Syllabus
for
Agricultural Science (SCQP01)

Agricultural Science (SCQP01)

1. Agronomy

2. Genetics & Plant Breeding

3. Soil Science & Agricultural Chemistry

4. Plant Physiology

5. Horticulture

6. Entomology

7. Agricultural Economics

8. Mycology & Plant Pathology

9. Agricultural Engineering & Statistics

10. Agricultural Extension Education

Syllabus
for
Agro-forestry (SCQP02)

Note:

 i. *There will be one Question Paper which will have 100 questions.*

 ii. *All questions will be complulsory.*

 iii. *The Question Paper will have two Parts i.e. Part A and Part B:*

 iv. *Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.*

 v. *Part B will have 75 questions based on Subject-Specific Knowledge.*

Agro-forestry (SCQP02)

Importance of Agriculture/Forestry/Livestock in National Economy:
Principles of crop ecology and crop adaptation, climate shift and its ecological implications, Argo-ecological regions in India.Geographical distribution of crop plants, Greenhouse effect, Climatic factors and their effect on plant processes and crop productivity, Role of GIS and GPS in agriculture. Major pests and diseases of rice, wheat, cotton, chickpea, sugarcane and their management. Important rural development programmed in India; organizational set up of agricultural research, education andextension in India; Elements of statistics.

Agricultural Soil fertility and fertilizer use:
Essential plant nutrients and their deficiency symptoms, concept of essentiality of plant nutrients, Indicators of soil fertility and productivity,

Sustainable land use systems:
Sustainable agriculture: parameters and indicators, Conservationagriculture, safe disposal of Agri-industrial waste for crop production, Argo-forestry.

Layout and establishment of orchards:
Pruning and training; propagation, climatic requirementand cultivation of fruits like mango, banana, citrus, guava, grape, pineapple, papaya, apple, pear,peach and plum; cultivation of plantation crops like coconut and cashew nut and spices like blackpepper, coriander, turmeric, important physiological disorders;

Forest:
importance, types, classification, ecosystem, biotic and abiotic components, ecological succession and climax, nursery and planting technique, social forestry, farm forestry, urban forestry, community forestry, forest management, silvicultural practices, forest mensuration, natural regeneration, man-made plantations, shifting cultivation, taungya, dendrology, hardwoods, softwoods, pulp woods, fuel woods, multipurpose tree species, wasteland management. Agroforestry -importance and land use systems, forest soils, classification and conservation, watershed management, forest genetics and biotechnology and tree improvement, tree seed technology, rangelands, wildlife - importance, abuse, depletion, management, major and minor forest products including medicinal and aromatic plants, forest inventory, aerial photo interpretation and remote sensing, forest depletion and degradation- importance and impact on environment, global warming, role of forests and trees in climate mitigation, tree diseases, wood decay and discoloration, tree pests, integrated pest and disease management, biological and chemical wood preservation, forest conservation, Indian forest policies, Indian forest act, forest engineering, forest economics, joint forest management and tribology.

Syllabus
for
Microbiology (SCQP03)

Microbiology (SCQP03)

Microbiology

- History and scope of microbiology

- Position of microorganisms in the living world

- Structure of a bacterial cell:

- Structure of bacteriophages

- Nitrogen Cycle

- General accounts of microbes in diverse environments

- Microbial growth curve

- Mechanisms of gene transfer

- Basic concepts of gene regulation

- Mutation in microbes

- Fermentative production

- N2 -fixation

- Bio fertilizers

- Microbial interactions

Cytology and Genetics

- Ultrastructure of plant an animal cell

- Cell cycle

- Mendel's laws and cytoplasmic inheritance
- Interaction of genes
- Linkage and crossing over
- Sex determination in plants and animals
- Modern concept of gene structure
- Mutations and mutagens

Biochemistry

- Proteins
- Enzymes
- Carbohydrates:
- Lipids
- Nucleic acids and Genetic code

Physiology

- Water relations
- Cell Membrane
- Photosynthesis
- Respiration
- Hormones

Biotechnology

- Genetic Engineering

Bio techniques

- Chromatography
- Electrophoresis

Ecology

- Abiotic environment

- Biotic environment

- Adaptations

- Population ecology

- Community Ecology

- Ecosystem function

- Ecological succession

- Environmental pollution

Ecology

Syllabus
for
Architecture and Planning
(SCQP04)

Architecture and Planning (SCQP04)

Unit 1: Architecture, Planning and Design

Architectural Graphics; Visual composition in 2D and 3D; Computer application in Architecture and Planning; Anthropometrics; Organization of space; Circulation- horizontal and vertical; Space Standards; Universal design; Building byelaws; Codes and standards;

Principles of Art and Architecture; World History of Architecture: Egyptian, Greco-Roman classical period, Byzantine, Gothic, Renaissance, Baroque-Rococo, etc.; Recent trendsin Contemporary Architecture: Art nouveau, Art Deco, Eclecticism, International styles, Post Modernism, Deconstruction in architecture, etc.; Influence of Modern art and Design in Architecture; Indian vernacular and traditional Architecture, Oriental Architecture; Works of renowned national and international architects;

Unit 2: Construction, Planning Techniques and Management

Project management techniques e.g. PERT, CPM etc.; Estimation and Specification; Professional practice and ethics; Form and Structure; Principles and design of disaster resistant structures; Temporary structures for rehabilitation.

Building construction techniques, methods and details; Building systems and prefabrication of building elements; Principles of Modular Coordination; Construction planning and equipment; Building material characteristics and applications; Principles of strength of materials; Alternative building materials; Foundations; Design of structural elements with different materials; Elastic and Limit State design; Structural systems; Principles of Pre-stressing; High Rise and Long Span structures, gravity and lateral load resisting systems

Application of G.I.S and Remote Sensing techniques in urban and regional planning; Tools and techniques of Surveys – Physical, Topographical, Land use and Socio-economic Surveys; Urban Economics, Law of demand and supply of land and its use in planning; Graphic presentation of spatial data; Local self-governance, Panchayatiraj institutions; Planning Legislation and implementation – Land Acquisition Act, PPP etc.; Decision support system and Land Information System; Urban geography and econometrics; Management of Infrastructure Projects; Demography and equity in planning;

Architecture and Planning (SCQP04)

Unit 3: Enviornmental and Infrastructure Planning

Natural and man-made ecosystem; Ecological principles; Environmental considerations in Planning and design; Environmental pollution- types, causes, controls and abatement strategies; Sustainable development, goals and strategies; Climate change and built environment; Climate responsive design

Process and Principles of Transportation Planning and Traffic Engineering; Road capacity and Travel demand forecasting; Traffic survey methods, Traffic flow Analysis; Traffic analyses and design considerations; Traffic and transport management and control in urban areas; Mass transportation planning; Intelligent Transportation Systems; Urban and Rural Infrastructure System Network.

Unit 4: Urban Design, Landscape and Conservation

Historical and modern examples of urban design; Elements of urban built environment – urbanform, spaces, structure, pattern, fabric, texture, grain etc.; Concepts and theories of urban design; Principles, tools and techniques of urban design; Public spaces, character, spatial qualities and Sense of Place; Urban design interventions for sustainable development and transportation; Development controls – FAR, densities and building byelaws.; Urban renewal and conservation; heritage conservation; historical public spaces and gardens; Landscape design; Site planning.

Unit 5: Building Services and Sustainability

Solar architecture; Thermal, visual and acoustic comfort in built environments; Natural and Mechanical ventilation in buildings; Air-Conditioning systems; Sustainable building strategies; Building Performance Simulation and Evaluation; Intelligent Buildings; Water supply; Sewerage and drainage systems; Sanitary fittings and fixtures; Plumbing systems; Principles of internal and external drainage system; Principles of electrification of buildings; Elevators and Escalators - standards and uses.

Building Services and Utilities – Electrical, HVAC, Sanitary and Plumbing, Solid and Liquid Waste Management, (with special reference to energy efficiency, recycling and re-use), Overview of green Building Rating Systems

Unit 6: Infrastructure and Services

Firefighting Systems; Building Safety and Security systems; Building Management Systems; Water treatment; Water supply and distribution system; Water harvesting systems; Principles, Planning and Design of storm water drainage system; Sewage disposal methods; Methods of solid waste management - collection, transportation and disposal; Recycling and Reuse of solid waste; Landuse – transportation - urban form inter-relationships; Design of roads, intersections, grade separators and parking areas; Hierarchy of roads and level of service; Para-transits and other modes of transportation, Pedestrian and slow moving traffic planning.

Unit 7: Remote Sensing and GIS in Architecture

Introduction, development of remote sensing technology, advantages; Different platforms of remote sensing; EM spectrum, solar reflection and thermal emission remote sensing, Interaction of EM radiation with atmosphere including atmospheric scattering, absorption and emission. Interaction

mechanisms of EM radiation with ground, spectral response curves. Photographic techniques in aerial and spaceborne remote sensing; Spectrozonal photography using various camera, film, filter combinations; Applications and limitations. Stereo aerial photography, principle of stereoscopy, elements of photogrammetry. Principles of image interpretation, digital image processing. Multi-spectral scanners and imaging devices; Salient QuickBird, GeoEye sensors and their applications. Image characteristics and interpretation of different geological landforms, structures and major igneous, sedimentary and metamorphic rock types; Remote sensing as a fore-runner in all exploration programs.

Syllabus
for
Biochemistry (SCQP05)

Biochemistry (SCQP05)

Note:

  i.   There will be one Question Paper which will have 100 questions.

  ii.   All questions will be complulsory.

  iii.   The Question Paper will have two Parts i.e. Part A and Part B:

  iv.   Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.

  v.   Part B will have 75 questions based on Subject-Specific Knowledge.

Biochemistry (SCQP05)

Introduction to Biochemistry

Understanding of Biochemistry as a discipline.

Fundamental properties of elements, their role in formation of biomolecules and in chemical reactions.

Concepts of mole, mole fraction, molarity, etc.

Unique property of water as a universal solvent.

Fundamentals of Adsorption, Viscosity, Distribution law, Osmotic pressure, etc.

Fundamental laws relating to photochemistry.

Bioorganic Chemistry and Metabolites

Significance of organic reactions

Electrochemistry to conductance, voltaic, and electrolytic systems.

Chemical bonding

Aliphatic and aromatic compounds and IUPAC nomenclature.

Formation of polymers and their importance.

Stereochemistry in determining conformations of biomolecules.

Cell Biology

Structure of cell and various cellular events.

Function of various subcellular organelles.

Cell theory and techniques for fractionation of sub-cellular organelles.

Composition of cytoskeleton and extracellular matrix.

Cell cycle, cell division and cell death mechanisms.

Biochemistry (SCQP05)

Biochemical Techniques

Chromatographic techniques and their application Centrifugation

and chromatography in biological investigations.

Principles of Electrophoresis, Spectrophotometry and ELISA and their applications.

Biomolecules

Biomolecules present in living cells.

Key contributions of scientists such as Hans Kreb, G. N. Ramachandran, Melvin Calvin, Louis Pasteur, Har Gobind Khorana, Watson etc.

Properties of carbohydrates, proteins, lipids, cholesterol, DNA, RNA, glycoproteins and glycolipids.

Process of fermentation and manufacture of Biodiesel.

Amino acid and nucleotide sequences of proteins and DNA respectively.

Nutrition

Glycemic index, balanced diet, micronutrient deficiencies and the remedies, nutraceuticals and their importance, junk foods and their hazards.

Need for specialized food for people with special needs - diabetes, pregnancy, inherited genetic disorders.

Use of alternate crops – cereals and pulses and their importance.

Cattle industry and its contribution to greenhouse gases.

Merits and demerits of vegetarian and non-vegetarian foods.

Metabolism

Importance of lipids as storage molecules and as structural component of biomembranes.

Importance of high energy compounds, electron transport chain, synthesis of ATP under aerobic and anaerobic conditions.

Role of TCA cycle in central carbon metabolism, importance of anaplerotic reactions and redox balance.

Properties of metabolic enzymes of the host and pathogens

Metabolic engineering for the production of useful biomolecules.

Bioenergetics and Membrane Biology

Basic concepts of Bioenergetics, mechanisms of oxidative phosphorylation and photophosphorylation.

Composition and structure of biomembranes, transport mechanisms across biological membranes.

Concept and mechanism of ATP synthesis.

Biochemistry (SCQP05)

Human Physiology

Mechanism of signal transduction by steroid and polypeptide hormones .

Process of gaseous exchange in tissues and lungs, respiratory adaption to high altitude.

Difference between hemoglobin and myoglobin.

Muscular dystrophies, the role of steroids in muscle building.

Nitrogen metabolism.

Clinical Biochemistry

Constituents of urine, blood and their significance. Causation

of diseases of liver, kidney, mechanism of Cancer.

Trigycerides and lipoproteins and their relationship with various diseases.

Role of enzymes in diagnosis of various diseases.

Microbiology

Contributions of Louis Pasteur, Edward Jenner and Robert Koch in microbiology and immunology.

Discovery of antibiotics and their targets, drug/antibiotic resistance, preventive and therapeutic approaches of infectious diseases.

Microorganisms as model systems in genetics and biochemistry.

Contribution of gut microbiome in human health.

Basic concepts of metabolic engineering and synthetic biology.

Immunology

Immune system including cells, organs and receptors.

Structure and functions of different classes of immunoglobulins, the genetic basis of antibody diversity and the importance of humoral, cell-mediated and innate immune responses in combating pathogens.

Different types of hypersensitivity, and the importance of conventional vs. recombinant vaccines.

Importance of antigen-antibody interaction in disease diagnosis.

Principles of tolerance, autoimmunity and the role of immunity in protection against pathogens.

Enzymology

Enzymes and their importance in biological reactions.

Difference between a chemical catalyst and biocatalyst.

Activation energy and its importance in biological reactions.

Biochemistry (SCQP05)

Molecular Biology and Genetic Engineering

DNA as genetic material, DNA replication, transcription, DNA repair and translation.

Coding and non-coding regions of eukaryotic genome.

Exposure of E. coli lac operon, PCR, expression vectors and their importance in Biotechnology.

Merits and Demerits of transgenic crops.

Genomics, proteomics, metabolomics and their importance in human health

Syllabus
for
Bio-Informatics (SCQP06)

Bio-Informatics (SCQP06)

Unit 1: Mathematics and Statistical Foundation

Calculus: The concept of limit of a Functions, continuity, differentiability, successive differentiation, Liebnitz theorem, asymptotes, definite integrals, reduction formulae, order and degree of ordinary differential equations, linear differential equations with constant coefficient and Laplace transformations

Algebra: Mappings, groups, subgroups, matrices, elementary operations of matrices, inverse of matrices, application of matrices to system of linear equations, vector spaces, linear transformation and their matrix representations.

Analysis Open set, closed set, limit, continuity, Taylor's theorem, Lagrange's mean theorem, Rolle's Theorem, sequences and series, convergence of series.

Probability Distribution: Basics of Binomial, Poisson and Normal distributions and their application in biology. Random Variable; Discrete and Continuous Probability Distribution, Probability mass function, probability Density function, Mathematical Expectation.

Geometry Plane, straight line, sphere, cone, cylinder, conicoids.

Unit 2: Role of Chemistry in Bioinformatics

Kinetic theory of gases, Atomic Structure, Periodic Properties, Chemical bonding, Distribution of electrons in organic compounds.

Homegenous equilibria, chemical Kinetics, p and d block elements, Stereo Chemistry, Configurational Isomerism, Elements of symmetry, Chirality.

Colligative properties, thermodynamics, Chemistry of elements of first transition series, Coordination Compouds, Organometallic Compounds, Alicyclic Compounds

Esters cont aining active methylene group, Aromatic Compounds, Nuclear Chemistry, Zero group elements, Phase Rule and Electrochemistry.

Bio-Informatics (SCQP06)

Unit 2: Biochemistry and Molecular Biology

Carbohydrates and lipids, their importance in cells. Proteins: Amino acids and peptides; primary, secondary, tertiary and quaternary structures; protein – protein interactions; sequence homology, functional and evolutionary relationships of proteins.

Nucleic acids: Bases, nucleotides, RNA and DNA. Different Structural from of DNA, denaturation and renaturation of DNA, protein-nucleic acid interactions.

Enzymes: Units of activity, coenzymes and metal cofactors, temperature and pH effects, MichaelisMenten kinetics, inhibitors and activators, active site and mechanism of enzyme action, isoenzymes, allosteric enzymes, regulation by covalent modification. Organization of metabolic systems: enzyme chains, multienzyme complexes and multifunctional enzymes, regulatory enzumes and feedback control of metabolic pathways, energy charge

Carbohydrate metabolism: Glycolysis, gluconeogenesis, glycogenolysis, glycogenolysis and pentose phosphate pathway; hormonal control. TCA cycle and oxidative phosphorylation.
B-oxidation and biosynthesis of fatty acids. Transamination and deamination of amino acids, ketogenic and glycogenic and glycogenic amino acids, urea cycle.Purine and pyrimidine biosynthesis.

Unit 3: Microbiology and Immunology

Viruses: Morphology, Architechture, Nomenclature, Classification and symmetry, Structure of a typical plant (TMV), Animal (polio) and Bacterial (T4) Viruses; Bacteriophages (Lytic & lysogenic cycles)

Role of microorganisms in biogeochemical cycles of Nitrogen and Carbon. Biological nitrogen fixation with special reference to Rhizobium. Industrial application of microorganisms: Organic acids, alcohol, food processing, milk products with special reference to Lactobacillus, antibiotics with reference to Streptomyces, biopesticides.

Methods in Microbiology – staining, sterilization method culture media, pure culture methods, methods for population estimation, growth determination.

Immunology: Immunity, Immune system in Human: Active and Passive Immunity, Antigens, Antibodies, Classes of Immunoglobulins,   Antigen – Antibody reaction, B-cells and T-cells and their role in immunity to infection, Autoimmunity.

Immunity to infectious agents; AIDS and other immunodeficiencies, Vaccines, Hybridoma Technology and Monoclonal antibodies, Gene Therapy.

Unit 4: Genetic Engineering, Gene Sequencing and RDT

DNA as genetic material, Structure and Biological importance of DNA; Types of RNA and their structure; Replication of DNA. Genetic code, Central Dogma, Transcription, Translation, RNA editing, DNA repair. Introduction: Plasmids and bacteriophages: Cosmids, M13, Shuttle vectors

and lamda of E. coli, Applications of genetic engineering in medicine, industry and agriculture. Enzymes for RDT: polymerase, restriction endonucleases, ligases, Introduction of r-DNA into living cells – Transformation and Transfection, Identification of recombinants.

Techniques in Genetic Engineering : PCR, Gene Sequencing – Maxam Gilbert method & Sanger method, Electrophoresis, Southern and northern blotting techniques. Transgenic plants and animals, Gene therapy, Intellectual Property Rights, Bioethics.

Unit 5: Bio-Physics

Energetics of a living body, sources of heat limits to temperature (qualitative treatment), heat dissipation to conservation, laws of thermodynamics. Nature of chemical bonds, intra and intermolecular interaction in biological systems. Force field used in Molecular Dynamics Simulation.

Absorption spectroscopy- Beer-Lambert's law, Colorimetry to Spectrophotometry(single and double beam spectrophotometer), primary biophysical events in photosynthesis.

Spectroscopic techniques to find out molecular structure (quantitative techniques), general spectroscopy (UV, Visible, Fluorescence, Atomic absorption, IR to Raman spectra). Instrumental techniques: Concept of chromatography, electrophoresis; spectrophotometry, UV-VIS, IR, NMR',- and spectroscopy.

Physical methods of imaging, intact biological structures (X-ray, CT-Scan, ECG, EEG, NMR) and radioactive pollution- GM counter

Structure of proteins – primary, secondary, tertiary and quaternary. X-ray crystallography Physical methods for determining size and shape of macromolecules – diffusion to sedimentation, reverse osmosis, ultracentrifugation, Ramachandran Plot Analysis.

Unit 6: Fundamentals of Information Technology and Computer Programming

An overview of resolution in computers and communication. Applications software (Word processing, spreadsheets, database, financial, communicating etc.) Processors (microclips, CPU., Main memory, representation of data & programs, microcomputer system unit, future processing power), Input and output, storage, Interactivity, Multimedia

System Software, The use of online resources and the internet, Communications technology (hardware, channels & Networks), Software development (programming & languages).

Introduction to programming in C++, C++ control structures (if, if/else, while, do/while, for, switch).

Functions (definition and prototypes, storage classes, Scope rules, Recursion, inline functions, references and reference parametrics, function overloading, function templates), Arrays (declaration, passing arrays to functions, sorting and searching arrays, multiple subscripted arrays.

Pointers (declaration & initialization, pointer operators, calling functions by reference, pointer expression and pointer arithmetic, pointers & arrays, arrays of pointers, function pointers),

Bio-Informatics (SCQP06)

Introduction to characters and string processing, classes(structures, class scope, access utility functions, constructors, destructors, use of data members and member functions).

Color models: CMY, HSV, RGB, Visualization techniques. Graphics display devices, Raster and Random scan devices, color CRT monitors, LCD and LED.

Artificial Neural Networks, Genetic algorithm, Bayesian modeling, Monte Carlo Simulation Method, Markov Models and their application

Perl basic: Variables, Perl operations, A Program to store DNA sequence, Concatenating DNA fragment, Transcription: DNA to RNA, Subroutines, scoping and subroutines, command-line arguments and arrays passing data to subroutines, modules and libraries of subroutines, fixing bugs.

Unit 7: Basics of Bio-Informatics

What is Bioinformatics and its relation with molecular biology Examples of related tools, databases and software, Data generation; Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray).Applications of Bioinformatics.

Biological Database and its Types, Introduction to data types and Source. Population and sample,Classification and Presentation of Data. Quality of data, private and public data sources. General Introduction of Biological Databases; Nucleic acid databases, Protein databases (Primary, Composite, and Secondary).Specialized Genome databases:Structure databases

Data storage and retrieval and Interoperability, Flat files, relational, object oriented databases and controlled vocabularies. File Format, Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search.The challenges of data exchange and integration. Ontologies, interchange languages and standardization efforts.

Sequence Alignments and Visualization, Introduction to Sequences, alignments and Dynamic Programming,Local alignment and Global alignment (algorithm and example), Pairwise alignment and multiple sequence alignment. Methods for presenting large quantities of biological data: sequence viewers, 3D structure viewers, Anatomical visualization.

Gene Expression and Representation of patterns and relationship,General introduction to Gene expression in prokaryotes and eukaryotes, transcription factors binding sites. SNP, EST, STS.Introduction to Regular Expression, Hierarchies, and Graphical models (including Marcov chain and Bayes notes).Genetic variability and connections to clinical data.

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Syllabus
for
Botany (SCQP07)

Note:

i. *There will be one Question Paper which will have 100 questions.*

ii. *All questions will be complulsory.*

iii. *The Question Paper will have two Parts i.e. Part A and Part B:*

iv. *Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.*

v. *Part B will have 75 questions based on Subject-Specific Knowledge.*

Botany (SCQP07)

1. Phycology and Microbiology

2. Biomolecules and Cell Biology

3. Mycology and Phytopathology

4. Archegoniate

5. Anatomy and Angiosperms

6. Economic Botany

7. Genetics

8. Molecular Biology

9. Plant Ecology and Phytogeography

10. Plant Semantics

11. Reproductive Biology of Angiosperms

12. Plant Physiology

13. Plant Metabolism

14. Plant Biotechnology

Syllabus
for
Chemistry (SCQP08)

Chemistry (SCQP08)

Physical Chemistry

1. Gaseous State

Behavior of real gases: Deviations from ideal gas behavior, compressibility factor, and its variation with pressure for different gases. Causes of deviation from ideal behavior. van der Waals equation of state, its derivation and application in explaining real gas behaviour; van der Waals equation expressed in virial form, Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, critical and van der Waals constants, law of corresponding states.

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

2. Liquid State

Structure and physical properties of liquids; vapour pressure, surface tension, viscosity, and their dependence on temperature, Effect of addition of various solutes on surface tension, cleansing action of detergents. Structure of water.

3. Ionic Equilibria

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di- and tri-protic acids. Salt hydrolysis, hydrolysis constants, degree of hydrolysis and pH for different salts. Buffer solutions; Henderson equation, buffer capacity, buffer range, buffer action, applications of buffers in analytical chemistry, Solubility and solubility product.

Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of indicators; selection of indicators and their limitations. Multistage equilibria in polyelectrolytes.

4. Solid State

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of $NaCl$, $CsCl$ and KCl. Various types of defects in crystals, Glasses and liquid crystals.

5. Thermodynamics

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics. First law: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Thermochemistry:

Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations), pressure on enthalpy of reactions.

Second Law:

Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third law of thermodynamics:

Third Law of thermodynamics, residual entropy, calculation of absolute entropy of molecules.

Free Energy Functions:

Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

6. Partial molar quantities

Partial molar quantities, dependence of thermodynamic parameters on composition; GibbsDuhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases

7. Dilute solutions or Colligative Properties

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties: [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

8. Molecular Spectroscopy & Photochemistry

Unit-I

Interaction of electromagnetic radiation with molecules and various types of spectra; BornOppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution. Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Unit-II

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion. Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation.

Unit-III

Photophysical and photochemical processes: laws of photochemistry, quantum yield. Jablonski diagrams: Franck-Condon principle, Law of photochemical equivalence, quantum efficiency, low and high quantum efficiency. kinetics of photochemical reactions ($H2 + Br2 \rightleftharpoons HBr$, $2HI \rightleftharpoons H2 + I2$), energy transfer in photochemical reactions (photosensitization and quenching), fluorescence, phosphorescence, chemiluminescence, Discussion of Electronic spectra and photochemistry (Lambert-Beer law and its applications).

9. Chemical Kinetics

Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated rate laws for first, second and fractional order reactions, pseudounimolecular reactions, determination of the order, kinetics of complex reactions (limited to first order): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions. Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.

10. Catalysis

Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, MichaelisMenten mechanism, acid-base catalysis.

11. Surface chemistry

Physical adsorption, chemisorption, adsorption isotherms (Freundlich, Temkin, Derivation of Langumuir adsorption isotherms, surface area determination), BET theory of multilayer adsorption (no derivation), Adsorption in solution

12. Phase Equilibria

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions. Three component systems, waterchloroform-acetic acid system, triangular plots. Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications.

13. Introduction to Quantum Chemistry:

Unit-I

Introduction to black-body radiation and distribution of energy, photo-electric effect, concept of quantization, wave particle duality (de-Broglie's hypothesis), The uncertainty principle, The wave function: wave function and its interpretation, conditions of normalization and Orthogonality and its significance. Basic idea about operators, eigen function and values, Schrodinger equation and application to free-particle and particle in a box, boundary conditions, wave functions and energies, degeneracy, hydrogen atom, Schrodinger equation in polar coordinates, radial and angular parts of the hydrogenic orbitals, degeneracies, spherical harmonics, representations of hydrogenic orbitals.

Unit-II

Quantitative treatment of simple harmonic osciallator model, setting up of Schodinger equation and discussion of solution of wave functions. Rigid rotator model and discussion of application of Schrodinger equation. idea about transformation to spherical polar coordinate, discussion on solution.

Unit-III

Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. Valence bond and molecular orbital approaches, LCAO-MO treatment of H2, H2 + ; bonding and anti-bonding orbitals, Comparison of LCAO-MO and VB treatments of H2 (only wavefunctions, detailed solution not required) and their limitations.

14. Conductance

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Walden's rules. Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

15. Electrochemistry

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb_2O_3 electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

Inorganic Chemistry

1. Atomic Structure

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de' Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and $\psi2$. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

2. Periodicity of Elements

s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s and p-block.

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

(b) Atomic radii (van'der Waals)

(c) Ionic and crystal radii.

(d) Covalent radii (octahedral and tetrahedral)

(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.

(f) Electron gain enthalpy, trends of electron gain enthalpy.

(g)Electronegativity, Pauling, Mullikan, Allred Rachow scales, electronegativity and bond order, partial charge, hybridization, group electronegativity. Sanderson electron density ratio

3. Chemical Bonding

(i) Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation, expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.

(ii) Covalent bond: Lewis structure, Valence Shell Electron Pair Repulsion Theory (VSEPR), Shapes of simple molecules and ions containing lone-and bond-pairs of electrons multiple bonding, sigma and pi-bond approach, Valence Bond theory, (Heitler-London approach). Hybridization containing s, p and s, p, d atomic orbitals, shapes of hybrid orbitals, Bents rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of simple homonuclear and heteronuclear diatomic molecules,

MO diagrams of simple tri and tetra-atomic molecules, e.g., N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2, $HCHO$, (idea of s-p mixing and orbital interaction to be given). Covalent character in ionic compounds, polarizing power and polarizability. Fajan rules, polarization. Ionic character in covalent compounds: Bond moment and dipole moment. ionic character from dipole moment and electronegativities.

4. Metallic bonding and Weak chemical forces

(iii) Metallic Bond: Qualitative idea of free electron model, Semiconductors, Insulators.

(iv) Weak Chemical Forces: van'der Waals, ion-dipole, dipole-dipole, induced dipole dipoleinduced dipole interactions, Lenard-Jones 6-12 formula, hydrogen bond, effects of hydrogen bonding on melting and boiling points, solubility, dissolution.

5. Oxidation-Reduction and general principle of metallurgy

Redox equations, Standard Electrode Potential and its application to inorganic reactions. Occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon or carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic Kroll process, Parting process, van Arkel- de Boer process and Mond's process, Zone refining.

6. Chemistry of s and p Block Elements

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behavior of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements. Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate.

Structure, bonding, preparation, properties and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Per-oxo acids of Sulphur inter-halogen compounds, polyhalide ions, pseudo-halogens, properties of halogens.

7. Noble Gases

Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF_2, XeF_4 and XeF_6; Bonding in noble gas compounds (Valence bond and MO treatment for XeF_2), Shapes of noble gas compounds (VSEPR theory).

8. Inorganic Polymers

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.

9. Coordination Chemistry

Werner's theory, EAN rule, piano-stool compounds, valence bond theory (inner and outer orbital complexes), Crystal field theory, d-orbital splitting, weak and strong fields, pairing energies, factors affecting the magnitude of (Δ). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar complexes, d orbital splitting in trigonal bipyramidal, square pyramidal and cubic ligand field environments, CFSE, Variation of lattice energies, enthalpies of hydration and crystal radii variations in halides of first and second row transition metal series, Qualitative aspect of Ligand field theory, MO diagrams of representative coronation complexes, IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with the coordination number 4 and 6, Chelate effect,

10. Transition Elements

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, and ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & Bsworth diagrams). Difference between the first, second and third transition series. Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy)

11. Lanthanoids and Actinides

Electronic configuration, oxidation states, color, spectra and magnetic behavior, lanthanide contraction, separation of lanthanides (ion-exchange method only).

12. Bioinorganic Chemistry

Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), toxicity, chelating agents in medicine. Iron and its application in biosystems, Haemoglobin; Storage and transfer of iron.

13. Organometallic Compounds

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. pi-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

Organic Chemistry

1. Basics of Organic Chemistry

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and relative stabilities of reaction intermediates (Carbocations, Carbanions, Free radicals and Carbenes). Organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

2. Stereochemistry

Concept of asymmetry, Fischer Projection, Newmann and Sawhorse projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules. Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixtures, Relative and absolute configuration: D/L and R/S designations.

3. Chemistry of Aliphatic Hydrocarbons

Carbon-Carbon sigma bonds

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz- Fittig Reactions, Free radical substitutions: Halogenation - relative reactivity and selectivity.

Carbon-Carbon pi-bonds.

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration demercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1, 2- and 1, 4- addition reactions in conjugated dienes and, DielsAlder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene. Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions.

4. Cycloalkanes and Conformational Analysis

Cycloalkanes and stability, Baeyer strain theory, Conformation analysis, Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms.

5. Aromatic Hydrocarbons

Aromaticity: Huckel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of substituent groups.

6. Chemistry of Halogenated Hydrocarbons

Alkyl halides: Methods of preparation, nucleophilic substitution reactions – SN1, SN2 and SNi mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination.
Aryl halides: Preparation, including preparation from diazonium salts. nucleophilic aromatic substitution; SNAr, Benzyne mechanism. Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions. Organometallic compounds of Mg and Li and their use in synthesis.

7. Alcohols, Phenols, Ethers and Epoxides

Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement.
Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism.

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH4

8. Carbonyl Compounds

Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, WolffKishner, LiAlH4, NaBH4, MPV, PDC and PGC); Addition reactions of unsaturated carbonyl compounds: Michael addition.

Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

9. Carboxylic Acids and their Derivatives

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids; Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen

condensation, Dieckmann and Reformatsky reactions, Hofmann bromamide degradation and Curtius rearrangement.

10. Sulphur containing compounds

Preparation and reactions of thiols, thioethers and sulphonic acids

11. Nitrogen Containing Functional Groups

Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Diazonium salts: Preparation and synthetic applications.

12. Polynuclear Hydrocarbons

Reactions of naphthalene phenanthrene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons.

13. Heterocyclic Compounds

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction Derivatives of furan: Furfural and furoic acid.

14. Alkaloids

Natural occurrence, General structural features, Isolation and their physiological action Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine

15. Terpenes

Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral, Neral and α-terpineol.

16. Organic Spectroscopy

Basic Principles of UV Spectroscopy:

Application of Woodward-Fiser rule in interpretation of Organic compounds: Application of visible, ultraviolet and infrared spectroscopy in organic molecules. Electromagnetic radiation, electronic transitions, λmax & εmax, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating λmax of conjugated dienes and α,β – unsaturated compounds.

Basic principles of IR Spectroscopy:

Identification of Functional groups of various classes of organic compounds: Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).

NMR (1 H and 13C NMR):

Application of Chemical Shifts, Splitting of signals, Spin coupling and Over Houser effect in interpretation of NMR spectra, Isotopic exchange

Basic principles Mass Spectrometry:

Application of fragmentation rule in characterization of organic compounds. Problems on structure elucidation of organic compounds based on spectral data

Syllabus
for
Computer Science and Information Technology (SCQP09)

> *Note:*
>   i.   *There will be one Question Paper which will have 100 questions.*
>   ii. *All questions will be complulsory.*
>   iii. *The Question Paper will have two Parts i.e. Part A and Part B:*
>   iv. *Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.*
>   v.   *Part B will have 75 questions based on Subject-Specific Knowledge.*

Computer Science and Information Technology (SCQP09)

Thinking and Decision Making: Creative thinking, unfamiliar relationships, verbalreasoning, finding patterns trends and Assessment of figures & diagrams.

- Geometrical designs &Identification
- Selection of related letters / words / numbers /figures
- Identification of odd thing / item out from a group
- Completion of numerical series based on the pattern /logic
- Fill in the blanks of the series based on the numerical pattern and logic of theseries
- Syllogisms (logic-based questions), Identification of logic & selection of correctanswers based on the logic

Mathematics:

- Set Theory: Concept of sets – Union, Intersection, Cardinality, Elementary counting; permutations and combinations. • Probability and Statistics: Basic concepts of probability theory, Averages, Dependent and independent events, frequency distributions, measures of central tendencies and dispersions.
- Algebra: Fundamental operations in algebra, expansions, factorization, simultaneous linear /quadratic equations, indices, logarithms, arithmetic,geometric and harmonic progressions, determinants and matrices.
- Coordinate Geometry: Rectangular Cartesian coordinates, distance formulae, equation of a line, and intersection of lines, pair of straight lines, equations of a circle, parabola, ellipse and hyperbola.
- Calculus: Limit of functions, continuous function, differentiation of function, tangents and normal, simple examples of maxima and minima. Integration of functions by parts, by substitution and by partial fraction, definite integrals, applications of definite integrals to areas.
- Vectors: Position vector, addition and subtraction of vectors, scalar and vector products and their applications to simple geometrical problems and mechanics.
- Trigonometry: Simple identities, trigonometric equations, properties of triangles,solution of triangles, heights and distances, general solutions of trigonometric equations.

Computer Awareness:

- Computer Basics: Organization of a computer, Central Processing Unit (CPU), structure of instructions in CPU, input/output devices, computer memory, and back-up devices.
- Data Representation: Representation of characters, integers and fractions, binary and hexadecimal representations, binary arithmetic: addition, subtraction, multiplication, division, simple arithmetic and two's complement arithmetic, floating point representation of numbers, Boolean algebra, truth tables, Venn diagrams.

Syllabus
for
Criminology (SCQP10)

Note:

i.   *There will be one Question Paper which will have 100 questions.*

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iii. *The Question Paper will have two Parts i.e. Part A and Part B:*

iv.   *Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.*

v.   *Part B will have 75 questions based on Subject-Specific Knowledge.*

<u>Criminology (SCQP10)</u>

GENERAL AWARENESS ABOUT CRIME, LAW AND SOCIAL ISSUES.

Basic Understanding of Indian Constitution:

Fundamental Rights – DPSP

High Profile or Sensational Criminal Cases in Past and Present Scenario:

Murder, Rape, Child Abuse, Human Trafficking, Corruption, Scams, Cyber Crime, Terrorism, etc.

Structure and Functions of Indian Criminal Justice System:

Police/Law Enforcement, Judiciary and Prisons/Correctional System.

Basic Knowledge about Indian Laws:

IPC, Cr PC and Special and Local Laws - For Examples (but not limited to), Offence against Human Body, Offence against Property, Offences against Women and Children, Offences against State, etc. FIR, Arrest and Bail Procedures in Cr PC; Basic Awareness of Juvenile Justice Act, POCSO Act, Protection of Women from Domestic Violence Act 2005, Sexual Harassment of Women at Workplace Act, 2013, etc.

Basic Understanding of Forensic Science in Criminal Investigation.

Social Issues:

Violence against Women and Children – Child Labour, Child Marriage, Dowry, Domestic Violence, Sexual Violence, Acid Attack, Caste and Communal Conflicts; Juvenile Delinquency and Youth Violence, Drug Addiction, Human Rights Violations.

Syllabus
for
Environmental Sciences/Studies
(SCQP11)

Note:

  i.   *There will be one Question Paper which will have 100 questions.*

  ii.   *All questions will be complulsory.*

  iii. *The Question Paper will have two Parts i.e. Part A and Part B:*

  iv.   *Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.*

  v.   *Part B will have 75 questions based on Subject-Specific Knowledge.*

Environmental Sciences/Studies (SCQP11)

Earth Sciences: Structure and composition of Environment- Atmosphere, Hydrosphere and Lithosphere, Earth Processes, Mineral and Power Resources in India, Biogeochemical Cycles, Meteorology, Climate Change, Origin and evolution of earth, Mineral and Power Resources in India.

Physical and Chemical Sciences: Fundamentals, Atmospheric Chemistry, Water Chemistry, Geochemistry, Green Chemistry. Water - physical characteristics, buffering capacity, Essential and trace elements in living systems, Bio-molecules - chemical components of cells, Bio- geochemical cycles – carbon, nitrogen and phosphorus, Hydrological cycle and global water balance, Toxicity of Heavy metals.

Life Sciences:

Origin of life: Theories of evolution, genetic drift, speciation, cell organelles, cell division, modes of reproduction, principles of inheritance, epistasis, mutations, chromosomal aberrations,extra- chromosomal inheritance.
Genetic Material: DNA structure and replication, transcription and translation, chromosome structure, protein structure, mutability and repair of DNA, reverse genetics.

Photosynthesis, Plant growth hormones, Dormancy and seed germination, Respiration
Plant and Animal systematics: Bryophytes, Tracheophytes, Gymnosperms, Angiosperms. Membrane structure and Ion transport, ATPase - structure and function, Photosynthesis, Photoperiodism, Vernalization, RUBISCO.
Animal systematics, physiology and diseases: Cnidaria, Echinodermata, Chordata, Protostomia; Anatomy and physiology of humans; major classes of bacterial and viral pathogens, Apoptosisand cancer, inherited diseases, animal cell culture.

Ecology and Environment: Biosphere, Organizational levels of biosphere, Ecosystem: Structure and Types, Food Chain and Energy Flow, Population and Community Ecology, Biodiversity andits Conservation.

Microbiology and Biotechnology: Principles of Microbiology, Microbiology of Air, Water, Soil, Sewage, Recombinant DNA technology, principles of gene cloning, transposition, applications of biotechnology in medicine, industry, agriculture and environment.

Natural resources and Management: Natural Resources-Forest, Water, Minerals, Marine, Energy (Renewable and Nonrenewable) - Sources, Threats, Conservation and Management,

Global Environmental issues: ozone depletion and global warming, Acid rain and Smog, Sustainable Development.

Environmental Science(SCQP11)

Environmental Pollution: Air, Water, Soil, Noise Pollution- Sources, Causes, Effects, Consequences.

Waste Management: Solid waste - disposal, Management; Waste to energy conversion. **Instrumentation:** Principles and applications of microscopy, spectrophotometry, centrifugation, radioisotope techniques, electrophoresis and chromatographic separation techniques, Blottingand hybridization techniques.

Syllabus
for
Food Science and Technology
(SCQP12)

Note:

  i.   *There will be one Question Paper which will have 100 questions.*

  ii.   *All questions will be complulsory.*

  iii. *The Question Paper will have two Parts i.e. Part A and Part B:*

  iv.   *Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.*

  v.   *Part B will have 75 questions based on Subject-Specific Knowledge.*

Food Science and Technology (SCQP12)

Introduction to Food Science and Technology:
Definition, scope and current trends in food science and technology.Food Groups, Nutrients and Balanced Diet.
Definition and meaning of food, nutrition, nutrient, health, concept and characteristics of abalanced diet.
Introduction to basic food groups and nutrients, food pyramid, macro and micronutrients. Effect of processing on nutrients. Browning reactions in foods. Classification (enzymatic, non-enzymatic and metallic browning), causes and prevention of browning

Cereals and Pulses
Composition and nutritive value, types of cereals, processing of cereals and pulses (gelatinizationof starch and the factors affecting it, germination and fermentation), toxic constituents in pulses,milling of pulses.

Fruits and vegetables
Classification of fruits and vegetables, composition and nutritive value; effect of processing onpigments.

Chocolate and cocoa products
Cocoa bean processing, preparation of chocolate liquor, cocoa butter and chocolate.

THEORY

Milk and milk products
Composition and nutritive value
Introduction to liquid milk technology (clarification, pasteurization, homogenization, fortification, sterilization), Types of milk, Effect of processing on milk, Introduction to milk products.

Eggs
Composition and nutritive value. Structure of an egg. Egg quality and deterioration. Green ring formation in boiled egg, preservation of eggs. Egg foams – stages of preparation and factors affecting them. Effect of heat on egg proteins; functions of eggs in cookery.

Meat, Fish and Poultry
Composition and nutritive value. Selection/purchasing criteria for meat, fish and poultry. Tenderization of meat.

Sugar
Composition and nutritive value. Properties of sugars. Manufacturing/refining of sucrose. Sugarcookery – crystalline and non- crystalline candies, sugar-based products.

Fats and oils
Composition and nutritive value**.** Types of fats/oils and their functions**.** Rancidity in fat and its prevention**.** Changes in fat during heating**.** Care of fat used for frying, emulsions.

Introduction to food hygiene and food adulteration
Food hygiene, factors affecting food safety, personal hygiene.Adulteration, adulterants and their effects on health.

Food Science and Technology (SCQP12)

BASIC BAKING TECHNOLOGY
Baking Industry and its scope in the Indian economy. History of Bakery - present trends, prospectsNutrition facts of bakery products.

Wheat Grain Technology
Wheat grain– its structure. Milling of wheat; types of refined wheat flour; composition of refinedwheat flour (gluten, amylose/ amylopectin, enzyme activity, moisture) and its storage.

Cake Technology
Preparation of cakes - types of cakes; ingredients used; methods of batter preparation; steps in cake making; balancing of cake formula; evaluation of the baked cake; operational faults in cakeprocessing and the remedial measures. Labeling and Packaging. Costing
Cake decoration- different methods of cake decoration

Pastry Technology
Preparation of pastry - types of pastries (short crust, puff/flaky and choux pastry); ingredients;processing and evaluation. faults and remedies

INTRODUCTION TO FOOD SAFETY AND PRESERVATION

Purpose and Scope of Preservation. Objectives of preservation and processing. Scope of preservation industry in India. Post-harvest Changes and Spoilage. Physical, chemical and microbiological changes in fruits and vegetables. Factors affecting growth of microorganisms andthe control measures

Food Safety
Key terms, factors affecting food safety, recent concerns.
Food laws, standards and regulations. Food additives and contaminants. Hygiene and sanitation

Principles and Methods of Preservation
Asepsis. Use of low temperature, Use of high temperature. Removal of moisture. Removal of air,Use of chemical preservatives. Fermentation. Irradiation. Gas preservation. Newer methods

Fruit and Vegetable Processing
Sauces and Beverages. Chutney and sauces- definition, method of preservation, steps in preparation of chutney and sauces. Fruit beverages- definition and classification, method of preservation (with special emphasis on pasteurization, use of chemical preservatives, sugar), roleof various ingredients.

ADVANCED BAKING TECHNOLOGY
Bread Technology. Preparation of bread - ingredients used; methods of dough preparation; stepsin bread processing; evaluation of the baked bread; staling of bread; diseases of bread.

Biscuit and Cookies Technology
Preparation of biscuits and cookies – types; ingredients; processing and evaluation. Crackers

Food Packaging
Packaging – it's importance, essential features of an ideal package; various food packaging materials and their characteristics recent trends in the field of packaging (active packaging, intelligent packaging, RFID) label regulations and designing for packaged foods , nutritional labelling.

Marketing and Cost Control
Marketing - definition, scope, understanding the 4Ps – (Product, Price, Place, Promotion), marketing techniques, marketing and distribution of processed products. Cost control – food cost,labor cost and other costs; costing of processed products.

ADVANCED FRUIT AND VEGETABLE PRESERVATION TECHNOLOGY

Dehydration and Concentration –
Definition and objectives, method of preservation, normal dryingcurve, water activity, factors affecting rate of drying, sun drying, types of dehydrators (air convection, drum, freeze and vacuum driers) steps in dehydration of fruits and vegetable**.**
Concentration- definition and objectives, techniques

Refrigeration and Freezing
Definition and objectives, difference between freezing and refrigeration, systems of refrigeration, method of preservation, steps in freezing fruits and vegetables, cryogenic freezing of fruits and vegetables, evaluation.

Canning
Definition and objectives, selection of fruits and vegetables, method of preservation, steps ofcanning fruits and vegetables (with special emphasis on blanching, exhausting and heat processing), spoilage of canned foods

Introduction to New Food Product Development
Need and importance for developing a new product, types of new products, challenges, failure of new product. Fruit and Vegetable Processing –Pectin Products Preserves and Pickles. Jam, Jelly andMarmalade- definition, role of pectin and theory of gel formation, method of preservation, steps of preparation, evaluation. Preserves- definition, method of preservation, steps of preparation, evaluation, candied, crystallized and glazed fruits. Pickles- definition, classification, method of preservation, steps of preparation of vinegar pickles, evaluation.

FOOD SAFETY, HYGIENE AND QUALITY TESTING

Food Laws and Regulations. Introduction to food acts laws and standards. National food safety andstandard act. International standards, regulatory agencies. Consumer protection act

Food Quality Management
Characteristics of quality. Quality Control, Quality Assurance. Total Quality Management. Quality Management System. Good Manufacturing Practices. Hazard Analysis Critical Control Point System

Introduction to Food Safety and Hygiene
Food hygiene. Factors affecting food safety. Food spoilage. Food handling. Special requirementsfor high-risk foods, Safe food cooking temperature and storage techniques.

Hygiene and Sanitation in Food Service Institutions
Cleaning and disinfection. Personal hygiene. Pest control. Waste disposal

Sensory Methods of Food Quality Testing
Sensation of taste, smell, appearance and flavor, sensory evaluation techniques

Objective Methods of Food Quality Testing
Physical test methods (moisture, acidity, water activity, texture, viscosity, color) Simple methods of chemical analysis (protein, fat, water, ash). Microbiological sampling and testing.

Syllabus
for
Forensic Science (SCQP13)

Note:

i. *There will be one Question Paper which will have 100 questions.*

ii. *All questions will be complulsory.*

iii. *The Question Paper will have two Parts i.e. Part A and Part B:*

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v. *Part B will have 75 questions based on Subject-Specific Knowledge.*

Forensic Science (SCQP13)

INTRODUCTION TO FORENSIC SCIENCE
Definition, History, Development and Scope of Forensic Science in India. Basic Principles of Forensic Science and its Significance, Organization and Functioning of State and Central Forensic Science Laboratories, Ethics in Forensic Science.

PHYSICAL EVIDENCES
Definition, Types, Class and Individual Characteristics, Different Searching Methods for Locating Physical Evidences at Scene of Crime, Chain of Custody.

FUNDAMENTAL OF POLICE-
Historical Development of Police System in India. Police in Indian Constitution. Objective of Police, General organization of Police at State & Range Level. Police Organization under Central Government: General Information, Structure and Function of
A. [1] BSF (2) Assam Rifles [3] CRPF [4] CISF [5] ITBP [6] NSG
[1] BPR & D [2] CBI [3] lB [4] RAW [5] NCRB [6] NICFS [7] NPA [8] UT PoliceForce.

POLICE SCIENCE-
Definition & Scope. Who is an Investigator, Investigator & his Qualities, General Guidelines for Investigator, Interview of Witness and Interrogation of suspect.

SCENE OF CRIME-
Meaning, Types , Protection of Scene of Crime, Crime Scene Documentation- Note Taking, Videography, Photography and, Sketching Methods, Importance of Photography, General Guidelines, Admissibility in Court, Various forms such as Videography.

CRIME SCENE MANAGEMENT AND RECONSTRUCTION-
Elements of Crime Scene Management: - Information Management, Technology Management, Man-Power Management & Logistic Management. Introduction to Crime Scene Reconstruction, Nature of Reconstruction, Basic Principles for Physical Evidence and Reconstruction (Recognition, Identification, Individualization And Reconstruction), Stages in Reconstruction, Types of Reconstruction, Pattern Evidence in Reconstruction (Bloodstain Pattern Analysis forReconstruction, Glass Fracture Patterns, Fire Burn Patterns, Tire and Skid Mark Patterns), Writing A Reconstruction Report. IPC (1860), Cr. P.C (1973) and IEA (1872)

INDIAN PENAL CODE (1860)-
Pertaining to Offences against Persons — Sections l20A, 299, 300, 302,304A, 304B, 307,309, 319, 320, 324, 326, 351, 354, 359, 362. Sections 375 & 377 and their Amendments.
Pertaining to Offences against Property Sections — 378, 383, 390, 391, 405,415, 420,441, 463, 4- 7, 498A, 499, 503, 511. Cr.P.C. (1973) Sections- 26, 27, 29, 31, 144, 154-158, 176, 291,

292, 293. IEA (1872) - Evidence and Rules of Relevancy in Brief, Expert Witness, Cross Examination and Re-Examination of Witnesses. Sections - 32, 45, 46, 135, 136, 137, 138

FINGER PRINTS, DOCUMENTS AND OTHER IMPRESSIONS-

Fingerprints: History, Types of Fingerprints, Type of Finger Print Patterns, Different Classifications, Systems Location and Preservation of Fingerprints, Development of Latent Prints by Physical and Chemical Methods, Matching of Fingerprints.

Documents: Definition of Questioned Documents, Types of Documents, Types of Writing Instruments their Characteristics and Examination, Paper and its Examination, Basic Tools needed for Forensic Document Examination- Ultraviolet, Visible, Infrared, and Fluorescence Spectroscopy, Photomicrography, Microphotography, Visible Spectral Comparator, Electrostatic Detection Apparatus.

Hand Writing: Hand Writing and its Characteristics, Factors Affecting Hand Writing, Samples for Comparison, Comparison of Hand Writings, Disguised and Indented Writings and their Detection, Typed and Computer Generated Documents, their Comparison, Alteration in Documents and their Detection, Foot & Shoe Prints, Methods of their Preservation and Examination, Tyre Marks and Track Marks and their Examination.

FORENSIC BIOLOGY AND SEROLOGY-

Brief Description and Function of Human Digestive System, Respiratory System, Circulatory System, Nervous System, Reproductive System.
Structure, Composition and Examination of biological fluids like - Blood and Bloodstains, Seminal stains, Saliva, Urine, Pus, Feces etc.

Hair and Fiber: Hair Anatomy, Collection, Examination of Hairs from Animal and Human Origin. Types of Fiber and their Properties, Examination etc.

Forensic Botany: Introduction, Nature & Scope, Woods & their Identification and Matching, Diatoms and their Forensic Significance in Drowning Cases, Study and Identification of Pollen Grains.

D N A: Structure of DNA, Polymorphism in DNA, General idea about RFLP and PCR Methods of Biological Fluid Analysis, Merits and Demerits of RFLP and PCR, Advanced Methods for Forensic DNA Examination etc.

CHEMICAL SEPARATION AND INSTRUMENTAL TECHNIQU

General Understanding Of: Distillations, Sublimation, Crystallization, Solvent Extraction.

Chromatographic Techniques: Definition, Different Classification like- According to Mode, Principle, Stationary Phase, etc., brief idea about Column Chromatography, Paper Chromatography, Thin Layer Chromatography, Gas Liquid Chromatography, LiquidChromatography, Hyphenated Chromatographic techniques as LC-MS, GG-MS etc.

Electromagnetic Spectrum & Spectroscopic Methods — Principle, Apparatus, Procedure & Importance: Emission Spectroscopy, Atomic Absorption Spectroscopy, UV Spectroscopy, Electron Spectroscopy, Raman Spectroscopy, IR & FTIR Spectroscopy.

General Idea About: Neutron Activation Analysis, Mass Spectrometry

Electrophoresis- Principle, Types, Equipment and Processing, Immune electrophoresis, Analysis of Proteins by electrophoresis and their detection.

FORENSIC MEDICINE:

Meaning And Scope, Identification of a Person: Through all Factors in Fixing Identity, Post-Mortem Examination (Autopsy) (Types of Autopsy, Objectives, and Procedures), Meaning & Modes of Death, and their Characteristics, Signs of Death and Post-Mortem Changes. Wounds and their Characteristics, Injuries due to Heat, Lighting, Electricity and Radiation, Firearm Injuries, Differentiation between Ante-Mortem and Post-Mortem Wounds.

FORENSIC TOXICOLOGY AND DRUG ANALYSIS —

Poison and Types of Poisoning, Action of Poison, Factors Modifying the Action of Poison, Extraction, Isolation and Clean-Up Procedures- For Non-Volatile Organic Poison, Volatile Poisons, Toxic Cations or Metallic Poisons, Toxic Anions From Viscera, Drugs, Botanical Evidence, Biological Evidence etc.

General idea and Examination of Opium, Semi — Synthetic Opiates, Cannabis products Such as Bhang, Ganja And Charas, LSD And Amphetamine, Important Benzodiazepines, Phenothiazines, Barbiturates Etc. Animal Poisons Like Snake, Cantharides, Bees, Wasp etc.

GENERAL CHEMISTRY:

Photochemistry: Interaction of Radiation with Matter, Difference between Thermal and Photochemical Processes, Laws of Photochemistry, Grothus-Drapper Law, Stark-Einstein Law. Jabolonski Diagram, Description of Fluorescence, Phosphoresence, Non-radiative Processes, Quantum Yield, Photosensitized Reactions, Energy Transfer Processes etc.

Organic Chemistry- Structure and Bonding: Hybridization, Bond Length and Bond Angles, Bond Energy, Localized and Delocalized Chemical Bond. Structure and Characteristics of Alkane, Alkene, and Cycloalkane, Alcohol, Phenol, Ethers, Aldehyde, Ketone, Carboxylic Acid etc.

Inorganic Chemistry- Trends in Periodic Table and Applications in Predicting and Explaining the Physical and Chemical Behaviors. Definitions of Acid and Base, Classification of Acids andBases, Essential and Trace Elements in Biological Process, Metallo Porphyrins with Special Reference to Haemoglobin, Types of Magnetic Behaviors, Method of Determining Magnetic Susceptibility, Spin only Formula, L-S Coupling.

BASIC PHYSICS

Physical Properties: Temperature, Weight and Mass, Density, Refractive Index, Diffraction,Polarization.

Laws of Motion- Motion in a Uniform Field, Centripetal Acceleration, Motion under a Central Force.

Basic Optics: Light as an Electromagnetic wave, Interference of Light, Principle of Superposition, Two-Slit Interference, Michelson Interferometer and its Application.

Microscopy: Numerical Aperture and Resolving Power of Microscopic Systems, How the Microscope Forms Images; Simple, Compound, Stereoscopic, Polarizing, Comparison, Fluorescence and Electron Microscopes.

Syllabus
for
Geology, Earth Sciences (SCQP14)

Geology, Earth Sciences (SCQP14)

UNIT-I

Physical Geology:
Introduction to Geology and its scope, Earth and solar system: origin, size, shape, mass, density and its atmosphere. A brief account of various theories regarding the origin and age of the Earth. Brief idea of interior of earth and its composition. Weathering and erosion: factors, types and their effects. Earthquakes: nature of seismic waves, their intensity and magnitude scale; Origin of earthquake. Volcanoes: types, products and causes of volcanism.

Geomorphology:
Basic principles of Geomorphology, geomorphological cycles, weathering and erosion; geomorphic mapping- tools and techniques. Epigene/ exogenic processes: degradation and aggradation. Hypogene/endogenic processes; Diastrophism and volcanism, Extraterrestrial processes; Geological work of wind, glacier, river, underground water and ocean.

Geodynamics:
Earth as a dynamic system. Elementary idea of continental drift, sea-floor spreading and mid-oceanic ridges. Paleomagnetism and its application. Plate Tectonics: the concept, plate margins, orogeny, deep sea trenches, island arcs and volcanic arcs.

Environmental Geology:
Earth and its spheres: atmosphere, hydrosphere, lithosphere, biosphere and Man; Earth Material. Energy budget: Solar radiation. Global environments: coastal, riverine, desertic, tropical, cold, polar. Concept of global warming and climate change. Geological hazards: Earthquakes, volcanism, landslides, avalanches, floods, droughts; Hazard mitigation.
Resource Management: Energy resources (Conventional and non-conventional), watershed management, land use planning, management of water resources, land reclamation.

Structural Geology:
Introduction to Structural Geology; contours, topographic and geological maps; Elementary idea of bed, dip and strike; Outcrop, effects of various structures on outcrop. Clinometer/Brunton compass and its use. Elementary idea of types of deformation; Folds: nomenclature and types of folds. Faults: nomenclature, geometrical and genetic classifications, normal, thrust and slip faults. Definition, kinds and significance of joints and unconformity.

Hydrology:
Definition of hydrogeology, Hydrological cycle. Hydrological parameters - Precipitation, evaporation, transpiration and infiltration. Origin of groundwater; Vertical distribution of groundwater. Types of aquifers;

Water bearing properties of rocks - Porosity and Permeability; specific yield, specific retention. Surface and subsurface geophysical and geological methods of ground water exploration. Groundwater provinces of India.

Physical Geography

Definition and Scope, Components of Earth System. Atmosphere – Heat Balance, Global Circulation Pattern, Tropical Cyclones, Monsoon, Climatic Classification (Koppen).Lithosphere – Internal Structure of Earth based on Seismic Evidence, Plate Tectonics andits Associated Features. Fluvial Cycle of Erosion – Davis and Penck. Hydrosphere – Hydrological Cycle, Ocean Bottom Relief Features, Tides and Currents.

Fundamentals of Remote sensing & GIS:

Remote sensing systems; remote sensing sensors; signatures of rocks, minerals and soils. Application of remote sensing in geoscience and geomorphological studies. Types of Indian and Foreign Remote Sensing Satellites, Digital image processing; fundamental stepsin image processing; elements of pattern recognition and image classification.

Introduction to Geographic Information System (GIS); components of GIS; productgeneration in GIS; tools for map analysis; integration of GIS with remote sensing.

UNIT-II

Crystallography:

Crystals and their characters, form, face, edge, solid angle; Interfacial angle and their measurements; Crystallographic axes and angles. Crystal parameters, Weiss and Miller system of notations. Symmetry elements and description of normal class of Isometric, Tetragonal, Hexagonal, Trigonal, Orthorhombic, Monoclinic and Triclinic systems.

Mineralogy:

Introduction to Mineralogy, Definition and characters of mineral. Physical properties of minerals. Chemical composition and diagnostic physical properties of minerals such as: Quartz, Orthoclase, Microcline, Hypersthene, Hornblende, Garnet, Muscovite, Biotite, Chlorite, Olivine, Epidote, Calcite. Polarizing microscope, its parts and functioning; Ordinary and polarized lights; Common optical properties observed under ordinary, polarized lights and crossed nicols. Optical properties of some common rock forming minerals (Quartz, Orthoclase, Microcline, Olivine, Augite, Hornblende, Muscovite, Biotite,Garnet, Calcite).

Geochemistry:

Introduction to geochemistry: basic knowledge about crystal chemistry. Types of chemical bonds, coordination number; Colloids in geological systems, ion exchanges and geological evidence for earlier colloids. Elementary idea of Periodic Table. : Cosmic abundance of elements; Composition of the planets and meteorites; geochemical evolution of the earth and geochemical cycles. Gold Schmidt's geochemical classification of elements; Distribution of major, minor and trace elements in igneous, metamorphic and sedimentary rocks. Elements of geochemical thermodynamics; Isomorphism and polymorphism.

Petrology:

Igneous Petrology: Magma: definition, composition, types and origin; Forms of igneousrocks; textures of igneous rocks. Reaction principle; Differentiation and Assimilation;Crystallization of unit-component and bi-component (mix-crystals) systems; Bowen's reaction series. Mineralogical and chemical classification of igneous rocks. Detailed petrographic description of Granite, Granodiorite, Rhyolite, Syenite, Phonolite, Diorite, Gabbro. Processes of formation of sedimentary rocks; Classification, textures and structures of sedimentary rocks. Petrographic details of important siliciclastic and carbonate rocks such as - conglomerate, breccia, sandstone, greywacke, shale, lime stones. Process and products of metamorphism; Type of metamorphism. Factors, zonesand grades of metamorphism. Textures and structures of metamorphic rocks. Classification of metamorphic rocks. Petrographic details of some important metamorphicrocks such as - slate, schists, gneiss, quartzite, marble.

Economic Geology:

Concept of ore and ore deposits, ore minerals and gangue minerals; Tenor of ores;Metallic and non-metallic ore minerals; Strategic, Critical and essential minerals.

Processes of formation of ore deposits; Magmatic, contact metasomatic, hydrothermal,sedimentation. Study of important metallic (Cu, Pb, Zn Mn, Fe, Au, Al) and non-metallic(industrial) minerals (gypsum, magnesite, mica). Distribution of coal and petroleum in India.

Mineral exploration:

Elementary idea of geological, geochemical and geophysical prospecting. Elementary ideaof mining and environmental considerations for mining.

Stratigraphy:

Definition, Principle of stratigraphy; Geological Time Scale and stratigraphic classification;Physiographic division of India. Study of following Precambrian succession: Dharwar, Cuddapha, Vindhyan and Delhi Supergroups; Brief idea of Palaeozoic succession of northwestern Himalaya; Triassic of Spiti; Mesozoic type secession of Kutch and Rajasthan;Cretaceous of Tiruchirapalli. Study of following type localities: Gondwana and Deccan Trap. Paleogene- Neogene sequences of northwest Himalaya and Assam.

Paleontology:

Definition, Fossils: definition, characters, binomial nomenclature in taxonomy, mode of preservation, condition of fossilization and significance of fossils. Morphology and geological distribution of brachiopods, pelecypods, cephalopods. Morphology and geological distribution of trilobite, echinoidea. Evolutionary history of horse. Morphology,distribution and significance of Gondwana flora.

Syllabus
for
Geophysics (SCQP15)

> *Note:*
>   i. *There will be one Question Paper which will have 100 questions.*
>   ii. *All questions will be complulsory.*
>   iii. *The Question Paper will have two Parts i.e. Part A and Part B:*
>   iv. *Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.*
>   v. *Part B will have 75 questions based on Subject-Specific Knowledge.*

Geophysics (SCQP15)

PHYSICS:

- **Mechanics and wave Motion: -**
  Gallilean invariance, Inertial, noninertial and accelerated frame. Principle ofequivalence, Various forces and energy considerations in motions of plants and satellites, conservation of linear momentum, variable mass, Moment of Inertia, Kineticenergy, Radius of gyration, Conservation of Angular momentum, Beats, Lissajous figures LCR circuits, Resonance, Fourier series.

- **Electromagnetic Theory and Electronics: -**

  Maxwell's equations, Displacement current, travelling waves, E M Fields in coaxial cable, Poynting vector, Progagation of e.m. waves. Semiconductors, P-n junction, transistor, Rectifiers, Filters, Common Emitter voltage amplifier.

- **Optics**: -

  Newton's rings, Michelson's interfer ammeter, coherence, Lasser, Fresnel and Franhoffer diffraction, and diffraction patterns, Polarisation, Brewster's Law, Optic axis, Nicol Prism, Huygen's theory of double diffraction.

- **Thermodynamics and statistical Mechanics: -**

  Entropy, Reversible and irreversible process, S.T. diagram, Enthalphy, Helmholtz andGibb's functions, Maxwell's and T-ds equations, Energy and Heat capacity equations, Clausiusclapeyron equations, specific heat, Thermodynamics,
  Black body radiations, Laws of radiation, Temperature of the Sun, Planek's radiation formula, Photo-electric effect, Crompton effect, Raman Effect, Duality, Michelson- Morley experiment.

MATHEMATICS:

Algebra:

- Partial fractions, inequalities, Theory of equations, algebra of matrices, properties of determinatesand its application to solve linear simultaneous equations,

Geophysics (SCQP15)

Trigonometry:

- De Moivre's theorem, logarithms of complex quantics and expansion of functions.

Calculus:

- Successive differentiation, asymptotes, curve tracing, curvature, maxima and minima, partial differentiations in determinate forms, mean value theorems, integration and reduction formulae and evaluation of area. Volume, surface and lengths.

Geometry:

- Hyperbola in rectangular coordinates, polar equation of a conic, general equation of second degree, confocal and system of conics, straight lines, plane, sphere, cone , cylinder and central conecoids in three dimensions.

Vectors:

- Divergence, grade and curl of vectors, Gauss, Stokes and Green's theorems with their applications,

Differential equations:

- Linear differential equations with constant coefficients, orthogonal trajectory, simple non linear differential equations, Integral equations and solution of linear differential equations using Laplace transform.

Mechanics:

- Forces in two dimensions, Virtual work, catenary, Center of gravity, friction, S H M, Projectiles, constrained motion, moments and product of inertia, equation of motion of a rigid body, D Alembert's principle, compound pendulum, conservation of energy and momentum, centre of pressure and laws of floatation.

Syllabus
for
Horticulture, Forestry, Seed Science, Rural Technology, Agronomy, Plant Breeding, Genetics (SCQP16)

Horticulture, Forestry, Seed Science, Rural Technology, Agronomy,Plant Breeding, Genetics (SCQP16)

Basic Biology: Spontaneous generation theory, prokaryotes vs eukaryotes, functional anatomy, structure and organization of bacteria, fungi and algae – economic importance, methods of sterilization, rhizosphere microorganisms and importance, plant-microbe interactions in soil, microbial transformation of nutrients in soil. Carbohydrates, lipids, proteins and amino acids – occurrence and classification, carbohydrate and lipid metabolism, glycolysis, TCA cycle, pentose phosphate pathway, ETC and oxidative phosphorylation, secondary metabolites – occurrence, classification, functions and applications.

Ecology: Physical environment; biotic environment; biotic and abiotic interactions. Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Characteristics of a population; population growth curves; population regulation; life history strategies; concept of metapopulation – demes and dispersal, intergenic extinctions, age structured populations. Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Types; mechanisms; changes involved in succession; concept of climax. Structure and function; energy flow and mineral cycling; primary production and decomposition; structure and function of some Indian ecosystems: terrestrial and aquatic. Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

Plant Biology: Photosynthesis: Light harvesting complexes; mechanisms of electron transport; photo protective mechanisms; CO_2 fixation-C3, C4 and CAM pathways. Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photo respiratory pathway. Nitrate and ammonium assimilation; amino acid biosynthesis. Plant hormones: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Structure, function and mechanisms of action of phytochromes, cryptochromes and phytotropins; stomatal movement; photoperiodism and biological clocks. Solute transport and photo assimilate translocation: Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photo assimilates. Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles. Responses of plants to biotic and abiotic stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress. Plant tissue culture and applications, molecular marker technology, transgenic technology – GMOs, transgenic plants for biotic and abiotic stress resistance and quality improvement, molecular pharming – production of vaccines, therapeutic proteins, industrial enzymes and bioplastics.

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

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

Horticulture: Scope and importance; global scenario of horticultural crops, classification of horticultural crops – nutritive value of horticultural crops, horticulture zones of India. Systematic botany – terminology, morphology description and classification of root, stem, leaf, inflorescence,

Flower and fruits – flowering mechanism – modes of pollination – asexual/ vegetative reproduction – floral biology – fertilization and fruit set, Principles involved in nomenclature.

Landscaping and Gardening: Importance and scope of gardening, gardens in India – concepts of landscape gardening – styles and types of gardens – Hindu, Mughal, English, Italian, Persian and Japanese gardens, ornamental landscaping in environmental protection.

Food Technology: Food processing industries/institutions/food scientists of importance in India, causes of food spoilage, methods of food preservation, post-harvest and storage of fresh fruits and vegetables, preparations of fruits and vegetables for processing, technology of foods of animal origin.

Syllabus
for
Life Sciences (SCQP17)

<u>Life Sciences (SCQP17)</u>

1. **Techniques:** Principles and applications of chromatography, spectroscopy, microscopy, electrophoresis, centrifugation, blotting, PCR & radioisotope techniques

2. **Chromatin structure and function**: Organization of chromosomes in prokaryotes and eukaryotes, chromatin types, centromere, Telomere and concept of gene

3. **Biochemistry**: Structure and functions of proteins, DNA, carbohydrates, lipids & vitamins. Bioenergetics, Glycolysis, TCA cycle, Electron Transport System and ATP synthesis, oxidation and synthesis of fatty acid, membrane structure and function

4. **Biotechnology:** Recombinant DNA technology, principles of gene cloning, applications of biotechnology in medicine, industry and agriculture, animal & plant cell culture, environmental biotechnology

5. **Microbiology:** Diversity of microbes, bacterial reproduction, antimicrobial agents, significance of microbes in the industry and agriculture, antigen, antibody, complement systems, immunity, vaccines, plant virus, animal virus and environmental microbiology.

6. **Molecular Genetics**: Principles of inheritance, linkage & crossing over, chromosomal aberrations, extrachromosomal inheritance, replication, transcription, translation, DNA repair and population genetics

7. **Plant Sciences**: Bryophytes, Pteridophytes, Gymnosperms, Angiosperms, Vascular system in plants, Economic important of plants, Photosynthesis, Photoperiodism, Vernalization, and Biogeochemical cycle

8. **Animal Sciences**: Characteristics of invertebrates and vertebrates, anatomy and physiology of different system of humans, nerve impulse transmission, endocrinology, human diseases Apoptosis and cancer, inherited diseases, animal cell culture.

Syllabus
for
Material Science (SCQP18)

Material Science (SCQP18)

Material Science (SCQP18)

Crystal structure, Different types of bonding: ionic, covalent, metallic and van der Wall's.Lattice energy - Madelung constants – Born Haber cycle – cohesive energy. Quantum states- binding energy-interatomic spacing - variation in bonding characteristics - Singlecrystals – polycrystalline - Non crystalline solids - Imperfection in solids – Vacancies –Interstitials. Equilibrium thermodynamics, Phase equilibria, Phase transformations,

Crystalline and amorphous solids, primitive and unit cells, Bravais lattices, crystal structure, lattice and basis. Packing factors – cubic, hexagonal, diamond structures Lattice translation operation. Elementary idea of point symmetry operations (inversion center, rotation and reflection symmetry). Primitive translation vectors, lattice planes – Miller indices for designating crystal planes. Inter-planar distances – directions. Reciprocal lattice. Volume of a primitive cell in the reciprocal space. Geometrical interpretation of the Bragg equation in the reciprocal space. Structural characterization Basic principles of X-ray diffraction spectroscopy.

Law of thermodynamics and related applications, Concepts of free energy and entropy,

Mechanical properties - Stress, Strain, Elastic properties Optical properties - refraction, reflection, Absorption, Transmission, Insulators, luminescence - Magnetic properties – para-magnetism - ferromagnetism - domain theory - magnetic hysteresis, – anti-ferromagnetism.

Free electron gas in one and three dimensions. Thermionic emission, work function, electrical conductivity of the free electron gas: Drude Lorentz Model, Sommerfield's quantum theory. The heat-capacity of the conduction electrons (Electron Specific heat) Widemann - Franz law and its validity. Metallic conduction, Energy bands, Brillouin zones, Temperature dependence of metallic conductivity - carrier concentrations in intrinsic, extrinsic semiconductors – Impurity contributions, Doping effects, Law of mass action. Fermi level - variation of conductivity, mobility with temperature

Material Science (SCQP18)

Electrons in periodic potential, Origin of energy bands in solids, classification of solids as metals, insulators and semiconductors on the basis of the band picture, Origin of the energy gap (qualitative discussions). Bloch's theorem in one dimension, nearly free electron approximation - formation of energy bands and gaps - Brillouin zones and boundaries - the Kroni-Penney model. E-K diagram, Reduced zone representation, Brillouin zone, concept of effective mass and holes, Fermi- Dirac distribution function, Density of states for electrons in band. Temperature dependence ofFermi energy.

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classification of nanostructures, nanoscale architecture – Effects of the nanometer length scale - surface to volume ratio – Effect of nanoscale dimensions on various properties – Structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of nanoscale dimensions on biological systems. Structure of nanomaterials - comparison with conventional materials.

Top down and bottom- u p synthesis approach, physical and chemical techniques for nanomaterial synthesis.

Syllabus
for
Mathematics (SCQP19)

Note:

i. *There will be one Question Paper which will have 100 questions.*

ii. *All questions will be complulsory.*

iii. *The Question Paper will have two Parts i.e. Part A and Part B:*

iv. *Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.*

v. *Part B will have 75 questions based on Subject-Specific Knowledge.*

Mathematics (SCQP19)

Algebra: Groups, subgroups, Abelian groups, non-abelian groups, cyclic groups, permutation groups; Normal subgroups, Lagrange's Theorem for finite groups, group homomorphism and quotient groups, Rings, Subrings, Ideal, Prime ideal; Maximal ideals; Fields, quotient field.

Vector spaces, Linear dependence and Independence of vectors, basis, dimension, linear transformations, matrix representation with respect to an ordered basis, Range space and null space, rank-nullity theorem; Rank and inverse of a matrix, determinant, solutions of systems of linear equations, consistency conditions. Eigenvalues and eigenvectors. Cayley-Hamilton theorem. Symmetric, Skew symmetric, Hermitian, Skew-Hermitian, Orthogonal and Unitary matrices.

Real Analysis: Sequences and series of real numbers. Convergent and divergent sequences, boundedand monotone sequences, Convergence criteria for sequences of real numbers, Cauchy sequences, absolute and conditional convergence; Tests of convergence for series of positive terms-comparison test, ratio test, root test, Leibnitz test for convergence of alternating series.

Functions of one variable: limit, continuity, differentiation, Rolle's Theorem, Cauchy's Taylor's theorem. Interior points, limit points, open sets, closed sets, bounded sets, connected sets, compact sets; completeness of R, Power series (of real variable) including Taylor's and Maclaurin's, domainof convergence, term-wise differentiation and integration of power series.

Functions of two real variable: limit, continuity, partial derivatives, differentiability, maxima and minima. Method of Lagrange multipliers, Homogeneous functions including Euler's theorem.

Complex Analysis: Functions of a complex Variable, Differentiability and analyticity, Cauchy Riemann Equations, Power series as an analytic function, properties of line integrals, GoursatTheorem, Cauchy theorem, consequence of simply connectivity, index of a closed curves.

Cauchy's integral formula, Morera's theorem, Liouville's theorem, Fundamental theorem of Algebra, Harmonic functions.

Mathematics (SCQP19)

Integral Calculus: Integration as the inverse process of differentiation, definite integrals and their properties, Fundamental theorem of integral calculus. Double and triple integrals, changeof order of integration. Calculating surface areas and volumes using double integrals and applications. Calculating volumes using triple integrals and applications.

Differential Equations: Ordinary differential equations of the first order of the form $y'=f(x,y)$. Bernoulli's equation, exact differential equations, integrating factor, Orthogonal trajectories, Homogeneous differential equations-separable solutions, Linear differential equations of secondand higher order with constant coefficients, method of variation of parameters. Cauchy-Euler equation.

Vector Calculus: Scalar and vector fields, gradient, divergence, curl and Laplacian. Scalar line integrals and vector line integrals, scalar surface integrals and vector surface integrals, Green's, Stokes and Gauss theorems and their applications.

Linear Programing:
Convex sets, extreme points, convex hull, hyper plane & polyhedral Sets, convex function and concave functions, Concept of basis, basic feasible solutions, Formulation of Linear Programming Problem (LPP), Graphical Method of LPP, Simplex Method.

Syllabus
for
Medical Laboratory Technology
(SCQP20)

Note:

   i.   *There will be one Question Paper which will have 100 questions.*

   ii. *All questions will be complulsory.*

   iii. *The Question Paper will have two Parts i.e. Part A and Part B:*

   iv. *Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.*

   v.   *Part B will have 75 questions based on Subject-Specific Knowledge.*

Medical Laboratory Technology (SCQP20)

- Anatomy

- Physiology

- Clinical Pathology Hematology

- Clinical Biochemistry

- Medical Microbiology

- Serology, Histopathology

- Biostatics

- Molecular Biology Applied Genetics

- Immunology and Immunological Techniques

- Biotechnology and Biomedical Techniques

Syllabus
for
Physiotherapy (SCQP21)

Physiotherapy (SCQP21)

ANATOMY
- Regional Anatomy: Thorax, Abdomen, Pelvis, Endocrine System
- Musculoskeletal Anatomy
- Neuroanatomy

PHYSIOLOGY
- General Physiology: Cell, and its Transport Mechanisms
- Blood
- Nerve Muscle Physiology
- Cardiovascular System
- Respiratory System
- Digestive System
- Endocrine System
- Special Senses
- Nervous System
- Renal System
- Reproductive System
- Exercise Physiology

BIOCHEMISTRY
- Nutrition
- Metabolism of Carbohydrate, Lipids, Proteins, Vitamins and Minerals
- Muscle Contraction
- Biochemistry of Connective tissue
- Hormone Action
- Acid-Base, water and electrolyte balance
- Clinical Biochemistry

SOCIOLOGY
- Definition and scope of sociology in relation to Physiotherapy
- Socialization and Social Groups
- Role of Social Worker
- Social Problems of disabled

INTRODUCTION TO YOGA- BASIC THEORY, SCIENCE AND TECHNIQUES
- Foundations of Yoga
- Yoga and Health
- Physiological effects of Yoga practices

GENERAL & CLINICAL PSYCHOLOGY
- Introduction to Psychology
- Growth and Development
- Sensation, attention and perception
- Motivation, Frustration and Emotions
- Intelligence and Learning
- Personality
- Social and Clinical Psychology

BIOMECHANICS AND KINESIOLOGY
- Basic Concepts in Biomechanics: Kinematics and Kinetics
- Joint structure and Function
- Muscle structure and function
- Biomechanics of the Thorax and Chest wall, Vertebral column, Peripheral joints, Temporomandibular Joint
- Analysis of Posture and Gait

PATHOLOGY
- General Pathology: Cell injuries, inflammation and repair, infectious diseases, immunopathology, Neoplasia and Nutritional disorders
- Systemic pathology: Hematology, Respiratory and Cardiovascular Pathology, Musculoskeletal System, Endocrine System, Neuropathology

MICROBIOLOGY
- General Microbiology
- Immunology
- Bacteriology
- Virology

PHARMACOLOGY
- Introduction to Pharmacology: Pharmacokinetics, Pharmacodynamics
- Drugs used in disorders of Cardiovascular system, Autonomic Nervous system, Musculoskeletal systems, Neurological Systems
- Drugs used in Inflammatory/Immune Diseases, movement disorders, Digestion and metabolism

EXERCISE THERAPY
- Introduction to Exercise Therapy
- Methods of Testing: MMT, Goniometry, etc.
- Relaxation
- Different types of Movements/Exercises – Active, Passive, Active – Assisted, Resistedetc.
- Stretching
- PNF
- Manual Therapy – Joint Mobilization, Manipulation and Soft Tissue ManipulationTechniques

- Aerobic exercises
- Balance and Coordination
- Gait and Posture including assistive devices
- Hydrotherapy

ELECTROTHERAPY

- Bio-Physics: Physical principles, Physics of devices, currents, sound and light, electrical supply
- Nerve Muscle Physiology and Pain physiology
- Low, Medium and High Frequency currents – physiological effects, indications, contraindications and application
- Actinotherapy – IRR, UVR
- Cryotherapy
- Ultrasound and LASER
- Superficial and Deep Heating Modalities- physiological effects, indications, contraindications and application
- Electro-diagnosis – SD curve, EMG and NCV
- Biofeedback

PHYSIOTHERAPY IN GENERAL MEDICINE & GENERAL SURGERY

Medical, Surgical and Physiotherapy assessment and management of:
- Infectious diseases
- Diseases of the cardiorespiratory system
- Endocrine diseases
- Diseases of the blood
- Diseases of the digestive and renal systems
- Diseases of the Skin
- Pediatrics
- Geriatrics
- Psychiatric Disorders
- Wound healing and Scars management
- General Pre and Post – Operative Complications and management.
- Surgical Oncology
- Thoracic and Abdominal Surgeries
- Burns
- ENT and Ophthalmology
- Obstetrics and Gynecology
- I.C.U. Management

MUSCULOSKELETAL PHYSIOTHERAPY

Clinical, Surgical Orthopedics and Physiotherapy assessment and management of:
- Fractures and Dislocations of Upper Limb and Lower Limb
- Fractures of Pelvis and Spine
- Soft Tissue Injuries
- Infectious, Inflammatory, Neoplastic and Degenerative Disorders
- Congenital and Acquired Deformities
- Amputations
- Orthoses and prostheses

- Manual Physiotherapy

NEUROLOGICAL PHYSIOTHERAPY

- Medical, Surgical and Physiotherapy assessment and management of Brain, Spinal Cord, Peripheral Nerve (injuries), Muscle Disorders and Paediatric Neurological conditions
- Neurophysiological Approaches: NDT, MRP, Roods etc.
- Vestibular Rehabilitation

CARDIOVASCULAR AND PULMONARY PHYSIOTHERAPY

- Medical, Surgical and Physiotherapy assessment and management of, Cardiovascular Diseases, Peripheral Vascular Diseases and Respiratory Diseases
- Physiotherapy techniques for Broncho-pulmonary hygiene
- Cardiorespiratory fitness assessment and training
- Cardiac Rehabilitation
- ICU set up and Physiotherapy care

SPORTS PHYSIOTHERAPY

- Physical fitness
- Prevention and Treatment of Sports specific injuries including overuse injuries

COMMUNITY MEDICINE AND REHABILITATION

- Health and Disease
- Epidemiology: Principles and Methods
- Health programs in India
- Nutrition and Health
- Occupational Health
- Disaster Management
- Environment and Health
- Mental Health
- Community based Rehabilitation
- Disability and Disability Evaluation
- Industrial Health & Ergonomics
- Role of Government, voluntary organizations and NGOs in CBR
- Vocational training

BIOSTATISTICS & RESEARCH METHODOLOGY

- Introduction to Research methodology and Biostatistics
- Formulation of Research problem and design
- Sampling
- Measurement & scaling techniques
- Methods of data collection
- Testing of hypothesis
- Measures of central tendency and dispersion
- Normal Probability Curve
- Statistical tests and their types

CLINICAL REASONING AND EVIDENCE BASED PHYSIOTHERAPY PRACTICE

- Clinical decision Making
- Introduction to Evidence Based Practice
- Development of Evidence based knowledge
- Assessing and using the evidence
- Communicating evidence

PHYSIOTHERAPY LAW AND ETHICS
- Biomedical ethical principles and code of conduct
- Code of ethics for physiotherapists
- Documentation and Informed Consent

ADMINISTRATION AND MANAGEMENT
- Nature and scope of administration
- Role of administrator
- Principles of hospital administration and its applications to physiotherapy.
- Planning and organization
- Personnel management

Syllabus
for
Nanoscience/ Integrative Biosciences (SCQP22)

Nanoscience/ Integrative Biosciences (SCQP22)

INORGANIC CHEMISTRY

Quantum numbers and their significance. s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s & p- block. Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and lattice energy. Madelung constant, Born-Haber cycle and its application, solvation energy. Lewisstructure, Valence Bond theory, Molecular orbital theory. Formal charge, Valence shell electron pair repulsion theory (VSEPR), Redox equations, Standard Electrode Potential and its application to inorganic reactions. Bronsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid- base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application ofHSAB principle. Inert pair effect, diagonal relationship Allotropy and catenation. Complex formation tendency of s and p block elements. Study of the compounds with emphasis on structure, bonding, preparation, properties and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudo halogens and basic properties of halogens. Werner's theory, valence bond theory (inner and outer orbital complexes), electro neutrality principle and back bonding.Crystal field theory, measurement of

10 Dq (Δo), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of

10 Dq (Δo, Δt). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedralgeometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

PHYSICAL CHEMISTRY

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics. First law: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U andH for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions. Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy. Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy.

Calculation of entropy change for reversible and irreversible processes. Third Law: Statement ofthird law, concept of residual entropy, calculation of absolute entropy of molecules. Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature. Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices.

Ionization of weak acids and bases, pH scale, common ion effect, Salt hydrolysis-calculation of hydrolysis

constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range. Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency.

Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy. Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions.

ORGANIC CHEMISTRY

Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes. Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules. Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations

PHYSICS

Basics of classical mechanics; Laws of motion; Planck's theory, de Broglies's hypothesis, The Harmonic Oscillator: Schrodinger approach; Hydrogenic Atoms: Orbitals. Free electron gas in one and three dimensions. Thermionic emission, work function, electrical conductivity of the free electron gas Energy Bands: Fermi-Dirac Statistics; Holes; Effective Mass; Density of States:3D,

2D, 1D; Conduction & Valence Bands; Electrons in periodic potential, Origin of energy bands in solids, classification of solids as metals, insulators and semiconductors on the basis of the band picture, Origin of the energy gap (qualitative discussions). Temperature dependence of Fermi energy. Crystal structure, Packing fraction, specific surface energy and surface stress, effect on the lattice parameter, Bragg's law of diffraction, Size and shape dependent optical, emission, electronic transport, refractive index, dielectric, mechanical, magnetic; quantum confinement in semiconductors; Mechanical properties – Stress and Strain concept, Elastic properties, General Optics and Optical properties - refraction, reflection, Absorption, Transmission, luminescence, Magnetic properties - paramagnetism - ferromagnetism - domain theory - magnetic hysteresis, – antiferromagnetism. Basics of Themodynamics, Laws of thermodynamics and related applications, Concepts of free energy and entropy. Semiconductor Physics; Energy Band Diagram: Electron Energy Bands, Dopant Atoms and Energy Levels, Position of Fermi Energy Level, Solid state phase transformations, excitons, band-gap variations-quantum confinement, Charge Carriers in Semiconductors: Intrinsic and Extrinsic Semiconductors, Carrier Transport Phenomena: Carrier Drift, Carrier Diffusion, Hall Effect. Semiconductor Electronic devices: p-n Junction, p-n Junction Diode, Metal-Semiconductor and Semiconductor Heterojunctions, Bipolar Transistor, Concept of direct and indirect band gap in semiconductors.

BIOLOGICAL SCIENCES

Evolution and origin of life, biological classification systems Plant anatomy and physiology: plant tissues, hormones, mineral nutrition, biofertilizers and pesticides Animal anatomy and physiology: animal tissues, blood, digestive system, respiratory system, excretion system, nervous system, endocrine system, reproduction system, skeleton system. Cytology and molecular biology: Cell and cell organelles, cell cycle, cell division-Mitosis and meiosis, DNA, RNA, DNA replication, translation, transcription, DNA repair mechanism. Biochemistry: Basic structures and functions of amino acids, carbohydrates, lipids, proteins. Enzymes. Kidney and liver function tests. Ecology: Ecosystem, ecological pyramids, environment pollution and green house effects. Immunology: Basics of immunology, antigens, antibody, antigen-antibody interactions, types of immunity, immunological disorders, hypersensitivity reactions, monoclonal antibodies, and immunization. Microbiology: Classification of pathogens, Gram staining, diseases and treatments. Genetics: Mendelian genetics, genetic disorders, and gene therapy. Biotechnology: Molecular biology techniques including DNA transformation techniques, types of vectors, cloning and expression. Restriction enzymes, types of polymeric chain reactions (PCR), and gel electrophoresis.

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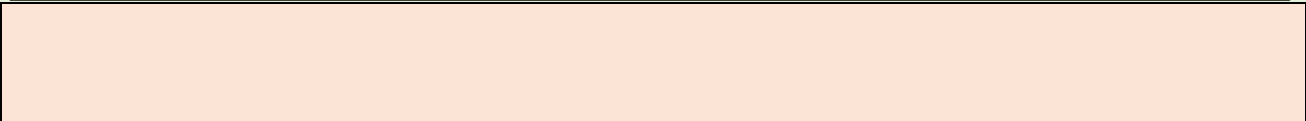
Syllabus
for
Pharmacy (SCQP23)

Pharmacy (SCQP23)

PHARMACEUTICS-I (INTRODUCTION TO PHARMACEUTICS)

1. History of pharmaceutical practice through ages
2. Pharmacopoeias with special reference to Indian, British, United States, International and Extra Pharmacopoeias and various systems of medicines.
3. Routes of administration and classification of pharmaceutical dosage forms.
4. Definition, general formulation and manufacturing procedures.
5. Methods employed in the preparation of plant extracts.

PHARMACEUTICAL CHEMISTRY-I (ORGANIC-I)

1. Fundamentals and classification of organic reaction.
2. Reaction intermediates
3. Stereochemistry
4. Study of reaction mechanism, reactivity and orientation, effect of substituent groups of following categories of reactions:
4.1 Addition reactions
4.2 Elimination reactions
4.3 Substitution reactions
4.4 Condensation and rearrangement reactions

PHARMACEUTICAL CHEMISTRY-II (INORGANIC)

1. The occurrence of impurities in pharmaceutical preparations
2. A systematic study of the following pharmaceutical inorganic compounds with reference to their preparations, properties, tests for identity and purity, pharmaceutical uses and assay methods as given in Indian Pharmacopeia (IP).
3. Group IA: Sodium and potassium compounds
4. Group IIIA and IIIB: Boron and aluminium compounds Group IVA and IVB: Bentonite, light and heavy kaolins and kaolin poultice.
5. Group VA and VB: Nitrogen, antimony, and bismuth compounds
6. Group VIB: Sulphur, selenium compounds
7. Group VIIA and VIIB: Hydrogen, oxygen and halogen compounds
8. Group VIII: Iron compounds
9. A study of major intra and extra cellular electrolytes, essential and trace elements and their physiological role.
10. Selected case studies in medicinal inorganic chemistry from the following topics: a) Biomedical uses of lithium b) Application of platinum compounds in medicine c) Gold compounds as therapeutic agents d) Ruthenium, titanium and gallium compounds in medicine
11. Metal compounds as contrast agents for MRI and medicinal applications of radio-active compounds.

ADVANCE MATHEMATICS
1. Differential equations and its applications
2. Laplace transforms
3. Biometrics
4. Probability
5. Correlation and regression analysis

PHARMACEUTICS-II (PHYSICAL PHARMACY)
1. Matter: State and selected properties
2. Micromeritics: Particle size and size distribution
3. Surface and Interfacial phenomenon
4. Rheology: Newtonian systems
5. Dispersed systems: Colloids
6. Complexation and protein binding: Classification of complexes, Methods of preparation and analysis, Pharmaceutical applications, Protein binding, Factors affecting complexation and protein binding.
7. Chemical kinetics: General considerations and concepts, Half-life determination, Factors affecting rate of reaction, Order of reaction, Determination of order of reaction.

PHARMACEUTICAL CHEMISTRY-III (ORGANIC-II)
1. Nomenclature of heterocyclic compounds
2. Classification of heterocyclic compounds
3. Chemistry, preparation, properties and pharmaceutical applications of following heterocyclic rings: Monocyclic rings; Bicyclic rings; Tricyclic rings.
4. Pericyclic reactions, Conservation of orbital symmetry, Orbital symmetry rules, Mechanism and stereochemistry of electro cyclic, cycloaddition and sigma tropic reactions
5. Applications of reagents used in organic syntheses
6. Oxidation and hydrogenation/reduction
7. Chemistry of bio-macromolecules

PHARMACEUTICAL MICROBIOLOGY
1. Introduction and scope of microbiology.
2. Classification of microbes and their taxonomy
3. Identification and cultivation of microbes
4. Control of microbes by physical and chemical methods
5. Immunity, primary and secondary defensive mechanisms of body, microbial resistance, interferon.
6. Food spoilage and preservation of food.
7. Microbial assay of antibiotics, vitamins and amino acids.

ANATOMY PHYSIOLOGY & HEALTH EDUCATION-I
1. Scope of anatomy & physiology and basic terminology used in the subject.
2. Structure of Human Cell, its components and their functions
3. Elementary Tissues of the Human Body
4. Osseous System
5. Haematopoiesic System
6. Lymph and Lymphatic System
7. Cardiovascular System
8. Health Education
a. Classification of food requirements and importance of balanced diet
b. Demography and family planning
c. First Aid

PHARMACEUTICS-III (PHARMACEUTICAL ENGINEERING)
1. Unit Operations
2. Material of Construction
3. Size Reduction.
4. Size Separation
5. Mixing
6. Filtration
7. Centrifugation
8. Crystallization
9. Refrigeration, Air Conditioning and Humidity Control
10. Evaporation
11. Distillation
12. Drying
13. Corrosion

PHARMACEUTICS I
(DISPENSING, COMMUNITY AND HOSPITAL PHARMACY)
1. Prescription
2. Pharmaceutical calculations
3. Principle involved and procedures adopted in dispensing of mixtures, solutions, emulsions, lotions, liniments, powders, capsules, tablets, tablet triturates, pastilles, lozenges, pills, ointments, creams, pastes, suppositories, jellies, inhalations, paints, sprays and ophthalmic preparations.
4. Incompatibility
5. Community pharmacy
6. Hospital pharmacy

PHARMACEUTICAL ANALYSIS-I
A. Theoretical aspects of quantitative analysis
B. Oxidation-Reduction titrations
C. C Precipitation titrations
D. Gravimetric analysis
E. Non-aqueous titrations

PHARMACOGNOSY-I
1. Definition, history, scope and development of pharmacognosy, sources of crude drugs and methods of their classification.
2. Plant hormones and their applications, influence of mutation and hybridization with reference to medicinal plants.
3. Pest control and natural pest control agents.
4. Quality control of crude drugs
5. Introduction of various types of primary and secondary metabolites as active constituents of crude drugs, general methods of their isolation, classification, properties and systematic pharmacognostic study of:
   a) Carbohydrates
   b) Lipids
   c) Resins and Tannins
   d) Pharmaceutical aids

ANATOMY, PHYSIOLOGY AND HEALTH EDUCATION – II
1. Central Nervous System
2. Autonomous Nervous System
3. Respiratory System
4. Endocrine System
5. Digestive System
6. Reproductive System

7. Urinary System
8. Sense Organs

PHARMACEUTICS -V (DOSAGE FORM DESIGN)
1. Pre-formulation studies
2. Study of different types of formulation additives
3. Stability studies
4. Polymers
5. Dissolution technology
6. Solubilization

PHARMACEUTICAL ANALYSIS-II
1. Conductometry
2. Potentiometry
3. Polarography
4. Amperometry
5. Coulometry
6. Radioimmunoassay
7. Thermal methods of analysis
8. X-ray diffraction
9. Miscellaneous methods of analysis

PHARMACEUTICAL CHEMISTRY- IV (BIOCHEMISTRY)
1. Enzymes
2. Co-enzymes
3. Carbohydrates metabolism
4. Lipid metabolism
5. Biological oxidation
6. Metabolism of ammonia and nitrogen containing monomers
7. Genetic code and protein synthesis

PHARMACOGNOSY II
1. Classification, cultivation, collection, commercial varieties, chemical constituents, substitutes, diagnostic macroscopic and microscopic features and specific chemical tests of following groups of drugs containing glycosides:
a. Saponins
b. Cardio active sterols
c. Anthraquinone cathartics etc.
2. Volatile oils
3. Plant bitters and sweeteners.
4. Studies of following drugs
5. Biological sources, preparation, identification tests and uses of the following enzymes

PHARMACEUTICAL JURISPRUDENCE & ETHICS
1. Pharmaceutical Legislations
   Drugs and pharmaceutical industry with special reference to
   India Code of pharmaceutical ethics
   Pharmacy Act 1948, Drugs and Cosmetics Act 1940 and Rules 1945, Medicinal & Toilet Preparations (excise duties) Act 1955.
2. Narcotic Drugs & Psychotropic Substances Act 1985 & Rules,
   Drugs Price Control Order 1995, Drug Policy 2002.
3. A brief study of the following with special reference to the main provisions.

   a. Poisons Act 1919.

b. Drugs and Magic Remedies (objectionable advertisements) Act 1954.
c. Medical Termination of Pregnancy Act 1970 & Rules 1975.
d. Prevention of Cruelty to Animals Act 1960.
e. States Shops & Establishments Act & Rules.
f. Insecticides Act 1968.
g. AICTE Act 1987.
h. Factories Act 1948.
i. Minimum Wages Act 1948.
j. Introduction to Intellectual Property Rights and Indian Patent Act 1970 with patents rules 1972.
4. A brief study of the various marketed pharmaceutical products from the following categories:
(i) Antibiotics (ii) Vitamins (iii) Antihypertensive (iv) Anti-diabetics (v) NSAIDs

PHARMACEUTICS- VI (COSMETIC TECHNOLOGY)

Fundamental of cosmetic science. Formulation considerations, preparation, packaging and evaluation of the following cosmetic preparation:
1. Face Preparation
2. Colored make-up preparations
3. Skin preparation
4. Shaving preparation
5. Shampoos
6. Hair Preparations
7. Dental Preparation.
8. Manicure Preparation
9. Herbal Cosmetics
10. Cosmetic for babies: Baby cream, lotion and powders.

PHARMACEUTICS-VII (PHARMACEUTICAL TECHNOLOGY-I)

1. Liquid Dosage Forms: Introduction, types of additives used in formulations, vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizers, colors, flavors and others, manufacturing, packaging and evaluation of clear liquids, suspensions and emulsions.
2. Semisolid Dosage Forms: Definition, types and mechanisms of drug penetration. Factors influencing penetration. Semisolid bases and their selection. General formulation of semisolids, clear gels, manufacturing procedure, evaluation and packaging.
3. Suppositories: Ideal requirements, bases, manufacturing procedures, packaging and evaluation.
4. Solid Dosage Forms
5. Solid Dosage Forms
6. Pharmaceutical aerosols
7. A brief introduction of blood products, plasma substitutes and surgical products.

PHARMACEUTICAL CHEMISTRY-V (MEDICINAL CHEMISTRY-I)

1. Introduction and basic principles of Medicinal Chemistry
2. Drugs affecting neuro transmission:
   a. Drug acting on cholinergic neurotransmission
   b. Drug acting on adrenergic neurotransmission
   c. Drug acting on seratonergic neurotransmission
   d. Local Anesthetic agents
3. Drugs affecting the Immune System
4. Drugs affecting the Respiratory System
5. Miscellaneous agents:
   a. Diagnostic and Medicinal Green and Fluorescein
   b. Pharmaceutical aids.

PHARMACOGNOSY III

1. Systematic study of source, cultivation, collection, processing, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following Alkaloid containing drugs: Tropane, Quinoline, isoquinoline, Indole, Steroidal, Steroidal amine and Purines
2. A brief account of plant-based industries and institutions involved in work on medicinal and aromatic plants in India
3. Utilization of aromatic plants and derived products.
4. Marine pharmacognosy novel medicinal agents from marine sources.
5. Introduction, classification and study of different chromatographic methods and their applications in evaluation of herbal drugs.
6. Holistic concept of drug administration in traditional systems of medicine, introduction to ayurvedic preparations like arishtas, asavs, gutikas, tails, churans, lehyas and bhasmas.

PHARMACOLOGY-I

1. General Pharmacology
a. Introduction to pharmacology, sources of drugs, dosage forms and routes of administration, mechanism of action, combined effects of drugs, factors modifying drug action, tolerance and dependence, pharmacogenetics.
b. Absorption, distribution, metabolism and excretion of drugs, principle of basic and clinical pharmacokinetics adverse drug reactions and treatment of poisoning, ADME drug interactions, receptors, bioassay of drugs and biological standardization, discovery and development of new drugs. Introduction to clinical trials, bioavailability and bioequivalence studies.
2. Pharmacology of peripheral nervous system
   a. Neurohumoral transmission (autonomous and somatic)
   b. Para-sympathomimetic, para-sympatholytic and sympathomimetics.
   c. Adrenergic receptors and neuron blocking agents, ganglionic stimulants and blocking agents.
   d. Neuromuscular blocking agents.
   e. Local anaesthetic agents.
3. Pharmacology of drugs acting on gastrointestinal tract
   a. Antacids, anti-secretory and anti-ulcer drugs (pathophysiology of ulcer).
   b. Laxatives and anti-diarrhea drugs.
   c. Appetite stimulants and suppressants.
   d. Emetics and anti-emetics.
   e. Carminatives, demulcents, protectives, adsorbents, astringents, digestants, enzymes and mucolytics.
4. Autacoids:
   a. Histamine, bradykinin, 5- HT and their antagonists.
   b. Prostaglandins, leukotrienes and platelet activating factors.
   c. Pentagastrin, cholecystokinin, angiotensin, bradykinin and substace
5. Analgesic, antipyretic, anti-inflammatory (vascular and cellular events of acute inflammation, chemical mediators of inflammation, pathogenesis of chronic inflammation), anti-gout and anti rheumatic drugs (pathophysiology of gout and rheumatoid arthritis)
6. Pharmacology of drugs used for respiratory system: Anti-asthmatic drugs (pathophysiology of asthma) including bronchodilators, antitussives, expectorants and respiratory stimulants.

PHARMACEUTICS -VIII (PHARMACEUTICAL TECHNOLOGY-II)

1. Microencapsulation: Types of microcapsules, importance of microencapsulation in pharmacy, microencapsulation by phase separation, co-accervation, multiorifice centrifugal, spray drying, spray congealing, polymerization complex emulsion, air suspension technique, coating pan and other techniques, evaluation of microcapsules.
2. Parenteral products:
   a. Preformulation factors, routes of administration, water for injection, pyrogenicity, non-aqueous vehicles, and isotonicity.
   b. Aseptic techniques: Sources of contamination and methods of prevention, design of aseptic area, laminar flow bench services and maintenance.

      c. Formulation details, containers and closures and their selection.

      d. Pre-filling treatment, washing of containers and closures, preparation of solution and suspensions, filling and closing of ampoules, vials, infusion fluids, lyophilization and preparation of sterile powders, equipment for large-scale manufacture and evaluation of parenteral products.

3. Design, development, production and evaluation of controlled released formulations.

4. Novel drug delivery systems: Drawbacks and deficiencies of conventional drug delivery systems, introduction to novel drug delivery systems, e.g., transdermal drug delivery patches, ocular inserts and osmotic pumps, introduction of liposomes and pro drugs.

5. Ophthalmic preparations: Requirements, formulation and methods of preparations, containers, and evaluation.

PHARMACEUTICAL BIOTECHNOLOGY

1. Introduction, historical perspective, genomics, proteonomics and other biotechnology related techniques, scope and future of pharmaceutical biotechnology.

2. Enzyme immobilization: Introduction, factor affecting enzyme kinetics, Technique of immobilization of enzymes, immobilization of plant and bacterial cell, study of enzymes.

3. rDNA technology: Introduction, transformation, conjugation, transduction, protoplast fusion and plasmid mediated gene transfer, gene cloning including enzymes acting on DNA, cloning vectors, insertion of target DNA into vector, transformation and growth of cells, selection of recombinant clones and their applications, techniques of genetic engineering, study of drugs produced by biotechnology such as activase, humulin, humantrope, HB etc.

4. Vaccine technology: Introduction, immunological principles, conventional vaccines, modern vaccine technologies, development of hybridoma for monoclonal antibodies and monoclonal antibody based pharmaceuticals, pharmaceutical considerations of vaccines.

5. Fermentation: Introduction to fermentation, fermenters and types of fermenters, factors affecting design of fermenter, the fermentation process and its optimization with special reference to ethyl alcohol, riboflavin, cephalosporin and ascorbic acid.

6. Production and downstream processing of biotech products: Introduction, production, downstream processing, issues to consider in production and purification of proteins, formulation of biotech products and its biopharmaceutical considerations, pharmacokinetics and pharmacodynamics of peptide and protein drugs.

7. Plant tissue culture: Introduction, laboratory requirements, cellular tot potency, types of cultures, protoplast fusion and somatic hybridization, transgenic plants and application of transgenic plants, cryopreservation and application of PTC in Pharmacy.

PHARMACEUTICAL CHEMISTRY-VI (MEDICINAL CHEMISTRY-II)

Classification, synthesis of selective drugs, Structure-activity relationship, Pharmacological/Biochemical mechanism of action, Therapeutic uses of following category of agents: (special emphasis should be given to specified drugs)

1. Drugs affecting central nervous system: General Anesthetics
   Anti Parkinsonian agents and Spasmolytic agents Psychopharmacological Agents

2. Drugs affecting Hormonal System:
   a. Thyroid hormones and Antithyroid agents
   b. Insulin and Oral Hypoglycaemic agents
   c. Steroidal agents:

3. Drugs affecting Haematopietic System.

4. Chemistry and physiological importance of water & lipid soluble Vitamins.

PHARMACEUTICS -IX (PACKAGING TECHNOLOGY)

1. Packaging of pharmaceutical dosage form
2. Packaging of solid oral dosage form
3. Packaging of semisolids and topical
4. Glass packaging materials.
5. Plastic packaging materials
6. Metal packaging materials
7. Tamper-resistant packaging
8. Child resistant package.

PHARMACOLOGY-II

Pharmacy (SCQP23)

1. Pathophysiology of CNS diseases and pharmacology of drugs used to treat them a) Neuro humoral transmission in CNS b) General anesthetics, alcohol and disulfiram.c) Hypnotics, sedatives, anti-anxiety agents, and centrally acting muscle relaxants. d) Psychopharmacological agents e) Antiepileptic drugs f) Narcotic analgesics and antagonists g) Drugs used in neurodegenerative diseases: Parkinson's disease and Alzheimer's disease h) Drug addiction and drug abuse i) CNS stimulants

2. Pathophysiology of diseases of endocrine system and pharmacology of drugs used for their treatment: a) Hypothalamic and pituitary hormones. b) Thyroid hormones and anti thyroid drugs. c) Insulin, oral hypoglycemic agents and glucagons. d) Corticosteroids. e) Androgens, anabolic steroids and drugs for erectile dysfunction. f) Estrogens, progestins and oral contraceptives. g) Oxytocin and drugs acting on the uterus. h) Parathormone, calcitonin and vitamin D, ACTH and corticosteroids.

3. Drug acting on Haematopoietic system: a. Haematinics (pathophysiology of anaemia) b. Anticoagulants c. Fibrinolytic and antiplatelet drugs d. Blood and plasma volume expanders.

PHARMACEUTICS-X (BIOPHARMACEUTICS AND PHARMACOKINETICS)

Bio pharmaceutics

1. Introduction: Definition and significance of Bio pharmaceutics in formulation development.
2. Gastrointestinal absorption of Drugs
3. Factor affecting Drug absorption
4. Methods of studying gastrointestinal absorption
5. Drug Disposition
6. Drug Excretion
7. Drug Biotransformation

Pharmacokinetics

1. Definition and need of pharmacokinetic and clinical pharmacokinetics.
2. Introduction to pharmacokinetic parameters, biological half-life, volume of distribution, clearance, rate constants for elimination.
3. One compartment model: Single dosing-intravenous injection and oral absorption, determination of pharmacokinetic parameters from plasma and urine data, measurements of Cmax, Tmax, and AUC.
4. Bioavailability and Bioequivalence: Definition and detailed protocol, Significance of Bioavailability and Bioequivalence studies. Regulatory requirements.

PHARMACEUTICAL CHEMISTRY-VII (MEDICINAL CHEMISTRY-III)

1. Drug Design and Development
2. Modern Medicinal Chemistry
3. Drugs affecting the Cardiovascular System: a) Anti-anginal and Vasodilators b) Anti-arrhythmic agents c) Antihypertensive agents d) Antihyperlipidemic agents
4. Drugs affecting the Urinary System
5. Chemotherapeutic agents: a) Antibiotics and Antibacterial agents b)Antibiotics c) Antiparasitic agents d) Antiamoebic agents f) Antifungal agents g)Anticancer agents, Immunosupressants and Immunostimulants g)Antiviral including anti-HIV agents.

PHARMACOLOGY-III

1. Pathophysiology of microbial diseases (Tuberculosis, leprosy, fungal diseases, urinary tract infections, sexually transmitted diseases) and pharmacology of drugs used for their treatment: a) General principles of Chemotherapy,

   b) Sulfonamides and cotrimoxazole, c) Antibiotics d) Anti-mycobacterial drugs, e) Anti-viral and anti-HIV drugs, f) Anti- malarial drugs, g) Drugs for amoebiasis and other protozoal infections, h) Anthelmentics

2. Pathophysiology of Cardiovascular and pharmacology of drugs used for their treatment. a) Cardiac glycosides, b) Antiarrhythmic drugs, c) Antianginal drugs, d) Antihypertensive drugs, e) Anti- hyper lipidemic drugs

3. Anti-neoplastic drugs (pathophysiology of cancer), immune stimulants and immunosuppressive

agents.
4. Drugs acting on urinary system

PHARMACOLOGY-IV
1. Principles of Clinical Pharmacology
2. Drugs used during infancy, neonates, in the elderly persons and their bio-pharmaceutics.
3. Drugs used during pregnancy and drug induced diseases.
4. The principles, mechanism and clinical evaluation of drug interactions.
5. Common clinical laboratory tests and their interpretation.
6. General principles of Clinical toxicology.
7. Therapeutic Drug Monitoring, Concept of Essential Drugs and Rational Drug use.
8. Principles of Toxicology

PHARMACEUTICAL INDUSTRIAL MANAGEMENT AND ACCOUNTANCY
1. Concept of Management: Administrative Management, Entrepreneurship development, Operative Management, Principles of Management, Identification of Key Points to give maximum thrust for development and perfection.
2. Economics: Principles of economics
3. Materials Management
4. Production Management
5. Accountancy

PHARMACEUTICAL ANALYSIS- IV (QUALITY ASSURANCE)
1. Quality assurance: Concept, Scope, quality control, audit, total quality management.
2. Development of new analytical methods.
3. Validation: Definition, types, validation of manufacturing and analytical equipment, validation of analytical procedures, importance and limitations of validation, organization for validation.
4. Pharmaceutical manufacturing documentation (PMD): Introduction, guidelines for designing and implementation of PMD programs.
5. Documentation: Protocols, forms and maintenance of records in pharmaceutical industries, preparation of documents for new drug approval and export registration to United States, United Kingdom, Europe and Africa.
6. Patent processing and its applications.
7. Requirement of GMP, GLP, ISO 9000, WHO and U.S. F.D.A.
8. In-process quality control tests, IPQC problems in pharmaceutical industries, sources and control of quality variation, total quality management.
9. Sampling plans, sampling and operating characteristics curves, interpretation of analytical data.
10. Regulatory control and regulatory drug analysis.

DRUG DESIGN
1 Drug Discovery, Design and Development
2 Quantum Mechanics and Molecular Dynamics
3 Ligand Based Drug Design
4 Structure Based Drug Design
5 Comparative Protein Modeling

PHARMACEUTICAL SALES AND MARKETING
1. Introduction to Pharmaceutical Marketing Management
2. Marketing Task: Demand States & Marketing task, Scope of Marketing and Different Markets
3. Concept of Marketing
4. Marketing Opportunities Market Oriented Strategic Planning
5. Developing Market Strategies & Marketing Mix, Product Strategy Positioning & Differentiating the Market Offering.
6. Managing & Delivering Marketing Programs.

7.   Value Net-Work & Marketing Channels
8.   Managing Sales Force: Recruitment & Selecting Representative, Training Sales Representative, Supervising, Norms for Customer Calls, Motivating Sales Representative, Evaluating Sales Representative

FOOD SCIENCE TECHNOLOGY
1.   Food Chemistry
2.   Food Microbiology
3.   Food Process Principles
4.   Food Technology
5.   Food laws and standards

Syllabus
for
Physics (SCQP24)

Physics (SCQP24)

Mathematical Methods: Calculus of single and multiple variables, partial derivatives, Jacobian, imperfect and perfect differentials, Taylor expansion, Fourier series. Vector algebra, Vector Calculus, Multiple integrals, Divergence theorem, green's theorem, Stokes' theorem. First orderequations and linear second order differential equations with constant coefficients. Matrices anddeterminants, Algebra of complex numbers.

Mechanics and General Properties of Matter: Newton's laws of motion and applications, Velocity and acceleration in Cartesian, polar and cylindrical coordinate systems, uniformly rotating frame, centrifugal and Coriolis forces, Motion under a central force, Kepler's laws, Gravitational Law and field, Conservative and non-conservative forces. System of particles, Center of mass, equation of motion of the CM, conservation of linear and angular momentum, conservation of energy, variable mass systems. Elastic and inelastic collisions. Rigid body motion,fixed axis rotations, rotation and translation, moments of Inertia and products of Inertia, paralleland perpendicular axes theorem. Principal moments and axes. Kinematics of moving fluids, equation of continuity, Euler's equation, Bernoulli's theorem.

Oscillations, Waves and Optics: Differential equation for simple harmonic oscillator and its general solution. Superposition of two or more simple harmonic oscillators. Lissajous figures. Damped and forced oscillators, resonance. Wave equation, traveling and standing waves in one-dimension. Energy density and energy transmission in waves. Group velocity and phase velocity.Sound waves in media. Doppler Effect. Fermat's Principle. General theory of image formation. Thick lens, thin lens and lens combinations. Interference of light, optical path retardation. Fraunhofer diffraction. Rayleigh criterion and resolving power. Diffraction gratings. Polarization:linear, circular and elliptic polarization. Double refraction and optical rotation.

Electricity and Magnetism: Coulomb's law, Gauss's law. Electric field and potential. Electrostaticboundary conditions, Solution of Laplace's equation for simple cases. Conductors, capacitors, dielectrics, dielectric polarization, volume and surface charges, electrostatic energy. Biot-Savart law, Ampere's law, Faraday's law of electromagnetic induction, self and mutual inductance. Alternating currents. Simple DC and AC circuits with R, L and C components. Displacement current, Maxwell's equations and plane electromagnetic waves, Poynting's theorem, reflection and refraction at a dielectric interface, transmission and reflection coefficients (normal incidenceonly). Lorentz Force and motion of charged particles in electric and magnetic fields.

Kinetic theory, Thermodynamics: Elements of Kinetic theory of gases. Velocity distribution and equipartition of energy. Specific heat of Mono-, di- and tri-atomic gases. Ideal gas, van-der-Waalsgas and equation of state. Mean free path. Laws of thermodynamics. Zeroth law and concept ofthermal equilibrium. First law and its consequences. Isothermal and adiabatic processes. Reversible, irreversible and quasi-static processes. Second law and entropy. Carnot cycle. Maxwell's thermodynamic relations and simple applications. Thermodynamic potentials and their applications. Phase transitions and Clausius-Clapeyron

equation. Ideas of ensembles, Maxwell-Boltzmann, Fermi- Dirac and Bose Einstein distributions.

Modern Physics: Inertial frames and Galilean invariance. Postulates of special relativity. Lorentz transformations. Length contraction, time dilation. Relativistic velocity addition theorem, mass energy equivalence. Blackbody radiation, photoelectric effect, Compton Effect, Bohr's atomic model, X-rays. Wave-particle duality, Uncertainty principle, the superposition principle, calculation of expectation values, Schrödinger equation and its solution for one-, two- and three-dimensional boxes. Solution of Schrödinger equation for the one-dimensional harmonic oscillator. Reflection and transmission at a step potential, Pauli Exclusion Principle. Structure of atomic nucleus, mass and binding energy. Radioactivity and its applications. Laws of radioactive decay.

Solid State Physics, Devices and Electronics: Crystal structure, Bravais lattices and basis. Miller indices. X-ray diffraction and Bragg's law Intrinsic and extrinsic semiconductors, variation of resistivity with temperature. Fermi level. p-n junction diode, I-V characteristics, Zener diode andits applications, BJT: characteristics in CB, CE, CC modes. Single stage amplifier, two stage R-C coupled amplifiers. Simple Oscillators: Barkhausen condition, sinusoidal oscillators. OPAMP and applications: Inverting and non-inverting amplifier. Boolean algebra: Binary number systems; conversion from one system to another system; binary addition and subtraction. Logic Gates AND, OR, NOT, NAND, NOR exclusive OR; Truth tables; combination of gates; de Morgan's theorem.

Syllabus
for
Plant Biotechnology (SCQP25)

Note:

i. *There will be one Question Paper which will have 100 questions.*

ii. *All questions will be complulsory.*

iii. *The Question Paper will have two Parts i.e. Part A and Part B:*

iv. *Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.*

v. *Part B will have 75 questions based on Subject-Specific Knowledge.*

Plant Biotechnology (SCQP25)

UNIT I

Introduction, Cryo and organ genic differentiation, Types of culture: Seed, Embryo, Callus, Organs, Cell and Protoplast culture. Micro propagation Axillary bud proliferation, Meristem andshoot tip culture, cud culture, organogenesis, embryogenesis, advantages and disadvantages ofmicro propagation.

UNIT- II

In vitro haploid production Androgenic methods: Anther culture, Microspore culture Ando genesis

Significance and use of haploids, Ploidy level and chromosome doubling,

diploidization, Gynogenic haploids, factors effecting gynogenesis, chromosome elimination

techniques for production of haploids in cereals.

UNIT - III

Protoplast Isolation and fusion Methods of protoplast isolation, Protoplast development, Somatic hybridization, identification and selection of hybrid cells, Cybrids, Potential of somatic

Hybridization limitations.

Soma clonal variation

Nomenclature, methods, applications basis and disadvantages

UNIT - IV

Plant Growth Promoting bacteria.
Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation, Biocontrol of pathogens, Growth promotion by free-living bacteria.

Syllabus
for
Soil Science - Soil & Water
Conservation (SCQP26)

Note:

  i.   *There will be one Question Paper which will have 100 questions.*

  ii. *All questions will be complulsory.*

  iii. *The Question Paper will have two Parts i.e. Part A and Part B:*

  iv. *Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.*

  v.   *Part B will have 75 questions based on Subject-Specific Knowledge.*

<u>Soil Science - Soil & Water Conservation (SCQP26)</u>

Soil and Water Conservation Engineering: Forms of precipitation, Hydrology cycle, Point rainfall analysis, frequency analysis, agricultural system, mechanics of water and wind, water management in Agri-Horti-Aquaculture system, mechanics of water and wind erosion, rational method of prediction of peak runoff and its limitation, concept of unit hydrograph and instantaneous hydrograph, factors affecting erosion and runoff, water erosion control measures-contour cultivation, strip cropping, terracing, afforestation, pastures, design of gully control structures- temporary and permanent, steam bank erosion, flood routing, flood amelioration byupstream soil water management, wind erosion control measure and sand dunes stabilization.

Irrigation Pump: Design, construction, performance characteristics, selection installation, servicing and maintenance of different pumps (reciprocating, centrifugal, gear turbine, submersible, propelled jet). Hydraulic and non-renewable power source for pumping solarpumps.

Irrigation and drainage engineering: Water wealth and irrigation in India, soil water plant relationship, forms and occurrence of soil water, methods and devices for soil moisture measurement, water requirement of crops, irrigation scheduling irrigation. Concept of irrigationefficiencies, water conveyance and control, design of canals, Lacey and Kennedy's theories.
Drainage needs and its benefits Darcy's Law, hydraulic conductivity, drainage coefficient drainagemethods, surface drainage (drainage of flat and sloping lands), design of open ditches their alignment and construction, design and layout of subsurface drains, depth and spacing of drainsand drainage outlets, installation of drains and drainage wells, drainage of salt affected areas.

Ground Water Hydrology and tube well Engineering: Occurrence and movement of ground water, steady and transient flow into wells, well interference, well drilling, design of wellassembly and gravel pack, installation of well screen, completion and development of wells.

Use of remote sensing and GIS in planning and development.

Syllabus
for
Statistics (SCQP27)

Statistics (SCQP27)

1. **Sequences and Series:** Convergence of sequences of real numbers, Comparison, root and ratio tests for convergence of series of real numbers.

2. **Differential Calculus:** Limits, continuity and differentiability of functions of one and two variables. Rolle's Theorem, mean value theorems, Taylor's theorem, indeterminate forms, maxima and minima of functions of one and two variables.

3. **Integral Calculus:** Fundamental theorems of integral calculus. Double and triple integrals, applications of definite integrals, arc lengths, areas and volumes.

4. **Matrices:** Rank, inverse of a matrix. Systems of linear equations. Linear transformations, eigenvalues and eigenvectors. Cayley-Hamilton theorem, symmetric, skew-symmetric and orthogonal matrices.

5. **Differential Equations:** Ordinary differential equations of the first order of the form $y' = f(x,y)$. Linear differential equations of the second order with constant coefficients.

6. **Descriptive Statistics and Probability:** Measure of Central tendency, Measure of dispersion, skewness and Kurtosis, Elementary analysis of data. Axiomatic definition of probability and properties, conditional probability, multiplication rule. Theorem of total probability. Bayes' theorem and independence of events.

7. **Random Variables:** Probability mass function, probability density function and cumulative distribution functions, distribution of a function of a random variable. Mathematical expectation, moments and moment generating function. Chebyshev's inequality.

8. **Standard Distributions:** Binomial, negative binomial, geometric, Poisson, hyper- geometric, uniform, exponential, gamma, beta and normal distributions. Poisson and normal approximations of a binomial distribution. Chi-square distribution, t-distribution and F-distribution.

9. **Joint Distributions:** Joint, marginal and conditional distributions. Distribution of functions of random variables. Product moments, correlation, simple linear regression. Independence of random variables Limit Theorems: Weak law of large numbers. Central limit theorem (i.i.d. with

finite variance case only).

10. **Estimation:** Unbiasedness, consistency and efficiency of estimators, method of moments and method of maximum likelihood. Sufficiency, factorization theorem. Completeness, Rao-Blackwell and Lehmann-Scheffe theorems, uniformly minimum variance unbiased estimators. Rao-Cramer inequality. Confidence intervals for the parameters of univariate normal, two independent normal, and one parameter exponential distributions.

11. **Testing of Hypotheses:** Basic concepts, applications of Neyman-Pearson Lemma for testing simple and composite hypotheses. Likelihood ratio tests.

12. **Sampling and Designs of Experiments:** Simple random sampling, stratified sampling and Cluster sampling, One-way, two-way analysis of variance. CRD, RBD, LSD and 2^2 and 2^3 factorial experiments.

Syllabus
for
Zoology (SCQP28)

Note:

   i.   *There will be one Question Paper which will have 100 questions.*

   ii.   *All questions will be complulsory.*

   iii.   *The Question Paper will have two Parts i.e. Part A and Part B:*

   iv.   *Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.*

   v.   *Part B will have 75 questions based on Subject-Specific Knowledge.*

Zoology (SCQP28)

- Cell Biology
- Bio chemistry
- Molecular Biology
- Ecology
- Evolution
- Biodiversity & Environment Conservation
- Immunology
- Genetics
- Bio techniques
- Vertebrates and Invertebrates
- Developmental Biology
- Biostatistics
- Animal Physiology
- Recombinant DNA technology

Syllabus
for
Atmospheric Science (SCQP29)

Note:

  i.   *There will be one Question Paper which will have 100 questions.*

  ii.   *All questions will be complulsory.*

  iii. *The Question Paper will have two Parts i.e. Part A and Part B:*

  iv.   *Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.*

  v.   *Part B will have 75 questions based on Subject-Specific Knowledge.*

Atmospheric Science (SCQP29)

Physics:

Properties of Matter, Equations of motion, Gravitation, Keplers laws, Heat and Thermodynamics, Electrodynamics, Optics, Modern Physics and Laws of Radiation.

Mathematics:

Ordinary differential equation and their solution, determinants and matrices (Fundamentals), Fourier series, Laplace Transform, Conic Section, Set Theory and Complex Variables.

Statistics:

Measures of central tendency, dispersion. Significance tests and linear correlation.

Computer Science:

Fundamentals of Computer, computer architecture, operating systems, Database Management System, Foundation of programming

Earth & Environment:

Earth Interior, Distribution of oceans and continents, composition and structure of atmosphere, world climate and climate change, physical environment, Environmental Pollution and its abatement, Environmental Awareness.

Syllabus
for
Animal Science (Poultry)
(SCQP30)

Note:

i.   *There will be one Question Paper which will have 100 questions.*

ii.   *All questions will be complulsory.*

iii.   *The Question Paper will have two Parts i.e. Part A and Part B:*

iv.   *Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.*

v.   *Part B will have 75 questions based on Subject-Specific Knowledge.*

Animal Science (Poultry) (SCQP30)

1. **Importance of Agriculture/Fishery/Livestock in National Economy:** Principle of crop ecology and crop adaptation, climate shift and its ecological implications. Agro-ecological regions in India. Geographical distribution of Livestock, Green House effect, Climatic factors and their effect on livestock and animal productivity, Role of GIS and GPS in agriculture. Major diseases of cattle and poultry and their management. Important rural development programmes in India, organisational set up of Animal Science research, education and extension in India; Elements of statistics.

2. **Genetics and Animal Breeding:** Biostatistics and computer applications, Principles of Genetics and Population Genetics, Livestock & Poultry Breeding.

3. **Livestock Economics:** livestock Production Economics, Marketing and price analysis, Finance and Project Management, Benefit-cost analysis, Project & Policies.

4. **Animal Husbandry Extension Education:** Livestock based livelihoods & their evolution, extension education & development, rural sociology in vetenary extension, transfer of technology for livestock development, communication and extension teaching methods, livestock entrepreneurship.

5. **Food Technology:** Livestock and Poultry food processing, industries/institutions. Food presentation and storage, Food microbiology.