



SHRI GURU RAM RAI UNIVERSITY

Patel Nagar, Dehradun-248001, Uttarakhand, India

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s 2(f) of UGC Act 1956]

1. Eligibility criteria for Applicants:

An applicant who has passed Post Graduate Degree Examination with at least 55% marks or with an equivalent Grade Point Average (GPA). Relaxation of 5% in the required percentage of marks will be given to applicants belonging to SC/ST/OBC (non-creamy layer)/differently-abled categories.

2. Written test:

For RET, there would be two papers i.e. **Paper-I and Paper-II** (Paper-I would be Research Methodology of 50 marks and Paper-II would be Subject specific of 50 marks. Both papers will have 50 questions each with multiple choices). The Entrance Test shall be of two hour duration (i.e. 120 minutes). Applicants have to qualify in aggregate with 50% (45% in case of reserved categories) marks. After qualifying the entrance examination, the applicant has to face a viva voce of 50 marks. Selected applicants list will be displayed on university web site; www.sgrru.ac.in.

3. Exemption from RET:

The applicants fulfilling at least one of the following conditions:

- Qualified in NET/SET/GATE/GPAT examination of the apex bodies as CSIR/UGC/ICAR/ICMR/DBT/AICTE.
- M.Phil Degree in a relevant subject obtained from any Recognized University.
- Senior citizen of age of 60 years and above with Master's degree.
- Candidate such as Advocate/Doctor/Artist/Industry Professional/Employee of Government/Semi-Government Organizations with Post Graduate Degree (at least 55% marks) and 10 years of professional experience.

The applicants entitled for exemption from RET shall also submit the application form along with relevant supporting documents within the stipulated period.

RET Paper I: Research Methodology

Unit I-Concept & Types of Research

Meaning and importance of Research – Types of Research – Selection and formulation of Research Problem – Research Design, Classification of Research, Pure and Applied Research, Exploring or Formulative Research, Descriptive Research, Diagnostic Research/Study, Evaluation research/Studies, Action Research, Experimental Research, Analytical Study of Statistical Method, Historical Research.

Unit II –Methods Research

Surveys, Case Study, Field Studies General Survey of various Methods including Survey Method, Interdisciplinary Method, Case Study Method, Sampling Method, Statistical Method, Observation Method, Interview Method, Schedule Method, Questionnaire Method, Documentary Method, Library Method, Historical Method and Scientific Method. Characteristic Features of Scientific Method; Empirical Verifiable, Cumulative, Self - Correcting, Deterministic, Ethical & Ideological neutrality (Value Free), Statistical Generalizability.

Unit III - Data Collection and Data Analysis

Collection, Objectives and Classification of Data, Aims, Methods and Objects of Tabulation of Data, Forms and Processes of Interpretation and Presentation of Data.

Primary, Secondary and Tertiary Data. Construction and adaptation of instruments, administration of questions and tests, Tabulation of data. Data organization in SPSS & Excel, Graphical representation of data

Definition and Aims of Content Analysis, Problems of Content Analysis, Computer and Content Analysis Discussion and Interpretation of results, Testing of Hypothesis: Logical and Statistical Techniques.

Unit IV: Report Writing

Locating Information on a Topic of Interest, Acquiring Copies of Articles of Interest, The Nature of Scientific Variables, Conceptual Versus Operational Definitions of Variables, Levels of Measurement, Various Paradigms, The Basic Format for a Research Report, Identification of the Parts of a Research Report, Citation and Referencing Styles, Essentials of Report Writing, Aids for Writing Good Research Report.

References:

- 1) Bagchi, Kanak Kanti (2007) Research Methodology in Social Sciences: A Practical Guide, Delhi, Abijeet Publications.
- 2) Kothari, C.R (2004) Research Methodology: An Introduction, Delhi, New Age.

RET Paper II: Subject Specific

1. Soil Science

UNIT- I

Soil fertility and soil productivity; nutrient sources – fertilizers and manures; essential plant nutrients - functions and deficiency symptoms, soil and fertilizer nitrogen – sources, forms, immobilization and mineralization, nitrification, denitrification. Biological nitrogen fixation -types, mechanism, microorganisms and factors affecting; nitrogenous fertilizers and their fate in soils; management of fertilizer nitrogen in lowland and upland conditions for high fertilizer use efficiency.

Soil and fertilizer phosphorus - forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behavior in soils and management under field conditions. Potassium - forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions, sulphur - source, forms, fertilizers and their behavior in soils; calcium and magnesium–factors affecting their availability in soils; management of sulphur, calcium and magnesium fertilizers. Micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability.

Common soil test methods for fertilizer recommendations; quantity– intensity relationships; soil test crop response correlations and response functions, fertilizer use efficiency; blanket fertilizer recommendations – usefulness and limitations. Site- specific nutrient management; plant need based nutrient management; integrated nutrient management, soil fertility evaluation - biological methods, soil, plant and tissue tests; soil quality in relation to sustainable agriculture.

UNIT-II

Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge soil components, surface charge characteristics of soils. Diffuse double layer theories of soil colloids, zeta potential, stability, coagulation/flocculation and peptization of soil colloids; electrometric properties of soil colloids; sorption properties of soil colloids.

Soil organic matter - fractionation of soil organic matter and different fractions, clay-organic interactions. Ion exchange processes in soil; cation exchange- theories based on law of mass action (Kerr-Vanselow, Gapon equations, hysteresis, Jenny's concept), adsorption isotherms, donnan-membrane equilibrium concept, clay-membrane electrodes and ionic activity measurement,; anion and ligand exchange – innersphere and outer-sphere surface complex formation. Fixation of oxyanions, hysteresis in sorption-desorption of oxy-anions and anions, shift of PZC on ligand exchange, AEC, CEC; experimental methods to study ion exchange phenomena.

UNIT-III

Concept of soil individual; soil classification systems – historical developments and modern systems of soil classification with special emphasis on soil taxonomy; soil classification, soil mineralogy and soil maps – usefulness.

Soil survey and its types; soil survey techniques - conventional and modern; soil series – characterization and procedure for establishing soil series; benchmark soils and soil correlations; soil survey interpretations; soil mapping, thematic soil maps, cartography, mapping units, techniques for generation of soil maps.

UNIT-IV

Preparation of solutions for standard curves, analytical reagents, qualitative reagents, indicators and standard solutions for acid-base, oxidation reduction and complexometric titration. Soil, water and plant sampling techniques, their processing and handling. Estimation of phosphorus, ammonium and potassium fixation capacities of soils. Principles of visible, ultraviolet and infrared spectrophotometry, atomic absorption, flame-photometry, inductively coupled plasma spectrometry; chromatographic techniques.

Electrochemical titration of clays; estimation of exchangeable cations (Na, Ca, Mg, K); estimation of root cation exchange capacity. Analysis of soil and plant samples for N, P, K, Ca, Mg, S, Zn, Cu, Fe, Mn, B and Mo. Analysis of plant materials by digesting plant materials by wet and dry ashing and of soil by wet digestion method.

2. Plant Pathology

Unit-I

Introduction, definition of different terms, basic concepts. Importance of mycology in agriculture, relation of fungi to human affairs. History of mycology. Concepts of nomenclature and classification, fungal biodiversity, reproduction in fungi. The comparative morphology, ultrastructure, characters of different groups of fungi up to generic level: (a) Myxomycota and (b) Eumycota- i) Mastigomycotina ii) Zygomycotina, iii) Ascomycotina, iv) Basidiomycotina, v) Deuteromycotina. Lichens types and importance, fungal genetics and variability in fungi.

Unit-II

Methods to prove Koch's postulates with biotroph and necrotroph pathogens., Pure culture techniques. Use of selective media to isolate pathogens. Preservation of plant pathogens and disease specimens. Use of centrifuge, pH meter, micrometer, haemocytometer, camera lucida. Microscopic techniques and staining methods, phase contrast system. chromatography, Use of electron microscope, spectrophotometer, ultracentrifuge and electrophoretic apparatus. Disease diagnostics, serological and molecular techniques for detection of plant pathogens. Evaluation of fungicides, bactericides etc. Field experiments, data collection. Preparation of manuscripts. Importance, definitions and concepts of plant diseases.

Unit-III

History and growth of plant pathology, biotic and abiotic causes of plant diseases., Growth, reproduction, survival and dispersal of important plant pathogens. Role of environment and host nutrition on disease development, Host parasite interaction, recognition concept and infection. Symptomatology. Disease development- role of enzymes, toxins, growth regulators; defense strategies- oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors. Altered plant metabolism as affected by plant pathogens. Genetics of resistance; 'R' genes; mechanism of genetic variation in pathogens. Molecular basis for resistance, marker-assisted selection. Genetic engineering for disease resistance. Disease management strategies.

History and introduction to phytopathogenic procarya, viz., bacteria, MLOs, spiroplasmas and other fastidious procarya. Importance of phytopathogenic bacteria. Evolution, classification and nomenclature of phytopathogenic procarya and list of important diseases caused by them. Growth, nutrition requirements, reproduction, preservation of bacterial cultures and variability among phytopathogenic procarya. General biology of bacteriophages, L form bacteria, plasmids and bdellovibrios. Procaryotic inhibitors and their mode of action against phytopathogenic bacteria. Survival and dissemination of phytopathogenic bacteria. Soil as an environment for plant pathogens, nature and importance of rhizosphere and rhizoplane, host exudates, soil and root inhabiting fungi. Types of biocontrol agents. Inoculum potential and density in relation to host and soil variables, Competition, predation, antibiosis and fungistasis. Suppressives soils, biological control- concepts and potentialities for managing soil borne pathogens.

History of plant viruses, composition and structure of viruses. Symptomatology of important plant viral diseases. Transmission, chemical and physical properties, host virus interaction, virus vector

relationship. Virus nomenclature and classification, genome organization, replication and movement of viruses. Isolation and purification, electron microscopy, protein and nucleic acid based diagnostics. Mycoviruses, phytoplasma arbo and baculoviruses, satellite viruses, satellite RNAs, phages, Viroids, prions. Principles of the working of electron-microscope and ultra- microtome. Origin and evolution, mechanism of resistance. genetic engineering, ecology, and listing of important diseases and their management.

UNIT-IV

Principles of plant disease management by cultural, physical, biological, chemical, organic amendments and botanicals methods of plant disease control. Integrated control measures of plant diseases. Disease resistance and molecular approach for disease management. Foliage, seed and soil application of chemicals, role of stickers, spreaders and other adjuvants, health vis-a-vis environmental hazards, residual effects and safety measures. History of fungicides, bactericides, antibiotics, concepts of pathogen, immobilization, chemical protection and chemotherapy. Nature, properties and mode of action of antifungal, antibacterial and antiviral chemicals.

History and development of chemicals, definition of pesticides and related terms; advantages and disadvantages of chemicals. Classification of chemicals based on chemical nature and mode of action used in plant disease control and their management. Chemicals in plant disease control, viz., fungicides bactericides and botanicals. Formulations and applications of different fungicides; chemotherapy and phytotoxicity of fungicides. Handling, storage and precautions to be taken while using fungicides; compatibility with other agrochemicals, persistence, cost-benefit ratio, factor affecting fungicides. General account off plant protection appliances; environmental pollution, residues and health hazards, fungicidal resistance in plant pathogens and its management.

Concept of biological control, definition, importance, principles of plant disease management with bioagents, history of biological control, merits and demerits of biological control. Types of biological interactions, competitions, mycoparasitism, exploitation for hypovirulence , rhizosphere colonization, competitive saprophytic ability, antibiosis, induced mechanism and its relevance in biological control. Factors governing biological control, role of physical environment, agroecosystem, operational mechanisms and cultural practices in biological control of plant pathogens, biocontrol agents, comparative approaches to biological control of plant pathogens b resident and introduced antagonists, control of soil-borne and foliar diseases. Compatibility of different bio-agents. Commercial production of antagonists, their delivery systems, application and monitoring . biological control in IDM, IDM and organic farming system, bio-pesticides available in market. Quality control system of bio-control agents.

UNIT-V

History and economic importance of seed pathology in seed industry, plant quarantine and SPS under WTO. Morphology and anatomy of typical monocotyledonous and dicotyledonous. infected seeds. Recent advances in the establishment and subsequent causes of disease development in seed and seedling. Localization and mechanism of seed transmission in relation to seed infection, seed to plant transmission of pathogens. Seed certification and tolerance limits, types of losses caused b seed borne diseases in true and vegetative propagated seeds. Epidemiological factors influencing the transmission of seed borne diseases, forecasting of epidemics through seed borne infection. Production of toxic metabolites affecting seed quality and its impact on human, animal and plant health.

3. SEED SCIENCE AND TECHNOLOGY

Unit 1:

Seed Biology, Floral biology, mode of reproduction, sporogenesis, pollination, fertilization, embryogenesis, fruit and seed development and physiological and harvestable maturity. Apomixis, parthenocarpy, polyembryony and somatic embryoids and synthetic seeds. Seed structure of monocot and dicot. Seed maturation and maturation drying in orthodox and recalcitrant seed. Seed chemical composition. Seed dormancy – types, causes, methods to overcome dormancy. Seed germination – phases, types and requirements. Physiological and biochemical changes in germinating seed. Role of hormones in dormancy and germination.

Unit 2:

Seed Production Genetic purity – concept and factors responsible for deterioration of varieties. Maintenance breeding. Generation system of seed multiplication. Seed production agencies – public and private. Compact area approach / seed village concept in seed production. Seed Replacement Rate, Seed Multiplication Ratio, Seed Renewal Period, Varietal Replacement Rate. Seed production planning. Factors affecting pollination and seed set viz., temperature, humidity, wind velocity, insect pollinators and supplementary pollination. Male sterility, self-incompatibility and their role in hybrid seed production. Techniques of hybrid seed production – emasculation and pollination, detasseling, male sterility, sex expression, self-incompatibility and chemical hybridizing agents. Principles and methods of seed production of varieties and hybrids of cereals – wheat, paddy, sorghum, pearl millet and maize; pulses – chickpea, pigeon pea, green gram, black gram, soybean and cowpea; oilseeds – groundnut, brassica, sesame, sunflower and castor; fibre crops – cotton and jute; vegetable crops – tomato, brinjal, okra, chilli, cabbage, cauliflower, radish, knolkhol, turnip, carrot and cucurbitaceous crops; important forage legumes – lucerne, desmanthus and grasses – cumbunapier and fodder sorghum ; plantation crops – coffee, tea, rubber, cocoa, cardamom, coconut and pepper. Disease free clonal propagation of crops – potato, sugarcane, tapioca, fruit crops – mango, citrus, apple, pear, plum. Clonal propagation of annual and perennial flowers like rose, gladiolus, chrysanthemum, marigold, dahlia, phlox and petunia. Clonal standards and degenerations. Micro propagation.

Unit 3:

Seed Processing, Principles of seed processing. Processing sequence for different crops. Layout of seed processing unit. Seed drying – principles and methods. Pre-cleaning, grading, upgrading, seed treatment and packaging. Working principles of seed processing machines viz., cleaner cum grader, specific gravity separator, indented cylinder separator and seed treater. Seed quality maintenance during processing. Seed enhancement techniques – seed coating, pelleting and priming.

Unit 4:

Seed Quality Control Seed legislation – the Seeds Act 1966, Seed Rules 1968, Seed Control Order, 1983 and Seed Bill 2004. Seed certification – history, concept, organization, phases and Indian minimum seed certification standards. Field inspection principles and methods. Inspection at

harvesting, threshing and processing. Pre- and post-processing quality testing of seed. Seed testing concepts and objectives, its role in seed quality control. Seed sampling, seed moisture testing, purity analysis, germination testing, tolerance limit and seed testing equipments. Quick viability test and seed standards. Seed vigour, its significance and testing methods. Testing for genuineness of varieties – principles and methods based on seed, seedling and plant characters, biochemical techniques – electrophoresis of proteins and isoenzymes and DNA fingerprinting. International Seed Testing Association (ISTA), its role in development of seed testing procedures, rules and seed quality assurance for international seed trade. OECD seed certification guideline – agricultural and vegetable crops.

Unit 5:

Seed Storage Seed storage – principle – purpose and types – short, medium and long term storage. Factors affecting seed storage and role of moisture, temperature and relative humidity. Viability nomographs. Longevity of orthodox and recalcitrant seeds. Seed deterioration causes and methods of control. Physiological, biochemical and molecular changes in seed ageing. Controlled storage. Germplasm storage. Cryo preservation. Seed storage containers, types – safe moisture content. Storage structures. Methods of stacking and their impact on seed quality. Seed storage godown maintenance and sanitation. Management of carry over seed.

Unit 6:

Seed Health Significance of seed health. Procedures for seed health test and rules. Externally and internally seed – borne pathogens, mode of infection, development and spread, methods of detection. Important seed-borne diseases of cereals, oilseeds, pulses, fibre crops, vegetables and their control measures. Quarantine and International procedures of phytosanitary certificates. Important storage pests, their identification, monitoring and detection. Use of pesticides, botanicals, mycotoxins for seed treatments. Carry over infestation, principles of fumigation and safe use of fumigants.

Unit 7:

Seed Industry Development and Marketing National and International seed industry development. Role of OECD and WTO in International seed trade. International Seed Federation (ISF). Market survey, demand forecasting, pricing policies, marketing channels, planning and sales promotion. Economics of seed production. Role of Government, semi Government, cooperative and private sectors in seed trade. Responsibilities of seed companies and dealers in Seed Act. Seed import and export.

Unit 8:

Protection of Plant Varieties Plant Variety Protection (PVP) and its significance. International Union for the Protection of New Varieties of Plants (UPOV) and its role in development of Plant Breeders Rights and Seed Industry Development. UPOV 1978 and 1991 Acts. Plant Breeders Rights and exceptions to it. Breeders exemption and farmers privilege. Plant patent v/s Plant breeders rights. Impact of PVP on seed supply system. Protection of Plant Varieties and Farmers' Right Act, 2001, its

essential features. Criteria for protection of different types of plant varieties. DUS testing principles and application. Breeders, Researchers and farmers rights. Compulsory licensing. Indian Biological Diversity Act, its essential features. Access to Biological resources, benefit sharing.

4. Botany

Unit I

Cryptogams and Phanerogams: A General account, Diagnostic features for classification of flowering plants; ICN, Taxonomic Tools and evidences, Nature, causes and classification of plant pathogen; Dissemination and methods of preservation and control of plant diseases, Host-parasite relationship, plant defense mechanism.

Unit II

Fungal and Bacterial disease of plant crops- rice, wheat, maize, sugarcane, cotton and groundnut; fruit crops- apple, peach, mango, citrus and grapes; vegetable crops- crucifers, tomato, potato and brinjal; other crops- tobacco, turmeric and coriander. Introduction to mushroom groups, taxonomic study of order Agaricales, Ecology of mushrooms, role of mushrooms in forest ecosystems, Mycorrhiza: VAM fungi, ectomycorrhiza and forest ecosystem. Tissue culture of wild mushrooms; Preparation of herbarium: methods of collection, identification and preserving wild mushrooms. Cultivation of edible and medicinal mushrooms: Volvariella, Agaricus, Pleurotus, Lentinus, Ganoderma.

Unit III

Physiology and Biochemistry: Functions of biological molecules, cell and organisms as biochemical entities; Metabolism and biochemical energetic, Palynology: General Introduction and history, Importance of Palynology in plant taxonomy, pollen biotechnology, aerobiology and pollen allergy, forensic palynology, melissopalynology, palaeopalynology and in hydrocarbon exploration.

Unit IV

Plant Breeding: Objectives, activities and achievements. Breeding methods for self, cross pollinated and clonal crops; Breeding for resistance to various stresses and quality; Biotechnology applications in crop improvement, IPR and plant breeders rights (PBR). Green Revolution.

Unit V

Biodiversity: Concept, biodiversity of major groups including microbial biodiversity, distribution, maintenance and loss of biodiversity. Conservation of Biodiversity: Concept, Environmental policies, Biosphere Reserves, National Parks, Sanctuaries, Botanical Gardens, Pollen storage and Seed Banks, Tissue culture and role of biotechnology in conservation of biodiversity; Cryopreservation. CITES, IUCN, Ethnobotany: A General account. Forest types of Uttarakhand and other Himalayan provinces, Forest heritage in Garhwal Himalaya; Classification; forest products (NTFPs, medicinal and aromatic plants, fibre, etc.),

5. Chemistry

Unit I

Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory). Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis. Cages and metal clusters. Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron-transfer reactions; nitrogen fixation, metal complexes in medicine. Solid state: Crystal structures; Bragg's law and applications; band structure of solids

Unit II

Basic principles of quantum mechanics: Postulates; operator algebra; exactly-solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules. Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions. Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.

Unit III

Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways. Common named reactions and rearrangements – applications in organic synthesis. Pericyclic reactions – electrocycloisatation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.

Unit IV

Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S), Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Polymer chemistry: Molar masses; kinetics of polymerization

Unit V

Characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-vis, NQR, MS, electron spectroscopy and microscopic techniques. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis. Structure determination of organic compounds by IR, UV-VIS, ^1H & ^{13}C NMR and Mass spectroscopic techniques.

6. Mathematics

UNIT – I

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

UNIT – II

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, power series, Transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Taylor series, Laurent series, and calculus of residues.

Algebra: Permutations, combinations, Euler's ϕ -function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homomorphism, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions, Galois Theory.

UNIT – III

Ordinary Differential Equations (ODEs):

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

Partial Differential Equations (PDEs):

Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant Coefficients. Method of separation of variables for Laplace, Heat and Wave equations.

UNIT – IV

Numerical Analysis: Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

UNIT – V

Descriptive statistics, exploratory data analysis. Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic functions. Standard discrete and continuous univariate distributions. Linear programming problem, simplex methods, duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1.

7. Physics

I. Mathematical Physics

Inverse and Trace of Matrix, Unitary Matrices, Orthogonality, Eigen values-Eigen vectors and Diagonalisation of matrices, Function of complex variable, Analytic functions, Cauchy's integral theorem and Cauchy's integral formula, theorem of residues, Contour integration.

II. Classical Mechanics

Newton's laws. Dynamical systems, Central force motions. Two body Collisions - scattering in laboratory and Centre of mass frames. Rigid body dynamics- moment of inertia tensor. Non-inertial frames and pseudoforces. Lagrangian and Hamiltonian formalism and equations of motion.

III. Quantum Mechanics

Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box). Wavefunction in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of angular momenta; Hydrogen atom. Stern-Gerlach experiment. Time-independent perturbation theory and applications.

IV. Atomic & Molecular Physics

Atomic models, Basic nuclear properties: size, shape and charge distribution, spin and parity, Quantum states of an electron in an atom. Electron spin. Spectrum of helium and alkali atom. hyperfine structure and isotopic shift, LS & JJ couplings. Zeeman, Paschen-Bach & Stark effects. Electron spin resonance. Nuclear magnetic resonance, chemical shift. Frank-Condon principle.

V. Condensed Matter Physics

Bravais lattices. Reciprocal lattice, structure factor, Bonding of solids. Free electron theory and electronic specific heat. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. band theory of solids: metals, insulators and semiconductors. Superconductivity: type-I and type-II superconductors. Defects and dislocations.

8. Marketing

Unit 1:

Meaning and Definition of Management, Principles of Management, Meaning of Communication and its types, Meaning of Human Resource Management and Human Resource Planning, Meaning of a Company and its formation.

Unit 2:

Introduction of Economics, Definitions, Principles of Economics, Theory of Demand and Supply, Indifference Curve Analysis, Demand Forecasting, Demand Analysis, Classical approach: Implications – Keynesian approach, Economic Functions of Modern Government – Role of Government in Economic Planning and Market Governance.

Unit 3:

Overview of Financial Management, Capital Budgeting, Concept of Capital Structure, Characteristics and Objectives of Management Accounting, Information Integrity of Accounting Information, Professional Organizations - Competence, Judgment, and Ethical Behavior Accounting Systems: Basic Functions of an Accounting System - Designing and Installation Accounting Systems, Introduction to Statistics, Calculation of Mean, Median, Mode and Standard Deviation.

Unit 4:

Introduction of Marketing and its functions, Pricing Strategies, Introduction to Marketing Research, Qualitative and quantitative research methods, Sampling methods, Questionnaire design, reliability and validity, Emerging Trends in marketing: Rural Marketing, Green marketing, Experiential marketing, Digital Marketing, e-business, Online marketing, Online retailing, Media marketing and advertising, Brand Management

Unit 5:

Social Entrepreneurship Social entrepreneurship, social entrepreneurs as change agents, financial sustainability Social entrepreneurship in India and abroad, Business ethics Corporate Social responsibility Corporate governance, Succession Planning Business growth and need of succession Planning in India. Its role and importance in expansion management.

9. Mass Communications

UNIT-I INTRODUCTION TO COMMUNICATION

Origin, growth and development of communications media – print, film, radio and television
Communication Theories – Four Theories of Press and other Theories. Fundamentals of
Communication – Definition, Nature, Scope, Types and Functions. Communication Models and
Theories. Fundamentals of Journalism – Definition, Nature, Scope and Functions

UNIT II- PRINT MEDIA AND MEDIA LAWS ETHICS

Qualifications, Duties and Responsibilities of Journalists. Principles and Practices of Editing and
Designing. Basics of News – Concept, Elements, News Sources, Structure of News, Principles of
News Writing Feature Writing. Specialized Reporting. Salient Features of Indian Constitution –
Preamble, Directive Principles of State Policy, Fundamental Rights and Duties. Freedom of Speech
and Expression in India. Major Media Laws of India .Press Council of India and Press Commissions.
Media Ethics and Code of Conduct for Media Professionals

UNIT III- ADVERTISING AND PUBLIC RELATIONS

Fundamentals of Advertising Types, Functions and Significance. Fundamentals of Public Relations
– Concept, Nature, Scope, Types, Functions and Significance. Advertising Agency – Structure,
Resources, Functions and Significance. Public Relations Management – Types of Publics and Art of
Management of Different Public Relations (Investor Relations, Employee Relations, Supplier
Relations, Distributor Relations, Customer Relations, Media Relations, Government Relations,
Community Relations etc. Corporate Communication – Role of Communication in Corporate Houses,
Corporate Communication Principles and Practices

UNIT IV- COMMUNICATION RESEARCH

Fundamentals of Communication Research. Defining Research Problem, Review of Literature,
Research Design, Primary Data Collection, Statistical Analysis, Results and Discussion, Testing of
Hypothesis, Sampling etc. Types of Media Research –Quantitative and Qualitative. Data Collection
and Analysis Procedures, Principles and Techniques of Writing Research paper

UNIT V- ELECTRONIC MEDIA AND NEW MEDIA PRODUCTION

Writing for Electronic Media – Principles and Techniques. Production for Radio and Television.
Production of Multi-Media Contents. Types of New Media – Computer, Internet, E-mail, Mobile
Phone, Video Streaming, Video Conferencing etc..Web Designing – Concept, Nature, Scope, Web
Language, Presentation, Multi-Media Production d) Cyber Laws and Ethics

UNIT VI - Current Affairs

General Awareness , Important Issues in the world and India - Political, Economical , Trade ,
Environment and Social Issue etc

10. Music

UNIT-I

1. History of Music-Vedic Time to 20th century.
2. Gharana and style of Music-Gwalior,Agara,Banaras,Dilli,Punjab etc.

UNIT -II

Detail study of Sangeet Utpatti; Musical scales (Indian and western); Detail study of Gram, Murchchhana and Chatussarna; Jaati Lakshana, Jaati Bheda, concept of Raag, Raag-Lakshana. Classification of Raag: 1) Gram Raag and Deshi Raag Classification 2) Male Raag classification 3) Thaata Raag classification 4) Shuddha, Chhayalaga and Sankeerna Raag classification 5) Raag-Ragini classification 6) Raagang classification; Time theory of Raagas; Placement of shuddha and vikrit swaras on shruties in Ancient, Medieval and Modern Period; Description of popular Raagas and Taalas;

UNIT -III

Notation systems of Hindustani, Karnataka and Western Music; Merits and demerits of a vocalist (Gayak); Comparative studies of Hindustani and Karnatak Swaras and Taalas; Karnatak names of Popular Hindustani Ragas; Knowledge of different Layakaaries such as dugun, Tigun, Chaugun, Aad, Kuad and Viaad.

UNIT -IV

- 1-Critical Study of Ragas and-Bhairav Bhoopali, Yaman, Malkauns, Chandrakauns, Bhimpalasi etc.
- 2-Critical study of Talas. Teental, Chartal, Ektal, Dhamar tal etc.

UNIT-V

Rasa, Principles of Rasa according to Bharata and others.

Rasa nishpatti and its application to Indian Classical Music.

Bhava and Rasa Rasa in relation to swara, laya, tala, chhanda and lyrics.

11. Pharmacy Practice

Unit I Clinical Pharmacy Practice

Definitions, development and scope of clinical pharmacy, Introduction to daily activities of a clinical pharmacist, Patient data analysis: The patient's case history, its structure and use in evaluation of drug therapy. Drug & Poison information, Pharmacovigilance: Scope, definition and aims, adverse drug reactions, causality assessment [different scales used], Reporting, evaluation, monitoring, preventing & management of ADRs. Pharmaceutical care concepts, Medication errors.

Unit II Hospital Pharmacy

Hospital - its Organisation and functions, Hospital pharmacy-Organisation and management: Organizational structure-Staff, Infrastructure & work load statistics, Roles & responsibilities of hospital pharmacist. The Budget – Preparation and implementation, Hospital drug policy: Pharmacy and Therapeutic committee (PTC), Hospital formulary, Hospital committees, Developing therapeutic guidelines. Hospital pharmacy services: Procurement & warehousing, Inventory control, Drug distribution in the hospital.

Unit III Pharmacotherapeutics

Etiopathogenesis and pharmacotherapy of disease associated with the following systems/diseases- Cardiovascular system, Respiratory system, Endocrine system, renal system, Gastrointestinal system, Haematological system, Dermatology, Musculoskeletal disorders, Infectious disease, Oncology.

Unit IV Clinical Research

Drug development process, Clinical development of drug: Introduction to Clinical trials, Various phases of clinical trial, Abbreviated New Drug Application submission, Good Clinical Practice – ICH, GCP, Central drug standard control organisation, (CDSCO) guidelines, Ethical guidelines in Clinical Research, Composition, responsibilities, procedures of IRB / IEC, Overview of regulatory environment in USA, Europe and India, Role and responsibilities of clinical trial personnel as per ICH GCP- Sponsor, Investigators, Clinical research associate, Auditors, Contract research coordinators, Regulatory authority. Informed consent Process

Unit V Pharmacoepidemiology & Pharmacoeconomics

Introduction to Pharmacoepidemiology, Outcome measurement, Concept of risk, Pharmacoepidemiological Methods, Introduction to Pharmacoeconomics, Cost categorization, Outcomes and Measurements of Pharmacoeconomics, Pharmacoeconomic evaluations.

12. Pharmacognosy

Unit I

Plant drug cultivation: General introduction to the importance of Pharmacognosy in herbal drug industry, Indian Council of Agricultural Research, Current Good Agricultural Practices, Current Good Cultivation Practices, Current Good Collection Practices, Conservation of medicinal plants- Ex-situ and In-situ conservation of medicinal plants.

Unit II

Extraction and Phytochemical studies: Recent advances in extractions with emphasis on selection of method and choice of solvent for extraction, successive and exhaustive extraction and other methods of extraction commonly used like microwave assisted extraction, Methods of fractionation. Separation of phytoconstituents by latest CCCET, SCFE techniques, including preparative HPLC and Flash column chromatography.

Unit III

Evaluation of cosmetic products: Determination of acid value, ester value, saponification value, iodine value, peroxide value, rancidity, moisture, ash, volatile matter, heavy metals, fineness of powder, density, viscosity of cosmetic raw materials and finished products. Study of quality of raw materials, general methods of analysis of raw material used in cosmetic manufacture as per BIS.

Unit IV

Herbal drug industry: Infrastructure of herbal drug industry involved in production of standardized extracts and various dosage forms. Current challenges in upgrading and modernization of herbal formulations. Entrepreneurship Development, Project selection, project report, technical knowledge, Capital venture, plant design, layout and construction. Pilot plant scale – up techniques, case studies of herbal extracts. Formulation and production management of herbals.

Unit V

Different tissue culture techniques: Organogenesis and embryogenesis, synthetic seed and monoclonal variation, Protoplast fusion, Hairy root multiple shoot cultures and their applications. Micropropagation of medicinal and aromatic plants. Sterilization methods involved in tissue culture, gene transfer in plants and their applications.

13. (A). Pharmaceutical Chemistry (M.Sc. based)

Unit I

Structure, formation, reaction, stereochemistry and stability of Carbocation, Carbanions, free radicals, carbene, and nitrene. Mechanism involving free radical, nucleophile & electrophile mediated reactions. S_N1 , S_N2 and mixed S_N1 and S_N2 mechanism and its stereo chemical aspects. Factor influencing nucleophilic substitution reactions, Reactivity effects of substrate structure, attacking nucleophilic group, leaving group and reaction medium, ambient nucleophile. Mechanisms involving Aromatic electrophilic reaction, Aromatic nucleophilic reactions, free radical reactions and elimination mechanism. Mechanism and stereo chemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemo selectivity, orientation and reactivity. Addition to cyclo propane ring. Geometrical isomerism & stereochemistry of olefins. Stereoisomerism of rings, stability of rings, ease of ring formation, Actual shape of six membered rings & its relation to properties & reactivity. Optical rotation, its significance, instrumentation. Optical rotatory dispersion-terminology, plain curve, rotatory dispersion & circular dichroism and octane rule.

Unit II

Chromatography: principles , instrumentation and application of following separation techniques Paper chromatography, Thin layer chromatography, Column chromatography, HPLC, GC, HPTLC, Electrophoresis, Ion exchange and Gel filtration chromatography. UV-Visible spectroscopy: Theory, absorption law, Colorimetric Methods, Chromophore and auxochrome concept, Solvent effect, Instrumentation and applications, Woodward's Fieser, Fieser Kuhn and Nelson rule, Spectral correlation with structures. Atomic spectrophotometry: Atomic emission & Atomic absorption spectrophotometry: principle, instrumentation, interferences and applications. Infrared spectroscopy, Interpretation of IR, spectra of simple compounds. NMR, Spectrometry: Principle, ionization techniques, instrumentation, fragmentation pattern & applications. GC-MS and LC-MS: Principle, Instrumentation and Applications.

Unit III

Carbohydrate : Introduction, classification, mutarotation, constituent of glucose, ring structure of glucose, configuration of monosaccharides, structure elucidation of disaccharides- sucrose, maltose, lactose, polysaccharides- starch. Glycosides arbutin ,amygdaline.

Alkaloids : General introduction, distribution in plants, classification, isolation & purification. General methods of structure determination. Structural elucidation of atropine, quinine, Nicotin, Terpenoids : General introduction, classification, isolation & purification, isoprene, structure elucidation of citral, menthol, camphor, Structures of abietic acid and β -carotene. Plant Pigments: Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of cyanidin, and quercetin. Porphyrins: General Introduction of haemoglobin and chlorophyll. Chemistry of chlorophyll (without synthesis). Structure and synthesis of haem.

Heterocyclic compounds: General chemical behaviour of aromatic heterocycles, classification (structural type), Heteroaromatic reactivity and tautomerism in aromatic heterocycles Strain –bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interactions. Stereo-electronic effects, aromatic and related effects. Attractive interactions - hydrogen bonding and intermolecular nucleophilic, electrophilic interactions., Small Ring Heterocycles: Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes, Benzo-Fused Five-Membered Heterocycles: Synthesis and reactions including medicinal applications of benzopyrroles, benzofurans and benzothiophenes, Six-Membered Heterocycles with One, Two or More Heteroatoms: Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and pyridines Synthesis and reactions of quinolizinium and benzopyrylium salts, coumarins and chromones Synthesis and reactions of diazines, triazines, tetrazines and thiazines

Unit-IV

Concept of isosterism and bioisosterism and their applications in drug design, Antimetabolite approach to drug design, Analog drug design, Prodrugs and drug latentiation – Carrier-linked prodrugs – Bioprecursors – Role of functional groups in prodrug design, General pathways of drug metabolism

Specific and non-specific drug action , Drug receptors, Basic concept and classification of receptors, Forces involved in drug receptors- interactions , Receptor agonism and antagonism , Stereochemical aspects of drug action – Stereoselectivity of optical isomers – Role of planarity in drug action – Stereoselectivity of conformational isomers,

Unit-V

Green chemistry: History, need, and goals. Green chemistry and Sustainability. Dimensions of sustainability, Limitations/Obstacles in pursuit of the goals of Green Chemistry. Opportunities for the next generation of materials designers to create a safer future. Hazard assessment and mitigation in chemical industry , Future trends in Green Chemistry: Oxidation-reduction reagents and catalysts, Statistical data analysis: Accuracy and precision, significant figures and computations, mean and standard deviation, distribution of random errors, reliability of results, confidence interval, comparison of results, comparison of means of two samples, paired t-test, number of replicate determinations and its use, correlation and regression, linear regression, analysis of variance, rejection of data.

13(B). Pharmaceutical Chemistry (M. Pharma based)

UNIT 1 Concept of organic reactions

Organic reaction mechanism : Methods of determining reaction mechanisms (kinetic and non-kinetic methods); Energy profile diagrams, reaction intermediates, crossover experiments and isotopic labelling; Order of reactions, reversible, consecutive and parallel reactions, solvent, ionic strength and salt effects; Acid-base catalysis; Nucleophilic substitution reactions; Uni- and bimolecular reactions, attacking and leaving groups, steric and electronic effects; Neighbouring group participation; Formation and hydrolysis of esters, amides and acyl halides; Different mechanisms. Electrophilic substitution reactions; Aromatic electrophilic substitutions including Friedel-Crafts reactions; Addition and elimination reactions.

UNIT II Spectral Analysis

UV-Visible Spectroscopy: Brief review of electromagnetic spectrum, UV-Visible range, energy-wavelength-colour relationships, Interaction of electromagnetic radiation (UVVis) with matter and its effects, Chromophores and their interaction with EMR, BeerLambert's law, Instrumentation of single beam and double beam spectrophotometers and applications.

IR Spectroscopy, Identification of functional groups, confirming the molecules with IR, estimating the purity of compound, finger print region

Mass Spectrometry: Basic principles and brief outline of instrumentation. Ion formation and types, molecular ion, meta stable ions, Fragmentation processes, Fragmentation patterns, Mass spectrum, its characteristics and representation.

NMR : Reference, Chemical shift, solvents used in NMR, D₂O exchange, identification of nature of protons and number of protons on particular chemical environment.

UNIT III Separation Techniques

Chromatography: General principles, classification of chromatographic techniques, normal and reversed phase, bonded phase, separation mechanisms.

Column chromatography: Merits and demerits, short-column chromatography and flash chromatography, vacuum liquid chromatography (VLC), medium pressure liquid chromatography, high pressure liquid chromatography (HPLC).

TLC, HPTLC, over pressure layer chromatography (OPLC), centrifugal chromatography.

Counter-current chromatography, droplet counter-current chromatography, ion-exchange, affinity, size exclusion and ion-pair chromatography.

Gas chromatography, introduction to GC-MS and LC-MS techniques.

UNIT IV Basics of Drug Action

General principles, Identification and study of targets for development of various therapeutic agents, Rational approach for drug design, Computer aided drug design, QSAR, Molecular modelling, Combinatorial Chemistry, Study of recently developed drugs and molecules in development pipeline.

Concept of isosterism and bioisosterism and their applications in drug design, Antimetabolite approach to drug design, Analog drug design, Prodrugs and drug latentiation, Carrier-linked prodrugs, Bioprecursors, Role of functional groups in prodrug design, General pathways of drug metabolism

Specific and non-specific drug action, Drug receptors, Basic concept and classification of receptors, Forces involved in drug receptors- interactions , Receptor agonism and antagonism , Stereochemical aspects of drug action Stereoselectivity of optical isomers, Role of planarity in drug action, Stereoselectivity of conformational isomers.

UNIT V Phytochemistry and Phytopharmaceuticals

Extraction and Phytochemical studies: Recent advances in extractions with emphasis on selection of method and choice of solvent for extraction, successive and exhaustive extraction and other methods. General introduction and classification, isolation and purification methods of alkaloids, structure elucidation of reserpine, atropine and morphine.

Classification, method of isolation, chemistry, degradation, synthetic methods, spectral techniques for structural elucidation and biological activity of flavonoids rutin and quercetin.

Study of chemistry, stereochemical aspects and pharmaceutical importance of plant derived steroids - cardiac glycosides (cholesterol, diosgenin).

General introduction and classification terpenoids; Essential Oils; Production of Essential Oils ; Chemistry and Analysis of Essential Oils ; Biological Activities of Essential Oils ; Aromatherapy with Essential Oils ; Industrial Uses of Essential Oils, Essential Oils Used in Veterinary Medicine; Trade of Essential Oils; Recent EU Legislation on Flavors and Fragrances of Essential Oils.

Recent advances in the chemistry of naturally occurring anti-neoplastic agents (catharanthus alkaloids, camptothecin); antimalarials (cinchona alkaloids, artemisinin derivatives).

14. Human Resource Management

Unit 1:

Meaning and Definition of Management, Principles of Management, Meaning of Communication and its types, Meaning of Human Resource Management and Human Resource Planning, Meaning of a Company and its formation.

Unit 2:

Introduction of Economics, Definitions, Principles of Economics, Theory of Demand and Supply, Indifference Curve Analysis, Demand Forecasting, Demand Analysis, Classical approach: Implications – Keynesian approach, Economic Functions of Modern Government – Role of Government in Economic Planning and Market Governance.

Unit 3:

Overview of Financial Management, Capital Budgeting, Concept of Capital Structure, Characteristics and Objectives of Management Accounting, Information Integrity of Accounting Information, Professional Organizations - Competence, Judgment, and Ethical Behavior Accounting Systems: Basic Functions of an Accounting System - Designing and Installation Accounting Systems, Introduction to Statistics, Calculation of Mean, Median, Mode and Standard Deviation.

Unit 4:

Introduction of Marketing and its functions, Pricing Strategies, Introduction to Marketing Research, Qualitative and quantitative research methods, Sampling methods, Questionnaire design, reliability and validity, Emerging Trends in marketing: Rural Marketing, Green marketing, Experiential marketing, Digital Marketing, e-business, Online marketing, Online retailing, Media marketing and advertising, Brand Management

Unit 5:

Social Entrepreneurship Social entrepreneurship, social entrepreneurs as change agents, financial sustainability Social entrepreneurship in India and abroad, Business ethics Corporate Social responsibility Corporate governance, Succession Planning Business growth and need of succession Planning in India. Its role and importance in expansion management.

15. Education

Unit-I

Philosophical & Sociological Bases of education

Unit-II

Advanced Educational Psychology

Unit-III

Research methodology and Statistics in Education

Unit-IV

Comparative Education and Curriculum Development

16. Biotechnology

Unit I

Plasma membrane: Structure, organisation, lipid bilayer, proteins & glycoconjugates, liposomes. Function- Ionic transport, types of transport (symport antiport, active & passive,), channel proteins. Intracellular compartmentalization Structure, organization and functions of Nucleus, Mitochondria, lysosome, Golgi body, Chloroplast, Peroxisome, Endoplasmic reticulum (Rough and smooth) Cell motility and shape: Structure and functions, Microfilament, Microtubules and Intermediate filament

Unit II

Mechanism of DNA replication in prokaryotes and eukaryotes, Mechanism of transcription in prokaryotes and eukaryotes, Reverse transcription, Post transcriptional processing of RNA: (capping, polyadenylation, splicing, RNA editing), Mechanism of translation in prokaryotes and eukaryotes.

Unit III

DNA sequencing: chemical and enzymatic methods, PCR. Site directed mutagenesis, Ribonuclease protection assay, Gel retardation assay, DNA foot printing, DNA finger printing, DNA profiling, Genomic analysis: Exon-intron trapping, S-1 mapping, RFLP, RAPD, AFLP. Gene therapy: Principles, strategies and ethics of gene therapy, Sequence alignment and applications: Local and Global alignment, Scoring Matrices; Homology and related concepts; Dot matrix; general gap, gap penalty.

Unit IV

Spectroscopic methods: principle and applications of UV-visible, IR, NMR, ESR Measurement of radioactivity: GM Counter, gamma counter, liquid scintillation counter. Tracer techniques of Autoradiography, Radioimmunoassay, Chromatography - General principle, types and application, Electrophoresis - General principle and application, Centrifugation: Basic principles. Common centrifuges used in laboratory, Microscopy.

Unit V

Carbohydrate – Classification, structure and functions, TCA cycle, Glycolysis, Amino acids & Proteins structures, Introduction to Monoclonal Antibodies and Hybridoma technology, Antigen-Antibody Interactions: Precipitation Reaction, Agglutination Reactions, RIA, ELISA, Western Blotting, Immuno precipitation, Immuno-fluorescence.

17. Pharmacy practice

Unit I Clinical Pharmacy Practice

Definitions, development and scope of clinical pharmacy, Introduction to daily activities of a clinical pharmacist, Patient data analysis: The patient's case history, its structure and use in evaluation of drug therapy. **Drug & Poison information, Pharmacovigilance:** Scope, definition and aims, adverse drug reactions, causality assessment [different scales used], Reporting, evaluation, monitoring, preventing & management of ADRs. **Pharmaceutical care concepts, Medication errors.**

Unit II Hospital Pharmacy

Hospital - its Organisation and functions, Hospital pharmacy-Organisation and management: Organizational structure-Staff, Infrastructure & work load statistics, Roles & responsibilities of hospital pharmacist. **The Budget – Preparation and implementation, Hospital drug policy:** Pharmacy and Therapeutic committee (PTC), Hospital formulary, Hospital committees, Developing therapeutic guidelines. **Hospital pharmacy services:** Procurement & warehousing, Inventory control, Drug distribution in the hospital.

Unit III Pharmacotherapeutics

Etiopathogenesis and pharmacotherapy of disease associated with the following systems/diseases- **Cardiovascular system, Respiratory system, Endocrine system, renal system, Gastrointestinal system, Haematological system, Dermatology, Musculoskeletal disorders, Infectious disease, Oncology.**

Unit V Clinical Research

Drug development process, Clinical development of drug: Introduction to Clinical trials, Various phases of clinical trial, Abbreviated New Drug Application submission, Good Clinical Practice – ICH, GCP, Central drug standard control organisation, (CDSCO) guidelines, Ethical guidelines in Clinical Research, Composition, responsibilities, procedures of IRB / IEC, Overview of regulatory environment in USA, Europe and India, **Role and responsibilities of clinical trial personnel as per ICH GCP-** Sponsor, Investigators, Clinical research associate, Auditors, Contract research coordinators, Regulatory authority. **Informed consent Process**

Unit 5 Pharmacoepidemiology & Pharmacoeconomics

Introduction to Pharmacoepidemiology, Outcome measurement, Concept of risk, Pharmacoepidemiological Methods, Introduction to Pharmacoeconomics, Cost categorization, Outcomes and Measurements of Pharmacoeconomics, Pharmacoeconomic evaluations.

18. Entomology

1. Insect Morphology

Principles, utility and relevance: insect body wall structure, cuticular outgrowths, colouration and special integumentary structures in insects, body tagmata, sclerites and segmentation, Head- Origin, structure and modification; types of mouthparts and antennae, tentorium and neck sclerites, Thorax- Areas and sutures of tergum, sternum and pleuron, pterothorax; Wings: structure and modifications, venation, wing coupling apparatus and mechanism of flight; Legs: structure and modifications, Abdomen-Segmentation and appendages; Genitalia and their modifications; embryonic and post-embryonic development; Types of metamorphosis. Insect sense organs (mechano-, photo- and chemo- receptors), Structure of different systems- digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive, musculature, endocrine and exocrine glands.

2. Principles of Integrated Pest Management

History and origin, definition and evolution of various related terminologies. Concept of IPM. Economic decision levels of insect pest population. Insect dominance, increase in agriculture pest problem, pest outbreak and factors affecting it; Categories of pest, Tools of pest management and their integration- legislative, cultural, physical and mechanical methods, host plant resistance, biological control, semiochemicals, botanicals and chemical control, insecticide resistance management; sampling, survey, surveillance and forecasting. Controversies, criticism and constraints in IPM. Case studies of successful IPM programmes. Pest control appliances and their maintenance.

3. Insect Taxonomy

Brief evolutionary history of Insects- introduction to phylogeny of insects and Major Classification of Super class Hexapoda. Distinguishing characters, general biology, habits and habitats of Insect orders and economically important families of orders Collembola, Protura, Diplura. Class Insecta: Subclass Apterygota – Archaeognatha, Thysanura. Subclass: Pterygota, Division Palaeoptera– Odonata and Ephemeroptera. Division: Neoptera: Subdivision: Orthopteroid and Blattoid Orders (=Oligoneoptera: Plecoptera, Blattodea, Isoptera, Mantodea, Grylloblattodea, Dermaptera, Orthoptera, Phasmatodea, Mantophasmatodea, Embioptera, Zoraptera), Subdivision: Hemipteroid orders (=Paraneoptera): Psocoptera, Phthiraptera, Thysanoptera and Hemiptera, Distinguishing characters, general biology, habits and habitats of Insect orders and economically important families contained in them (Continued). Division Neoptera– Subdivision Endopterygota, Section Neuropteroid-Coleopteroid Orders: Strepsiptera, Megaloptera, Raphidioptera, Neuropterand Coleoptera, Section Panorpid Orders Mecoptera, Siphonaptera, Diptera, Trichoptera, Lepidoptera, and Section Hymenopteroid Orders: Hymenoptera.

4. Insect Physiology & Nutrition

Scope and importance of insect physiology and nutrition, physiology of different systems- digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive, musculature, endocrine and exocrine glands, thermodynamics; physiology of integument, moulting; growth,

metamorphosis and diapauses, Insect nutrition- role of vitamins, proteins, amino acids, carbohydrates, lipids, minerals and other food constituents; extra and intra- cellular micro-organisms and their role in physiology; artificial diets,

5. Toxicology of Insecticides

Definition and scope of insecticide toxicology; history of chemical control; pesticide use and pesticide industry in India, classification of insecticides and acaricides based on mode of entry, mode of action and chemical nature. Structure and mode of action of organo- chlorines, organophosphates, carbamates, pyrethroids, tertiary amines, neonicotinoids, oxadiazines, phenyl pyrozoles, insect growth regulators, microbials, botanicals, new promising compounds, etc., principles of toxicology; evaluation of insecticide toxicity; joint action of insecticides- synergism, potentiation and antagonism; factors affecting toxicity of insecticides; insecticide compatibility, selectivity and phytotoxicity, Insecticide metabolism; pest resistance to insecticides; mechanisms and types of resistance; insecticide resistance management and pest resurgence, Insecticide residues, their significance and environmental implications. Insecticide Act, registration and quality control of insecticides; safe use of insecticides; diagnosis and treatment of insecticide poisoning.

6. Pests of Field Crops

Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect and mite pests and vectors, Insect pests of cereals and millets and their management. Polyphagous pests: grasshoppers, locusts, termites, white grubs, hairy caterpillars, and non-insect pests (mites, birds, rodents, snails, slugs etc.), Insect pests of pulses, tobacco, oilseeds and their management, Insect pests of fibre crops, forages, sugarcane and their management.

7. Biological Control of Crop Pests and Weeds

History, principles and scope of biological control; important groups of parasitoids, predators and pathogens; principles of classical biological control- importation, augmentation and conservation, Biology, adaptation, host seeking behaviour of predatory and parasitic groups of insects. Role of insect pathogenic nematodes, viruses, bacteria, fungi, protozoa etc., their mode of action. Biological control of weeds using insects, Mass production of quality biocontrol agents- techniques, formulations, economics, field release/application and evaluation, Successful biological control projects, analysis, trends and future possibilities of biological control. Importation of natural enemies- Quarantine regulations, biotechnology in biological control. Semiochemicals in biological control.

8. Storage Entomology

Introduction, history and concepts of storage entomology. Post-harvest losses. Factors responsible for grain losses. Important pests namely insects, mites, rodents, birds and micro-organisms associated with stored grains and agricultural products. Association of stored grain insects with fungi and mites, their systematic position, identification, distribution, host range,

biology, nature and extent of damage. Sources of infestation. Type of losses in stored grains and their effect on quality including biochemical changes. Ecology of insect pests of stored commodities. Stored grain deterioration process. Type of storage structures. Ideal storage conditions. Management of rodent and bird pests. Preventive and curative measures for the management of insect pests of stored grains. Characteristics of pesticides, their use and precautions in their handling with special emphasis on fumigants. Integrated approaches to stored grain pest management.

9. Pests of Horticultural and Plantation Crops

Systematic position, identification, distribution, host range, bionomics and seasonal abundance, nature and extent of damage and management of insect pests of various crops, Fruit Crops- mango, guava, banana, jack, papaya, pomegranate, litchi, grapes, ber, fig, citrus, aonla, pineapple, apple, peach and other temperate fruits, Vegetable crops- tomato, potato, radish, carrot, beetroot, cole crops, french beans, chow-chow, brinjal, okra, all gourds, gherkin, drumstick, leafy vegetables etc., Plantation crop- coffee, tea, rubber, coconut, arecanut, cashew, cocoa etc.; Spices and Condiments- pepper, cardamom, clove, nutmeg, chillies, turmeric, ginger, beetlevine etc., Ornamental, medicinal and aromatic plants and pests in polyhouses/ protected cultivation.

19. Social Works

Unit 1

Personality: Concept, Stages of Development with special reference to Indian Concept of lifespan, Types, Determinants.

Heredity and Environment theories of Personality: Sigmund Freud, Carl Jung, Alfred Alder, Allport.

Unit 2

Concept of Normalcy and Abnormalcy.

Defence Mechanism

Etiology of Abnormal Behaviour.

Symptoms of Abnormal Behaviour.

Types of Abnormal Behaviour: Psychosis and Psychoneurosis.

Management of Mental disorder.

Unit 3

Motives & Principles of Social Work.

Social Work as a Profession.

Philosophy and Basic Values of Social Work.

Social Work Education, Training and Knowledge.

Unit 4

Social Welfare and Development Programmes: Child Development, Youth Development, Women's Empowerment, Welfare of the Aged, Handicapped, Welfare of Backward Classes with special reference to Scheduled Castes/Scheduled Tribes, Labour Welfare.

Social Welfare Agencies: Government and Non-Government Organizations. Historical Development of Social Case Work. Social Group Work: Meaning, Objectives, Principles, Processes, Skill and Role of Group Worker. Community Organization: Meaning, Objectives, Steps, Assumption, Principles, Models and Strategies.

Unit 5

Methods of Data Collection: Questionnaire Schedule Interview, Observation and Case Study.

Eradication of Major Social evils – Dowry, Child Marriage, Child Prostitution, Child Labour, Domestic Violence.

Unit 6

Latest policy and those awareness, Recent trends in Counselling, Concept of HRM and HRD, its objectives, Scope and Principles. People's Participation in Rural Development, History of Medical and Psychiatric Social Work.

20. Cancer Research

Unit I: Fundamentals of cancer

Introduction to cancer and cancer management, classification of cancers and tumors, Cancer epidemiology.

Unit II: Etiology of cancer

Etiology of cancer, Tobacco and cancer pathogenesis, Virus mediated oncogenesis (RNA and DNA viruses), inflammation and cancer, Chemical & physical carcinogens, carcinogenesis mechanism, types of carcinogenesis.

Unit III: Molecular Biology of Cancer

Cellular Oncogenes, tumor suppressor genes, onco-signaling, cell cycle regulation, Apoptosis, Necrosis, autophagy, senescence, telomeres Gene Regulation. Genomic Instability, Angiogenesis and its implication in tumor progression, evolution and pathogenesis of metastasis, Models for metastasis, cancer stem cells

Unit V: Tumor Immunology and Immunotherapy

Anti-tumor immune response of regulatory T cells, NK cells, immune surveillance theory, tumor associated antigens, evasion of immune surveillance by cancer cells, Principles of immunotherapy, CART cells.

Unit VI: Experimental Techniques in Cancer Research

Cancer cell culture techniques, Cell Proliferation assays, Cancer stem cell assays & Radiolabelling Techniques Gene silencing/ over expression Animal models for cancer