

M.Sc. Physics Semester-I
PHY 101- Mathematical Methods in Physics

S.NO.	MONTH	NAME OF TOPIC
1	JULY	Unit I: Analytic function and the Cauchy-Riemann equations, Cauchy's integral theorem, Taylor's and Laurent series, Cauchy's residues theorem, singular points, poles, residues, evaluation of definite integrals. Practical Lab
2	AUGUST	Unit-II : Fourier series, Fourier integral, Fourier Transform, Fourier sine and cosine transform, inversion formula for Fourier sine and cosine transforms, change of scale property, shifting theorem, multiple Convolution theorem, Fourier transform of the derivatives of a function. Practical Lab
3	SEPTEMBER	Unit-III: Laplace transforms, first and second shifting theorems, inverse Laplace transform-first and second shifting theorems, Laplace transform and inverse Laplace transform of derivative and integral of function, Convolution theorem. Practical Lab, Educational Trip
4	October	Unit-IV: Error Analysis, Computer Arithmetic, Linear ordinary differential equations, Second-order homogeneous and nonhomogeneous differential equations with constant and variable coefficients. Practical Lab
5	October	Mid-Term I
6	NOVEMBER	Unit-IV: Numerical Integration and Differentiation, Trapezoidal & Simpson's rule, Runge-Kutta method, Simultaneous and Higher order equations. Practical Lab
7	DECEMBER	Unit-V: Bisection method, Newton-Raphson Method, Solution of Linear equations, Curve fitting, Least squares approximation, Linear Vector spaces, Eigen vectors and Eigen Value problems, Caley Hamilton theorem, Introduction to Group theory SU(2) and O(3). Practical Lab
8	DECEMBER	Mid-Term-II

M.Sc. Physics Semester-I
PHY 102- Classical Mechanics

S.NO.	MONTH	NAME OF TOPIC
1	JULY	Unit I: Principle of Least Action, Lagrange's equation and its applications, Generalized, coordinates, Lagrangian of a system of particles, Symmetry and Conservation laws, Central field problems, Scattering cross-section, Rutherford Formula, Laboratory and CM Frame, two body problem, Kepler problem, Generalized momentum, Legendre transformation. Practical Lab
2	AUGUST	Unit-II : Small oscillations, normal coordinates and its applications, Orthogonal transformation, Coupled Oscillators, Free forced and parametric oscillations, Damped Oscillations, Forced oscillations under friction, Vibrations of molecules. Practical Lab
3	SEPTEMBER	Unit III Hamiltonian, Hamilton's Canonical equations, Canonical transformations, Hamilton's variational principle, Derivation of Lagrange's and Hamiltonian, Method of Lagrange's multipliers. Practical Lab, Educational Trip
4	OCTOBER	Unit-IV: Hamilton-Jacobi equation and its applications, Action angle, variable adiabatic invariance of action variable : The Kepler problem in action angle variables, Eulerian angles, Euler theorem, Eigen values of the inertia tensor, Euler equations, Force free motion of a rigid body. Practical Lab
5	OCTOBER	Mid-Term-I
6	NOVEMBER	Unit-IV: Rigid body dynamics- moment of inertia tensor, non-inertial force, Psuedo Force, Coriolis Force, Holonomic and nonholonomic constraints, D-Alembert's Principle, Extension of Hamilton's Principle for nonconservative and nonholonomic systems. Practical Lab
7	DECEMBER	Unit-V: Special theory of relativity- Lorentz transformations, Four Vector Formulation, Lagrangian and Hamiltonian of a charged particle in presence of EM Fields, Field transformations, relativistic kinematics and mass–energy equivalence, stress tensor, energy momentum tensor, relative motion of charged particle in EM fields. Practical Lab
8	DECEMBER	Mid-Term-II

M.Sc. Physics Semester-I
PHY 103- Quantum Mechanics-I

S.NO.	MONTH	NAME OF TOPIC
1	JULY	Unit I: Superposition of amplitudes, States of a quantum mechanical system, representation of quantum mechanical states, properties of quantum mechanical amplitude, operators and change of state, postulates, essential definitions and commutation relations, quantum conditions and uncertainty relation, Co-ordinate and momentum representation of operators & position, momentum and angular momentum, time dependence of expectation values. Practical Lab
2	AUGUST	Unit-II : Schrodinger equation, Simple Harmonic Oscillator, central field problem- hydrogen atom, Energy quantization, Variational technique, application to Hydrogen and Helium atom, WKB method for one dimensional problem, application to bound states (Bohr-Sommerfeld quantization) and the barrier penetration -alpha decay. Practical Lab
3	SEPTEMBER	Unit-III : Hamiltonian matrix and the time evolution of Quantum mechanical States: Hermiticity of the Hamiltonian matrix, Time independent perturbation of an arbitrary system. Practical Lab, Educational Trip
4	OCTOBER	Unit-III : simple matrix examples of time independent perturbation, energy states of a two state system, Ammonia molecule as an example of two state system diagonalizing of energy matrix, Pauli matrices.
5	OCTOBER	Mid-Term-I
6	NOVEMBER	Unit-IV: Time dependent Perturbation: Transitions in a two state system, The Fermi Golden rule, Adiabatic and Sudden Perturbation, phase space, emission and absorption of radiation, induced dipole transition and Spontaneous emission of radiation, energy width of a quasi stationary state. Practical Lab
7	DECEMBER	Unit-V: Compatible observables and constants of motion, symmetry transformation and conservation laws, invariance under space and time translations and space rotation, Angular momentum. Practical Lab
8	DECEMBER	Mid-Term-II

M.Sc. Physics Semester-I
PHY 104- Advanced Electronics

S.NO.	MONTH	NAME OF TOPIC
1	JULY	Unit I: Microwave Electronics: Introduction to Microwaves & its applications. General equation, input independence characteristic, Reflection & transmission coefficient, standing wave ratio, resonant and anti resonant line impedance matching, smith chart & its applications, coaxial, twin, strip & micro-strip lines. Practical Lab
2	AUGUST	Unit-II : Wave propagation in rectangular & circular wave guides, wave-guide modes, Q of wave guides, wave guide coupling. Microwave Passive Components: s-parameter representation and analysis of microwave component such as tees, two hole direction coupler attenuators, phase shifter, Rectangular cavity resonator, circulator & isolator. Practical Lab
3	SEPTEMBER	Unit-III: Microwave Tube Devices: Conventional Vacuum tubes at microwave, O type device- Klystron (two cavity & reflex), M type device magnetron, Introduction to TWT (Travelling Wave Tubes). Practical Lab, Educational Trip
4	OCTOBER	Unit-III : Microwave Semiconductor Devices IMPATT, TRAPATT & Gum Devices, Gyrotron, Free Electron Lasers. Practical Lab
5	OCTOBER	Midterm I
6	NOVEMBER	Unit-IV: Opto-electronic devices: Basics of Optical Fiber, Optical Fibers- step index, single and multimode, graded index, Light propagation- total internal reflection, Acceptance angle and Numerical aperture, Fiber losses and dispersions, Optical Sources: Light Emitting diodes spontaneous emission – surface emitting LED, edge emitters, semiconductor diode. Practical Lab
7	DECEMBER	Unit-V: Optical Sources: LASER- stimulated emission, Double hetero structure LASER, drivers for LED and LASER, Optical Detectors: Photo detectors- characteristics of photo detectors photoconductor, p-n photodiode, PIN photodiode Schottky barrier photodiode, Avalanche photodiode, Phototransistor. Practical Lab
8	DECEMBER	Mid-Term-II

M.Sc. Chemistry Semester-I
Paper-1.1: Inorganic Chemistry Subject Code:CH-511

S.No.	Month	Name Of Topic
1	July	Unit-I: Structure and Bonding in Main Group Compounds: VSEPR theory and its limitations, Walsh diagrams (tri-atomic molecules), $d\pi-p\pi$ bonds, Bent rule and energetics of hybridization, general trends in acid-base behaviour of binary oxides. Practical Lab
2	August	Unit-II: Metal-Ligand Bonding in Metal Complexes: Limitations of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π -bonding, η^2 , η^3 , η^5 , η^6 systems with reference to molecular orbital theory. Practical Lab
3	September	Unit-III: Metal-Ligand Equilibriums in Solution: Stepwise and overall formation constants and their interaction, trends in stepwise constant, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH metry and spectrophotometry. Practical Lab, Educational Trip
4	October	Unit-IV: Symmetry and Group Theory in Chemistry:
5	October	Mid-Term I
6	November	Unit IV characters of a representation, the great orthogonality theorem (without proof) and its importance, properties of character of representation. Unit-V: Applications of Group Theory in Chemistry: Introduction of character tables, formation of character tables of C_{2v} & C_{3v} point groups. Practical Lab
7	December	Unit V relationship between reducible and irreducible representations, formation of hybrid orbitals: σ -bonding in trigonal planar (BF_3), tetrahedral (CH_4), square pyramid (BrF_5) and square planar (XeF_4); symmetry aspects of molecular vibrations of H_2O and NH_3 in IR and Raman spectroscopy. Practical Lab
8	December	Mid-Term II

M.Sc. Chemistry Semester-I
Paper-1.2: Organic Chemistry Subject Code:CH-512

S.No.	Month	Name Of Topic
1	July	Unit-I: Nature of Bonding in Organic Molecules: Delocalized chemical bonding: conjugation, cross-conjugation, resonance, hyper-conjugation, bonding in fullerenes, tautomerism; aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Hückel's rule, energy level of π -molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity, PMO approach; bonds weaker than covalent bond: addition compounds (crown ether complexes and cryptands) and inclusion compounds (catenanes and rotaxanes). Practical Lab
2	August	Unit-II: Structure and Reactivity: Thermodynamic and kinetic aspects of reactions, isotope effect, effects of structure on reactivity, resonance and field effects, steric effect, quantitative treatment, The Hammett equation and linear free energy relationship, substituent and reaction constants, Taft equation. Reaction Mechanism: Types of reaction mechanism, potential energy diagram, transition states and intermediates, methods of determining mechanisms (product analysis, intermediates analysis, isotope effect, kinetic and stereochemical studies). Practical Lab
3	September	Unit-II Reactions Intermediates: Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzyne and nitrenes. Unit-III: Stereochemistry: Conformational analysis of cycloalkanes & decalins, effect of conformation on reactivity, conformation of sugars, strain due to unavoidable crowding, elements of symmetry, chirality, molecules with more than one chiral centre, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Practical Lab, Educational Trip
4	October	Unit-III Optical activity in the absence of chiral carbon (biphenyls, allenes and spirane)chirality due to helical shape, invertomers, asymmetric synthesis, determination of configuration (absolute & relative) and conformation. Unit-IV Aliphatic Nucleophilic Substitution Reactions: The SN ₂ , SN ₁ , mixed SN ₁ & SN ₂ , S _N i and SET mechanisms, reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium; neighbouring group participation by π - and σ -bonds, classical and non-classical carbocations, phenonium ions, norbornyl systems.
5	October	Mid-Term-I
6	November	Unit-IV Rearrangement of epoxides, transannular rearrangement; nucleophilic substitution at vinylic, allylic and aliphatic trigonal carbon; phase transfer catalysis, ambient nucleophiles, regioselectivity. Aromatic Nucleophilic Substitution Reactions: S _N Ar SN ₁ , S _N Ar SN ₂ , benzyne and SRN ₁ mechanisms, reactivity effects of substrate structure, leaving group and attacking nucleophile, von Richte, Sommelet-Hauser and Smiles rearrangements. Practical Lab
7	December	Unit-V: Aliphatic Electrophilic Substitution Reactions: Bimolecular mechanisms SE ₂ , SE ₁ , SE _i mechanism, electrophilic substitution accompanied by double bond shifts, effect of substrates, leaving groups and the solvent polarity on the reactivity. Aromatic Electrophilic Substitution Reactions: Arenium ion mechanism, orientation and reactivity in benzene ring, energy profile diagrams, ortho/para ratio, ipso attack, orientation and reactivity in other ring systems, quantitative treatment of reactivity in substrates and electrophiles, diazonium coupling, Vilsmeier-Haack reaction, Reimer-Tiemann reaction, Gattermann-Koch reaction, Houben-Hoesch reaction, Fries rearrangement, Bischler-Napieralski reaction. Practical Lab
8	December	Mid-Term-II

M.Sc. Chemistry Semester-I
Paper-1.3: Physical Chemistry Subject Code:CH-513

S.No.	Month	Name Of Topic
1	July	Unit-I: Quantum Chemistry-I: Introduction to Exact Quantum Mechanical Results: The Schrodinger equation and the postulates of quantum mechanics. Approximate Methods: The variation theorem, linear variation principle, perturbation theory (first order and non-degenerate), applications of variation method and perturbation theory to Helium atom. Practical Lab
2	August	Unit-II: Quantum Chemistry-II: Angular Momentum: Ordinary angular momentum, generalized angular momentum, Eigen functions for angular momentum, Eigen values of angular momentum, operator using Ladder operator's addition of angular momentum. Molecular Orbital Theory: Hückel theory of conjugated systems bond and charge density calculations, applications to ethylene, butadiene, cyclopropenyl radical cyclobutadiene, introduction to extended Hückel theory. Practical Lab
3	September	Unit-III: Chemical Dynamics: Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions. Dynamics of chain reactions (hydrogen-bromine reaction), photochemical reactions (hydrogenbromine and hydrogen-chlorine reactions), kinetics of enzyme catalysed reactions, general features of fast reactions, study of fast reactions (flow method, relaxation method, flash photolysis), dynamics of unimolecular reactions (Lindemann Hinshelwood and Rice-Ramsperger-Kassel-Marcus). Practical Lab, Educational Trip
4	October	Unit-IV: Adsorption: Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electro-kinetic phenomenon), catalytic activity at surfaces, different isotherms, thermodynamics of adsorption. Practical Lab
5	October	Mid-Term-I
6	November	Unit-IV Micelles: Surface active agents, classification of surface-active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solubilisation, micro emulsion, reverse micelles. Practical Lab
7	December	Unit-V: Macromolecules: Definition & types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization, molecular mass number and mass average molecular mass, molecular mass determination (osmometry, viscometry, diffusion, light scattering and sedimentation methods), chain configuration of macromolecules, calculation of average dimension of various chain structures. Practical Lab
8	December	Mid-Term-II

M.Sc. Chemistry Semester-I

Paper-1.4: CHEM-514: Mathematics for Chemists Subject Code:CH-514

S.No.	Month	Name Of Topic
1	July	Unit-I: Basic Mathematics: Matrix algebra, determinants, linear equations, basic rules for differentiation, partial differentiations, maxima and minima, basic rules for integration.
2	August	Unit-II: Mathematics and Linear Programming Problems: Basic concept of differential equations, solution of linear differential equation of constant coefficients.
3	September	Unit II: Vectors: definition dot, triple and cross product. Linear programming problems: Formulation, graphical solution., Educational Trip
4	October	Unit-III: Basic Operations Research: Operations research-concept and applications of OR, transportation problem, assignment problems, basic concepts of inventory control.
5	October	MID TERM-I
6	November	Unit-IV: Basic Statistics: Basic concept of statistics, representation of data-histogram, Pie chart, measures of central tendency, deviation, dispersion, skewness and kurtosis.
7	December	Unit IV: random variables, mathematical expectations. correlation, regression. Unit-V: Statistical Inference: Probability theory, probability distribution: discrete (binomial and Poisson), sampling concepts, sampling test for mean, testing of hypothesis-test based on t-distribution (t-test).
8	December	MID TERM-II

M.Sc. Chemistry Semester-I
Paper-1.4: CHEM-514: Biology for Chemists Subject Code:CH-514

S.No.	Month	Name Of Topic
1	July	Unit-I: Cell Structure and Functions: Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells, overview of metabolic processes: catabolism and anabolism, origin of life: unique properties of carbon, chemical evolution and rise of living systems. Practical Lab
2	August	Unit-II: Carbohydrates: Monosaccharides: structure, conformation and functions of important derivatives of monosaccharides; structural polysaccharides: cellulose and chitin, storage polysaccharides: starch and glycogen; structure and biological functions of glucosaminoglycans or mucopolysaccharides, glycoproteins and glycolipids, role of sugars in biological recognition. Practical Lab
3	September	Unit-III: Lipids: Fatty acids, structure and function of triacylglycerols, cholesterol, bile acids; lipoproteins: composition and function, role in atherosclerosis; properties of lipid aggregates: micelles, bilayers, liposomes; biological membranes, fluid mosaic model of membrane structure, lipid metabolism: β -oxidation of fatty acids. Practical Lab, Educational Trip
4	October	Unit-IV: Amino-acids and Proteins: Amino acid metabolism: degradation and biosynthesis of amino acids; sequence determination:
	October	MID TERM I
5	November	Unit-IV: Chemical and enzymatic hydrolysis of proteins, secondary structure of proteins, α-helix, β-sheets,
6	December	Unit-V: Nucleic Acids: Purine and pyrimidine bases of nucleic acids, structure of ribonucleic acids (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA, chemical and enzymatic hydrolysis of nucleic acids, chemical basis of heredity, an overview of replication, transcription, translation and genetic code. Practical Lab
	December	MID TERM II

M.Sc. Botany Semester-I
Paper 1.1-Biology and Diversity of Lower Plants

S.No.	Month	Name Of Topic
1	July	Unit I Phycology: Algae in diversified habitats (terrestrial, fresh water, marine), thallus organization, cell ultrastructure, reproduction (vegetative, asexual, sexual). Practical Lab
2	August	Unit I Criteria for classification of algae: pigments, reserve food, flagella. Modern classification. Unit-II Salient features of Cyanophyta, chlorophyta, charophyta, xanthophyta, Bacillariophyta, phaeophyta and Rhodophyta with special reference to Microcystis, Hydrodictyon, Chara, Draparnaldiopsis, Sargassum, Dictyota, Batrachospermum. Algal blooms, algal biofertilizers; algae as food, feed and usage in industry. Practical Lab
3	September	Unit-III Mycology: General characters of fungi, substrate relationship in fungi, cell ultrastructure, unicellular and multicellular organization, cell wall composition, nutrition (saprobic, biotrophic, symbiotic), heterothallism, heterokaryosis, parasexuality, recent trends in classification, phylogeny of fungi. Practical Lab, Educational Trip
4	October	Unit-IV General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina with special reference to Pilobolus, Chaetomium, Morchella, Melampsora, Polyporus, Drechslera and Phoma. Fungi in industry. Practical Lab
5	October	Mid-Term I
6	November	Unit IV medicine and as food, mycorrhizae, fungi as biocontrol agents. Usages of fungi as food, medicine and in Industry. Fungi biocontrol agents. Micorrhizae. Unit-V Bryophyta: morphology, structure, reproduction and life history, distribution, classification, general account of Sphaerocarpaceae-Sphaerocarpos, Jungermanniales-Porella. Practical Lab
7	December	Unit V Calobryales-Calobryum, Anthocerotales-Notothylus, Sphagnales-Sphagnum, Polytrichales-Pogonatum. Economic and ecological importance. Practical Lab
8	December	Mid-Term II

M.Sc. Botany Semester-I
Paper 1.2-Pteridophyta, Gymnosperm and Paleobotany

S.No.	Month	Name Of Topic
1	July	Unit-I General characters and classification of pteridophyta, Stear system, Telome theory, Heterospory and origin of seed habit. Practical Lab
2	August	Unit I Introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida. Unit-II Life history of Psilotum, Lycopodium, Gleichenia, Isoetes, Botrychium and Ophioglossum. Practical Lab
3	September	Unit-III General characters, classification and economic importance of Gymnosperm, Evolution of Gymnosperm, Distribution in India, Life History of Ginkgo, Taxus and Gnetum. Practical Lab, Educational Trip
4	October	Unit-IV General Characters and life history of fossil gymnosperm Lyginopteris, Medullosa, Caytonia, Glossopteris, Cycadeoidea, Pentoxylon, and Cordaites. Practical Lab
5	October	Mid-Term I
6	November	Unit-V General introduction of Paleobotany, fossilization, types of fossils, Techniques of fossil study, Geological time scale. Practical Lab
7	December	Unit-V General characters of fossil members of pteridophyta with special reference to Horneophyton, Asteroxylon and Cladoxylon. Paleobotany and evolution of vascular plants. Practical Lab
8	December	Mid-Term II

M.Sc. Botany Semester-I
Paper 1.3-Plant Physiology

S.No.	Month	Name Of Topic
1	July	Unit-I Water relation of plants:- Unique physicochemical properties of water, chemical potential, water potential, apparent free space, bulk movement of water. Soil plant atmosphere continuum (SPAC), stomatal regulation of transpiration, signal transduction in guard cell. Practical Lab
2	August	Unit-I Membrane Transport:- Passive-non-mediated transport and Ernst equation, passive-mediated transport, ATP driven active transport, Uniport, Symport, Antiport, Ion channels. Practical Lab
3	September	Unit-II Enzyme: nomenclature, structure, function and mode of action. Structure of proteins:- primary, secondary, tertiary, quaternary domain structure, reverse turn and Ramchandran plot. Protein ability: electrostatic forces, hydrogen bonding, di-sulfide bonding hydrophobic interaction. Practical Lab, Educational Trip
4	October	Unit-III Photosynthesis:- Photosynthetic pigments, absorption and transformation of radiant energy, photooxidation, four complexes of thylakoid membranes: photo system I, cytochrome b-f complex, photosystem II and coupling factors, photolysis of water and C4 evolution, noncyclic and cyclic transportation of electrons, proton gradient and photophosphorylation. Practical Lab
5	October	Mid-Term I
6	November	Unit-III calvin cycle regulation of RUBISCO activity. C4 pathway and its adaptive significance, CAM pathway, differences between C3 and C4 plants. Glycolate pathway and photorespiration chlororespiration and CO2 concentrating mechanism in micro-organism. Unit-IV Respiration:- Anaerobic and aerobic respiration amphibolic nature of TCA cycles, pentose phosphate pathway, glyoxylate pathway, oxidative phosphorylation. Practical Lab
7	December	Unit-IV gluconeogenesis, high energy compounds: their synthesis and utilization. Unit-V Plant growth regulators:- Auxins-chemical nature, bioassay, physiological effects and mode of action. Chemical nature, bioassay, physiological effect and mode of action of Gibberellins, Cytokinins and Abscisic acid. N2 fixation, Abiological, Biological, mechanism of N2 fixation. Practical Lab
8	December	Mid-Term II

M.Sc. Botany Semester-I
Paper 1.4-Microbiology and Plant Pathology

S.No.	Month	Name Of Topic
1	July	Unit-I Important landmarks in the history of microbiology archaeobacteria and eubacteria: General account, ultrastructure, nutrition and reproduction, economic importance, cyanobacteria-salient features and biological importance. Practical Lab
2	August	Unit-I Viruses: Classification, characteristics and ultrastructure of isolation and purification of viruses, chemical nature, replication, transmission of viruses, cyanophages, economic importance. Phytoplasma : General characteristics and role in causing plant diseases. Unit-II General account of immunity, allergy, properties of antigens antibodies. Antibody structure and function, affinity and antibody specificity. Monoclonal antibodies and their uses. Practical Lab
3	September	Unit-II antibody engineering, serology, types of vaccines. Preliminary account of Biofilms, biochips, biosensors and biosurfactants. Unit-III History and scope of plant pathology : General account of diseases caused by plant pathogens. Pathogen attack and defense mechanisms Morphological, physiological, biochemical and molecular aspects. Practical Lab, Educational Trip
4	October	Unit-III Plant disease management : Chemical, biological, IPM systems, development of transgenics, biopesticides, plant disease clinics. Unit-IV Symptomatology, identification and management of following plant diseases. Practical Lab
5	October	Mid-Term I
6	November	Unit-IV Fungal diseases : Wheat (Rust, Smut, Bunt), Bajra (Green ear, ergot and smut), crucifer (Rust). Paddy (Paddy blast), Cotton (Wilt), Grapes (Downy mildew and powdery mildew). Unit-V Preliminary account of application of Biotechnology in plant pathology. Bacterial disease : Wheat (Tundu), Soft rot of vegetables. Practical Lab
7	December	Unit-V Viral disease : Tobacco mosaic, Bhindi yellow mosaic. Phytoplasma disease : Little leaf of brinjal. Nematode disease : Root-knot of vegetables. Practical Lab
8	December	Mid-Term II

M.Sc. Zoology Semester-I
Paper- Z-1.1 INVERTEBRATE: STRUCTURE AND FUNCTIONS

S.No.	Month	Name Of Topic
1	July	<p>UNIT I</p> <p>1. Introduction: The concept of “Invertebrate” and “Vertebrate” animal groups, a study of the general body plan of invertebrates. Elementary idea of the animal diversity in marine, estuarine and fresh water environments.</p> <p>2. Locomotory mechanisms: a) Amoeboid movements, ultra-structure of cilia and flagella: ciliary and flagellar movements; molecular and physiological mechanisms involved in the three kinds of movements. b) Myonemes and muscle fibers in invertebrate structure and their role in locomotion. c) Locomotion in relation to hydrostatics, coelom, metamerism, arthropodization. d) An outline of flight mechanism in insects. Practical Lab</p>
2	August	<p>UNIT I 3. Feeding mechanisms: a) Amoeboid feeding. b) Ciliary feeding. c) Filter feeding. d) Parasitic mode of feeding. e) Feeding mechanisms in insect and echinoderms.</p> <p>UNIT - II</p> <p>1. Respiration: a) Respiration in lower invertebrates (Protozoans to helminthes). b) Gills and Lophophores. c) Gills and lungs in Mollusca. d) Gills, trachea and lung like structures in Arthropods. c) Physiology of respiratory pigments in invertebrates.</p> <p>2. Excretion: a study of structural and functional organization of excretory systems in various invertebrate groups and a survey of various excretory products met with in them. Practical Lab</p>
3	September	<p>UNIT - II 3. Osmoregulation and ionic regulation: a survey of principal mechanisms in fresh water, marine and terrestrial forms.</p> <p>UNIT – III</p> <p>1. Structural and functional organization of nervous systems and receptors: a) Plan of nervous systems in the Coelenterates, Platyhelminthes, Annelids, Arthropods, Molluscs and Echinoderms: structural and functional complexities of brain and ganglionic structures. b) Receptors: Structural and functional organization of the mechanoreceptors. chemoreceptors and photoreceptors.</p> <p>2. Endocrine system: Endocrine organs: Structure, functions and their hormones. Role of neurosecretions and hormones in developmental events of insects and crustaceans. Practical Lab, Educational Trip</p>
4	October	<p>UNIT - II 3. Reproduction: a) Reproduction in Protozoa b) Reproduction in Porifera c) Reproduction in Metazoa: Sexual reproduction; Parthenogenesis. d) Reproduction in Metazoa: Asexual reproduction in Coelenterata and Polychaeta. e) Larval forms of invertebrates and their significance. Practical Lab</p>
5	October	Mid-Term I
6	November	<p>UNIT - IV</p> <p>1. Criteria for phylogenetic interrelationships between Invertebrate phyla.</p> <p>2. Origin of Parazoa, Mesozoa and Metazoa. Origin or Radiata (Coelenterata and Ctenophora). Origin of Bilateria from Radiata (Importance of Planula larva and Ctenophores).</p> <p>3. Phylogenetic significance of Rhynchocoela. Interrelationship of important Pesudocelomate groups, Rotifera. Gastrotricha, Kinorhynca, Nematomorpha and Entoprocta. Practical Lab</p>
7	December	<p>UNIT - V</p> <p>1. Affinities and evolutionary significance of the unsegmented lesser protostome phyla (Priapulida, Echiuroidea and Sipunculida).</p> <p>2. Phylogenetic relationships between the coelomate protostome phyla (Annelida, Onychopohra. Arthropoda & Mollusca). Affinities and evolutionary significance of the Lophophorate coelomate phyla (Brachiopoda, Phoronida & Ectoprocta).</p> <p>3. Affinities of the invertebrate deuterostome phyla (Chaetognatha, Echinodermata, Pogonophora & Hemichordata). Practical Lab</p>
8	December	Mid-Term II

M.Sc. Zoology Semester-I
Paper-Z-1.2 BIOCHEMISTRY

S.No.	Month	Name Of Topic
1	July	UNIT I 1. Introduction: Basic chemical concepts: a study of the chemical bonds and functional groups. 2. Biocatalysts: Classification and nomenclature of the enzymes; nature of enzymes, enzyme specificity; factors affecting enzyme activity; enzymatic and non-enzymatic catalysts; coenzymes and their functions. Enzymes and prosthetic groups. 3. Energy considerations: Biological oxidation & reduction. Fundamental reactions of biological oxidation; redox potential and electron transport system. Practical Lab
2	August	UNIT II 1. Carbohydrate – Classification, structure, general properties and functions of polysaccharides and complex carbohydrates; amino sugars, proteoglycans and glycoproteins. 2. Lipids – Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrocides, steroids, bile acids, prostaglandins, lipoproteins and lipopolysaccharides. 3. Nucleic acids – Classification, structure, properties and functions of nucleic acids. Primary, secondary and tertiary structure of nucleic acids, DNA forms and conformations, Denaturation of DNA. Practical Lab
3	September	UNIT III 1. Proteins – Peptide synthesis: chemical and Merrifield synthesis. Primary (peptide conformation, N- and C- terminal, peptide cleavage), Secondary (α -helix, sheet, random coil, Ramachandran plot), Tertiary and Quaternary structures of proteins. 2. Vitamins – Classification, structure, properties and functions of vitamins. 3. Hormones – Classification, structure, properties and functions of Hormones. Practical Lab, Educational Trip
4	October	UNIT IV 1. Metabolic pathways of protein (General reactions of amino acid metabolism - Transamination, decarboxylation, oxidative & non-oxidative deamination of amino acids.) 2. Metabolic pathways of carbohydrates (Glycolysis, various forms of fermentations in micro-organisms, citric acid cycle, its function in energy generation and biosynthesis of energy rich bond, pentose phosphate pathway and its regulation. Gluconeogenesis. Practical Lab
5	October	Mid-Term I
6	November	Unit-IV glycogenesis and glycogenolysis, glyoxylate and Gamma aminobutyrate shunt pathways, Cori cycle, Entner-Doudoroff pathway, glucuronate pathway. Metabolism of disaccharides.) 3. Metabolic pathways of lipids (hydrolysis of tri-acylglycerols, α -, β -, ω - oxidation of fatty acids. Oxidation of odd numbered fatty acids – fate of propionate, role of carnitine, degradation of complex lipids. Fatty acid biosynthesis & Lipid biosynthesis) and nucleic acids (Biosynthesis and degradation of purine and pyrimidine nucleotides and its regulation). Practical Lab
7	December	UNIT V 1. Bioanalytical Techniques: Spectroscopy – Concepts of spectroscopy, Visible and UV spectroscopy, Laws of photometry. Beer-Lambert's law, Principles and applications of colorimetry. 2. Bioanalytical Techniques: Chromatography – Principles of partition chromatography, paper, thin layer, ion exchange and affinity chromatography, gel permeation chromatography, HPLC and FPLC. 3. Bioanalytical Techniques: Electrophoretic techniques – Principles of electrophoretic separation: Continuous, zonal and capillary electrophoresis, different types of electrophoresis including paper, cellulose and gel. Electroporation, SDS-PAGE gel electrophoresis. Practical Lab
8	December	Mid-Term II

M.Sc. Zoology Semester-I
Paper-Z-1.3 CELL BIOLOGY

S.No.	Month	Name Of Topic
1	July	UNIT I 1. Microscopy: A general idea of properties of light, lenses and magnification power. An elementary knowledge about principles and functioning of microscopes: - light (dissecting and compound), interference, polarizing, fluorescence, phase contrast, UV and electron (SEM and TEM). 2. Cytological techniques: Centrifugation and ultracentrifugation, intravital and supravital staining, preparation of cell cultures, isolation and fractionation of cell. 3. The evolution of the Cell: - From molecules of the First Cell; From Prokaryotes to Eukaryotes; From Single Cell to multi-cellular Organisms. Practical Lab
2	August	UNIT II 1. Plasma membrane and intracellular compartments: Structure and functions of membrane, Endocytosis and exocytosis; principles of membrane transport, carrier proteins, ion channels. 2. Structure and functions of endoplasmic reticulum. Signal recognition particles, ER signal peptides; signal transduction. 3. Vesicular traffic organelles: Structure and functions of Golgi complex and lysosomes, transport from Golgi bodies to lysosomes. Practical Lab, Educational Trip
3	September	UNIT III 1. Structure and functions of microbodies, glyoxysomes, peroxysomes, and spherosomes. Structure and functions of ribosomes. 2. Energy transducer organelles: Structure, functions and evolution of mitochondria and plastids; their role as energy transducers. Practical Lab
4	October	Unit-III 3. Structure of cilia, flagella, vacuoles and cytoskeleton – Microtubules, Actins filaments. UNIT IV 1. Nucleus: Structure of interphase nucleus, pore complex, nucleoplasm and nucleolus. 2. Chromosomes: Chromatin organization in dividing and non-dividing cells, structure of chromosomes, solenoid model, importance of C-value paradox, centromere and telomere. Practical Lab
5	October	Mid-Term I
6	November	Unit-IV 3. Karyotype banding techniques, FISH, GISH, Mc FISH, cytometry; giant and mini chromosomes. Unit V 1. Cell cycle and mitosis: Stages of cell cycle (G1, S, G2 and M stage), centriole cycle. Practical Lab
7	December	Unit-V 2. Mechanism of mitosis, anaphasic movements. Mechanism of meiosis, nondisjunction. 3. Regulation of cell division and abnormalities: Genetic regulation of cell cycle, check points, cyclins, MPF, chalones, mitotic poisons; molecular origin of cancer; apoptosis. Practical Lab
8	December	Mid-Term II

M.Sc. Zoology Semester-I
Paper-Z-1.4 EVOLUTION AND BIOSTATISTICS

S.No.	Month	Name Of Topic
1	July	UNIT – I 1. Concepts of evolution and theories of organic evolution, Geological time – scale. 2. Lamarckism and Darwinism, New concepts regarding Lamarckism & Darwinism. 3. Hardy-Weinberg law of genetic equilibrium. A detailed account of destabilizing forces: (i) Natural selection (ii) Mutation (iii) Isolation and its role in species formation (iv) Genetic drift (v) Migration (vi) Meiotic drive. Patterns and mechanisms of reproductive isolation, Models of speciation (Allopatric, Sympatric, Parapatric). Practical Lab
2	August	UNIT – II 1. Molecular population genetics, Patterns of change in nucleotide and amino acid sequences, Ecological significance of molecular variations, Emergence of Non-Darwinism Hypothesis. 2. Genetics of quantitative traits in populations, Genotype-environment interactions, Inbreeding depression and heterosis, Molecular analysis of quantitative traits, phenotypic plasticity. Practical Lab
3	September	UNIT-II 3. Genetics of speciation. Phylogenetic and biological concept of species. UNIT – III 1. Molecular Evolution: Gene Evolution, Evolution of gene families, Molecular drive, Assessment of molecular variation. Origin of higher categories: Micro-and Macro-evolution 2. Characteristic of evolution Extinction, replacement, irreversibility of specialization etc. 3. Adaptation diversity & nature of adaptation: adaptive radiations, occupation of new environments & niches, mimicry and coloration. Practical Lab, Educational Trip
4	October	UNIT-III 4. Role of Remote Sensing for sustainable development. UNIT – IV 1. Biostatistics Objective & significance: important terms & symbols, graphs (bar diagrams, histograms, frequency polygons, line diagrams). Practical Lab
5	October	Mid-Term I
6	November	UNIT-IV 2. Frequency distributions & centering constants (Mean, Median and Mode). 3. Measures of variation (Standard deviation, Variance, Standard error of the Mean). Sampling variation of proportions, Significance of difference in proportions. Practical Lab
7	December	UNIT - V 1. Student t-test, Chi-square test. Rates and ratios 2. Correlation and Regression. Analysis of Variance (ANOVA) 3. Probability distributions: Binomial, Poissons and normal. Practical Lab
8	December	Mid-Term II

M.Sc. Physics Semester-III
Paper Name : Nuclear Physics-I Subject Code:PHY-301

S.NO.	MONTH	NAME OF TOPIC
1	July	Unit I: Basic nuclear properties: size, shape and charge distribution, spin and parity, Binding energy, semi-empirical mass formula, liquid drop model, Two Nucleon system and Nuclear Forces, General nature of the force between nucleons, saturation of nuclear forces, charge independence and spin dependence. Practical Lab
2	August	Unit-II : General forms of two nucleon interaction, central, non-central and velocity dependent potentials, analysis of the ground state ($3S_1$) of deuteron using a square well potential. Practical Lab
3	September	Unit-II rangedepth relationship, excited states of deuteron, quantitative discussion of the ground state of deuteron under non-central force, calculation of the electric quadropole and magnetic dipole moments and the D-state admixture. Practical Lab, Educational Trip
4	October	Unit III Nucleon-Nucleon Scattering and Potentials: Partial wave analysis of the neutron-proton scattering at low energy assuming central potential with square well shape, concept of thescattering length, coherent scattering of neutrons by protons in ortho and Para hydrogen molecules, conclusions of these analyses regarding scattering lengths, the effective range theory and the shape independence of nuclear potential, A qualitative discussion of protonproton scattering at low energy and high energy. Practical Lab
5	October	Mid-Term I
6	NOVEMBER	Unit-IV: Interaction of radiation and charged particle with matter: Law of absorption and attenuation coefficient, Photoelectric effect, Compton scattering, pair production, Energy loss of charged particles due to ionization, Bremstrahlung, energy target and projectile dependence of all three processes, Range-energy curves, Straggling. Practical Lab
7	DECEMBER	Unit-V: Experimental Techniques: Gas filled counters, Scintillation counter, Cerenkov counters, Solid state detectors, Surface barrier detectors, Electronic circuits used with typical nuclear state detectors, Surface barrier detectors, Electronic circuits used with typical nuclear. Practical Lab
8	DECEMBER	Mid-Term II

M.Sc. Physics Semester-III

Paper Name : Classical Electrodynamics-II Subject Code:PHY-302

S.NO.	MONTH	NAME OF TOPIC
1	July	Unit I: Plane Electromagnetic Waves and Wave Equation: Plane waves in a non-conducting medium, Frequency dispersion characteristics of dielectrics, conductors and plasmas, waves in a conducting or dissipative medium, superposition of waves in one dimension, group velocity, casualty connection between D and E, Kramers-Kroning relations. Practical Lab
2	August	Unit-II : Magneto-hydrodynamics of conducting fluids and Plasma Physics: Plasma Physics, Introduction of Lab and Space plasma, Plasma Parameters, Debye Length, Electron and Ion Temperature, Electron and Ion Number Density, Characteristic Frequencies, Plasma Frequencies, Cyclotron Frequencies. Practical Lab
3	September	Unit III Plasma Waves and Oscillations, Modes of a Cold, Warm and Hot Plasmas, Effect of Magnetic Field on Plasma Dispersion Characteristics, Pinch effect, Instabilities, Hydrodynamic and Velocity Space, Linear and non-linear phenomena, MHD equations, magnetic field lines, magnetic hysteresis, hydro-magnetic waves. Practical Lab, Educational Trip
4	October	Mid-Term I
5	October	Unit-IV: Radiation by moving charges : Lienard-Wiechert Potentials for a point charge, Total power radiated by an accelerated charge, Larmor's formula and its relativistic generalization, Angular distribution of radiation emitted by an accelerated charge, Radiation emitted by a charge in an arbitrary ultra relativistic motion, Distribution in frequency and angle of energy radiated by accelerated charges. Practical Lab
6	NOVEMBER	Unit-V: Radiation damping, self fields, of a particle, scattering and absorption of radiation by a bound system: Introductory considerations, Radiative reaction force from conservation of energy. Practical Lab
7	DECEMBER	Unit-V Abraham Lorentz evaluation of the self force, difficulties with Abraham Lorentz model, Integro-differential equation of motion including radiation damping. Practical Lab
8	DECEMBER	Mid-Term I

M.Sc. Physics Semester-III
Paper Name : Solid State Theory Subject Code:PHY-303

S.NO.	MONTH	NAME OF TOPIC
1	July	Unit I: Nearly free electron model, origin and magnitude of energy gap, Bloch function, Kronig-Penney model, wave equation of electron in periodic potential, number of orbitals in a band, Fermi surfaces, various schemes for construction of Fermi surfaces, De Hass-van Alfen affect. Practical Lab
2	August	Unit-II : Analysis of strain, elastic compliance and stiffness constants, elastic energy density, elastic stiffness constants of cubic crystals and elastic waves in cubic crystals, Vibration of crystals with monatomic basis, two atoms per primitive basis, quantization of elastic waves, phonon momentum, inelastic scattering by phonons. Practical Lab
3	September	Unit III Meissner effect, heat capacity, London's equation, microwave and infrared properties, isotope effect, flux quantization, density of states, Types of Superconductors, AC and DC Josephson tunneling, Cooper pairs and derivation of BCS Hamiltonian, results of BCS theory (no derivation), coherence length field quantization in a superconducting ring, duration of persistent current, high temperature superconductors. Practical Lab, Educational Trip
4	October	Mid-Term I
5	October	Unit-IV: Semiconductors: Band gap in semiconductors, equation of motion, effective mass in semiconductors, intrinsic carrier concentration, calculation of impurity conductivity, Law of mass action, ellipsoidal energy surfaces in Si and Ge, Hall effect recombination mechanism, Optical transitions and Shockley Read theory, excitons, photoconductivity, photo luminescence. Practical Lab
6	NOVEMBER	Unit-V: Linear Combination of atomic orbitals method, Density function theory, Hartree Fock methods, spin-polarized relativistic Korringa-Kohn-Rostoker Green's function. Practical Lab
7	DECEMBER	Unit-V APW, Projector Augmented Plane wave, linear muffin tin orbitals, k.p methods, Molecular dynamics simulation, Monte Carlo methods, Applications to systems of classical particle. Practical Lab
8	DECEMBER	Mid-Term II

M.Sc. Physics Semester-III

Paper Name : Energy Studies-I Subject Code:PHY-304

S.NO.	MONTH	NAME OF TOPIC
1	July	Unit I: Solar Thermal Energy Conversion: Solar radiation, liquid flat plate collectors - performance analysis, collector efficiency factor, collector heat removal factor, parametric analysis, testing procedures, applications, evacuated tube collector. Practical Lab
2	August	Unit-II : Concentrating collectors: Flat plate collectors with reflectors, cylindrical parabolic collector, compound parabolic collector, parabolic dish collector, central receiver collector, Solar thermal power generation. Practical Lab
3	September	Unit III Solar Photovoltaics (SPV): Silicon material, ribbon silicon, production of junctions, oxidation process, high efficiency solar cells, bifacial solar cells, basic components of thin film solar cell. Practical Lab, Educational Trip
4	October	Mid-Term I
5	October	Unit-III thin film materials- amorphous silicon, copper indium diselenide, tandem cells, organic solar cells, Characteristic curves of solar cell, module technology, electrical output properties of solar cells, SPV water pumping. Practical Lab
6	NOVEMBER	Unit-IV: Wind Power Generation: Physical principles, Betz limit, horizontal and vertical axis wind turbines, technical description of generation system, energy conversion, losses and characteristic power curve, power control- stall and pitch, introduction to hybrid systems. Practical Lab
7	DECEMBER	Unit-V: Hydroelectric Power Generation: Principles, construction types and classification, system components, reaction and impulse turbines, energy conversion chain, losses and power curve, Energy Storage: Thermal, Chemical, Mechanical and Electrical Energy storage. Practical Lab
8	DECEMBER	Mid-Term I

M.Sc. Chemistry Semester-III
Paper-3.1: CHEM-631: Chromatography

S.No.	Month	Name Of Topic
1	July	<p>Unit-I: General Introduction of Separation: Nature of separation process, classification of separation methods.</p> <p>Chromatography: General introduction, principles and types, physical state of mobile phase, mechanism and techniques involved in separation.</p> <p>Paper Chromatography: Principle, types, choice of paper and solvent, location of spot, development, visualization, measurement of R_f values, applications.</p> <p>Supercritical Fluid Chromatography (SFC): Principle, instrumentation, qualitative and quantitative analysis.</p> <p>Practical Lab</p>
2	August	<p>Unit-II: Thin Layer Chromatography (TLC): Principle, advantage over paper chromatography, types, preparation of thin layer, choice of sorbent and solvent, development, detection and applications.</p> <p>Principle, advantage over TLC, instrumentation, choice of sorbent and solvent, development, detection and applications.</p> <p>Practical Lab</p>
3	September	<p>Unit-III: Column Chromatography: Principle, resolution, stationary phase, column efficiency, factors influencing column efficiency, experimental set up and applications; principle and application of flash chromatography.</p> <p>Gas Chromatography (GC): Principle, instrumentation, column efficiency, solid supports, liquid phase, column temperature, detectors, chromatographic identification, multi-dimensional GC, fast GC, applications.</p> <p>Practical Lab, Educational Trip</p>
4	October	<p>Unit-IV: High Performance Liquid Chromatography (HPLC): Principle, instrumentation, identification of peaks, effect of temperature and packing material, types of HPLC: partition, adsorption, ion-exchange, size-exclusion or gel; derivatization in HPLC: post and pre-columns, applications.</p> <p>Practical Lab</p>
5	October	Mid Term I

6	November	<p>Unit IV Ion-Exchange or Ion Chromatography (IC): Principle, types, regeneration, ion-exchange resins and their capacity, retention, selectivity, factors affecting separation, bonded phase chromatography (BPC), high performance ion chromatography (HPIC), applications.</p> <p>Unit-V: Electrophoresis: Theory and classification, factors affecting mobility, electrophoresis phenomena: electrolysis, electroosmosis, temperature and supporting media; instrumentation, methodology, preparation of gelstaining and de-staining, preparative zone electrophoresis, continuous electrophoresis, applications.Practical Lab</p>
7	December	<p>Unit-V : Capillary Electrophoresis (CE): Principle, theory, instrumentation, sample preparation and applications, capillary electrochromatography and micellar electro-kinetic capillary chromatography.Practical Lab</p>
8	December	Mid Term II

M.Sc. Chemistry Semester-III

Paper-3.2: CHEM-632: Spectroscopy(Common Paper for all Specializations)

S.No.	Month	Name Of Topic
1	July	Unit-I: Ultraviolet-Visible (UV-VIS) Spectroscopy: Electromagnetic radiation and spectroscopy, principles of absorption spectroscopy, nature of electronic excitations, chromophores, auxochromes, origin of UV bands, types of absorption bands, factors affecting the position of UV bands, calculation of λ_{max} of simple organic compounds, visible spectra, qualitative and quantitative applications. Practical Lab
2	August	Unit I Infrared (IR) Spectroscopy: IR regions, molecular vibrations, force constant and bond strengths, calculation of vibrational frequencies, Fermi resonance, combination bands, overtones, hot bands, factors affecting the band positions and intensities, sample handling, anharmonicity, group frequencies, applications. Unit-II: Nuclear Magnetic Resonance (NMR) Spectroscopy: Nuclear angular momentum, nuclear spin, magnetization & nuclear precession, types of NMR spectrometers, free induction decay, population densities of nuclear spin states, basic theory, equivalent & non-equivalent protons, shielding and de-shielding of nuclei, chemical shift and its measurements, factors affecting chemical shift. Practical Lab
3	September	Unit II spin-spin interactions: theory, types, factors affecting coupling constant "J". typical ¹ H NMR absorption signals of various type of compounds. spin systems & classification of spectra, splitting patterns of AX, ABX, AMX, ABC, A2B2, etc. spin systems. simplification of spectra: shift reagents and spin decoupling; proton exchange, nuclear Overhauser effect, basic idea about NMR of nuclei studied other than proton viz. ¹⁵ N, ¹⁹ F & ³¹ P. applications of NMR spectroscopy. Unit-III: Carbon-13 NMR Spectroscopy: Carbon-13 nucleus, operating frequency, chemical shifts and their calculation, factors affecting chemical shifts, spin-spin coupling, proton-coupled, proton-decoupled and off-resonance carbon-13 spectra. applications of ¹³ C NMR spectroscopy. Practical Lab, Educational Trip
4	October	Unit III Electron Spin Resonance (ESR) Spectroscopy: Basic principle, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value, hyperfine splitting, isotropic and anisotropic hyperfine coupling constants, spin-orbit coupling, significance of g-tensor, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques and applications. Unit-IV: Mass Spectrometry: Basic principle, production of ions by electron impact, chemical ionization and field desorption techniques, separation and detection of ions. mass spectrum: molecular ion peak, base peak, isotopic peak, metastable peak; fragmentation patterns of organic molecules with examples of various classes compounds Practical Lab
5	October	Mid Term I
6	November	Unit IV McLafferty rearrangement, factors affecting the fragmentation pattern and governing the reaction pathways, identification of molecular ion peaks, determination of molecular weight and molecular formula of compounds, hydrogen deficiency index, nitrogen rule, negative ion mass spectrometry, brief introduction to high resolution mass spectrometry (HRMS) and combined or hyphenated techniques likes GC-MS, LC-MS, IC-MS, CE-MS, ICP-MS; applications mass spectrometry. Practical Lab
7	December	Unit-V: Structure Elucidation: An integrated problem-solving approach based on analytical data including CHNS/O percentage, spectral data (UV, IR, NMR, MS, etc.) and hyphenated technique data (GC-MS, LC-MS, ICP-MS, LCNMR, etc.) including reaction sequences for structure elucidation of organic compounds. Practical Lab
8	December	Mid Term II

M.Sc. Chemistry Semester-III
Group-II: Organic Chemistry Specialization
Paper-3.3: CHEM-633: Organic Synthesis

S.No.	Month	Name Of Topic
1	July	Unit-I: Disconnection Approach-I: Introduction, synthons and synthetic equivalents, functional group inter-conversions, order of events, one and two group C-X disconnections, chemo-selectivity, reversal of polarity, cyclization reactions, amine synthesis. Practical Lab
2	August	Unit I Protecting Groups: Principle of protection of alcohol, amine, carbonyl and carboxyl groups, simple practices / exercises. Unit-II: Disconnection Approach-II: One group C-C-disconnections involving alcohols and carbonyl compounds,
3	September	Unit II Two group C-C disconnections in Diels-Alder reactions, 1,3-difunctionalised compounds and α,β -unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds, Michael addition and Robinson annellation. Practical Lab, Educational Trip
4	October	Unit-III: Oxidation: Introduction, different oxidative processes, oxidation of hydrocarbons: alkenes, saturated C-H groups (activated and inactivated), aromatic rings; alcohols and diols; aldehydes and ketones, ketals, carboxylic acids, amines, hydrazines and sulfides; oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium (III) nitrate. Practical Lab
5	October	Mid Term I
6	November	Unit-IV: Reduction: Introduction, different reductive processes, reduction of hydrocarbons: alkenes, alkynes and aromatic rings; carbonyl compounds: aldehydes, ketones; acids and their derivatives; epoxides; nitro, nitroso, azo and oxime groups; hydrogenolysis. Unit-V Molecular Rearrangements: General mechanistic considerations, nature of migration, migratory aptitude, memory effects, a detailed study of the rearrangements on carbon, nitrogen and oxygen atoms. Practical Lab
7	December	Unit V Pinacol-pinacolone, Wagner-Meerwein, Tiffeneu-Demjanov, Dienone-Phenol, Wolff; Beckmann, Hoffman, Curtius, Lossen, Schmidt; Baeyer-Villiger, Benzil-Benzilic acid, Favorskii, Neber; electrophilic rearrangement: Wittig rearrangement; aromatic rearrangements: Fries, Benzidine rearrangement. Practical Lab
8	December	Mid Term II

M.Sc. Chemistry Semester-III
Group-II: Organic Chemistry Specialization
Paper-3.4: CHEM-634: Heterocyclic Chemistry

S.No.	Month	Name Of Topic
1	July	<p>Unit-I: Nomenclature of Heterocycles: Trivial, systematic (Hantzsch-Widman system), fusion and replacement systems of nomenclature for monocyclic, fused, spiro and bridged heterocycles.</p> <p>Aromatic Heterocycles: Classification (structural type), aromaticity in heterocycles: relationship with carbocyclic aromatic compounds, criteria of aromaticity (structural, electronic, energetic and magnetic criteria); heteroaromatic ring systems, tautomerism in aromatic heterocycles.</p> <p>Non-aromatic Heterocycles: Strain, bond angle strain and torsional strain and their consequences of in small ring heterocycles, conformation of flexible heterocycles: five-membered & six-membered heterocycles; stereo-electronic effects in saturated six-membered heterocycles: anomeric and related effects; attractive interactions through space (hydrogen bonding and nucleophilic-electrophilic interactions).</p> <p>Practical Lab</p>
2	August	<p>Unit-II: Three-membered Heterocycles: Three-membered heterocycles with one heteroatom: syntheses and reactions of aziridines, azirines, oxiranes, oxirenes, thiiranes, thiirenes.</p> <p>Three-membered heterocycles with two heteroatoms: syntheses and reactions of diaziridines, diazirines, oxaziridines, thiaziridines.</p> <p>Four-membered Heterocycles: Four-membered heterocycles with one nitrogen heteroatom: syntheses and reactions of azetidines, azetidiones.</p> <p>Four-membered heterocycles with one oxygen heteroatom: syntheses and reactions of oxetanes, oxetanones.</p> <p>Four-membered heterocycles with one sulphur heteroatom: syntheses and reactions of thietanes, thietanones.</p> <p>Practical Lab</p>
3	September	<p>Unit-III: Five-membered Heterocycles: Five-membered heterocycles with one heteroatom: structure, stability, basicity, aromaticity, reactivity, synthesis and reactions of pyrrole, furan, thiophene. Five-membered heterocycles with two heteroatoms: structure, reactivity, synthesis, reactions and some medicinal importance of imidazoles, oxazoles and thiazoles.</p> <p>Five-membered heterocycles with more than two heteroatoms: synthesis, reactions and some medicinal importance of triazoles and tetrazoles.</p> <p>Practical Lab, Educational Trip</p>
4	October	<p>Unit III Benzo-fused five-membered heterocycles with one nitrogen heteroatoms: synthesis, reactions and some medicinal importance of indoles.</p> <p>Benzo-fused five-membered heterocycles with two nitrogen heteroatoms: synthesis, reactions and some medicinal importance of benzimidazoles.</p> <p>Unit-IV: Six-membered Heterocycles-I: Six-membered heterocycles with nitrogen heteroatoms: synthesis, reactions and some medicinal importance of azines (pyridines), diazines (pyradizine, pyrimidine and pyrazine) and triazines (striazines).</p> <p>Practical Lab</p>
5	October	Mid Term I
6	November	<p>Unit IV Benzo-fused six-membered heterocycles with one nitrogen heteroatoms: synthesis, reactions and some medicinal importance of quinoline and isoquinoline.</p> <p>Benzo-fused six-membered heterocycles with one nitrogen heteroatoms: synthesis, reactions and some medicinal importance of acridine.</p> <p>Benzo-fused six-membered heterocycles with two nitrogen heteroatoms: synthesis, reactions and some medicinal importance of quinazoline and quinoxaline.</p> <p>Practical Lab</p>
7	December	<p>Unit-V: Six-membered Heterocycles-II: Six-membered heterocycles with one oxygen heteroatom: synthesis and reactions of pyrylium salts and pyrones.</p> <p>Benzo-fused six-membered heterocycles with one oxygen heteroatom: synthesis, reactions and some medicinal importance of coumarins and chromones.</p> <p>Seven-membered Heterocycles: Synthesis and some medicinal importance of azepines, oxepines, thiepinines, benzodiazepines, benzoxazepines and benzothiazepines.</p> <p>Practical Lab</p>
8	December	Mid Term II

M.Sc. Botany Semester-III
Paper XI: Plant Development and Reproduction

S.No.	Month	Name Of Topic
1	July	UNIT-I Unique features of plant development. Root development: Organization of root apical meristem (RAM), cell fates and lineages, vascular tissue differentiation, lateral roots, root hairs. Practical Lab
2	August	UNIT- II Shoot development: Organization of the shoot apical meristem (SAM), cytological and molecular analysis of SAM, control of cell division and cell to cell communication, control of tissue differentiation, especially xylem and phloem, secretory ducts and laticifers, wood development in relation to environmental factors. Practical Lab
3	September	UNIT-III Leaf growth and differentiation: Determination, phyllotaxy, control of leaf form, differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll. UNIT-III Reproduction:Vegetative and sexual reproduction, flower development, genetics of floral organ differentiation, homeotic mutants in Arabidopsis and Antirrhinum. Practical Lab, Educational Lab
4	October	UNIT-III Male gametophyte: Structure of anthers, microsporogenesis, role of tapetum, pollen development and gene expression, male sterility, sperm dimorphism and hybrid seed production, pollen germination, pollen tube growth and guidance, pollen storage, pollen embryos. Female gametophyte: Ovule development,megasporogenesis, organization of the embryo sac, structure of the embryo sac cells. Practical Lab
5	October	Mid Term I
6	November	UNIT-IV 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 gametophyticself incompatibility (GSI,SSI)(cytological, biochemical and molecular aspects), double fertilization, in-vitro fertilization. Practical Lab
7	December	UNIT-V Seed development and growth: Endosperm development during early maturation and desiccation stages, embryogenesis, ultra structure and nuclear cytology, cell lineages during late embryo development, storage proteins of endosperm and embryo, polyembryony, apomixis, Parthenocarty,
8	December	Mid Term II

M.Sc. Botany Semester-III
Paper XII: Cytogenetics

S.No.	Month	Name Of Topic
1	July	UNIT-I Chromatin organization: Chromosome structure and packaging of DNA, molecular organization of centromere and telomere, nucleolus and ribosomal RNA genes, euchromatin and heterochromatin, karyotypes of chromosomes, polytene, lampbrush, B-chromosomes and sex chromosome, molecular basis of chromosome pairing. Practical Lab
2	August	UNIT-II Structural and numerical alterations in chromosomes: Origin, meiosis and breeding behaviour of duplication, deficiency, inversion and translocation heterozygotes, Origin, occurrence, production and meiosis of haploids, aneuploids and euploids, origin and production of autopolyploids, chromosome and chromatid segregation, allopolyploids, types, genome constitution and analysis, evolution of major crop plants, induction and characterization of trisomics and monosomics. Practical Lab
3	September	UNIT-III Gene Structure and expression: Genetic fine structure, cis-trans test, fine structure analysis of eukaryotes, introns and their significance, RNA splicing, regulation of gene expression in prokaryotes and eukaryotes, Panoply of operon, catabolite repression, attenuation and anti-termination. Genetic recombination and genetic mapping: Recombination, independent assortment and crossing over, molecular mechanism of recombination, role of RecA and RecBCD enzymes, site-specific recombination, chromosome mapping, linkage groups, genetic markers, construction of molecular maps, correlation of genetic and physical maps. Practical Lab, Educational Trip
4	October	UNIT-III Mutations: Spontaneous and induced mutations, physical and chemical mutagens, molecular basis of gene mutation. UNIT-IV Somatic-cell genetics: an alternative approach to gene mapping. Transposable elements in prokaryotes and eukaryotes, mutation induced by transposons, site-directed mutagenesis, DNA damage and repair mechanisms, inherited diseases and defects in DNA repair, initiation of cancer at cellular level, protooncogenes and oncogenes. Practical Lab
5	October	Mid Term I
6	November	UNIT-IV Sex determination, sex linked inheritance, sex limited characters and sex reversal, multiple allele's and blood groups in man. UNIT-V Molecular cytogenetics: Nuclear DNA content, C-value paradox, cot curve and its significance, restriction mapping- concept and techniques, multigene families and their evolution. Practical Lab
7	December	UNIT-V physical mapping of genes of chromosomes, computer assisted chromosome analysis, chromosome microdissection and microcloning, flow cytometry and confocal microscopy in karyotype analysis. Practical Lab
8	December	Mid Term II

M.Sc. Botany Semester-III
Paper XIII: Taxonomy of Angiosperms

S.No.	Month	Name Of Topic
1	July	UNIT-I Angiosperm Taxonomy: Brief history, Aims and fundamental components, taxonomic key, Phenetic versus phylogenetic systems, Salient features of main system of classification and their relative merits and demerits. Practical Lab
2	August	UNIT-II The species concept: Taxonomic hierarchy, species, genus, family and other categories, principles used in assessing relationship, delimitation of taxa and attribution of rank. Salient features of the International Code of Botanical nomenclature. Practical Lab
3	September	UNIT-III Taxonomic evidence: Morphology, anatomy, palynology, embryology, cytology, phytochemistry. Practical Lab, Educational Trip
4	October	UNIT-III Taxonomic tools: Herbarium, floras, cytological, phytochemical, serological, biochemical and molecular techniques, computers and GIS, Relevance of taxonomy to conservation. Practical Lab
5	October	Mid Term I
6	November	UNIT-IV Evolutionary tendencies and range of flower variations in following families- Asteraceae, Cucurbitaceae, Myrtaceae, Sterculiaceae, Combretaceae and Rubiaceae. Practical Lab
7	December	UNIT-V Phylogeny of Angiosperms: Ancestors of Angiosperms, time and place of origin of Angiosperms, Habit of Angiosperm, Primitive families and their Important genera of angiosperm. Practical Lab
8	December	Mid Term II

M.Sc. Botany Semester-III
Paper XIV (a): Advanced Plant Pathology-I

S.No.	Month	Name Of Topic
1	July	UNIT-I Phenomenon of plant infection, penetration, post infection development, factors affecting infection, defense mechanisms. Practical Lab
2	August	UNIT-I Host pathogen interaction: The response of the host, pathogenecity and virulence, host specific toxins in relation to pathogenesis and disease resistance. Practical Lab
3	September	UNIT-II Plant disease control: Physical control, chemical control, plant quarantines, plant disease resistance and breeding of resistance varieties. Methods: Techniques of isolation, purification, culture and inoculation of pathogens.Technique of tissue culture and its applications in plant pathology.Raising virus free plants in culture. Practical Lab, Educational Trip
4	October	UNIT-III Fungal diseases: Symptomatology and disease identification,Some important diseases of cereals: Smuts, rusts, leaf blights, spots, mildews, karnal bunt and flag smut of wheat; covered smut and stripe disease of barley. Brown spot and blast of paddy, downy mildews and Drechlera (Helminthosporium) blights of Maize. Practical Lab
5	October	Mid Term I
6	November	UNIT-III ergot and smut of Bajra, leafspots and smuts of jowar, green ear disease of Bajra. UNIT-IV Other Diseases: Red rot and smut of sugarcane; Wilt of cotton, flax and pigeon pea; Flax rust; Blight of gram; Early blight of tomato and potato; Late blight of potato; Tikka disease of
7	December	UNIT-V Molecular base of host-parasitic interactions,signal transductionand plant disease development,acquired immunity, SAR, role of salicylic acid in plant disease development,culture of obligate parasites. Practical Lab
8	December	Mid Term II

M.Sc. Zoology Semester-III
Paper- Z-3.1 CHORDATA

S.No.	Month	Name Of Topic
1	July	UNIT – I 1. Origin and outline classification of chordates. 2. Inter-relationships of Hemichordata, Urochordata and Cephalochordata and their relations with other deuterostomes. Practical Lab
2	August	UNIT-I 3. Life histories of sessile and pelagic tunicates (ascidian), Pyrosoma, Salpa, Doliolum and Oikopleura. UNIT - II 1. Geological time scale and fossils. 2. Origin, evolution and adaptive radiations of vertebrates: Agnatha. (Ostracoderms and Cyclostomes). Practical Lab
3	September	UNIT-II 3. Early gnathostomes (Placoderms). UNIT - III 1. A general account of Elasmobranchi, Holocephali, Dipnoi and Teleostomi. 2. Adaptive radiation in bony fishes. 3. Origin, evolution and adaptive radiation of Amphibia. Practical Lab, Educational Trip
4	October	UNIT - IV 1. Origin and evolution of reptiles; the conquest of land Seymouria and related forms; Cotylosauria; basic skull types and outline classification of reptiles. 2. Dinosaurs: Types and evolutionary significance. Practical Lab
5	October	Mid Term I
6	November	UNIT-IV : 3. Living reptiles: a brief account of Rhynchocephalia, Chelonia, Squamata & Crocodilia. UNIT - V 1. Origin and evolution of birds; Origin of flight; flight adaptations. Practical Lab
7	December	UNIT-V 2. Origin of mammals, primitive mammals (Prototheria & Metatheria). A general survey of main radiations in eutherian mammals, excluding detailed reference to individual orders. 3. Evolution of man; relationships of man with other primates; fossil record of ancestry of man. Practical Lab
8	December	Mid Term II

M.Sc. Zoology Semester-III
Paper-Z-3.2 ANIMAL ECOLOGY

S.No.	Month	Name Of Topic
1	July	UNIT – I 1. Concepts of modern ecology. 2. Limiting factors: Leibig's law of minimum, Shelford's law of tolerance; combined concept of limiting factors, conditions of existence as regulatory factors. 3. Analysis of environment: The general Methods. Practical Lab
2	August	UNIT – II 1. Role of physical factors: temperature, light, water, atmospheric gases, media, substratum, climatology. 2. Brief review of important physical factors as limiting factor. 3. Nutrients and environment. Practical Lab
3	September	UNIT – III 1. Organization at the population level: (a) General properties of population. (b) Population growth form and forces shaping the population growth. (c) Measurement of population; simple numerical problems on population measurement. (d) Animal aggregation and social life. Practical Lab, Educational Trip
4	October	UNIT - III 2. Organization at the community level: (a) Biotic community concept. (b) Community structure and concept of community dominance. (c) Ecotone and concept of "edge effect". 3. Patterns in communities: Stratification, zonation, activity, food web, reproductive and social structure. (e) Community versus continuum. (f) Evolution of communities. UNIT – IV 1. Succession in community: Basic types of succession; convergence and divergence in succession; modifications in succession; concept of climax, monocl意思 versus polyclimax theory; barriers and ecesis in succession; biome. Practical Lab
5	October	Mid Term I
6	November	UNIT - IV 2. Fluctuations within community: Irruptive cycle, fluctuation, causes of fluctuation, cycles. 3. Environment and animals in ecosystem: (a) Nature and constituents of ecosystem. (b) Fundamental operation of ecosystem. (c) Flow of matter and energy in ecosystem. (d) Homeostasis in the ecosystem. (e) Cycling of chemical elements in ecosystem (biogeochemical cycles). Practical Lab
7	December	UNIT – V 1. Concept of productivity: Productivity of land and water, measurement of productivity. 2. Organization and dynamics of ecological communities: The habitat approach: A detailed knowledge of extent, zonation, environment, biota, adaptations and communities of fresh water, marine, terrestrial and estuarine ecosystems. 3. The ecological outlook: Space ecology, nuclear radiations, human population explosion, resources; applied human ecology. Practical Lab
8	December	Mid Term II

M.Sc. Zoology Semester-III
Paper-Z-3.3 (D) SPECIAL PAPER: FISH BIOLOGY-I

S.No.	Month	Name Of Topic
1	July	UNIT-I Origin and evolution of fishes, classification of fishes upto orders as proposed by berg (Characters of principal subdivisions Elasmobranchii, Crossopterygii and Actinopterygii). Practical Lab
2	August	UNIT-I Conservation and status of Fish fauna of India with special reference to Rajasthan. Zoogeography of Fishes in India. UNIT-II General account and phylogenetic significance of ostracoderms and placoderms. Practical Lab
3	September	UNIT-II General characters, classification, affinities and phylogenetic status of cyclostomata, Lamprey and hagfishes. Petromyzon and Ammoecoete larva. Practical Lab, Educational Trip
4	October	UNIT-III Integument: Structure and function, Fin musculature and eye muscles. Exoskeleton: scales of fishes (Placoid, cycloid, ctenoid, Cosmoid and Ganoid scales). Colouration in fishes. Mechanism of colour change, significance and uses of colouration. Practical Lab
5	October	Mid Term I
6	November	UNIT-IV Structure, functions and modifications of median and paired fins. Fish locomotion: Mechanism and types. Endoskeleton: Axial skeleton, Skull, Vertebral column, ribs, fin skeleton, visceral arches, girdles and types of jaw suspension in fishes. Practical Lab
7	December	UNIT-V Swim bladder: Structure and function, modification, blood supply of the bladder, structure of bladder wall, gas secreting complex, Connection with ear. Origin and functions of swim bladder. Weberian ossicles: Structure, function and significance. Fish migration: Types, factors influencing migration and significance. Practical Lab
8	December	Mid Term II

M.Sc. Zoology Semester-III
Paper-Z-3.4 (D) SPECIAL PAPER: FISH BIOLOGY-II

S.No.	Month	Name Of Topic
1	July	UNIT-I Food, feeding habits of fishes: Carnivorous fishes, Herbivorous fishes, Omnivorous fishes, Plankton feeders. Fishes: Surface, column and bottom feeders. Alimentary canal and its modifications, physiology of digestion and absorption of food, Feeding intensity, methods for food analysis and adaptation for foraging. Artificial food. Practical Lab
2	August	UNIT-II Composition of Blood, Structure of heart in Scoliodon and Teleost's, vascular system and circulation of blood, Hemoglobin and its adaptation in fishes. Respiratory organs, assessor Respiratory organs, Air breathing organs, physiology of respiration and its regulation. Practical Lab
3	September	UNIT-III Excretory organs: Structure and histology, physiology of excretion, Osmoregulation in marine, fresh water and estuarine fishes, Role of hormone in excretion and osmoregulation. Nervous system: Forebrain, Midbrain Hindbrain, spinal cord and nerves, sense organs: Olfactory. Auditory and photoreceptors and lateral line system. Practical Lab, Educational Trip
4	October	UNIT-IV Endocrine glands and Neurosecretory system. General study of fish behaviour with special reference to chemical communication in fishes. Reproduction in fishes. Reproductive organs (male and female), maturation, spawning and fertilization. Reproductive behaviour: courtship and parental care. Practical Lab
5	October	Mid Term I
6	November	UNIT-IV Gonadosomatic Index, Sexual dimorphism, hormonal control of reproduction, relationship of fecundity with body parameters, Fecundity and its methods. UNIT-V Embryonic development: Categories in fishes with respect to development, cleavage, fate maps of Blastula, Gastrulation, Larval development, viviparity hatching and Postembryonic development. Recent trends in fish study and research, fisheries economics and extension. Practical Lab
7	December	UNIT-V Fishery resources as common property resources, Maximum Sustainability Yield (MSY), Minimum Economic Yield (MEY), Optimum Sustainability Yield (OSY), Fisheries extension programmes, Fish Farmer's Development Agencies (FFDAs). Practical Lab
8	December	Mid Term II

M.Sc. Physics Semester-II
PHY201- Statistical Mechanics

S.NO.	MONTH	NAME OF TOPIC
1	January	Unit I: Basic Principles, Canonical and Grand Canonical ensembles: Concept of statistical distribution, phase space, systems and ensemble, entropy in statistical mechanics Connection between thermodynamic and statistical quantities, micro canonical ensemble, Gibb's distribution formula, equation of state, specific heat and entropy of a perfect gas using microcanonical ensemble. Practical Lab
2	February	Unit-II : Canonical ensemble, thermodynamic functions for the canonical ensemble, calculation of mean values, energy fluctuation in a gas, grand Canonical ensemble, thermodynamic functions for the grand canonical ensemble, density fluctuations, Partition functions and Properties, partition function for an ideal gas and calculation of thermodynamic quantities. Practical Lab
3	February	Mid-Term-I
4	March	Unit III Gibbs Paradox, validity of classical approximation, determination of translational, rotational and vibrational contributions to the partition function of an ideal diatomic gas, Specific heat of a diatomic gas, ortho and para hydrogen, Landau theory of phase transition, Random walk and Brownian motion, Langevin theory. Practical Lab, Educational Trip
5	April	Unit IV Identical particles and symmetry requirement, difficulties with Maxwell-Boltzmann statistics, quantum distribution functions, Bose-Einstein and Fermi-Dirac statistics, Boson statistics and Planck's formula, quantization of harmonic oscillator and creation and annihilation of Phonon operators, quantization of Fermion operators. Practical Lab
6	May	Unit-V: Theory of Metals: Fermi- Dirac distribution function, density of states, temperature dependence of Fermi energy, specific heat, use of Fermi- Dirac statistics in the calculation of thermal conductivity and electrical conductivity, Wiedemann -Franz ratio, susceptibility, width of conduction band, Drude theory of light, absorption in metals. Practical Lab
7	May	Mid-Term-II

M.Sc. Physics Semester-II
PHY202- Classical Electrodynamics-I

S.NO.	MONTH	NAME OF TOPIC
1	January	Unit I: Electrostatics: Electric field, Gauss law, Differential form of Gauss law, curl of electric field, the scalar potential, surface distribution of charges and dipoles and discontinuities in the electric field and potential, Poisson and Laplace equations, Green's Theorem, Uniqueness of the solution with Dirichlet or Neumann Boundary conditions. Practical Lab
2	February	Unit-II : Boundary Value Problems in Electrostatics: Methods of Images, Point charge in the presence of a grounded conducting sphere point charge in the presence of a charge insulated conducting sphere, Point charge near a conducting sphere at fixed potential, conducting sphere in a uniform electric field by method of images. Practical Lab, Educational Trip
3	February	Mid-Term-I
4	March	Unit III Multipoles, Electrostatics of Macroscopic Media Dielectrics: Multiple expansion, multipole expansion of the energy of a charge distribution in an external field, Elementary treatment of electrostatics with permeable media, Boundary value problems with dielectrics, Molar polarizability, and electric susceptibility, Models for molecular polarizability, Electrostatic energy in dielectric media. Practical Lab
5	April	Unit-IV: Magnetostatics: Introduction and definition, Biot & Savart's law, the differential equation of magnetostatics and Ampere's law, Vector potential and Magnetic induction for a circular current loop, Magnetic fields of a localized current distribution, Magnetic moment, Force and torque on and energy of a localized current distribution in an external magnetic induction, Macroscopic equations. Practical Lab
6	May	Unit-V: Time varying fields, Maxwell's equations and Conservation Laws: Energy in a magnetic field, Vector and Scalar potentials, Gauge transformations, Lorentz gauge, Coulomb gauge, Green functions for the wave equation, Derivation of the equations of Macroscopic Electromagnetism. Practical Lab
7	May	Mid-Term-II

M.Sc. Physics Semester-II
PHY203- Quantum Mechanics-II

S.NO.	MONTH	NAME OF TOPIC
1	January	Unit I: Scattering (non-relativistic): Differential and total scattering cross section, transformation from CM frame to Lab frame, solution of scattering problem by the method of partial wave analysis, expansion of a plane wave into a spherical wave and scattering amplitude. Practical Lab
2	February	Unit-II : Energy dependence and resonance scattering, Breit-Wigner formula, quasi stationary states, The Lippman-Schwinger equation and the Green's function approach for scattering problem, Born approximation and its validity for scattering problem, Coulomb scattering problem under first Born approximation in elastic scattering. Practical Lab
3	February	Mid-Term-I
4	March	Unit III Relativistic Formulation and Dirac Equation: Attempt for relativistic formulation of quantum theory, The Klein-Gordon (KG) equation, Probability density and probability current density, solution of free particle KG equation in momentum representation, interpretation of negative probability density and negative energy solutions, Dirac equation for a free particle, properties of Dirac matrices and algebra of gamma matrices.
5	April	Unit IV: Relativistic Formulation and Dirac Equation: Attempt for relativistic formulation of quantum theory, The Klein-Gordon (KG) equation, Probability density and probability current density, solution of free particle KG equation in momentum representation, interpretation of negative probability density and negative energy solutions, Dirac equation for a free particle, properties of Dirac matrices and algebra of gamma matrices. Practical Lab
6	May	Unit-V: The Quantum Theory of Radiation: Classical radiation field, transversality condition, Fourier decomposition and radiation oscillators, Quantization of radiation oscillator, creation, annihilation and number operators, photon states, photon as a quantum mechanical excitations of the radiation field, fluctuations and the Uncertainty relation. Practical Lab
7	May	Mid-Term-II

M.Sc. Physics Semester-II
PHY204- Atomic & Molecular Physics

S.NO.	MONTH	NAME OF TOPIC
1	January	Unit I: Hydrogen Atom : Gross structure energy spectrum, probability distribution of radial and angular ($l = 1, 2$) wave functions (no derivation), Magnetic dipole in external magnetic field, Space quantization, effect of spin, relativistic and spin orbit corrections to energy levels of hydrogen, Hamiltonian including all corrections and term shifts, fine structure. Practical Lab
2	February	Unit-II : Systems with Identical Particles: Indistinguishability and exchange symmetry, many particle wave functions and Pauli's exclusion principle, spectroscopic terms for atoms, Heitler-London method for molecule, Vector representation and Coupling of angular momenta, interaction energies, LS- Russel Saunders coupling, jj coupling. Practical Lab
3	February	Mid-Term-I
4	March	Unit III Interaction with External Fields: Atom in a weak uniform external electric field and first and second order Stark effect, calculation of the polarizability of the ground state of H-atom and of an isotropic harmonic oscillator, Linear Stark effect for H-atom levels, spin-orbit interaction, Normal and anomalous Zeeman Effect, Splitting of levels, Paschen Back effect, Difference between Zeeman and Paschen Back effect. Practical Lab, Educational Lab
5	April	Unit-IV: Symmetries of Dirac Equation: Lorentz covariance of Dirac equation, proof of covariance and derivation of Lorentz boost and rotation matrices for Dirac spinors, Projection operators involving four momentum and spin, Parity (P), Charge, Conjugation(C), time reversal (T) and CPT operators for Dirac spinors, Bilinear covariant, and their transformations behaviour under Lorentz transformation. Practical Lab
6	May	Unit-V: General features of electronic spectra, Fine structure of electronic bands, P, Q and R Branches, Franck-Condon's principle, Electronic, rotational and vibrational spectra of diatomic molecules, Classical and Quantum theory of Raman Effect, Raman spectra for rotational and vibrational transitions, Vibrational-Rotational Raman spectra, comparison with infra red spectra, Selection rules. Practical Lab
7	May	Mid-Term-II

M.Sc. Chemistry Semester-II
Paper-2.1: CHEM-521: Inorganic Chemistry

S.No.	Month	Name Of Topic
1	January	Unit-I: Reaction Mechanism of Transition Metal Complexes-I: Energy profile of a reaction, reactivity of metal complex, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage. Practical Lab
2	February	Unit-II: Reaction Mechanism of Transition Metal Complexes-II: Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction, redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions. Practical Lab
3	February	Mid-Term I
4	March	Unit-III: Electro. Spectra and Magnetic Prop. of Transition Metal Complexes: Spectroscopic ground states, correlation (d ² and d ³ in octahedral and tetrahedral symmetry), Orgel and Tanabe-Sugano diagrams for transition metal complexes (d ¹ -d ⁵ states), calculations of D _q , B and β parameters using simplified T-S diagrams, charge transfer spectra introduction about circular dichroism and optical rotatory dispersion. Practical Lab, Educational Trip
5	April	Unit III spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover. Unit-IV: Metal π-Complexes: Metal carbonyls of Fe, Co & Ni, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls. Practical Lab
6	May	Unit IV preparation, bonding structure and important reaction of transition metal nitrosyls, dinitrogen and dioxygen complexes; tertiary phosphine as ligand. Unit-V: Metal Clusters: Higher boranes: Wade's rule, styx numbers & structures, carboranes, metalloboranes, metallocarboranes, metal carbonyl and halide clusters, compounds with metal-metal multiple bonds. Practical Lab
7	May	Mid Term-II

M.Sc. Chemistry Semester-II

Paper-2.2: CHEM-522: Organic Chemistry

S.No.	Month	Name Of Topic
1	January	Unit-I: Free Radical Reactions: Types of free radical reactions, free radical substitution mechanisms, neighbouring group assistance, reactivity for aliphatic and aromatic substrates at a bridgehead carbon, reactivity in the attacking radicals, effect of solvents on reactivity, allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction, Hunsdiecker reaction, free radical rearrangements. Elimination Reactions: E2, E1 and E1cB mechanisms and their spectrum, orientation of the double bond, reactivity effects of substrate structures, attacking base, leaving group and medium; mechanism and orientation in pyrolytic elimination. Practical Lab
2	February	Unit-II: Addition to Carbon-Carbon Multiple Bonds: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemo-selectivity, orientation and reactivity, addition to cyclopropane ring, hydrogenation of double and triple bonds, hydrogenation of aromatic rings, hydroboration, hydroxylation, Michael reaction, Sharpless asymmetric epoxidation. Addition to Carbon-Hetero Multiple bonds: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles; addition of Grignard reagents, organozinc and organolithium reagents to carbonyl group and unsaturated carbonyl compounds, Wittig reaction, mechanism of condensation reactions: Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin, Stobbe, Dieckmann reactions, Robinson annulations, Reformatsky reaction, hydrolysis of esters and amides, ammonolysis of esters. Practical Lab
3	February	Mid-Term I
4	March	Unit-III: Photochemistry-I: Photochemical reactions, basic principles, types of excitations, energy dissipation, fate of excited molecule, energy transfer, quantum yield, actinometry; photochemistry of alkenes: inter- & intramolecular reactions of the olefinic bond, addition reactions, cis-trans isomerization, photo-oxidation reactions, cyclisation reactions, photochemistry of 1,3-, 1,4- and 1,5-dienes, photochemistry of aromatic compounds: excited states of benzene, isomerization, dimerization, additions and substitutions, photo-reduction, photo-Fries rearrangement; photochemistry of vision. Practical Lab, Educational Trip

5	April	Unit-IV: Photochemistry-II: Photochemistry of carbonyl compounds: photochemical reactions of cyclic and acyclic saturated carbonyl compounds; bond cleavage, photo-reduction, cyclo-addition reactions: dimerization and oxetane formation; photochemical reactions of α,β -unsaturated carbonyl compounds: hydrogen abstraction reactions, photo-cycloadditions, photodimerization, rearrangements: cyclohexenones and cyclohexadienones; photochemical reactions of β,γ -unsaturated carbonyl compounds: cleavages, rearrangements. Practical Lab
6	May	Unit-V: Pericyclic Reactions: Molecular orbitals and their symmetry, frontier orbitals of ethylene, 1,3-butadiene, 1,3,5- Hxatriene and allyl system; molecular orbital symmetry: m-plane and C ₂ -axis, classification of pericyclic reactions, analysis of reactions: Woodward-Hoffmann correlation diagrams, FMO and PMO approach; electrocyclic reactions: conrotatory and disrotatory motions, $4n$, $4n+2$ and allyl systems; cycloaddition reactions: antarafacial and suprafacial additions, $4n$ and $4n+2$ systems, $2+2$ addition of ketenes, 1,3-dipolar cycloadditions and chelotropic reactions; sigmatropic rearrangements: suprafacial and antarafacial shifts of H atom and carbon moieties, 3,3- and 5,5 sigmatropic rearrangements, Claisen, Cope and aza-Cope rearrangements; Ene reaction. Practical Lab
7	May	Mid Term-II

M.Sc. Chemistry Semester-II
Paper-2.3: CHEM-523: Physical Chemistry

S.No.	Month	Name Of Topic
1	January	<p>Unit-I: Classical Thermodynamics: Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies, partial molar free energy, partial molar volume and partial molar heat content and their significance, determinations of these quantities, concept of fugacity and determination of fugacity. Non-ideal Systems: Activity, activity coefficient, Debye-Hückel theory for activity coefficient of electrolytic solutions, determination of activity and activity coefficients, ionic strength. Practical</p>
2	February	<p>Unit-II: Statistical Thermodynamics: Concept of distribution, thermodynamic probability and most probable distribution, ensemble averaging, postulates of ensemble averaging, canonical, grand canonical and micro-canonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers), partition functions-translation, rotational, vibrational and electronic partition functions, and calculation of thermodynamic properties in terms of partition, application of partition functions, Heat Capacity Behaviour of Solids: Chemical equilibria, equilibrium constant, Fermi-Dirac statistics, distribution law, applications to metals and helium, Bose-Einstein statistics. Practical Lab</p>
3	February	Mid-Term I
4	March	<p>Unit-III: Non-equilibrium Thermodynamics: Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g. heat flow, chemical reaction, etc.), transformations of the generalized fluxes and forces, non-equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity relations, diffusion, electric conduction, irreversible thermodynamics for biological systems. Practical Lab, Educational Trip</p>
5	April	<p>Unit-IV: Electrochemistry: Debye-Huckel-Onsager treatment and its extension, ion-solvent interactions, Debye-Hückel-Jerummode, thermodynamics of electrified interface equations, derivation of electro-capillarity, Lippman equations (surface excess), methods of determination, structure of electrified interfaces, Guoy-Chapman, Stern, Bockris, Devanathan models, over potentials, exchange current density, derivation of Butler-Volmer equation, Tafel plot. Practical Lab</p>
6	May	<p>Unit-V: Electrical Double Layer at Metal/Semiconductor-Electrolyte Interface: Thermodynamics of double layer, determination of surface excess charge and other electrical parameters-electrocapillarity, excess charge capacitance, and relative surface excesses, metal/ water interaction-contact adsorption, its influence on capacity of interface, complete capacity-potential curve, constant capacity region hump, semiconductor/electrolyte interface, capacity of space-charge, Mott-Schottky plot. Practical Lab</p>
7	May	Mid Term-II

M.Sc. Chemistry Semester-II
Paper-2.4: CHEM-524: Computer Applications in Chemistry

S.No.	Month	Name Of Topic
1	January	Unit-I: General Introduction: Elements of a computer system, block diagram of computer system and function of its components, concept of hardware and software, memory, introduction to operating systems (DOS, Windows). PC Software: Word processing: Creating and saving documents, formatting, inserting tables and pictures, mail merge, spread sheets, charts, graphs and use of functions, introduction to presentation packages, graphics and animation. Practical Lab
2	February	Unit-II: Report Generation and Presentation: MS Office: Introduction to Word, Excel and Power Point; MS Word: Documentation and manipulation, saving and printing, incorporation of graphs, tables pictures and chemical structures into the documents; MS Excel: Spread sheets, report generation, cell manipulation, database management, graphical representation of tabulated data, Pi-chart, bar and line graphs, surface and 3D graphs; Power Point: Application of power point for the presentation of reports and slides. Practical Lab
3	February	MID TERM I
4	March	Unit-III: Computing and Languages: Elements of programming languages, constants and variables, operations and symbol expressions, flow chart, functions and subroutines, graphics, statements, commands, commands for accessing hardware, elements of C language. Windows: Introduction and applications. Practical Lab
5	April	Unit-IV: Computer Applications in Chemistry: Introduction to CAD: A balance approach to computer aided process design, computer interface with instruments and laboratory information system: computers in fault & true analysis, computers in communication, internet: basic concepts, importance in chemical industries.
6	May	Unit-V: Computation in Chemistry: Computation in chemistry such as pressure from Van der Waals equation, pH of solution, kinetics, radioactive decay, lattice energy, determination of order of reaction, Pauling's relation, ionic radii, molecular weight of an organic compound, resonance energy, isoelectric point of amino
7	May	MID TERM II

M.Sc. Botany Semester-II
Paper 2.1- Plant Ecology

S.No.	Month	Name Of Topic
1	January	UNIT – I Climate, soil and vegetation patterns of the world : Life zones, major biomes, and major vegetation and soil types of the world. Environment – Holistic environment, factors and their interactions, animals and man. Practical Lab
2	February	UNIT - II Vegetation organization: Concepts of community and continuum, analysis of communities (analytical and synthetic characters), community coefficients, interspecific associations, ordination, concept of ecological niche. Practical Lab
3	February	MID TERM I
4	March	UNIT - II Vegetation development: Temporal changes (cyclic and non-cyclic), mechanism of ecological succession (relay floristic and initial floristic composition, facilitation, tolerance and inhibition models), changes in ecosystem, properties during succession. UNIT – III Ecosystem organization: Structure and functions, primary production (methods of measurement, global pattern, controlling factors), energy dynamics (trophic organization, energy flow pathways, ecological efficiencies), litter fall and decomposition (mechanism, substrate quality and climatic factors), Concept of global biogeochemical cycles. Practical Lab, Educational Trip
5	April	UNIT - III Biological diversity: Concept and levels, role of biodiversity in ecosystem functions and stability, speciation and extinction, IUCN categories of threat, distribution and global patterns, terrestrial biodiversity hot spots, inventory. UNIT – IV Air, water and soil pollution : Kinds, sources, quality parameters, effects on plants and ecosystems. Climate change : Greenhouse gases (CO ₂ , CH ₄ , N ₂ O, CFCs : sources, trends and role), ozone layer and ozone hole, consequence of climate change (CO ₂ utilization, global warming, sea level rise, UV radiation), carbon
6	May	UNIT – V Ecosystem stability : Concept (resistance and resilience), ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems, ecology of plant invasion, environmental impact assessment, ecosystem restoration. Ecological management : Concepts, sustainable development, sustainability indicators, role of International Union for Conservation of Nature & Natural Resources (IUCN), World Wide Fund for Nature (WWF), UNEP, UNESCO, IGBP etc. Practical Lab
7	May	MID TERM II

M.Sc. Botany Semester-II
Paper 2.2-Plant Resource Utilization and Conservation

S.No.	Month	Name Of Topic
1	January	UNIT – I Plant Diversity: Concept, status in India, utilization and concerns. Sustainable Development: Basic Concepts, origin of agriculture. World Centers of primary diversity of domesticated plants: According to vavilov, the Indo-Burmese center, plant introduction and secondary centers. Practical Lab
2	February	UNIT – II Cultivation and uses-:Fodder, Fiber, medicinal and vegetable oil yielding crops of Rajasthan. Important firewood and timber yielding plants and non wood forest products (NWFPs) such as bamboos, rattans, raw materials for paper making, gums, dyes, and fruits. Practical Lab
3	February	MID TERM I
4	March	UNIT – III Green revolution: Benefits and adverse consequences, innovations for meeting world food demands.Plants used as avenue trees for shade, pollution control and aesthetics: Principles of conservation, environmental status of plants based on IUCN. Practical Lab, Educational Trip
5	April	UNIT – IV 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 conservation of wild biodiversity. UNIT – V Strategies for conservation – ex situ conservation: Principles and practices. Practical Lab
6	May	UNIT - V botanical gardens, field gene banks, seed banks, in vitro repositories, cryobanks, general account of the activities of Botanical Survey of India (BSI), National Bureau of Plant Genetic Resources [NBPGR], Indian Council of Agricultural Research (ICAR), Council of Scientific and Industrial Research (CSIR) and the Department of Biotechnology (DBT) for conservation. Practical Lab
7	May	MID TERM II

M.Sc. Botany Semester-II
Paper 2.3-Cell and Molecular Biology

S.No.	Month	Name Of Topic
1	January	Unit-I The dynamic cell : Structural organization of the plant cell, specialized plant cell types, chemical composition, biochemical energetics. Cell wall : Structure and functions, biogenesis, growth. Plasma membrane : Structure, models and functions, sites for ATPases, ion carriers, channels and pumps, receptors. Plasmodesmata : Structure, role in movement of molecules. Practical Lab
2	February	Unit-II Chloroplast : Structure, genome organization, gene expression, RNA editing, nucleochloroplastic interactions. Mitochondria : Structure, genome organisation, biogenesis. Plant vacuole : Tonoplast membrane, ATPase, transporters as storage organelle. Nucleus : Structure, nuclear pores, nucleosome organization, DNA structure- A, B and Z forms, DNA replication, damage and repair, transcription, plant promoters and transcription factors, mRNA transport nucleolus, rRNA biosynthesis. Practical Lab
3	February	MID TERM I
4	March	Unit-III Restriction enzymes : Cleavage of DNA into specific fragments, construction of a restriction map from the fragments, restriction sites as genetic markers, RFLP and their use in plant breeding. Ribosomes : Structure, Protein synthesis, mechanism of translation, initiation, elongation and termination, structure and role of tRNA. Practical Lab, Educational Trip
5	April	Unit-IV Protein sorting : Targeting of proteins to organelles. Cell shape and motility : The cytoskeleton, organization and role of microtubules and microfilaments, motor movements, implications in flagellar and other movements. Cell cycle and apoptosis: Control mechanisms, role of cyclins and cyclin-dependent kinases, retinoblastoma and E2F proteins. Cytokinesis and cell plate formation, mechanisms of programmed cell. Practical Lab
6	May	Unit-V Other Cellular organelles : Structure and functions of microbodies, Golgi apparatus, Lysosomes, Endoplasmic Reticulum (ER). Techniques in cell biology : Immunotechniques, insitu hybridization to locate transcripts in cell types, (FISH, GISH), confocal microscopy. Practical Lab
7	May	MID TERM II

M.Sc. Botany Semester-II
Paper 2.4-Biochemistry

S.No.	Month	Name Of Topic
1	January	Unit-I Energy flow: Principles of thermodynamics, free energy and chemical potential, redox reactions, structure and functions of ATP. Enzyme: Discovery and nomenclature, characteristics of enzyme, concept of holozymes, apozymes, coenzyme, ribozyme, abzyme and artificial enzyme, regulation of enzyme activity, mechanism of enzyme action and Michaelis-Menten equation. Practical Lab
2	February	Unit-II Carbohydrates Metabolism: Classification, structure and function of monosaccharides, disaccharides, polysaccharides and glycoproteins including starch, cellulose and pectins. Practical Lab
4	February	MID TERM I
3	March	Unit-III Amino acids, Proteins and Nitrogen Metabolism: Nod factor, root nodulation, structure of amino acids, stereo-monomers, Amphoteric properties, synthesis of amino acids by reductive amination, GS-GOGAT system and transamination. Practical Lab, Educational Trip
5	April	Unit-IV Lipid metabolism: Structure and function of lipids, fatty acid biosynthesis, synthesis of membrane lipids, structural lipids storage and their catabolism.Sulphur metabolism : sulphur uptake, transport and assimilation. Practical Lab
6	May	Unit-V Biomolecules: General structure, classification properties, distribution biosynthesis and function of primary metabolites (carbohydrates, proteins, amino acids, lipids) and secondary metabolites (flavonoids, alkaloids, steroids etc). Practical Lab
7	May	MID TERM II

M.Sc. Zoology Semester-II
Paper-Z-2.1 IMMUNOLOGY AND BIOTECHNOLOGY

S.No.	Month	Name Of Topic
1	January	UNIT - I 1. Innate and Acquired Immunity; phylogeny and ontogeny of Immune system. 2. Organization and structure of lymphoid organs, cells of the immune system and their differentiation. 3. Nature of Immune responses, Nature of antigens and superantigens, factors influencing Immunogenicity, epitopes and haptens. Practical Lab
2	February	UNIT - II 1. Structure and functions of Antibodies, Antigen-Antibody interactions in vitro and in vivo, complement system, Major histocompatibility complex in mouse and HLA system in humans. 2. Organization and expression of Ig genes. T-cell and B-cell generation, activation and differentiation. Cytokines, cell mediated effector functions. 3. Immunological tolerance and Anti-immunity; Hyper sensitivity and immune responses to infection agents especially intracellular parasites. Practical Lab
3	February	MID TERM I
4	March	UNIT – III 1. Basics: Definition, Biotechnology – an Interdisciplinary science. It's brief history, scope, significance, and limitations. 2. Genetic engineering, culture media, culture methods, restriction enzymes, cloning vectors, cell fusion, somatic hybridisation. 3. Recombinant DNA technology: Isolation of genetic materials gel-electrophoresis, amplification by PCR, insertion of r-DNA in host. Bioreactors and downstream processing. Educational Trip, Practical Lab
5	April	UNIT IV 1. Animal tissue culture: Introduction, Primary culture, cell lines and cloning. Tissue and Organ Culture, IVF, embryo- transfers. 2. Brief discussion on the chemical, Physical and metabolic functions of different constituents of culture medium. Basic techniques of mammalian cell cultures in – vitro. Microcarrier culture, cell Synchronization and cell culture. 3. Application of animal cell culture. Hybridoma technology and monoclonal antibodies. Practical Lab
6	May	UNIT – V 1. Biotechnology in Industry: Food, dairy, beverages, etc. 2. Biotechnology in agriculture: BT cotton, pest resistant and virus resistant plants. 3. Biotechnology in medicine: Humulin production, gene therapy, molecular diagnosis (DNA fingerprinting, ELISA), transgenic animals. Practical Lab
7	May	MID TERM II

M.Sc. Zoology Semester-II
Paper-Z-2.2 ANIMAL TAXONOMY

S.No.	Month	Name Of Topic
1	January	UNIT - I 1. Introduction to the science of taxonomy; stages in Taxonomy, importance of taxonomy.2. Rules of nomenclature. Linnaean hierarchy. 3. Principles of classification: theories of biological classification & their history. Practical Lab
2	February	UNIT - II 1. Concept of species; typological, biological, evolutionary and recognition species concepts. Concepts of superspecies and subspecies. 2. The species category; the polytypic species; population systematic intraspecific categories. 3. Methods of classification: taxonomic collection & the processes of identification. Practical Lab
3	February	MID TERM I
4	March	UNIT - III 1. Taxonomic characters; types and use of taxonomic characters; concept of key characters, types of variations (qualitative and quantitative) within a single population, 2. Methods of arriving on taxonomic decisions at species level; preparation and use of taxonomic keys. 3. Newer trends in taxonomy: Cytotaxonomy - importance of cytology and genetics in taxonomy. Sonotaxonomy - importance of sound, call and sonogram in taxonomy. Molecular taxonomy – importance of macromolecular composition in taxonomy. Educational Trip, Practical Lab
5	April	UNIT – IV 1. Classification of Invertebrates upto order with salient characteristics and examples of each group. Practical Lab
6	May	UNIT – V 2. Classification of Vertebrates upto order with salient characteristics and examples of each group. Practical Lab
7	May	MID TERM II

M.Sc. Zoology Semester-II

Paper-Z-2.3 GENETICS

S.No.	Month	Name Of Topic
1	January	UNIT-I 1. Basics: Definitions of heredity, variation, gene, allele, autosomes, allosomes, haploid, diploid. 2. Homologous chromosomes, locus, homozygous, heterozygous, hemizygous, dominant, recessive, phenotype, genotype, filial generations. 3. Types of cross: monohybrid, dihybrid, test cross, back cross, reciprocal cross, probable gamete formation for cross, use of symbols. Practical Lab
2	February	UNIT-II 1. Laws of heredity and their variations: Works of Mendel and Morgan. 2. Incomplete dominance, multiple allele, pleiotropy, genetic interactions. 3. Linkage and crossing over: Mechanism of crossing over, linkage groups, linkage maps; accessory genetic elements (plasmids, transposons and retroelements). Practical Lab
3	February	MID TERM I
4	March	UNIT-III 1. Genetics of sex: Sex linkage, sex influenced and sex-limited traits, sex determination, effects of environment on sex determination. 2. Human genetics: Abnormalities in chromosome structure and number, 3. Inborn errors of metabolism, eugenics, euphenics and euthenics, genetic counselling. Practical Lab, Educational Trip
5	April	UNIT-IV 1. Molecular basis of inheritance. DNA: Structure and types of DNA; DNA as a genetic material, gene structure, 2. Replication of DNA, enzymes and accessory proteins involved in DNA replication, DNA damage and repair, gene mutation and its molecular mechanism. 3. RNA: Structure and types of RNA (r-RNA, m-RNA, t-RNA, hn-RNA, Sn-RNA, antisense- RNA); types of RNA polymerase, transcription, step initiation, chain elongation and termination; post transcriptional modification, cap and tail formation, RNA splicing. Practical Lab
6	May	UNIT-V 1. Translation: Mechanism of prokaryotic and eukaryotic translation, protein folding; role of chaperons. 2. Gene regulation: Gene regulation in Prokaryota, positive and negative regulation- Lac operon, tryptophan operon; gene regulatory proteins (motifs); gene regulation in Eukaryota. 3. Applied Molecular Biology: RNA interference, molecular mechanism of antisense molecules, ribozymes, molecular mapping- RFLP analysis and its application in forensic, disease diagnosis and generic counselling. Practical Lab
7	May	MID TERM II

M.Sc. Zoology Semester-II
Paper-Z-2.4 ANIMAL PHYSIOLOGY

S.No.	Month	Name Of Topic
1	January	UNIT I 1. Digestion and Absorption of food in gastrointestinal tract. 2. Regulation of gastrointestinal processes. 3. Obesity and Starvation. 4. Common disorders of digestive tract. Practical Lab
2	February	UNIT II 1. Physiology and regulation of respiration. 2. Homeostasis, prevention of blood loss. 3. Cardiac cycle. 4. Blood pressure and common cardiovascular diseases Practical Lab
3	February	MID TERM I
4	March	UNIT III 1. Structure and mechanism of Kidney function. 2. Ionic and Osmotic balance. 3. Osmoregulation in aquatic and terrestrial environments. 4. Homeostasis. Practical Lab, Educational Trip
5	April	UNIT IV 1. Structure and function of muscle fibers in vertebrates. 2. Molecular theory of contraction. 3. Muscle fatigue 4. Skeletal muscle disorder- Tetany, Cramps, Muscular dystrophy. Practical Lab
6	May	UNIT V 1. Electrochemical potential and membrane excitation. 2. Impulse conduction via myelinated, non-myelinated fibres and synaptic junctions. 3. Neurotransmitters and Neuromodulators. 4. Sense organs: eye and ear. Practical Lab
7	May	MID TERM II

M.Sc. Physics Semester-IV

Paper Name : Nuclear Physics-II Subject Code:PHY-401

S.NO.	MONTH	NAME OF TOPIC
1	January	Unit I: Nuclear shell model: Single particle and collective motions in nuclei, assumptions and justification of the shell model, average shell potential, spin orbit coupling, single particle wave functions and level sequence, magic numbers, shell model predictions for ground state parity, angular momentum, magnetic dipole and electric quadrupole moments and their comparison with experimental data, nuclear isomerism. Practical Lab
2	February	Unit-II : Collective nuclear models: Collective variable to describe the cooperative modes of nuclear motion, Parameterization of nuclear surface, brief description of the collective model Hamiltonian in the quadratic approximation, Vibrational modes of a spherical nucleus, Collective modes of a deformed even-even nucleus and moments of inertia. Practical Lab
3	February	Mid-Term-I
4	March	Unit III Nuclear gamma decay: Electric and magnetic multipole moments and gamma decay probabilities in nuclear system (no derivations), Reduced transition probability, Selection rules, internal conversion and zero-zero transition. Practical Lab, Educational Trip
5	April	Unit IV Nuclear beta decay: General characteristics of weak interaction, nuclear beta decay and lepton capture, electron energy spectrum and Fermi-Curie plot, Fermi theory of beta decay, Fermi and Gammas-Teller selection rules, ft-values, Experimental verification of parity violation, The V-A interaction and experimental evidence. Practical Lab
6	May	Unit-IV: Nuclear Reactions: Theories of Nuclear Reactions, Partial wave analysis of reaction Cross section, Compound nucleus formation and breakup, Resonance scattering and reaction, Breit-Wigner dispersion formula for S-waves ($l=0$), continuum cross section, statistical theory of nuclear reactions. Practical Lab
7	May	Mid-Term-II

M.Sc. Physics Semester-IV
Paper Name : Solid State Theory Subject Code:PHY-402

S.NO.	MONTH	NAME OF TOPIC
1	January	Unit I: Magnetic Properties of materials, Quantum theory of Diamagnetism and Paramagnetism, Susceptibility of rare earth and transition metals, Ferromagnetism: Weiss molecular field and exchange, Heisenberg's exchange interaction, relation between exchange integral and meanfield constant, spin waves, Magnons dispersion relation, Antiferromagnetism, Ferrimagnetism. Practical Lab
2	February	Unit-II : Electrical properties of metals, ionic materials and semiconductors, dielectrics, dielectric strength, ferroelectricity, piezoelectricity, optical properties of materials, light interaction with solids, atomic and electronic interactions, optical properties of metals, optical properties of non-metals. Practical Lab
3	February	Mid-Term-I
4	March	Unit III Thermal properties, thermal expansion, heat capacity, thermal conductivity, thermal stresses, Nuclear magnetic resonance, Line width, Motional narrowing of resonance line, hyperfine splitting, Nuclear quadrupole resonance, Electron paramagnetic resonance, Principle of MASER action. Practical Lab, Educational Trip
5	April	Unit IV Vacuum Techniques: basic idea of conductance, pumping speed, Vacuum Pumps; Mechanical Pump, Diffusion pump, Turbo Molecular Pump, Ion Pump; Gauges; Thermocouple Gauge, Penning Gauge, Pirani Gauge, Hot Cathode Gauge. Practical Lab
6	May	Unit-V: Basic theory of X-ray diffraction, Indexing of Debye-Scherrer patterns from powder samples, Electron microscopes (SEM & TEM), Scanning probe microscopes (SPM), Scanning Tunneling microscope, atomic force microscope, Basic principles of X-ray absorption fine structure Spectroscopy, X-ray photo-emission Spectroscopy. Practical Lab
7	May	Mid-Term-II

M.Sc. Physics Semester-IV
Paper Name : Laser Subject Code:PHY-403

S.NO.	MONTH	NAME OF TOPIC
1	January	Unit I: Spontaneous and Stimulated emission, Population inversion, Idea of laser. Gaussian beam and its properties, Stable and Unstable Optical Resonators, Longitudinal and Transverse modes of laser cavity, Gain in a regenerative laser cavity, Threshold for 3 and 4 level laser systems. Practical Lab
2	February	Unit-II : Q-switching and mode locking – Pulse shorting – nano, pico and femtosecond operation, Ruby laser, He-Ne laser, carbon oxide laser, Excimer laser, X-ray laser, Dye laser, Neodymium : YAG and Neodymium : glass laser, Fiber laser, Semiconductor laser, Quantum-well laser, Diode – Pumped solid state laser. Practical Lab
3	March	Unit III Laser fluorescence and Raman scattering, Laser induced multiphoton process, Ultrahigh resolution spectroscopy with lasers and its applications. Practical Lab, Educational Trip
4	March	Mid-Term-I
5	April	Unit-IV: Holography: Construction of hologram and reconstruction of the image, Types of Hologram, Medical and Engineering applications of lasers, Potential of lasers in defense applications. Practical Lab
6	May	Unit-V: Optical Fibers, Light wave communication, Light propagation- total internal reflection, Acceptance angle and Numerical aperture, Fiber materials and Fabrication, Fiber cables, comparison of Fiber cables with conventional metallic cables, Optical Fibers- step index, single and multimode, graded index, Fiber losses and dispersions. Practical Lab
7	May	Mid-Term-II

M.Sc. Physics Semester-IV
Paper Name : Energy Studies-II Subject Code:PHY-404

S.NO.	MONTH	NAME OF TOPIC
1	January	Unit I: Nuclear reactions : Introduction to fission and fusion nuclear energy, typical reactions. Basic Concepts: Binding Energy of a nuclear reaction, mass energy equivalence and conservation laws, nuclear stability and radioactive decay, radioactivity calculations. Practical Lab
2	February	Unit-II : Interaction of Neutrons with Matter: Compound nucleus formation, elastic and inelastic scattering, cross sections, energy loss in scattering collisions, critical energy of fission, fission cross sections, fission products, fission neutrons, energy released in fission, γ -ray interaction with matter, fission fragments. Practical Lab
3	February	Mid-Term I
4	March	Unit III The Fission Reactor: The fission chain reaction, reactor fuels, conversion and breeding, the nuclear power resources, nuclear power plant & its components, power reactors and current status. Reactor Theory: Neutron flux, continuity equation, diffusion equation, boundary conditions, solutions of the DE, Neutron moderation. Practical Lab, Educational Trip
5	April	Unit-IV: Energy Conservation and Management: Thermodynamic basis of energy conservation, Irreversible processes, Reversibility and Availability, Exergy and available energy, Energy conservation in HVAC systems and thermal power plants, Energy conservation in buildings, UValue of walls / roof. Practical Lab
6	May	Unit-V: Green Buildings: Thermal comfort, classification of climate zones, Heat flow calculations in buildings,. Direct heat gains through windows. Convective gains/losses, Gains from people, appliances etc. Passive and low energy concepts and applications. Passive cooling/heating concepts, building form and orientation. Practical Lab
7	May	Mid-Term-II

M.Sc. Chemistry Semester-IV
Paper-4.1: CHEM-641: Environmental Chemistry
(Common Paper for all Specializations)

S.No.	Month	Name Of Topic
1	January	Unit-I: Air Pollution: Concept of environment chemistry, composition of atmosphere, major sources of air pollution, chemical reactions, smog formation, acid rain, classification and effect of air pollutants, NO _x , SO _x , CO _x particulates and ozone; Greenhouse effect and global warming, ozone depletion, automobile emissions, prevention and control of vehicular pollution, alternative fuels: Biodiesel, ethanol, CNG, ultra-low sulphur diesel (ULSD). Practical Lab
2	February	Unit-I Monitoring of Air Pollution: Principles of environment monitoring, methods for monitoring of air pollutants including NO _x , SO _x , CO _x , SPM. Prevention and Control of Air Pollution: Control of pollution by fuel selection and utilization, process or equipment modification, devices, site selection, stacks, planting trees and growing vegetation, general methods of air pollution control. Unit-II: Water Pollution: Types of water pollution, sources of water pollution, water pollutants, their classification and effects, water pollution laws and standards. Practical Lab
	February	Mid Term I
3	March	Unit-II Analysis of Water: Chemical and physical examination of water, preservation and pre-concentration, hydrogen ion concentration, acidity, alkalinity, hardness, pH, free CO ₂ , Cl ₂ , metals, ions, dissolved chlorine and oxygen, BOD, COD, chlorine dosage, E. coli index, general methods of water pollution control. Unit-III: Soil Pollution: Composition and types of soil, mineral and organic matter in soil, soil pollution by industrial wastes, urban wastes, radioactive pollution and agriculture practices. Soil Analysis: Analysis of nitrates, nitrites, ammonical nitrogen, total nitrogen, phosphates, organic carbon, potassium, calcium, sodium, magnesium, iron, zinc, etc. Practical Lab, Educational Lab
4	April	Unit-III Control of Soil Pollution: Control of domestic and industrial wastes, soil remediation, environment friendly technologies for agriculture Unit-IV: Industrial Pollution: Environmental pollution from various industries and control of industrial pollution. Industrial Wastes and their Treatment: Characteristics and types of industrial wastes, principles of industrial waste treatment, protection of biosphere and surface water from pollution with industrial sewages, sampling and chemical analysis of industrial wastewater, wastewater treatment, solid waste management, hazardous waste management. Practical Lab
5	May	Unit-V: Radioactive Pollution: Radioactive substances, state of radioactive isotopes in solution, gases and solids; units of radiation, analysis of radionuclides, sources of radioactive pollution, radioactive fallout, nuclear reactors, nuclear installations, radioactive ore processing, nuclear accidents, effects of radioactive pollution on power plants and polymers, control of radioactive pollution. Practical Lab
	May	Mid Term II

M.Sc. Chemistry Semester-IV
Paper-4.3: CHEM-643: Chemistry of Natural Products

S.No.	Month	Name Of Topic
1	January	Unit-I: Terpenoids and Carotenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule, stereochemistry and synthesis of the following representative molecules: citral, geraniol, α -terpineol, menthol, farnesol, zingiberene, abietic acid and β -carotene. Practical Lab
2	February	Unit-II: Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, identification (qualitative idea only), general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants; structure. Practical Lab
3	February	Mid Term I
4	March	Unit II stereochemistry and synthesis of the following molecules: ephedrine, coniine, nicotine, atropine, quinine and morphine. Unit-III: Steroids and Hormones: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry, isolation, identification (qualitative idea only), structure determination and synthesis of cholesterol, bile acids, androsterone, testosterone, oestrone, progesterone, aldosterone. Unit-IV: Porphyrins: Structure and synthesis of haemoglobin and chlorophyll. Practical Lab, Educational Trip
5	April	Unit IV Plant Pigments: Occurrence, nomenclature, isolation, general methods of structure determination and synthesis of apigenin, luteolin, quercetin, myricetin, daidzein, cyanidin, cyanidin-7-arabinoside, hirsutidin. Biosynthesis of Flavonoids: Acetate pathway and shikimic acid pathway. Practical Lab
6	May	Unit-V: Prostaglandins: Occurrence, nomenclature, classification, biogenesis and physiological effects, synthesis of PGE ₂ and PGF ₂ α . Pyrethroids and Rotenones: Synthesis and reactions of pyrethroids and rotenones (for structure elucidation, emphasis is to be placed on the use of spectral parameters wherever possible). Practical Lab
7	May	Mid Term II

M.Sc. Chemistry Semester-IV
Paper-4.4: CHEM-644: Medicinal Chemistry

S.No.	Month	Name Of Topic
1	January	<p>Unit-I: Drug Design and Development: Drug Discovery and Development: Introduction and procedures followed in drug design and development; Lead compounds: Concept, identification, structural modifications, role in drug discovery; Physico-chemical properties of drugs: Acid-base properties, relative acid strength, water solubility; Stereochemistry and drug action: Enantiomers and diastereomers, biological activity. Isosterism and Bioisosterism: Introduction, classifications, methods of identification and applications of bioisosteres in drug design. Pro-drugs and Soft Drugs: Introduction, properties, classification, major applications. Molecular Modelling and Drug Design: Introduction, quantum mechanics, molecular mechanics, molecular dynamics, simulation, in silico drug design, structure-based and ligand-based drug design, virtual screening, ADME predictions. Structure Activity Relationships (SARs): Introduction, physico-chemical parameters (lipophilic, electronic, steric, molar refractivity, surface activity parameters and redox potentials); molecular descriptors: Definition, types, classification and applications; quantitative methods: Hansch analysis, Free-Wilson analysis, Free-Wilson and Hansch analysis, Topliss scheme, Craig's plot; QSAR models: development, validation and applications. Practical Lab</p>
2	February	<p>Unit-II: Pharmacokinetics & Pharmacodynamics: General introduction of pharmacology, clinical pharmacology. Pharmacokinetics: Introduction, dosage forms of drugs, routes of drug administration, membrane transport, ADME and toxicity profile; Drug absorption: Physico-chemical factors, bioavailability, bioequivalence; Drug disposition: Apparent volume, clearance, blood brain barriers, peak time, peak plasma concentration, plasma protein binding; Drug metabolism (biotransformation): First pass metabolism, pathways of drug metabolism (phase I and II transformations), factors affecting, genetic polymorphism, significance; Drug elimination: Renal excretion, kinetics of elimination, drug toxicity. Pharmacodynamics: Drug receptors: Introduction, classification, biological response, affinity and efficacy, dose-response relationships, ED₅₀, LD₅₀, TD₅₀, MIC, therapeutic index, agonists & antagonists, regulations; factors affecting bioactivity and drug action, drug-receptor interactions, theories of drug-receptor interactions: Occupancy theory, induced-fit theory, rate theory, macromolecular perturbation theory, activation-aggregation theory, two-state (multi-state) receptor theory; enzyme inhibition and enzyme stimulation; membrane active drugs: Introduction, theories and types. Practical Lab</p>
3	February	Mid Term I
4	March	<p>Unit-III: Anti-cancer Drugs: Cellular apoptosis, oncogenes, tumor suppressor genes, cancer chemotherapy; mechanism of action of alkylating agents i.e. nitrogen mustards (nitrogen mustard, mechlorethamine, cyclophosphamide), ethylenimines (thiotepa), nitrosoureas (carmustine), alkylsulfonates (busulfan), methyl hydrazines (procarbazine), triazines (dacarbazine), organoplatins (cis platin); antimetabolites (5-fluorouracil, 6-mercaptopurine, capecitabine, methotrexate); microtubule damaging agents / mitosis inhibitors (vinblastine, paclitaxel); topoisomerase inhibitors (irinotecan, etoposide); targeted drugs i.e. tyrosine kinase inhibitors (imatinib), EGF receptor inhibitors (gefitinib), angiogenesis inhibitors (sunitinib), proteasome inhibitors (bortezomib); hormonal drugs (prednisolone, ethinyl estradiol, tamoxifen, letrozole, finasteride) and antibiotics (actinomycin, doxorubicin); synthesis of procarbazine, methotrexate, paclitaxel, irinotecan, imatinib, tamoxifen, actinomycin. Anti-viral Drugs: Structure and classification of viruses, viral replication and pathogenesis, mechanism of action of anti-viral drugs (non-retroviral): anti-herpes virus drugs (idoxuridine, acyclovir), anti-influenza virus drugs (zanamivir), anti-hepatitis virus drugs (ribavirin); mechanism of action and structure activity relationship of anti-viral drugs (anti-retrovirus): NRTIs (zidovudine), NNRTIs (nevirapine, efavirenz) and PIs (ritonavir, saquinavir); synthesis of idoxuridine, zanamivir, zidovudine, nevirapine, ritonavir. Practical Lab, Educational Lab</p>
5	April	<p>Unit-IV: Cardiovascular Drugs: Cardiovascular diseases, cardiac electrophysiology, central and peripheral sympatholytic and vasodilators, central intervention of cardiovascular output, intermediary myocardial metabolism, mechanism of action of cardiac glycosides (digoxin), anti-anginal (glyceryl trinitrate, tenitramine), anti-arrhythmic agents (procainamide, lidocaine, propafenone), centrally acting (methyldopa, clonidine), calcium channel blockers (amlodipine, felodipine), α and β blockers (propranolol, acebutolol, labetalol); synthesis of digoxin, procainamide, amlodipine, propranolol, labetalol. Anti-hypertensive Drugs: Blood pressure, classes of anti-hypertensive drugs, renin-angiotensin pathway, mechanism of action of ACE inhibitors (captopril, enalapril, lisinopril), angiotensin receptor blockers (losartan, candesartan, valsartan), calcium channel blockers (nifedipine, verapamil, diltiazem), potassium channel blockers (nicorandil), diuretics (mannitol, acetazolamide, hydrochlorothiazide, furosemide), vasodilators (prazosin, doxazosin); synthesis of captopril, losartan, verapamil, diltiazem, doxazosin. Practical Lab</p>

6	May	<p>Unit-V: Sedative and Hypnotic Drugs: Classification of sedatives and hypnotics, GABA receptors, physiology of sleep, mechanism of action and SAR of benzodiazepines (diazepam, temazepam, nitrazepam, alprazolam, triazolam), imidazopyridines (zolpidem), barbiturates (butobarbital, pentobarbital, phenobarbital) and melatonin receptor antagonists (ramelteon); synthesis of diazepam, alprazolam, zolpidem, phenobarbital, ramelteon.</p> <p>Anti-depressant Drugs: Biological basis of depression, mechanism of action of selective norepinephrine reuptake inhibitors (amoxapine), selective serotonin reuptake inhibitors (citalopram), norepinephrine and serotonin reuptake inhibitors (amitriptyline), dopamine and norepinephrine reuptake inhibitors (bupropion), serotonin receptor modulators (trazodone), mood stabilizers (carbamazepine), ionotropic glutamate receptor antagonists (ketamine, amphetamine).</p> <p>Anti-psychotic Drugs: Schizophrenia, neurotransmitters, neurochemistry of mental diseases, introduction of antipsychotic/ tranquilizer drugs, mechanism of action of reserpine alkaloids, phenothiazines and thioxanthenes (chlorpromazine, thiothixene, fluphenazine), butyrophenones (haloperidol), benzazepines (clozapine, olanzapine and quetiapine); synthesis of reserpine, chlorpromazine, clozapine, olanzapine, quetiapine.Practical Lab.</p>
7	May	Mid Term II

M.Sc. Chemistry Semester-IV
Paper-4.2: CHEM-642: Recent Methods of Organic Synthesis

S.No.	Month	Name Of Topic
1	January	<p>Unit-I: Modern Approaches of Organic Synthesis: Principles and concepts of green chemistry, atom economy, waste minimization techniques, different approaches to green synthesis. Reagents: Dimethyl carbonate; polymer supported reagents: chromic acid and per-acids. Catalysts: Introduction to catalysts, homogeneous and heterogeneous catalysts, solid acid-base catalysts, metal oxide supported catalysts, oxidation catalysts, basic catalysts, polymer supported catalysts, phase transfer catalysts, biocatalysts. Practical Lab</p>
2	February	<p>Unit-II: Solvents for Organic Synthesis: Introduction, characteristics properties, types and examples of green solvents. Water: Reasons for using water as green solvent, biphasic systems, synthesis in water (asymmetric aldol reaction, synthesis of quinoxalines, carbon dioxide fixation, preparation of nanoparticles), near critical water. Supercritical Liquids: The phase diagram of CO₂, supercritical CO₂, its properties and applications in dry cleaning, decaffeination of coffee and synthesis. Practical Lab</p>
3	February	Mid Term I
4	March	<p>Unit-II Ionic Liquids: Basic concept, types, physicochemical properties, preparation of ionic liquids: dialkylimidazolium and alkylpyridinium cation based ionic liquids, ionic liquids with fluorine containing anions and chiral ionic liquids; synthetic applications of ionic liquids (alkylation, allylation, oxidation and hydrogenation), concept of supported ionic liquids and their applications. Unit-III: Microwave Assisted Organic Synthesis: Introduction of microwave assisted organic syntheses, fundamentals of microwave technology, microwave activation, equipment, time and energy benefits, limitations. Practical Lab, Educational Lab</p>
5	April	<p>Unit-III applications, reactions in organic solvents: Esterification, Diels-Alder reaction; solvent free reactions (solid state reactions): saponification, alkylation of reactive methylene compounds. Unit-IV: Ultrasound Assisted Organic Synthesis: Basics of sonochemistry, ultrasound cavitation, sonochemical effect, experimental parameters, transducers, reactors, homogeneous and heterogeneous sonochemistry, Kornblum-Russell reaction, Hetero-Michael reaction, preparation of Grignard's reagent. Electrochemical Organic Synthesis. Practical Lab</p>
6	May	<p>Unit-IV Basic principle, anodic oxidations, cathodic reductions, elimination reactions, Kolbe reaction, synthesis of sebacic acid. Unit-V: Organic Synthesis Using Reactors: General introduction and types of reactors, chemical reactor design, simulation and optimization; mass and energy balance, mass and energy transfer. Batch reactors: Basic concepts, types and reactions; concepts of laboratory and pilot scale organic syntheses. Vapour phase reactors: Types and design. Raw materials, process flow diagrams, product syntheses, separations, purifications and waste compositions at industrial scale productions of pharmaceuticals, agrochemicals, organic fertilizers and dyes. Practical Lab</p>
7	May	Mid Term II

M.Sc. Botany Semester-IV
Paper XVI. Biotechnology and Biometrics

S.No.	Month	Name Of Topic
1	January	Unit-I Concepts and scope of plant biotechnology. Plant cell totipotency, Cellular differentiation. Plant tissue culture, Micropropagation-organogenesis, somatic embryogenesis, shoot bud differentiation and plantlet formation. Protoplast isolation, purification, culture, regeneration and fusion. Somatic hybrids and cybrids and their applications. Germplasm conservation and cryopreservation. Practical Lab
2	February	Unit-II Secondary Metabolites: Production of useful compounds through cell culture. Construction, operation and application of bioreactors. Production of bioactive compounds-alkaloids, antioxidants, flavanoids, terpenoids etc. Biotransformation, hairy root culture, elicitation-chemical and biological elicitors. Practical Lab
3	February	MID TERM I
4	March	Unit-III Genetic Engineering of Plants: Aims and strategies for development of transgenics. Tools and techniques of recombinant DNA technology. Direct and indirect methods of gene transfer. Agrobacterium mediated gene transfer, biolistics, microinjection, electrofusion. In Planta transformation. Gene cloning and vectors-plasmids, cosmids, Lambda phage, BAC, YAC. Practical Lab, Educational Trip
5	April	Unit-IV Genomic and cDNA library, genetic and physical mapping of genes, structural and functional genomics, molecular markers (RAPD, RFLP, AFLP). Transposon mediated gene tagging. High throughput sequencing, genome projects (wheat, Rice, Tomato), protein profiling and its significance. Chloroplast transformation. Intellectual property rights (IPR). Ecological risks and ethical concerns of GM crops. DNA and Protein microarray. Practical Lab
6	May	Unit-V Biometry: Mean, median and mode, standard deviation and standard error, variance, coefficient of variance, probability distribution, chi-square test hypothesis, simple correlation. Practical Lab
7	May	MID TERM II

M.Sc. Botany Semester-IV
Paper XVII. Plant Morphology and Anatomy

S.No.	Month	Name Of Topic
1	January	Unit-I Modular type of growth. Diversity in plant forms in annuals, biennials and perennials. Convergence and evolution of tree habit in Gymnosperms and Angiosperms. Practical Lab
2	February	Unit-II Morphology of roots: Structural modifications for food storage, respiration, reproduction and interaction with microbes. Anatomical study of monocot and dicot roots. Practical Lab
3	February	MID TERM I
4	March	Unit-III Morphology of shoots: Branching patterns. Monopodial and sympodial growth. Canopy architecture. Modifications in stem and leaf. Nodal anatomy: Leaf and branch traces and gaps. Practical Lab, Educational Trip
5	April	Unit-IV Anatomical study of monocot and dicot stems, Epidermal tissue system (stomata, trichomes, secretary glands). Secondary growth with special reference to anomalous structures in various stems. Wood science: Types of woods, anatomy of wood of Magnolia, Shorea, and Pinus. Heart wood and sap wood. Practical Lab
6	May	Unit-V Different types of leaves. Internal structure of various types of leaves in monocot and dicot plants. Morphology of Flowers: A modified shoot, structure and development of flowers. Morphology of accessory parts of flowers. Pollens and Carpels morphology. Practical Lab
7	May	MID TERM II

M.Sc. Botany Semester-IV
Paper XVIII. Seed Biology and Plant Breeding

S.No.	Month	Name Of Topic
1	January	Unit-I Significance of seed, suspended animation in seeds, seed dormancy, methods of breaking dormancy, types of seeds, structure of seeds, transformation of seed parts, germination of seeds. Practical Lab
2	February	Unit-II Ecological adaptations in seeds, storage of nutrients in seeds, material stored in seeds, mobilization of stored products during seed germination, seed dispersal mechanism. Practical Lab
3	February	MID TERM I
4	March	Unit-III Seed testing, seed separation and processing, germination test, viability, seedling evaluation. Structure of seeds of important crop plants with special reference to Rajasthan (wheat, pearl millet, mustard, gram, pea, spices). Terminator seed technology, seed bank, seed certification. Legislation and seed law enforcement. Practical Lab, Educational Trip
5	April	Unit-IV Plant breeding: Aims and objectives, brief history, plant breeding work in India, crop varieties of important crops of India, research institutes related to plant breeding, plant introduction. Practical Lab
6	May	Unit-V Plant selection methods (mass, pureline and clonal), hybridization, breeding methods in self & cross-pollinated and vegetatively propagated crops. Heterosis and inbreeding depression and causes of hybrid vigour. Practical Lab
7	May	MID TERM II

M.Sc. Botany Semester-IV
Paper XIX (a). Advanced Plant Pathology II

S.No.	Month	Name Of Topic
1	January	Unit-I Concept of disease, animate and non-animate diseases. Classification of plant diseases. Major groups of plant pathogens and symptoms caused by them. History of plant pathology and contribution of following scientists in the development of plant pathology: Dodge, Ganman, Butler, Walker, Stakeman, Horshfall, Diamond, T.S. Sadashivan, R.S. Singh, S.N. Dasgupta, S.P. Ray Chaudhary, G.Rangaswamy, N.Prasad, H.C. Arya and R.S. Mehrotra. Disease pre-disposition factors and disease development, plant disease forecasting. Epiphytotics. Practical Lab
2	February	Unit-II Bacterial diseases: Brown rot, Ring rot of potato, Fire blight of stone fruits, Tundu disease of wheat, Stalk rot of maize, Bacterial blight of rice, Soft rot of vegetables, Red strip of sugarcane, Crown gall disease, Angular leaf spot of cotton, Citrus canker. Practical Lab
3	February	MID TERM I
4	March	Unit-III Virology: Classification, morphology, physiology and nature of viruses. Symptomatology, isolation, purification and culturing of viruses. Viral infection, nutrition, synthesis and mutation. Transmission of viral diseases, acquired immunity, interference and synergism. General account of viroids. Viral diseases: Potato virus X and Y, Potato yellow dwarf, Tomato mosaic and tomato ring mosaic, Tobacco necrosis, Cucumber mosaic, Bunchy top of banana, Bhindi yellow mosaic. Practical Lab
5	April	Unit-IV Nematology: Classification and identification of plant pathogenic nematodes. Morphology and anatomy of nematodes. Methods used in nematology. Nematode diseases: Ear cockle of wheat, Root knot of vegetables, Molya disease of wheat. Non-parasitic diseases: Diseases due to deficiency of Nitrogen, Zinc, Boron, Oxygen. Preliminary studies on diseases due to excess of Ozone; PAN (Peroxyacyl nitrate), Sulphur dioxide, Sulphur and Hydrogen Fluoride in atmosphere, soil and water. Practical Lab
6	May	Unit-V Cecidology: Classification and anatomy of galls. Some insect induced plant galls of Rajasthan (Pongamia leaf galls, Cordia leaf galls, Zyziphus stem galls, Prosopis stem galls). Mechanism and physiology of insect galls. Plant pathogenic mollicutes (Spiroplasma, Phytoplasma), symptoms caused by them, their transmission and translocation in plants. Important diseases caused by Mollicutes: Sesame phyllody, Grassy shoot of sugarcane, Sandal spike, Corn stunt, Citrus greening. Practical Lab
7	May	MID TERM II

M.Sc. Zoology Semester-IV
Paper- Z-4.1 ANIMAL BEHAVIOUR

S.No.	Month	Name Of Topic
1	January	UNIT – I 1. Introduction of animal behaviour: definition, concept of ethology, scope and limitations. 2. Orientation: Classification of various types of taxes and kinesis. 3. Methods of studying behaviour: Brain lesions; electrical stimulation, drug administration. Practical Lab
2	February	UNIT – II 1. Types of behaviour and their regulation: Components of feeding behaviour: Hunger drive; directional movement, avoidance, eating, carrying and hoarding. 2. Factors influencing choice of food, Nervous regulation of food and energy intake. 3. Motivated behaviour: drive, satiation and its neurophysiological control. Practical Lab
3	February	MID TERM I
4	March	UNIT – III 1. Learning: Habituation conditioned reflex; trial and error; latent learning; learning and discrimination, imprinting; neural mechanism of learning. 2. Instinctive behaviour: Concept, phyletic decent and physiology. 3. Hormones and behavior: Mammalian nervous system and involvement of hypothalamus in the regulation of behavioural patterns. Practical Lab
5	April	UNIT - IV 1. Social behaviour in primates: (a) Primate societies. (b) Social signals, olfactory, tactile, visual, vocal and acoustic. (c) Status: Dominance and hierarchy, territorial behaviour, courtship and mating, aggression. 2. Behaviour of domestic and zoo animals. 3. Behaviour in birds: Behaviour of Streptopelia (ring dove); homing and migration. Practical Lab
6	May	UNIT - V 1. Reproductive behaviour in fish (Stickle back or any other fish). 2. Behaviour in insects: Social behaviour, communications, concealment behaviour, role of pheromones. 3. Behavioural genetics: Single gene effect, multiple gene effect, behavioural variation in an individual; genetics and human behaviour. Practical Lab
7	May	MID TERM II

M.Sc. Zoology Semester-IV
Paper-Z-4.2 DEVELOPMENTAL BIOLOGY OF CHORDATES

S.No.	Month	Name Of Topic
1	January	UNIT – I 1. Theories of development: Preformation and epigenesis. 2. Gametogenesis (i). Spermatogenesis: Growth of spermatocyte and acrosome formation; Spermiogenesis. (ii). Oogenesis: (a) Growth of oocyte and vitellogenesis. (b) Organization of egg cytoplasm; role of the egg cortex. (c) Morphogenetic determination in egg cytoplasm. 3. Fertilization: Significance of fertilization in development and the essence of activation of the egg. Practical Lab
2	February	UNIT – II 1. Early embryonic development. Patterns of cleavage: morulation and blastulation. 2. Gastrulation in chordates (tunicates to mammals). (a) Fate maps. (b) Cell lineage. (c) gastrulation process and its significance (d) Morphogenetic movements. 3. Primary embryonic induction: (a) Concepts of potencies; prospective fates; progressive determination, totipotency and pluripotency, nuclear transfer experiment. (b) Induction of the primitive nervous system (Spemann's primary organizer) (c) Nature & regionally specific properties of inductor. (d) Competence. (e) Abnormal (heterogeneous) inductors. (f) Chemistry and mechanism of action of inducing substances. Practical Lab
3	February	MID TERM I
4	March	UNIT – III 1. Cell differentiation and differential activity. 2. Organogenesis: (a) Morphogenetic processes in epithelia and mesenchyme in organ formation. (b) Morphogenesis of brain, neural crest cells and their derivatives. (c) Development of the Brain, eye & heart. 3. Maternal contributions in early embryonic development. Practical Lab, Educational Trip
5	April	UNIT – IV 1. Genetic regulations of early embryo development. 2. Embryonic adaptations: (a) Evolution of cleidoic egg and its structural and physiological adaptations. (b) Development and physiology of extra-embryonic membranes in amniotes. (c) Evolution of viviparity. (d) Development, types and physiology of mammalian placenta. 3. Metamorphosis in amphibia: (a) Structural and physiological changes during metamorphosis. (b) Endocrine control of metamorphosis. Practical Lab
6	May	UNIT – V 1. Types of regeneration, physiological, reparative and compensatory hypertrophy, regenerative ability in chordates. (b) Morphological and histological processes in amphibian limb regeneration. (c) Origin of cells of regeneration, de-differentiation, re-differentiation, (d) pattern formation during amphibian limb generation; Reasons for failure of limb generation ability in other chordates and mammals; methods for induction of regenerations. 2. Abnormalities of Embryonic development: teratogenesis. 3. Gerontology, Senescence and ageing. Practical Lab
7	May	MID TERM II

M.Sc. Zoology Semester-IV
Paper-Z-4.3 (D) SPECIAL PAPER: FISH BIOLOGY-I

S.No.	Month	Name Of Topic
1	January	UNIT-I Survey of principal fisheries of India (Indian major carps, Mackerel, Sardine, Bombay Duck fisheries). Biology of Indian major carps, catfishes, Hilsa, sardine mackerel, sharks mahseer, prawns and oysters. Exotic fishes: Cyprinus carpio, Hypophthalmichthys molitrix carassius, Trout, Mosquito fish. Larvivores fishes, predatory fishes and weed fishes. Practical Lab
2	February	UNIT-II Fish Marketing, Domestic fish marketing in India, Price policy and fish marketing system in India. Aquaculture and its importance with special reference to India. Role of aquaculture in rural development. Giant fish water, Prawn Culture and Oyster Culture, Different types of fish culture: Composite fish culture, Cage culture and integrated culture, factors affecting fish culture. Biota of pond water, carrying capacity of a pond Types of pond for culture, Growing or stocking pond, Kinds of fish farm, Extensive fish culture, Intensive fish culture, cultivable species. Practical Lab
3	February	MID TERM I
4	March	UNIT-III A detailed study of methods of fishing: Fishing crafts and Fishing gears in India (Spear and Harpoon, Fish traps, Nets, Types of Nets, Use of electric Current, Modernization of fishing methods). Pond management, fish seed resources and their transport, induced breeding by hormones. Practical Lab, Educational Lab
5	April	UNIT-IV Fish preservation and processing (Spoilage of fish, Rigor Mortis, causes of spoilage of fish, Preservation of fish, Chilling, Freezing, Deep freezing and freeze drying, salting, Brining, Smoking, Canning. Food poisoning by fish. Fishery resources and Economic value: Bio chemical composition of fish, fish as food. Fish and mankind, byproducts of fishing industry. Practical Lab
6	May	UNIT-V Inland fisheries resources: Riverine fisheries, The Ganga River System, The Brahmaputra River System, The East coast River System. The Indus River System, Riverine resources of cold-water fishery and Reservoir fisheries, cold water Fisheries of lake. Estuarine fisheries: Open estuaries, Embanked estuary, Principal fisheries of brackish water. Marine fisheries: Fishery resources, coastal fisheries, factors influencing fish production. Practical Lab
7	May	MID TERM II

M.Sc. Zoology Semester-IV
Paper-Z-4.4 (D) SPECIAL PAPER: FISH BIOLOGY-II

S.No.	Month	Name Of Topic
1	January	UNIT-I Estimation of population number and mortality rates in fresh waters. Age and growth studies: Factors influencing growth of fish, Regulation of Growth, Growth Periodicity, Methods for determining Age and Growth, Practical utility of determining Age and Growth. Length Weight relationship and indices of condition and growth. Practical Lab
2	February	UNIT-II Limnology: Definition, types of lakes/ponds, their significance, Plankton: Definition, types, diurnal variations, planktons and their significance in fisheries. Fisheries management and threat: Conservation of genetic and ecological diversity. In-situ & Ex-situ conservation; cryopreservation, application of gametes. Threats and conservation of fishes. Practical Lab
3	February	MID TERM I
4	March	UNIT-III Water pollution and fisheries: causes of water pollution, Domestic sewage, Industrial wastes and effluents, Soil erosion and Sedimentation, Fertilizers, Pesticides and Insecticides, Radioactive Waste, Thermal Waste, Oil Pollution, Acidification, Mining Wastes, effect of Pollutants on fishes. Aquatic weeds: types, habitat and their control. Aquaria setting up and maintenance. Practical Lab, Educational Trip
5	April	UNIT-IV Diseases of fishes: Causes, etiology, Symptoms, treatment and their control. Specialized organs: Bioluminescent organs, electric organs, sound producing organs, poisonous and venomous organs. Practical Lab
6	May	UNIT-V Adaptations to special conditions of life: Hill stream fishes, deep sea fishes, cave dwelling fishes. Application of genetics and biotechnology in fishes, transgenic fishes and fish genomics. Aspects of fish genetics: Gene and Chromosomes Mutation: Sex chromosomes, Sex determination, Polyploidy, hybridization and mutation. Practical Lab
7	May	MID TERM II