression in *E.coli*, Heterologous protein production in Eukaryotes- *Saccharomyces cerevisiae* and Mammalian cell expression system; Gene Expression Regulation studies-Gel retardation assay, Reporter genes, DNA finger printing, HRT, HART; Regulatory RNAs (Interfering and antisense RNA) and gene expression DNA manipulating enzymes

Microbes : Isolation, Preservation and Improvement of industrially important microorganisms, Kinetics of microbial growth and product formation, Fermentation system; batch and continuous system, fed batch system, multistage system, solid state fermentation. Bio reactors, Antibiotics. Symbiotic free nitrogen fixers, asymbiotic free nitrogen fixers, algal, phosphate solublizing, mycorrhizae and green manure.

Plant cell culture, plant transformation technology & its applications: **F**eatures of Ti & Ri Plasmid, Mechanism of DNA transfer role of Virulence gene, Use of Ti & Ri as vectors, Multiple gene transfers vector less or direct DNA transfer ,Use of reporter gene, Particle bombardment ,electroporation, Microinjection, Transformation of monocots, Transgene stability & gene silencing in Plant transformation. Applications of Plant Transformation for

	Productivity & performance Herbicide resistance like atrazine, Insect resistance Bt gene, non Bt like protease inhibiters, Virus resistance, disease resistance, antibiotic stress, post harvest losses long shelf life of fruits & flowers. Chloroplast transformation, Advantage vectors & success with tobacco & potato Metabolic engineering & Industrial products, Single Cell protein. **Immunology:** Structure and classes of antibodies, Complement fixation, monoclonal antibodies, genetic basis of antibody diversity. MHC I and II: structure and antigen presentation. T and B lymphocytes activation and role in humoral and cell mediated immunity. Vaccines live and attenuated, killed, multi-subunit and DNA vaccines. Hypersensitivity and auto immune diseases. ELISA, RIA, Hybridoma Technology. **Animal cell culture and tissue engineering:** Cell lines, cell culture growth kinetics, Basic Techniques of mammalian cell culture (Open and closed cell-cultures, Primary Cell culture), Cell surgery and Cell Fusion Methods (Preparation of anucleated cells and polykaryon cells, preparation of ghost RBCs, Preparation of mini cells, micro cells, Surgical manipulation of in vitro fertilization, Hybridoma cell preparations, Use of Hybridoma technology: e.g. M AB and other related techniques, Mini cells, micro cells and anucleated cells in fusion and their application.) Tissue Engineering: Capillary culture Units, feeder layers. Use of Animal Cells in Culture: Mutant cell preparation, Evaluation of Chemical carcinogenicity, Cell malignancy Testing, Toxicity Testing, Karyotyping and cytogenetic characterization, Production of metabolic products, ESC applications, Pluripotent stem cell applications. **Plant secondary metabolites:** control mechanisms & manipulation of Phenyl Propanol pathway, Shikimate pathway, Alkaloids, Industrial enzymes, Biodegradable plastics, Therapeutic proteins, lysozomal enzymes, edible vaccines, Purification strategies, oleosin partitioning technology Integration of Genetic Engineering of Plants in Agriculture Diseases resistant, Biotic & Abiotic stress resistant, Enhancement of nutritional value of crop Plants & molecular farming **Chromatography techniques:** High pressure liquid chromatography (HPLC); Agarose gel electrophoresis, Pulse field gel electrophoresis, SDS-PAGE, Isoelectrofoccusing, 2-Dimentional electrophoresis, ELISA, flow cytometry, Hybridoma technology, southern blotting, northern blotting, western blotting. **Bioinformatics:** Biological Databases, Information Retrieval from Biological Databases, Unique Requirements of Database Searching, Heuristic Database Searching, Basic Local Alignment Search Tool (BLAST), FASTA, Comparison of FASTA and BLAST.