



# ADICHUNCHANAGIRI UNIVERSITY

Estd. under ACU Act, 2012 (Karnataka Act No. 18 of 2013)

B G Nagara - 571448, Karnataka, India

## Ph.D. Entrance Examination: 2020-21

**Date: Will be announced Shortly**

**Time: 10.00AM to 01.00 PM**

**Place: B.G. Nagara**

### Syllabus

The entrance exam will be conducted in two parts.

**Paper I. Principles of Basic Research Methodology (40 marks).** This is common to all faculties *viz.* Engineering & Technology, Medical, Pharmacy, Natural Sciences, Nursing, Education and Library & Information Science.

**Paper II. Specialty paper (60 marks)**

#### Syllabus for Paper I

#### Principles of Basic Research Methodology

1. Research Methodology: An Introduction.
2. Defining the Research Problem.
3. Research Design.
4. Sampling Design.
5. Measurement and Scaling Techniques.
6. Methods of Data Collection.
7. Processing, Statistics and Analysis of Data.
8. IPR - Invention and creativity.
9. Sampling fundamentals.
10. Interpretation and Report Writing.
11. Principle and methods of fundamental research method, Literature drug and research problem survey, clinical research.
12. Writing an article for a Scientific journal.



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## Syllabus for Paper II Engineering and Technology Faculty Civil Engineering Syllabus

1. **Engineering Mechanics:** System of Coplanar Forces, Centroids and Moment of Inertia, Friction, Kinematics of a particle, Kinematics of rigid bodies, Momentum and Energy principles.
2. **Strength of Materials:** Simple Stresses and strains, Shear force and bending moment, Shear stresses in beams, Principal stresses and strains, Direct and bending stresses, Columns and struts, thin cylinders.
3. **Fluid Mechanics:** Fluid statics, pressure measurement, buoyancy & floatation, fluid kinematics, fluid dynamics, flow measurement, orifices, mouth pieces, notches, weirs, flow through pipes, dimensional analysis and models, laminar flow, turbulent flow in pipes, boundary layer theory, flow through channels, rapidly varied flow.
4. **Surveying:** Measurement of Horizontal distances, Chain surveying, Measurement of angles, Measurement of Elevations, Theodolite Surveying, Tacheometric Surveying, Curves.
5. **Theory of Structures:** Fixed Beams, Continuous Beams, Moving Load, influence lines, Strain.
6. **Concrete Technology:** Cement, Aggregates, Water, Admixtures, Fresh Concrete, Properties of Hardened Concrete.
7. **Geotechnical Engineering:** Structure of soil, Three Phase System, Index Properties of soils, Classification of Soils, Soil Water and Effective stress principal, Permeability of soils, Consolidation, Compaction, Shear strength, Exploration and in situ soil measurements.
8. **Water Resources Engineering:** Hydrology, Precipitation, Infiltration, Evaporation and evapo-transpiration, Run-off, Hydrographs, Floods, Ground water hydrology, Irrigation.
9. **Environmental Engineering:**
  - i. **Water Supply Engineering:** Introduction to Water Supply, Quality of Water, Sources of Water, Raw Water Conveyance, Treatment of Water, Distribution of Water.
  - ii. **Sanitary Engineering:** Sewage and Sewerage, Sewer Design, Sewer Appurtenances, Sewer Pumping, Waste Water Characteristics, Sewage Treatment, Effluent Dispose.



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## Mechanical Engineering Syllabus

1. **Prime movers** - Classification of I. C Engines - 2 Stroke & 4 Stroke Petrol & Diesel Engines. Concept of Mechanical efficiency, BHP & IHP, Laws of 1st & 2nd Thermodynamics, zeroth Law, applications.
2. **Turbines**- Steam turbines, Gas turbines and Water turbines - Parts, classification and applications.
3. **Refrigeration & Air-conditioning** - properties, COP, unit of Refrigeration, Refrigeration effect, Tonne Refrigeration, Ice making capacity. Types of refrigeration system.
4. **Manufacturing Process** - Part of a lathe, operation in a lathe. Types of Drilling Machine, operation a Drilling machine. Types of milling machines, operation on milling machines. Grinding machines, bonding materials, grinding terminology. Types of grinding machine, Soldering, brazing & welding classification & types. Lubrication & bearing types.
5. **Power transmission** - Belt drives, gear drives.
6. **Heat treatment of Metals** - Annealing, Normalizing, Hardening, Tempering, Carburizing, Cyaniding, Nitriding and Flame hardening, Iron-Carbon equilibrium diagram.
7. **Engineering Materials** - Ferrous and non-ferrous metals and their applications.

## Electronics and Communications Engg. Syllabus

1. **Analog Circuits** - BJT and MOSFET, Diode Circuits, Amplifiers, op - Amp Applications.
2. **Network Theory** - Basic Concepts, Network Theorems, 2-Port Network parameters.
3. **Signals and Systems** - Continuous-time signals, Discrete-time signals & LTI Systems.
4. **Electrical Machines** AC & DC, Transformers.
5. **Simplification of Boolean Expressions** - Karnaugh maps combinational logic Design.
6. **Sequential logic circuits** - Flip flops & counters, shift Register



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7. **Control Systems** - Transfer function, Frequency Response, Time response of second order control systems, nyquist criteria - Bode plots, phase & gain margins.
8. **Communication** - Analog communication, Digital Communication.
9. **Power Electronics** - Thyristor, Choppers & Inverters.
10. **Electromagnetics** - Electric & magnetic fields, max wells equations, Transmission lines.
11. **Microprocessors** - Architecture, operation, programming and interfacing.
12. **VLSI Circuits** - MOS Transistors, Fabrication, Scaling of MOS Circuits, FPGA Based Systems, Testing and Verifications.
13. **Transducers.**

## Computer Science & Engineering Syllabus

1. Discrete Mathematical Structures (Set Memory Fundamentals of Logic, Relations functions) Computer Organization (as per CSE 46 Syllabus).
2. Data Structures using C (Stack, recursion, Queues and lists, Trees, sorting, searching)
3. Operating systems (as per CS 52 Syllabus)
4. OOP with C++ (as per CSE 36 Syllabus)
5. DBMS (as per CS53 Syllabus)
6. Analysis & Design of Algorithms (as per CSE 43 Syllabus)
7. Object oriented Analysis & design (as per CS 72 Syllabus)
8. Software Engg. (Overview, Requirements Engg, Software Design, verification & Validation).



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## Mathematics Syllabus

### Unit 1: Partial Differential Equations:

Classifications, systems of surfaces and characteristics, examples of hyperbolic, parabola and elliptic equations, method of direct integration, method of separation of variables, One-dimensional wave and heat equations, Various possible solutions of wave and heat equations.

### Unit 2: Numerical Methods:

Solutions of algebraic and transcendental equations: Bisection, iterative and Newton-Raphson methods Introduction, Lagrange and Newton Interpolations, Interpolating polynomials - piecewise polynomial interpolation, Spline's interpolation formula, Hermite Interpolation, Bivariate Interpolation, least square approximations. Numerical integration: Newton's cotes formula, Simpson's rules, Weddle's rule, Gaussian

### Unit 3: Ordinary Differential equations:

Solutions of ordinary differential equations: Euler's, Picard's method, Initial Value and boundary value problems, Runge - Katta's Method of order IV for 1<sup>st</sup> and 2<sup>nd</sup> order ordinary differential equations. System of equations predictor - corrector formulae, Shooting method

### Unit 4: Probability

Random experiments, sample spaces, event, axioms, addition and multiplication rules, conditional probability, independent events, Baye's theorem.

### Unit 5: Linear Algebra

Matrix Algebra, Consistency of Systems of linear equations, Eigen values and Eigen vectors. Gauss Seidel Iterative method, LU Decomposition method.

## Nanotechnology Syllabus

### Unit 1: Introduction to Nanotechnology:

Classification of phases & properties of materials, density of states & electronic energy bands- conductors, semiconductors and insulators, quantum effects in nanoscale materials. Properties of materials at Nanoscale:- Physical properties: Mechanical, Thermal, Electrical, Electronic, Magnetic and Superconducting, Optical properties & Coupled properties (Electromagnetic, ferroic properties, etc.)

### Unit 2: Principles in Nanomaterial synthesis:

Bottom-Up and Top-Down approach, Mechanisms involved in nano-synthesis: Fundamentals of thermodynamics: Laws of thermodynamics (zeroth, first, second &



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third laws). Statistical processes, diffusion (Fick's laws), Heat capacity. Phase transformation, Nucleation processes (Homogeneous & Heterogeneous). Basics of chemical kinetics,

### **Unit 3: Synthesis methods for Nanomaterials:**

Chemical precipitation, Sol-gel, Chemical reduction, Sonochemical synthesis, Hydrothermal, Solvothermal, Solution combustion, Super-critical fluid. Spin coating & Ball milling. Lithography techniques and Nanofabrication. Biological methods- Synthesis using microorganisms.

### **Unit 4: Structure and morphology Characterization Techniques:**

Structural characterisation: X-ray, Neutron & Electron diffraction. Surface & interface characterization techniques- Optical microscopy. Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Electron Energy Loss Spectroscopy (EELS), Atomic Force Microscopy (AFM), Scanning Tunnelling Microscopy (STM).

### **Unit 5: Spectroscopy and other special techniques:**

Spectroscopy: Fourier Transform Infrared (FTIR), Electrical characterisation: Four probe I-V characterisation, scanning tunneling spectroscopy, Mechanical testing: using Universal Testing Machine. Impedance spectroscopy, Contact angle measurement.

### **Unit 6: Advanced Smart Nanomaterials:**

Carbon Based Nanostructures: Carbon Nanotubes (CNTs), Graphene, Fullerenes, Carbon clusters. Smart fluids (magneto-and Electro-rheological fluids), Polymeric materials, Metal & Metal oxide nanomaterials, Core-Shell nanostructures, Nanocomposite materials, Glasses, Glazes & other ceramics.

### **Unit 7: Applications of Nanomaterials:**

Applications based on Powder metallurgy & processing, Mechanical alloying, Anti-corrosion coatings & super hydrophobic surfaces. Dielectric, Piezoelectric, Pyroelectric, Ferromagnetic & Ferroelectric memory devices. P-N junctions, Photodetectors, Field Effect Transistors, High Electron Mobility Transistors. Energy Systems: Photovoltaic's (Solar cells), Batteries & Fuel cells.

## **Management Studies/Business Administration Syllabus**

- 1. Economics:** Demand and Supply - Production and Cost decisions - Pricing (policies and strategies in different market structure) - Measurement of National Income - Fiscal and Monetary Policy - Economic Reforms since 1991 - Inflation and Deflation - Money and Capital market, Indian Financial markets and Regulatory Bodies, Reforms in Indian Financial Markets - FDI - Business cycles.



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2. **Organizational Behaviour and Human Resource Management:** Personality - Learning Motivation - Emotions at workplace - Group Dynamics, Organizational Climate - Culture Change & Development - Leadership - Managing Conflicts - Organizational Development - Human Resource Development - HR Planning - Recruitment - Selection - Training and Development - Performance and Potential appraisals - Career and Succession Planning.
3. **Accounting & Financial Management:** Financial Accounts - Financial Statement Analysis and Ratio Analysis - Fund flow and cash flow Statements - Costing Budgetary Control. Goals of Financial Management - Capital budgeting - Capital Structure - Leverage - Cost of Capital, Working Capital Policy.
4. **Marketing:** Consumer Markets and Business Markets - Segmentation - targeting and Positioning - Marketing Mix 4P's - Product life cycle - Services Marketing: Additional Ps - Customer Relationship Management, Digital and Social Media Marketing - Brand Management - Retailing on the net.
5. **Strategy:** Strategic Management - Vision- Mission - Objectives - Environmental analysis - Strategy formulation - Corporate Level SBU Level - Functional Strategies - Strategy implementation.
6. **Corporate Governance:** Procedures and Principles, Governance Reforms in India - Business Ethics: Ethics and Management System; Ethical issues and Analysis in Management; Value based organizations; Personal framework for ethical choices; Ethical pressure on individual in organizations; Gender issues; Ecological consciousness; - Corporate Social Responsibility.
7. **International Business:** Modes of International Business - Liberalization - Globalization - Privatization - Entry Strategies and FDI in International Business - Internationalization process of multinational enterprises - Cross culture management - EXIM Policy - World Trade Organization.
8. **Entrepreneurship:** Entrepreneurship and the Entrepreneurial Mind-Set - Entrepreneurial Intentions and Corporate Entrepreneurship - Entrepreneurial Strategy: Generating and Exploiting New Entries - Creativity and the Business Idea - Identifying and Analyzing Domestic and International Opportunities - Intellectual Property and Other Legal Issues for the Entrepreneur - The Business Plan - The Marketing Plan - The Organizational Plan - The Financial Plan - Sources of Capital - Strategies for Growth and Managing the Implication of Growth - Qualities required for future Entrepreneurs.



## Medical Faculty

### Anatomy

#### Unit 1: General Embryology:

- A brief account of the male and female reproductive system, gestation period - subdivisions; testis, ovary; definition of gamete; sperm, ovum, gametogenesis, migration of primordial germ cells into gonadal ridge; structure of sperm, growth of ovarian follicles, and uterine cycle.
- Principles of Family Planning (contraception), In vitro fertilisation (for integrated teaching).
- **First week of Development**  
Definition and process of fertilisation, formation of zygote; cleavage, formation of morula and blastocyst; implantation; formation of decidua- its subdivision. Types of implantation and abnormal sites of implantation.
- **Second week of Development**  
Differentiation of embryoblast and trophoblast; changes in the embryo blast, bilaminar germ disc changes in the trophoblast, formation of cytotrophoblast, syncytiotrophoblast, amniotic membrane, yolk sac, extra embryonic mesoderm, extra embryonic coelom, connecting stalk, formation of chorion, amniotic cavity, primary yolk sac and appearance of prochordal plate.
- **Third week of Development**  
Appearance of primitive streak and primitive node; formation of intraembryonic mesoderm resulting in trilaminar germ disc; formation of notochord, buccopharyngeal and cloacal membranes, pericardial sac, paraxial, intermediate and lateral plate mesoderm, secondary yolk sac, intraembryonic coelom and allantoic diverticulum; derivatives of ectoderm, endoderm and mesoderm.
- **Fourth to Eight week of Development**  
Formation of somites, neural tube, cephalocaudal folding, lateral folding, body form, stomodeum, proctodeum, gut and vitelline duct; subdivisions of gut into foregut, midgut and hindgut.
- **Placenta**  
Formation of placenta and chorionic villi; decidua basalis; features and functions of placenta, placental circulation; abnormalities, placental barrier and types of placentae.
- **Umbilical Cord**  
Formation and features of umbilical cord.



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- **Amniotic Cavity and Twinning**  
Amniotic cavity and membrane; amniotic fluid - functions,  
Formation and types of twins and multiple pregnancies. Conjoined twins.
- **Teratology**  
Genetical and environmental factors as causes for congenital malformations.

## Unit 2: Systemic Embryology

- Development of individual organs of the respiratory system, cardiovascular system, digestive system, urinary system, genital system and nervous system. Special sensory organs (in brief), endocrine glands and mammary gland.
- Developmental abnormalities.
- Development of skeletal system, muscular system (in brief)
- Development of face, branchial apparatus and associated congenital anomalies.

## Unit 3: Osteology

- Classification of bones with examples; general features, general pattern of blood supply; particular features; relations of blood vessels and nerves to bones.
- Skull - All normae and interior of skull, foetal skull, mandible. Identification of individual skull bones.

## Unit 4: Muscular System

- Classification and identification of the muscles of the body; main attachments, nerve supply and actions; Actions of muscle groups on functional basis with reference to joints.

## Unit 5: Arthrology

- Classification of joints, general features of different types of joints, detailed study of the following joints of the body with movements: temporomandibular, atlanto occipital, atlanto axial, shoulder, elbow, radio ulnar, wrist, carpo metacarpal joint of thumb. Hip, knee, ankle and sub talar joint. Intervertebral and sacroiliac joint.

## Unit 6: Gross anatomy

- Thorax
- Cardio - Vascular System
  - Pericardium, Thoracic wall, position and parts of the heart, conducting system, blood supply and nerve supply of heart, names of the blood vessels and their distribution in the body; region wise.



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- Developmental anomalies
- Respiratory System
  - Pleura and lungs - position, parts, relations, blood supply and nerve supply.  
Lungs - emphasis on Bronchopulmonary segments.
- Mediastinum - Superior - arch of aorta. Posterior - Thoracic duct, esophagus and azygos system of veins.
- Diaphragm - with nerve supply.
- Abdomen
- Peritoneum - General disposition - horizontal and vertical; viscerae - general disposition, position, parts, relations, blood supply and nerve supply of abdominal organs.
- Pelvic Organs
- Parts, position, relations, blood supply and nerve supply.

## **Unit 7: Endocrinal System and Individual Endocrine Glands (Regionwise)**

- Organs, relations, blood supply, nerve supply, microscopic anatomy and normal development.
- Clinical manifestations of common endocrine disorders.

## **Unit 8: Nervous System and its Components:**

- Parts of nervous system, meninges, ventricles, motor and sensory pathways, cranial nerves, functional areas, normal development, microscopic anatomy of neurons, motor and sensory, cortex and their blood supply with cross sectional studies and morphology of spinal cord.
- General features of medulla oblongata, pons, midbrain, cerebellum and cerebrum
- Common neurological disorders : case studies and demonstration.

## **Unit 9: Special Sensory Organs**

- Gross anatomy of eyeball, ear, nose and tongue.

## **Unit 10: Lymphatic System**

- Spleen and Thymus (Region wise)
- Gross anatomy of the major groups (region-wise) of the lymph nodes of the body and their drainage areas.
- Gross anatomy of the major lymphatics especially thoracic duct and its tributaries.



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## **Unit 11: Micro Anatomy**

- General Histology, study of the basic tissues of the body; functional correlation of the structural components of the organs.
- Systemic histology of concerned organs.

## **Unit 12: Postnatal Growth and Development**

- Meaning of the terms like growth, development, principles of growth and development, types of postnatal growth, periods of growth and development and factors influencing them. Assessment of growth and development, Genetic aspects of Growth & development.
- Milestones of development, growth and development during adolescence

## **Unit 13: Radiological Anatomy**

- Identification of normal anatomical features in skiagrams, including special radiological investigations (Barium studies, Intra Venous Urogram, Ultrasound, Hysterosalpingography, Cholecystography, CT Scan and MRI).

## **Unit 14: Surface Anatomy**

- Surface features of the body and projections, outline of heart, lungs, pleura, liver, kidneys, ureter and important blood vessels and nerves.

## **Unit 15: Genetics -**

- Introduction - DNA, RNA, Protein Synthesis, Mitosis and Meiosis, Chromosomes - Methodology,
- Chromosomal abnormalities - Non dysjunction, Numerical abnormalities, (Downs, Turners and Kline felters Syndrome), congenital abnormalities (structure, deletion, translocation, inversion), pedigree Q chart, types of inheritance, autosomal dominant & autosomal recessive, inborn errors of metabolism and genetic counseling.

## **Unit 16: Bio-medical Waste :**

- Types, potential risks and their safe management.



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## Community Medicine Syllabus

### Unit 1: Concepts in Public Health

- i. Concept of Disease control strategies.
- ii. Public Health importance of the Health Promotion Approach.
- iii. Concept of Health for All, Millennium development goals.
- iv. Multi-sector approach in Health care programs.
- v. Health Care as part of Community Development Community Participation in health care programs.

### Unit 2: Role of Social sciences in Health

- i. Need and Importance and Role of Medico- Social work in Public Health Behavioural sciences. Need and importance of Health - Seeking Behaviour in implementing Health care programs.
- ii. Meaning and relationship of Behavioural Sciences to Health.
- iii. Principles of Social Psychology as applicable to Health.
- iv. Principles of social Anthropology as applicable to Health

### Unit 3: Principles and Practice of Information, Education and Communication

- i. Principles of IEC Health Education.
- ii. Objectives of Health Education.
- iii. Content of Health Education.
- iv. Relevance of using Communication Methods in the implementation of Health care.
- v. Meaning of Communication.
- vi. Principles of effective Communication, relevant to health.
- vii. Communication Blocks and means of overcoming the blocks.
- viii. Communication strategies for facilitating effective implementation of Health programs.
- ix. at individual and community levels.
- x. The use and influence of Mass Media for IEC.
- xi. Practice (Methods) of IEC and its application in Community Health.
- xii. Quantitative and Qualitative Evaluation of impact of IEC programs.
- xiii. Population Education.

### Unit 4: Maternal and Child Health Care

- i. Meaning and relevance of Risk Approach to Maternal and Child Health.
- ii. Review of the public health relevance of Maternal and Child health physical, mental, social and behavioral problems.
- iii. Rationale, Components and Implementation of Antenatal, Intranatal and Postnatal Care.
- iv. Rationale, Components and Implementation of Child Health Care.



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- v. Maternal and Childhood Disease control strategies.
- vi. Indicators of MCH care and their interpretation.
- vii. Child rights, life skill education.

## Unit 5: Biostatistics

- i. Collection / Organisation of data / Measurement scales.
- ii. Presentation of data and Record keeping.
- iii. Measures of central tendency.
- iv. Measures of variability.
- v. Sampling and Planning of health survey.
- vi. Probability, Normal distribution and inductive statistics.
- vii. Estimating population values.
- viii. Tests of significance (Parametric / Non-parametric).
- ix. Analysis of variance.
- x. Multi-Variate Analysis and Meta-analysis.
- xi. Association and correlation and Regression.
- xii. Vital Statistics.
- xiii. Evaluation of health and measurement of morbidity / mortality.
- xiv. Life table and its uses, survival analysis.
- xv. Use of computers.
- xvi. Census.
- xvii. Qualitative Research methodologies.
- xviii. Evaluation methodologies.

## Unit 6: Principles and Application of Epidemiology.

- i. Principles of Epidemiology.
- ii. Types and detailed methodologies of Epidemiological studies such as Descriptive, Analytical, Experimental and importance of Multi-Centric studies.
- iii. Appropriate choice of epidemiological approach for given situations.
- iv. Interpretation of Epidemiological studies.
- v. Community diagnosis.
- vi. Meta-analysis and systematic review.

## Unit 7: Health Information System.

- i. Uses of Health Information System in Health planning including Situational analysis, Prioritization, Monitoring and Evaluation.
- ii. Sources and methods of data acquisition.
- iii. Applications of health information on National and International Notification of Diseases.
- iv. Use of Internet and Intranets including NICNET, etc.
- v. Health Management Information System (HMIS), Mother and Child Tracking system (MCTS).



## Medical Biochemistry Syllabus

### 1. Biophysical Chemistry

- a. pH, Buffers Henderson – Hassel Balch equation. Principles and procedures of determination of pH, pO<sub>2</sub>, pCO<sub>2</sub> (Blood gas analysis).
- b. Isotopes-detection and measurement of stable and radioactive isotopes; their application in Medical field.
- c. Bioenergetics – Free energy change, high-energy linkages, Redox potentials.

### 2. Proteins: Functional roles of proteins in humans. Charge and chemical properties of amino acids and proteins. Amino acid sequence determination, structure of proteins in detail (primary, secondary, tertiary and quaternary).

- a. Structure of Insulin, Collagen, Hemoglobin and Myoglobin. Methods of study of structure of proteins and different levels of structural organization.
- b. Peptide bond: Characteristics, Ramachandran plot, Biologically important peptides.
- c. Conjugated proteins, lipoproteins and glycoproteins, structure of immunoglobulins.

### 3. Enzymes

- a. Classification, kinetics, specificity.
- b. Isoenzymes and coenzymes.
- c. Active site of enzyme. Methods of locating the functional groups of active sites.
- a. Mechanism of enzyme action in detail. Enzyme regulations. Mechanism of specific
- b. enzymes.
- c. Immobilized enzymes – application.
- d. Factors affecting enzyme catalyzed reactions, Michaelis-Menten constant, Lineweaver – Burk plot, Edey-Hofstee plot.
- e. Enzyme inhibitions – competitive, non-competitive, uncompetitive and allosteric, mechanism and application. Enzyme poisons
- f. Diagnostic enzymology
- g. Therapeutic applications of enzymes
- h. Enzyme as reagents, immobilized enzymes, -applications
- i. Enzyme linked immunosorbent assays

### 4. Introduction to intermediary metabolism, various methods of study of intermediary metabolism with examples. Their advantages and disadvantages.

### 5. Biological Oxidation: electron transport chain, mechanisms of electron transport and oxidative phosphorylation. Regulation of oxidative phosphorylation.



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6. Carbohydrate metabolism: Carbohydrates of physiological importance. A detailed discussion of the metabolic pathways as it occurs in humans.
7. Amino acid metabolism: A detailed study of metabolism of the amino acids in humans and the special compounds formed from amino acids .
8. Lipid metabolism: Lipids of physiological importance. Fatty acids – Oxidation of saturated and unsaturated fatty acids, bio-synthesis of fatty acids and triacylglycerols. Ketone body metabolism Biosynthesis and degradation of phospholipids. Role of Phospholipids, biosynthesis and metabolism of Cholesterol. Plasma lipoproteins, role of adipose tissue and liver in fat metabolism. Hyper and hypo lipoproteinemias
9. Integration of metabolic pathways of carbohydrate, protein and lipid. Regulation of metabolic pathways. Metabolism in well fed and starvation state.
10. Adipose tissue: White adipose metabolism and Adipokines. Brown adipose tissue metabolism
11. Porphyrins and heme metabolism and associated disorders.
12. Molecular Biology and Genetics
  - a. Biological importance of Nucleic acids. Structure of nucleic acids (RNA, DNA and biologically important nucleotides).
  - b. Nucleotide metabolism and associated disorders
  - c. DNA metabolism
  - d. RNA metabolism
  - e. Protein biosynthesis
  - f. Regulation of gene expressions, Epigenetics
  - g. Mutations
  - h. Methods of study of base sequence of DNA.
  - i. Structure and functions of gene with respect to mammalian genome.
  - j. Recombinant DNA technology.
  - k. General Principles of blotting techniques and their applications
  - l. PCR and its application in Medicine.
  - m. Genomic libraries, DNA probes, DNA Microarrays, CRISPR Cas-9, DNA markers, RFLP, DNA fingerprinting
  - n. Fluorescent in situ hybridization (FISH)
  - o. DNA vaccines
  - p. Transgenic animals
  - q. Application of molecular techniques in forensic investigation and medico-legal cases
  - r. Gene therapy



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- s. Overview of human genome project
- t. Pattern of Inheritance and population genetics, risk calculation

13. Vitamins: Detailed account of chemistry and biochemical roles of fat soluble and water-soluble vitamins, requirements, source and deficiency symptoms, therapeutic uses and toxicity. Antivitamins.

14. Minerals: Classification, sources, absorption, transport, fate, metabolism, biochemical functions, excretion, regulation, RDA, deficiency manifestations of the following: calcium, phosphorous, iron, copper, iodine, zinc, fluoride, magnesium, manganese, selenium, sodium, potassium and chloride.

15. Nutrition

- a. Energy metabolism – B.M.R., R.Q., Energy requirement at different stages, balanced diet. Diet planning in health and disease. SDA of foods
- b. Biological significance of Protein, carbohydrates and fat requirements, RDA, biological values of proteins. .
- c. Malabsorption syndromes, parenteral nutrition.
- d. Modification and Supplementation of dietary requirements in Health and Disease.
- e. Malnutritional disorders: Protein energy malnutrition, Malabsorption syndromes, parenteral nutrition.
- f. Obesity, BMI, causes and consequences of obesity
- g. Metabolic syndrome

16. Specialized tissues

- a. Muscle tissue – composition, mechanism of muscle contraction.
- b. Nerve tissue – composition, transmission of nerve impulse, neurotransmitters: formation and functions
- c. Erythrocytes – composition and metabolism, blood clotting, other blood cells. Phagocytosis.
- d. Connective tissue – composition, chemistry of collagen, elastin and other fibrous proteins.
- e. Bone and teeth – composition. Osteocalcin.
- f. Composition of lens – Biochemical changes during cataractogenesis.
- g. Structure of biomembranes, transport across membranes.

17. Basic concepts in laboratory investigations. Units of measure, reagents, clinical laboratory supplies, basic separation techniques, laboratory calculations, specimen collection and processing, safety in the laboratory, clinical utility of laboratory tests (including sensitivity, specificity, ROC curves, etc), analysis in the laboratory, selection and evaluation of methods (including statistical techniques), evidence-based



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laboratory medicine, establishment and use of reference values, pre-analytical variables and biological variations, quality management, clinical laboratory informatics. quality assurance and Quality control, POCT

18. Inborn errors of metabolism involving amino acid, carbohydrate lipid, purine, pyrimidine and porphyrin metabolism, mucopolysaccharidoses.

19. Diabetes mellitus: concepts and recent advances

20. Plasma lipoproteins in health and disease, Dyslipidemias, Atherosclerosis, risk factors of CHD

21. Cardiac markers and Laboratory Investigations in Myocardial Infarction

22. Liver function tests, jaundice, hepatic coma.

23. Kidney function tests and interpretations of RFT

24. Pancreatic function tests and Gastric function tests and interpretations.

25. Adrenal Function test and interpretations.

26. Endocrines – A detailed account of the synthesis, mechanism of action, chemistry, functions and regulatory role of hormones secreted by pituitary, pancreas, adrenal, thyroid, parathyroid and gonads. Endocrine disorders. Methods of assay and clinical interpretations.

27. Biochemistry of Pregnancy, Amniocentesis and prenatal diagnosis markers

28. Bone diseases: Disorders of calcium and phosphorus metabolism, osteoporosis, pagets disease, osteosarcoma, bone markers

29. Biochemical aspects of cancer.

- a. Carcinogens: Physical, chemical and biological
- b. Genetic basis of carcinogenesis: oncogenes, protooncogenes, tumour suppressor genes.
- c. Epigenetic regulation in cancer
- d. Gene expression profiling in cancer
- e. Cancer cell biology: cell cycle abnormalities, telomerase activity, proliferative capacity and decreased apoptosis
- f. Metastasis
- g. Tumor markers



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- h. Biochemical basis of cancer chemotherapy and drug resistance
  - i. New methods of anti-cancer therapy: targeted cancer therapy, cancer immunotherapy.
  - j. Tumour markers.
30. Composition of CSF, alterations in disease.
31. Immunology
- a. Cellular and humoral components of immune system, T & B Lymphocytes, antigen presenting cells
  - b. Immunoglobulins – Classes, structural functional relationship
  - c. Hybridoma technology
  - d. Innate and adaptive immune responses, self/non-self-recognition
  - e. Role of T-helper cells in immune response
  - f. Concept of Immune tolerance and Autoimmunity
  - g. Antigens and concepts in vaccine development – types of vaccines, immunological basis of vaccine development, recombinant DNA technology in vaccine development
  - h. Plasma cell disorders - multiple myeloma
32. Regulation of fluid and electrolyte balance and associated disorders
33. Regulation of acid-base balance and associated disorders
34. Hematopoietic disorders
- a. RBC membrane and metabolism
  - b. ABO blood group system - biochemical basis, transfusion biology.
  - c. Anaemia; types, causes, pathophysiology, morphology & peripheral picture
  - d. Hemoglobinopathies
35. Hemostasis and thrombosis: Biochemical mechanisms, related laboratory tests, antiplatelet/anticoagulant/fibrinolytic therapy
36. Stem cells in clinical medicine and research
- a. Basic concepts regarding stem cells
  - b. Types of stem cells: embryonic and induced pluripotent stem cells (iPSC)
  - c. Potential applications in the clinical medicine
  - d. Ethical and legal issues related to use of stem cells in medicine
37. Biochemical basis of neurodegenerative disorders: Alzheimer's disease, Parkinsonism, Prions disease, Huntington's disease, multiple sclerosis Myasthenia gravis –pathophysiology, Hereditary myopathies - Duchenne muscular dystrophy



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38. Chromatography: Principles, procedures and applications of paper, thin layer, ion exchange, gas phase and affinity chromatography. HPLC, gel filtration, GC- MS and its applications.
39. Electrophoresis: Principles, procedure and applications of paper, agarose gel, polyacrylamide, capillary, immuno-electrophoresis. Isoelectric focusing.
40. Spectroscopic analysis of biomolecules: Photometry, and spectrophotometer: principles and applications, Chemiluminescence / ECLIA - Principles and applications, Nuclear Magnetic Resonance, Mass spectrometry, Flame Photometry: Principle and applications. Fluorometer: Principle and applications
41. pH meters: Principles, procedures and application
42. Centrifugation: principles and application. Ultra-Centrifugation Techniques: Their applications in the study of lipoproteins.
43. Radio Immuno Assay: Competitive binding assay – Principles procedure and applications. Elisa – Principles and applications.
44. Ion selective electrodes : Principles, applications in medicine.
45. Biosensors: Principles and applications
46. Cell fractionation : Isolation and purification of sub cellular particles, biochemical markers of different subcellular organelles.
47. DNA and RNA – isolation and purification
48. Automation in Medical Laboratory Technology and Instrumentation

## Medical Microbiology Syllabus

### History of Microbiology

- i. Contributors in Microbiology
- ii. Louis Pasteur
- iii. Robert Koch
- iv. Discovery of important microorganisms
- v. Nobel Laureates in Microbiology



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## General Microbiology

- i. **Bacterial growth and nutrition:** bacterial growth requirement, bacterial growth curve, factors affecting bacterial growth, bacterial metabolism
- ii. **Sterilization and disinfection:** Definition, Physical methods of sterilization, chemical disinfectants, testing of disinfectants.

## Applied Microbiology

**Antimicrobial susceptibility testing:** Disk diffusion method, dilution test, E test, automated and molecular methods.

## Biomedical waste management

- i. Categories of biomedical waste
- ii. Treatment and disposal methods
- iii. Waste segregation in hospitals
- iv. Biomedical waste rules 2016

## Immunology

- i. Introduction
- ii. Definition of immunity
- iii. Types of immunity
- iv. Mechanism of innate immunity, active and passive immunity
- v. Local immunity.

## Systemic Bacteriology

- i. Isolation & identification of bacteria
- ii. Gram positive cocci of medical importance including Staphylococcus cocci etc.
- iii. Gram negative bacilli of medical importance including Vibrios, Pseudomonas & other non-fermenters,

## Virology

- i. General properties of viruses
- ii. Classification of viruses
- iii. Morphology of Virus
- iv. Virus replication
- v. Laboratory diagnosis of viral infections

## Mycology

- i. General characteristics & classification of fungi
- ii. Morphology & reproduction of fungi
- iii. Laboratory diagnosis of fungal infections



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## **Parasitology**

- i. General characters & classification of parasites
- ii. Methods of identification of parasites
- iii. Stool examination for ova and cyst

## **Clinical Microbiology**

- i. Hospital acquired infections
- ii. Definition
- iii. Sources of infection
- iv. Types of Hospital acquired infections
- v. Prevention of Hospital acquired infections

## **Medical Pharmacology Syllabus**

### **Unit 1: General Pharmacological Principles**

1. Introduction, Routes of Drug Administration
2. Pharmacokinetics: Membrane Transport, Absorption and Distribution of Drugs
3. Pharmacokinetics: Metabolism and Excretion of Drugs, Kinetics of Elimination
4. Pharmacodynamics: Mechanism of Drug Action; Receptor Pharmacology
5. Aspects of Pharmacotherapy, Clinical Pharmacology and Drug Development
6. Adverse Drug Effects

### **Unit 2: Drugs Acting on Autonomic Nervous System**

1. Autonomic Nervous System: General Considerations
2. Cholinergic System and Drugs
3. Anticholinergic Drugs and Drugs Acting on Autonomic Ganglia
4. Adrenergic System and Agonists
5. Antiadrenergic Drugs (Adrenergic Receptor Antagonists)
6. Drugs for Glaucoma

### **Unit 3: Autacoids and Related Drugs**

1. Histamine and Antihistaminic drugs
2. 5-Hydroxytryptamine, its Antagonists and Drug Therapy of Migraine
3. Prostaglandins, Leukotrienes (Eicosanoids) and Platelet Activating Factor
4. Nonsteroidal Anti-inflammatory Drugs and Antipyretic-Analgesics
5. Antirheumatoid drugs
6. Antigout Drugs

### **Unit 4 Respiratory System Drugs**

1. Drugs for Cough and
2. Drugs for Bronchial Asthma



## **Unit 5: Hormones and Related Drugs**

1. Introduction
2. Anterior Pituitary Hormones
3. Thyroid Hormone and Thyroid Inhibitors
4. Insulin, Oral Hypoglycemic Drugs and Glucagon
5. Corticosteroids
6. Androgens and Drugs for Erectile Dysfunction
7. Estrogens, Progestins and Contraceptives
8. Oxytocin and Other Drugs Acting on Uterus
9. Drugs Affecting Calcium Balance

## **Unit 6: Drugs Acting on Peripheral (Somatic) Nervous System**

1. Skeletal Muscle Relaxants
2. Local Anesthetics

## **Unit 7: Drugs Acting on Central Nervous System**

1. General Anesthetics
2. Ethyl and Methyl Alcohols
3. Sedative-Hypnotics
4. Antiepileptic Drugs
5. Antiparkinsonian Drugs
6. Drugs Used in Mental Illness: Antipsychotic and Antimanic Drugs
7. Drugs Used in Mental Illness: Antidepressant and Antianxiety Drugs
8. Opioid Analgesics and Antagonists
9. CNS Stimulants and Cognition Enhancers

## **Unit 8: Cardiovascular Drugs**

1. Cardiac Electrophysiological Considerations
2. Drugs Affecting Renin-Angiotensin System and Plasma Kinins
3. Cardiac Glycosides and Drugs for Heart Failure
4. Antiarrhythmic Drugs
5. Antianginal and Other Anti-ischaemic Drugs
6. Antihypertensive Drugs

## **Unit 9: Drugs Acting on Kidney**

1. Relevant Physiology of Urine Formation
2. Diuretics
3. Antidiuretics

## **Unit 10: Drugs Affecting Blood and Blood Formation**

1. Haematinics and Erythropoietin
2. Drugs Affecting Coagulation, Bleeding and Thrombosis



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## 3. Hypolipidaemic Drugs and Plasma Expanders

### Unit 11: Gastrointestinal Drugs

1. Drugs for Peptic Ulcer and Gastroesophageal Reflux Disease
2. Antiemetic, Prokinetic and Digestant Drugs
3. Drugs for Constipation and Diarrhoea

### Unit 12: Antimicrobial Drugs

1. Antimicrobial Drugs: General Considerations
2. Sulfonamides, Cotrimoxazole and Quinolones
3. Beta-Lactam Antibiotics
4. Tetracyclines and Chloramphenicol (Broad-Spectrum Antibiotics)
5. Aminoglycoside Antibiotics
6. Macrolide, Lincosamide, Glycopeptide and Other Antibacterial Antibiotics; Urinary Antiseptics
7. Antitubercular Drugs
8. Antileprotic Drugs
9. Antifungal Drugs
10. Antiviral Drugs
11. Antimalarial Drugs
12. Antiamoebic and Other Antiprotozoal Drugs
13. Anthelmintic Drugs

### Unit 13: Chemotherapy of Neoplastic Diseases

1. Anticancer Drugs

### Unit 14: Miscellaneous Drugs

1. Immunosuppressant Drugs
2. Drugs Acting on Skin and Mucous Membranes
3. Antiseptics, Disinfectants and Ectoparasiticides
4. Chelating Agents
5. Vitamins
6. Vaccines and Sera
7. Drug Interactions

## Medical Physiology Syllabus

### Unit 1: History of Physiology & General Physiology

History of Physiology.

Genetic control mechanism.

Biophysics principles, Bioelectric potentials.

Growth, Development and Ageing

Regulations of Body fluids & electrolyte & applied aspects.



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## **Unit 2: Environmental Physiology**

Physiology at High altitude, Hyperbarism, Regulation of body temperature, Space Physiology; Environmental pollution- radiation, smoke, noise, industrial.

## **Unit 3: Yoga & Meditation**

Yoga Asanas, Physiological Effects of Yoga, Physiological Effects of Meditation, Health Benefits of Yoga & Meditation.

## **Unit 4: Endocrine System**

Introduction; Mechanism of hormone action; Endocrine functions of Hypothalamus; Anterior pituitary hormones: functions, regulation, disorders. Posterior pituitary hormones- ADH & Oxytocin functions, regulation, disorders; Thyroid hormones: synthesis, fate, functions, regulation, disorders; Parathyroid hormone: synthesis, functions, regulation, disorders. Adrenal cortex and Adrenal medulla Hormone: secretion, functions, regulation, disorders; Pancreatic hormones- Insulin & Glucagon secretion, functions, regulation, disorders.

## **Unit 5: Reproductive System**

Sex Chromosomes, Determination, Differentiation; Functional Anatomy of Reproductive System; Puberty & Menopause ; Spermatogenesis & Testosterone ; Oogenesis; Menstrual cycle ; ovarian cycle & Ovulation; Estrogen & progesterone ; Placenta – Circulation, functions & Physiological basis of fertilization & implantation ; Pregnancy; parturition ; Lactation and contraception.

## **Unit 6: Cardiovascular System**

General organization of CVS; Physiological anatomy of Heart; Cardiac muscle ; Excitatory and Conducting tissue; Electrocardiography: Normal ECG & abnormal ECG; Cardiac Cycle; Heart sounds; Heart rate and its regulation; Hemodynamics of blood flow; Arteries and Arterioles; Blood pressure, its regulation, applied; Microcirculation; Local Blood Flow Regulation, Lymphatic system; Oedema; Cardiac Output; Venous Return; Coronary Circulation; Ischemic heart disease; Cardiac failure; Circulatory Shock; Congenital heart Disease; Regional Circulations; Effect of exercise on CVS.

## **Unit 7: Respiratory System**

Internal & External Respiration; Functional Anatomy of Respiratory Tract; Functions of respiratory system; Mechanics of respiration; Compliance; Surfactant; Lung volumes and capacities; Dead space; Diffusion of Gases; Respiratory membrane; Transport of O<sub>2</sub>; Oxygen–hemoglobin dissociation curve; Transport of CO<sub>2</sub> ; Neural control of Respiration; Chemical control of Respiration; Pulmonary Circulation;



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Ventilation perfusion ratio; Hypoxia ; Respiratory adjustments in exercise; Artificial Respiration; Pulmonary function Test.

## **Unit 8: Kidney**

Structure & Functions of kidney; Nephron- Functional unit; Juxtaglomerular Apparatus; Renal Circulation; Clearance ; Formation of urine: Glomerular Filtration, Tubular reabsorption & secretion; Concentration & Dilution of urine; Role of kidney in acid base balance; Physiology of micturition; Renal failure, dialysis; renal transplant; artificial kidney; diuretics; Composition of urine & abnormal constituents ; Renal Function Tests.

## **Unit 9: Special Senses**

**Vision:** Functional anatomy of eye; Optics, Errors of refraction; Aqueous humor; Pupillary reflexes; Microscopic structure of retina, Rods & Cones, Photochemistry of vision ; dark & light adaptation; Colour vision ; Visual pathway; Visual cortex. Movements of eyeballs.

**Hearing:** Physiological anatomy and Functions of external ear; middle ear and inner ear; Cochlea, Mechanism of hearing; Place principle, Auditory pathway & auditory cortex; Deafness, Audiometry.

**Taste:** Functional anatomy of taste buds, different taste modalities, pathway, receptors of taste, pathways, applied.

Smell: Functional anatomy of receptors, primary olfactory sensations, pathway, Applied.

## **Unit 10: Central Nervous System**

General organization of Nervous System; Structural and Functional divisions and Levels; Synapse; Receptors; Ascending Tracts; Physiology of pain; Internal analgesia system; Sensory Cortex; Thalamus.

**Motor system** - Organization and different motor components; Spinal cord – Organization for motor functions, Cord reflexes, Spinal shock; Reflexes; Muscle Spindle and Golgi tendon organs; Motor Cortex; Descending Tracts; Upper motor Neuron Lesion , Lower Motor Neuron Lesion.

**Brain stem** - Role in control of Motor functions, Vestibular apparatus and brainstem nuclei, Maintenance and regulation of tone, posture and equilibrium; Cerebellum and its motor function; Basal Ganglia and its motor functions; Parkinson's disease.

**Higher function of the brain** - learning, Memory, Language; Limbic system; Hypothalamus; Reticular activating system; Electroencephalogram; Sleep; Cerebral blood Flow and Cerebrospinal fluid.



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## Medical Pathology Syllabus

1. General Pathology including Immunopathology.
2. Hematopathology, Clinical Pathology.
3. Cardio vascular system, Respiratory System, Gastro Intestinal System including Liver & Biliary tract, Pancreas, Renal system, Male and Female Genital System and Breast.
4. Central and Peripheral Nervous, Endocrine System, Musculo-skeletal System, Reticulo-endothelial System (Lymph nodes, Spleen and Thymus), Dermatopathology and Ophthalmic pathology, Bone, Joints and soft tissues.
5. Blood banking, Transfusion Medicine and Immunohematology.
6. Cytopathology, Genetic disorders, molecular pathology.
7. Quality control, Telepathology, laboratory accreditation, Recent advances
8. Autopsy Pathology



## Pharmacy Faculty

### Pharmaceutical Analysis

- 1. Spectroscopy:** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, IR spectroscopy, Spectrofluorometric, Flame emission spectroscopy and Atomic absorption spectroscopy, NMR spectroscopy, Mass Spectroscopy.
- 2. Chromatography:** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following:
  - a) Paper chromatography
  - b) Thin Layer chromatography
  - c) Ion exchange chromatography
  - d) Column chromatography
  - e) Gas chromatography
  - f) High Performance Liquid chromatography
  - g) Affinity chromatography.
- 3. Qualification and Validation:** Definition of Qualification and Validation of analytical instruments, Advantage of Validation, Streamlining of Qualification & Validation process and Validation Master Plan. Analytical method validation and computerized system validation.
- 4. General Principles of Intellectual Property:** Concepts of Intellectual Property (IP), Intellectual Property Protection (IPP) and Intellectual Property Rights (IPR).
- 5. Impurity and Stability Studies:** Definition, classification of impurities in drug Substance or Active Pharmaceutical Ingredients and quantification of impurities as per ICH guidelines.
- 6. Modern Bio-Analytical Techniques:** Extraction of drugs from biological samples, Separation of drugs from biological samples using different techniques and Guidelines for BA/BE studies.
- 7. Quality Control and Quality Assurance:** Concept and Evolution of Quality Control and Quality Assurance, cGMP guidelines according to schedule M, USFDA (inclusive of CDER and CBER) Pharmaceutical Inspection Convention (PIC), WHO and EMEA covering, Analysis of raw materials, finished products, packaging materials, in process quality control (IPQC), Developing specification (ICH Q6 and Q3).
- 8. Herbal and Cosmetic Analysis:** Herbal remedies- Toxicity and Regulations, Adulteration and Deterioration, Regulatory requirements for setting herbal drug industry, testing of natural products and drugs: Monographs of Herbal drugs, Herbal drug-drug interaction and Evaluation of cosmetic products.



## Pharmaceutical Chemistry Syllabus

### 1. Basic Aspects of Organic Chemistry.

Organic intermediates: Carbocations, carbanions, free radicals, carbenes and nitrenes their method of formation, stability and synthetic applications. Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations. Nucleophilic uni- and bimolecular reactions (SN1 and SN2), Elimination reactions (E1 & E2), Hoffman & Saytzeff's rule, Rearrangement reaction.

### 2. Stereochemistry & Asymmetric Synthesis.

Basic concepts in stereochemistry: optical activity, specific rotation, racemates and resolution of racemates, the Cahn, Ingold, Prelog (CIP) sequence rule, meso compounds, pseudo asymmetric centres, axes of symmetry, Fischers D and L notation, cis-trans isomerism, E and Z notation. Methods of asymmetric synthesis using chiral pool, chiral auxiliaries and catalytic asymmetric synthesis, enantiopure separation and Stereo selective synthesis with examples

### 3. Study of mechanism and synthetic applications of following named reactions.

Sandmeyer Reaction, Mitsunobu reaction, Mannich reaction, Vilsmeier-Haack Reaction, Sharpless asymmetric epoxidation, Baeyer-Villiger oxidation, Shapiro & Suzuki reaction, Ozonolysis and Michael addition reaction.

### 4. Synthetic Reagents & Applications

Aluminiumisopropoxide, N-bromosuccinamide, diazomethane, dicyclohexylcarbodiimide, Wilkinson reagent, Wittig reagent. Osmium tetroxide, titanium chloride, diazopropane, diethyl azodicarboxylate, Triphenylphosphine, Benzotriazol-1-yloxy tris (dimethylamino) phosphonium hexafluoro-phosphate.

### 5. Heterocyclic Chemistry

Mechanism and application involved in synthesis of drugs containing five, six membered and fused heterocyclics such as Debus-Radziszewski imidazole synthesis, Knorr Pyrazole Synthesis Pinner Pyrimidine Synthesis, Combes Quinoline Synthesis, Bernthsen Acridine Synthesis, Smiles rearrangement and Traube purine synthesis

### 6. Green Chemistry.

Pericyclic reactions, Microwave assisted reactions: Merit and demerits of its use, increased reaction rates, mechanism, superheating effects of microwave, effects of solvents in microwave assisted synthesis, microwave technology in process optimization, its applications in various organic reactions and heterocycles



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synthesis. Catalysis: Types of catalysis, heterogeneous and homogeneous catalysis, advantages and disadvantages.

## 7. Characterization of Compounds.

Structural Characterization of compounds using IR, <sup>1</sup>HNMR, <sup>13</sup>CNMR and MS Spectroscopy.

## 8. Drug discovery.

Stages of drug discovery, lead discovery; identification, validation and diversity of drug targets. Biological drug targets: Receptors, types, binding and activation, theories of drug receptor interaction, drug receptor interactions, agonist's vs antagonists, and artificial enzymes. Rational Design of Enzyme Inhibitors Enzyme kinetics & Principles of Enzyme inhibitors, Enzyme inhibitors in basic research, rational design of non-covalently and covalently binding enzyme inhibitors.

## 9. Introduction to Computer Aided Drug Design.

History, different techniques and applications. Quantitative Structure Activity Relationships: Basics History and development of QSAR and its application Applications, Molecular Properties and Drug Design, Pharmacophore Mapping and Virtual Screening.

## Pharmaceutics Syllabus

### 1. Preformulation Studies.

Study of physicochemical characteristics of drug substances, BCS classification of drugs & its significance.

### 2. Optimization techniques in Pharmaceutical Formulation.

Concept and parameters of optimization, Optimization techniques in pharmaceutical formulation and processing.

### 3. Formulation and manufacturing considerations and quality control tests of different dosage forms (solid dosage forms, liquid dosage forms, semi-solid dosage forms).

### 4. Additives of formulation, types, examples, advantages, disadvantages, drug excipient interaction, incompatibility, various types of incompatibilities.

### 5. Drug stability: Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. Accelerated stability studies. ICH guidelines.



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6. **Drug delivery systems (DDS):** NDDS models, osmotic pumps, various release patterns eg. Controlled release, delayed release. Sustained release etc., order of release. Oral controlled DDS, factors affecting controlled release.
7. **Carriers in DDS:** polymers and their classification, types, carbohydrates, surfactants, proteins, lipids, prodrugs etc.
8. **Transdermal drug delivery systems (TDDS):** principles, absorption enhancers, evaluation of TDDS.
9. **Drug targeting:** microspheres, nano particles, liposomes, monoclonal antibodies, etc.
10. **Drug Absorption, Distribution, Biotransformation, and elimination.** Protein binding, Bioavailability, factors influencing bioavailability, evaluation of bioavailability, bio-equivalence. Methods to improve bioavailability.

## Pharmacology and Phytopharmaceuticals Syllabus

### Pharmacology

#### 1. Neurotransmission

- a. General aspects and steps involved in neurotransmission.
- b. Neurohumoral transmission in autonomic nervous system (Detailed study about neurotransmitters- Adrenaline and Acetyl choline).

#### 2. Central Nervous System Pharmacology:

General and local anesthetics Sedatives and hypnotics, drugs used to treat anxiety. Depression, psychosis, mania, epilepsy, neurodegenerative diseases. Narcotic and non-narcotic analgesics.

#### 3. Cardiovascular Pharmacology:

Diuretics, antihypertensives, antiischemics, anti-arrhythmics, drugs for heart failure and hyperlipidemia.

#### 4. Laboratory Animals:

CPCSEA guidelines to conduct experiments on animals.  
Good laboratory practice.

#### 5. Preclinical Screening of new substances for the Pharmacological Activity using *in vivo*, *in vitro*, and other possible animal alternative models.



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General principles of preclinical screening. CNS Pharmacology, Respiratory Pharmacology, Cardiovascular Pharmacology.

## 6. Cell Biology:

Genome organization. Gene expression and its regulation, importance of siRNA and micro RNA, gene mapping and gene sequencing. Intercellular and intracellular signaling pathways.

Recombinant DNA technology and gene therapy.

## 7. Gene Therapy:

Various types of gene transfer techniques, clinical applications and recent advances in gene therapy.

## 8. Mechanism of Drug Actions at Cellular and Molecular Level: Endocrine Pharmacology: Chronopharmacology: Chronopharmacology.

## 9. Regulatory Guidelines for Conducting Toxicity Studies: OECD, ICH, EPA and Schedule Y OECD principles of Good laboratory practice (GLP).

Acute, sub-acute and chronic- oral, dermal and inhalational studies as per OECD guidelines.

## 10. Toxicokinetics:

Toxicokinetic evaluation in preclinical studies, saturation kinetics Importance and applications of toxicokinetic studies. Alternative methods to animal toxicity testing.

Regulatory Perspectives of Clinical Trials.

## Pharmacognosy

### 11. Extraction Technology for Medicinal and Aromatic Plants

Study of various extraction techniques employed for medicinal and aromatic plants. Factors affecting choice of extraction.

Methods of extraction, isolation, purification, identification and estimation of alkaloids, glycosides, steroids, terpenoids, and volatile oils.

Applications of chromatography in isolation, identification and purification of phytoconstituents.

High throughput screening (HTS). Ethnomedicine approach for drug discovery

### 12. Chemistry of natural products

Chemistry, general methods of identification, methods of extraction and estimation of Alkaloids, Glycosides, Coumarins, Polyphenols, Steroids and Terpenes.



Applications of UV, IR, NMR, <sup>1</sup>HNMR, <sup>13</sup>CNMR and Mass spectroscopy for structural elucidation of phytoconstituents.

### 13. Advances in natural product research

Nutraceuticals - Antioxidants, Vitamins Supplements, Dietary fibres, PUFA

Bitters, colouring agents and sweetening agents

Potentials of Marine pharmacognosy

Methods of authentication of plants. Microtechnique and microscopy. Preparation of herbarium and herbal database.

### 14. Phytopharmacology

General concept of pharmacological screening.

Bioavailability and pharmacokinetic significance for herbal drugs with examples of clinically used herbal drugs. Clinical trials for herbal drugs.

Different models for screening of the following pharmacological activities of herbal drugs including *in-vitro* and enzyme bioassays.

- a. Adaptogens
- b. Anti-cancer
- c. Anti-diabetics & Hypolipidaemics
- d. Hepatoprotective and Anti-hepatotoxics
- e. Anti-microbial
- f. Antioxidants
- g. Anti-inflammatory and anti-ulcer

Use of cell line cultures and enzymes for screening of anti-cancer, cytotoxic, antidiabetic and adaptogenic activities.

### 15. Quality control of herbal drugs (crude drugs, extracts and formulations).

Quality control methods for medicinal plant materials. Evaluation and standardization of herbal drugs according to WHO guidelines.

Standardization requirements of herbal medicines and traditional preparations: their quality, safety and efficacy assessment. Quality control of single and multicomponent classical Ayurvedic formulations by study of HPTLC and HPLC fingerprints.

Role of marker compounds for analysis of drugs, finger printing, phytoequivalence studies in herbal drug standardization



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Importance of monographs of medicinal plants, their comparative study as per- Indian Pharmacopoeia, Indian Herbal Pharmacopoeia, API, Ayurvedic formulary of India, British Herbal Pharmacopoeia, American Herbal Pharmacopoeia.

## 16. Herbal Formulations

Shelf life study- protocols to study stabilization of herbal based products. Assessment of physical, physico-chemical and chemical parameters at different stages

Novel drug delivery systems for plant actives and extracts and their applications.

Nanotechnology in natural product research-Introduction to nanotechnology, applications, types of nano formulations. Preparation and characterization of nano formulations for plant secondary metabolites.

## 17. Herbal Cosmetics

Raw materials of herbal origin and their uses in cosmetics: oil, waxes, gums, colors, perfumes, protective agents, bleaching agents, preservatives, antioxidants and other ancillary agents. Formulation and standardization of herbal cosmetics like skin care preparations, deodorants and hair care preparations.

## Pharmacy Practice Syllabus

- 1. Introduction to Clinical Pharmacy:** Definition, evolution and scope of clinical pharmacy, International and national scenario of clinical pharmacy practice, Pharmaceutical care. Ward round participation, Drug therapy review (Drug therapy monitoring including medication order review, chart endorsement, clinical review and pharmacist interventions).
- 2. Clinical Pharmacy Services:** Patient medication history interview, Basic concept of medicine and poison information services, Basic concept of pharmacovigilance, Hemovigilance, Materiovigilance and AEFI, Patient medication counselling, Drug utilisation evaluation, Documentation of clinical pharmacy services, Quality assurance of clinical pharmacy services.
- 3. Patient Data & Practice Skills:** Patient's case history - its structure and significances in drug therapy management, common medical abbreviations and terminologies used in clinical practice, communication skills: verbal and non-verbal communications, its applications in patient care services.
- 4. Lab Data Interpretation:** Haematological tests, Renal function tests, Liver function tests, Tests associated with cardiac disorders, Pulmonary function tests, Thyroid



function tests, Fluid and electrolyte balance, Microbiological culture sensitivity tests.

## 5. Medicines & Poison Information Services

**Medicine Information Service:** Definition and need for medicine information service, Medicine information resources, Systematic approach in answering medicine information queries, Preparation of verbal and written response, Establishing a drug information centre.

**Poison Information Service:** Definition, need, organization and functions of poison information centre.

6. **Health Promotion:** Definition and health promotion activities, family planning, Health screening services, first aid, prevention of communicable and non-communicable diseases, smoking cessation, Child & mother care.
7. **Home Medicines Review Program:** Definition, objectives, Guidelines, method and outcomes, Research in community pharmacy.
8. **Cardiovascular System:** Hypertension, Congestive cardiac failure, Acute coronary syndrome, Arrhythmias, Hyperlipidemias.
9. **Respiratory System:** Asthma, Chronic obstructive airways disease, Drug induced pulmonary diseases.
10. **Endocrine System:** Diabetes, Thyroid diseases.
11. **Gastrointestinal System:** Peptic ulcer diseases, Reflux esophagitis, Inflammatory bowel diseases, Jaundice & hepatitis, Cirrhosis, Diarrhoea and Constipation, Drug-induced liver disease.
12. **Hematological Diseases: Anaemia, Deep vein thrombosis, Drug induced hematological disorders.**
13. **Bone and Joint Disorders:** Rheumatoid arthritis, Osteoarthritis, Gout, Osteoporosis Dermatological Diseases: Psoriasis, Eczema and scabies, impetigo, drug induced skin disorders Ophthalmology: Conjunctivitis, Glaucoma.
14. **Patient Data Analysis:** The patient's case history, its structure and use in evaluation of drug therapy & Understanding common medical abbreviations and terminologies used in clinical practices.



## 15. Clinical laboratory tests used in the evaluation of disease states, and interpretation of test results

- a. Haematological, Liver function, Renal function, thyroid function tests, tests associated with cardiac disorders.
- b. Fluid and electrolyte balance
- c. Microbiological culture sensitivity tests
- d. Pulmonary Function Tests

## 16. Drug & Poison Information

- a. Introduction to drug information resources available
- b. Systematic approach in answering DI queries
- c. Critical evaluation of drug information and literature
- d. Preparation of written and verbal reports.
- e. Establishing a Drug Information Centre
- f. Poisons information- organization & information resources

## 17. Pharmacovigilance & Clinical Research

- a. Scope, definition and aims of pharmacovigilance
- b. Adverse drug reactions - Classification, mechanism, predisposing factors, causality assessment (different scales used) & Reporting, evaluation, monitoring, preventing & management of ADRs
- c. Role of pharmacist in management of ADR.
- d. Drug development process.
- e. Various phases of clinical trial.
- f. Abbreviated New Drug Application submission.
- g. Good Clinical Practice – ICH, GCP, Central drug standard control organisation (CDSCO) guidelines.
- h. Challenges in the implementation of guidelines.
- i. Ethical guidelines in Clinical Research.
- j. Composition, responsibilities, procedures of IRB / IEC.
- k. Overview of regulatory environment in USA, Europe and India.
- l. Designing of clinical study documents (protocol, CRF, ICF, PIC)
- m. Informed consent Process
- n. Data management and its components
- o. Safety monitoring in clinical trials.

## 18. Communication skills: including patient counselling techniques, medication history interview, and presentation of cases.

## 19. Pharmaceutical Care Concepts

## 20. Critical Evaluation of Biomedical Literature

## 21. Medication Errors



## Natural Sciences Faculty

### Biochemistry Syllabus

#### Unit 1: Techniques

**Chromatographic techniques:** Paper chromatography, thin layer chromatography, partition chromatography, adsorption chromatography, ion exchange chromatography, gel filtration chromatography, affinity chromatography, GLC, HPLC, HPTLC, FPLC and chromatofocusing.

**Electrophoretic techniques:** Polyacrylamide gel electrophoresis, SDS-PAGE, 2D electrophoresis, agarose gel electrophoresis, isoelectric focusing, pulsed field electrophoresis, Separation of proteins, lipoproteins and nucleic acids. Denaturing gradient gel electrophoresis and temperature gradient gel electrophoresis. Visualizing separated components - staining, fluorescence, Periodic acid-Schiff staining, zymogram and reverse zymogram.

**Spectroscopic techniques:** Beer-Lambert's law and its limitations. Extinction coefficient, fluorescent probes and their applications. Fluorimeter, atomic absorption spectroscopy and atomic emission spectroscopy.

#### Physical methods of determining size, shape and structure of molecules:

Nuclear magnetic resonance and Infrared spectroscopy: Principles and applications. CD and its applications to proteins. X-ray diffraction.

**Isotopic tracers:** Heavy isotopes and radio isotopes, Mass spectrometer. Ionization, fragmentation, m/e, time of flight, MALDI and ESI.

**Centrifugation:** Subcellular fractionation using differential and gradient centrifugation.

**Radioisotopes in biology:** Concept of half-life, decay constant, detection and quantitation -

GM counter and solid and liquid scintillation counter, autoradiography and their applications.

**Microscopic techniques:** Scanning and transmission electron microscopes, freeze-etch and

freeze-fracture methods for electron microscopy, Confocal microscopy.

**Molecular biology techniques:** Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods, analysis of RNA and DNA. PCR, nested PCR, RT-PCR and Real time PCR technique and their applications.

**Blotting techniques:** Dot blot, Southern, Northern, Western blot, DNA foot print assay, DNA finger print assay, gel retardation assay, nuclease protection assay. RFLP and RAPD.

#### Unit 2: Biomolecules

**Carbohydrates:** Structure elucidation, degradation, graded acid hydrolysis, periodate oxidation, degradation of oxopolysaccharides, methylation and acetylation.



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**Glycobiology:** Glycoproteins, N- and O-glycosylation, lectins, carbohydrates in tissue engineering. Proteoglycans; Structural polysaccharides; hyaluronan, chitin, chondroitin and pectin. Determination of site of glycosylation and type of linkage (O-glycosyl and N-glycosyl). **Proteins:** Determination of primary structure: Sequencing strategies- N-terminal and C-terminal sequencing methods. Determination of s-s-bond position. Secondary structure of protein;  $\alpha$ ,  $\beta$  sheet,  $\beta$  bend,  $\beta$  turn and super secondary structures. Secondary structure prediction methods; Ramachandran plot, Chou-Fasman algorithm. Tertiary and quaternary structures.

**Lipids:** Oils, fats, and waxes, cholesterol, phospholipids, glycolipids, sphingolipids, cerebrosides and gangliosides.

**Nucleic Acids:** Physicochemical properties of nucleic acids, melting of DNA,  $T_m$ , factors affecting  $T_m$ , Cot curve, classification of DNA based on cot curve. Chemical reactions of DNA and RNA. Sequencing of DNA - Dideoxy method. Chargaff's rule, secondary structure of DNA. Watson and Crick model, B and Z DNA, other models of DNA structure. Secondary structure of tRNA and clover leaf model. Other secondary structural features in DNA, stem loop structure, palindromic sequences, cruciforms. DNA protein interaction, zinc finger leucine zipper, helix-turn-helix, other motifs.

## Unit 3: Metabolism

**Carbohydrate metabolism:** Glycolysis, gluconeogenesis, regulation, Cori cycle, citric acid cycle and their regulation, energetics, anaplerosis, glyoxylate cycle. HMP shunt pathway, interconversion of hexoses. Utilization of non-glucose sugars.

**Lipids:** Degradation of triacylglycerols, phospholipids, sphingolipids and their regulations. Lipase, hormone sensitive lipase, phospholipases and sphingomyelinase. Energetics of fatty acid degradation, chain elongation and desaturation. Metabolism of circulating lipids, chylomicrons, HDL, LDL and VLDL. Reverse cholesterol transport by HDL, Foam cell formation. Regulation of blood cholesterol, triglycerides, LDL and HDL. Obesity.

**Phospholipids:** Inter conversion of phospholipids, biosynthesis of prostaglandins, thromboxanes, leukotrienes and ether lipids.

**Integration of metabolic pathways:** Integration of carbohydrate and lipid metabolism, and their regulation and manipulation. Hormonal regulation of glucose metabolism, Effect of insulin, glucagon, catecholamines, growth hormones and corticosteroids on carbohydrate and lipid metabolism in different tissues.

**Proteins:** General mechanisms of degradation in cells. ubiquitin-proteasome pathway, lysosomal pathway. Non-ribosomal peptide synthesis - glutathione and gramicidine.

**General mechanisms of amino acid metabolism and regulations:** Deamination, transamination, decarboxylation and desulphuration. Ketogenic and glucogenic amino acids. Regulation of amino acid biosynthesis. Transglutaminase cycle and urea cycle.

**Purines and pyrimidines:** Uric acid formation. Salvage pathways, Gout and Lysch-Nyhan syndrome. Conversion of nucleotides to deoxynucleotides. Mechanisms of action of methotrexate, 5-fluorouridine, azathymidine.



**Biosynthesis of cofactors:** NAD<sup>+</sup>, FAD and coenzyme A, polyamine biosynthesis and their metabolic role.

## Unit 4: Bioenergetics

**Thermodynamics:** I, II and III laws of thermodynamics. Enthalpy, entropy, free energy and chemical equilibrium.

**High energy compounds:** Energy currency, ATP, ADP, creatine phosphate, phosphoenol pyruvate as energy rich compound.

**Photosynthesis:** Photosynthetic apparatus in plants, photosystems I and II, light harvesting antenna complex. Electron flow and phosphorylation; cyclic and noncyclic, oxygen evolution, Calvin cycle. C<sub>3</sub>, C<sub>4</sub> and CAM cycle. Photorespiration, bacterial photosynthesis.

**Respiration:** Plant mitochondrial electron transport and ATP synthesis.

**Nitrogen metabolism:** Importance of nitrogen in biological systems, nitrogen cycle. Nitrogen fixation; symbiotic and non-symbiotic, nitrogenase complex, energetics and regulation. **Mitochondrial electron transport:** Entry of reducing equivalents for oxidation (malate-aspartate shuttle and glycerol phosphate shuttle). Organization of respiratory chain complexes, structure and function of the components - Fe-S proteins, cytochromes, Q cycle, proton transfer, P/O ratio, respiratory control, oxidative phosphorylation, uncouplers and inhibitors ATP synthesis, ATP synthase complex, binding change mechanism, proton motive force, Mitchell's hypothesis.

Substrate level phosphorylation, futile cycles and their application.

## Unit 5: Enzymology

Nomenclature and IUB classification of enzymes. Enzyme specificity, specific activity, assay methods- coupled enzyme assays, continuous, end point and kinetic assay. Units of enzyme activity, IU and Katal.

**Enzyme Kinetics:** Michaelis-Menten equation, steady state approach. V<sub>max</sub>, K<sub>m</sub> and their significance. Linear transformation of Michaelis-Menten equation; Lineweaver-Burk plot, Eadie-Hofstee, Haynes-Wolf and Cornish-Bowden.

**Inhibition:** Reversible and irreversible inhibition. competitive, non-competitive, uncompetitive inhibition and suicide inhibition. Determination of K<sub>i</sub> and K<sub>d</sub>.

**Cooperativity:** Binding of ligands to macromolecules; Scatchard plot, cooperativity, positive and negative cooperativity. Oxygen binding to hemoglobin, homotropic and heterotropic effectors, aspartyltranscarbamylase as an allosteric enzyme.

**Enzyme catalysis:** Principles of catalysis, mechanism of enzyme catalysis, factors influencing enzyme catalysis, Chymotrypsin, zymogen activation, acid-base catalysis, charge relay network, Lysozyme, RNA as an enzyme, co-enzymic action of NAD<sup>+</sup>, FAD, TPP, PLP, Biotin, CoA, folic acid and lipoic acid.

**Enzyme regulation:** Feedback regulation, fine control of enzyme activity. Fast reactions - Stopped flow, temperature jump method.



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## Unit 6: Molecular Biology

Central dogma of molecular biology.

### **DNA replication, repair and recombination in prokaryotes and eukaryotes:**

Mechanism of replications, enzymes, fidelity of replication, DNA damage and repair mechanisms, homologous and site-specific recombination.

**RNA synthesis and processing in prokaryotes and eukaryotes:** Transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing and polyadenylation.

**Protein synthesis and processing in prokaryotes and eukaryotes:** Ribosome, formation of initiation complex, initiation factors, elongation, termination, genetic code, aminoacylation of tRNA, translational proof-reading, translational inhibitors, Post-translational modification of proteins.

**Control of gene expression at transcription and translation level:** regulating the expression of prokaryotic and eukaryotic genes, role of chromatin in gene expression, DNA methylation, gene silencing. Role of chaperones.

## Unit 7: Immunology

Innate and acquired immunity. Cells and molecules involved in innate and adaptive immunity. Antigens, antigenicity, immunogenicity, antibodies, haptens, epitopes and paratopes. B and T cell epitopes, structure and function of antibody molecules. Structure of immunoglobulins, hyper variable region, isotypic, allotypic and idiotypic variations. Generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity.

**Cellular basis of immunity:** Primary and secondary immune response. T, B and accessory cells. Development of T and B cells. Sub sets of T and B cells. T helper cells, T-killer cells, T-suppressor cells. T and B cell receptors, antigen processing and presentation. T and B interaction.

**In vitro antigen-antibody reaction:** Precipitation, agglutination, complement fixation, immuno diffusion, immunoelectrophoresis, immunofluorescence, RIA and ELISA.

## Unit 8: Genetics and Genetic Engineering

**Mendelian principles:** Dominance, segregation, independent assortment.

**Alleles:** multiple alleles, lethal alleles, pseudoallele.

**Extensions of Mendelian principles:** Codominance, incomplete dominance, gene interactions, linkage and crossing over, sex linkage, sex limited and sex influenced



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characters, Linkage and construction of genetic maps. Extra chromosomal inheritance.

**Mutation:** Types, causes and detection, mutant types - lethal, conditional, biochemical, loss of function, gain of function, insertional mutagenesis.

**Structural and numerical alterations of chromosomes:** Deletion, duplication, inversion, translocation.

**Genetic Engineering:** Restriction-modification systems, restriction enzymes- type I, II and III, specificity, sticky ends and blunt ends, isoschizomers.

**Gene cloning:** genomic cloning, shot gun cloning, cDNA cloning.

**Vectors:** Plasmids, phage, cosmids and phagemid. Yeast cloning vectors, plant vectors, bacterial artificial chromosome, SV40, shuttle vectors, construction of expression vectors.

**Ligation:** Blunt end and sticky end ligation, use of linkers and adaptors, homo polymer tailing, colony hybridization, plaque hybridization.

**Transformation:** Micro injection, electroporation, lipofection, calcium phosphate method, protoplast fusion/somatic cell hybridization and biolistic methods.

**Identifying the right clones:** Direct screening, insertional inactivation of marker gene, visual screening, plaque phenotype. Indirect screening- immunological techniques, hybrid arrest translation and hybrid select translation. Screening using probes- construction of gene probes, hybridization and labelling.

## Unit 9: Endocrinology, cell signaling and cell communication

**Endocrine System:** Chemistry of hormones, hormones produced by hypothalamus, pituitary, thyroid, parathyroid, pancreas, adrenals, gonads and intestine.

**Regulation of hormone production and release:** hypothalamus-pituitary-target organ axis and regulation by feedback mechanism.

**Cell signaling:** Autocrine, paracrine, juxtacrine and endocrine signaling. General mechanisms of cell signaling by hydrophilic factors, transmembrane receptors, G protein coupled receptors, receptor tyrosine kinase, eicosanoid receptors. Second messengers - IP<sub>3</sub>, DAG, cAMP, protein kinases. Nitric oxide signaling; generation and action. Signal transduction pathways regulation of signaling pathways, bacterial and plant two component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.

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

## Unit 10: Biostatistics and Biochemical calculations

**Biostatistics:** Measures of Central tendency and Dispersion.

**Probability distribution:** Binomial, Poisson and Normal. Parametric and Nonparametric statistics, Confidence Interval, Errors.



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**Quantitative Techniques:** Levels of significance, Regression and Correlation, t-test; Analysis of variance and multiple range tests, chi-square test, experimental design, data transformation. Use of Statistics in Biosciences, Use of Computers in Quantitative analysis.

**Biochemical calculations:** Specific gravity, percent solution, dilution and dilution factors, ionic strength; molarity, normality, mole concept, Avogadro principles. Acids and bases, buffers, pH, pKa, Henderson-Hasselbach equation, buffer capacity, buffering capacity of amino acids.

Determination of LD50, ED50, IC50.

## Biotechnology Syllabus

### Unit 1: Basic Laboratory Principles

Calculation and Concept of pH, buffer, osmosis, normality, molarity, molality, mole, ppm, ppb, titration, dilutions and concentrations.

### Unit 2: Biophysical techniques

**Chromatographic Techniques:** General principles, TLC, column chromatography (Ion exchange chromatography, Exclusion chromatography, GLC, Affinity chromatography)

HPLC- Different types and its applications.

**Electrophoretic Techniques:** General principles, Native gels, SDS-PAGE, IEF, 2D gel electrophoresis, Agarose gel electrophoresis, Pulse field gel electrophoresis, Capillary electrophoresis.

**Spectroscopic Techniques:** UV/visible, fluorescence, circular dichroism, NMR, ESR spectroscopy, X-ray diffraction, mass spectrometry.

Radiolabeling techniques: Detection and measurement of radioisotopes, molecular imaging of radioactive material, safety guidelines.

**Microscopic Techniques:** Light microscopy, scanning and transmission electron microscopy, fluorescent and confocal microscopy.

**Molecular Biological Techniques:** PCR, RFLP, Southern and Northern blotting, AFLP techniques, Real-time PCR. In situ localization, FISH and GISH.

### Unit 3: Enzyme Technology and Medicinal Chemistry.

Nomenclature and Classification of Enzymes. Criteria of purity of enzymes- Specific activity. Enzyme units-Katal and IU. Enzyme activity- chemical nature of enzymes.

**Enzyme Kinetics:** Factors affecting the enzyme activity- Concentration, pH and temperature. Kinetics of a single-substrate enzyme catalysed reaction, Michealis-Menten Equation, Km, Vmax, L.B Plot, Turnover number, Kcat. Kinetics of Enzyme Inhibition. Kinetics Allosteric enzymes.



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**Industrial Enzymes-** Thermophilic enzymes, amylases, lipases, proteolytic enzymes in meat and leather industry, enzymes used in various fermentation processes, cellulose degrading enzymes, Metal degrading enzymes.

**Clinical enzymes-** Enzymes as thrombolytic agents, Anti-inflammatory agents, streptokinase, asparaginase, Isoenzymes like CK and LDH, Transaminases (AST, ALT), Amylases, Cholinesterase. Immobilization of enzymes, ELISA. Biosensors. Enzyme Engineering and site directed mutagenesis, Designer enzymes.

**Enzyme Structure activity Relationship (SAR) and Drug Discovery-** Properties of Enzymes. Lead Compound, Structure based drug design, combinatorial chemistry, High-throughput screening.

**Medicinal Chemistry:** Concept of IC<sub>50</sub>, LD<sub>50</sub>, MIC, usage of biostatistical tools, SAR, Graphing tools.

## Unit 4: Biochemistry and Molecular Genomics

Biomolecules, Metabolism, Membrane transport, Structure and regulation of prokaryotes and eukaryotes genes, Transcription, Translation, Post-transcriptional and Translational modifications, Molecular interaction, Molecular markers, Genetic and physical mapping, Genetic engineering; Cloning and expression vectors, rDNA technology, Gene cloning approaches, Whole genome sequencing & annotation, High throughput gene expression and Function elucidation technologies, PCR, Blotting techniques, Gene transfer technologies, Protein-protein interactions, Signal transduction pathways and their elucidation, Primary and secondary metabolic pathways, Systems biology frameworks for metabolic engineering.

## Unit 5: Animal Biotechnology

**Animal Cell Cultures Techniques:** History of animal cell culture; Different tissue culture techniques; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture; Behaviour of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number; Development, Characterization and maintenance of cell lines, Cryopreservation; Commercial scale production of animal cells, stem cells and their application; Application of animal cell culture for in vitro testing of drugs; Testing of toxicity of environmental pollutants in cell culture.

**Cell characterization:** cytotoxicity assays, cell quantitation, cell culture contamination: monitoring and eradication, cryopreservation, confocal microscopy.

**Stem cell culture and its applications:** Cell and Tissue engineering: Growth factors for in situ tissue regeneration, biomaterials in tissue engineering, approaches for tissue engineering of skin, bone grafts, nerve grafts. Haemoglobin-based blood substitutes, bio artificial or biohybrid organs. Limitations and possibilities of tissue engineering.

## Unit 6: Medical Biotechnology and Infectious Diseases.

Microbial (viral, bacterial, fungal) , Life style diseases, Cell & developmental biology, Cancer biology, Immunotechnology, Antigen antibody interactions, Antibody



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engineering, vaccines and the associated manufacturing processes, molecular and immuno diagnostics methods and their applications, Cell culture technologies, Regenerative medicine & transplantation technology, Hypersensitivity and autoimmune diseases, tolerance, animal biotechnology, Animal cell preservation, Stem cells and healthcare, Clinical trials.

## **Unit 7: Immunology and Immunotechnology.**

**Innate and adaptive immune system:** Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. Generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity. Immunological techniques: ODD, immunoelectrophoresis, RIA, ELISA, Immunofluorescence, Western blot.

## **Unit 8: Cell Biology and Membrane Biology.**

Structure of fluid mosaic model of membrane, lipid bilayer, transport across membrane, mechanism of sorting and regulation of intracellular transport. Structural organization and function of intracellular organelles.

**Organization of Chromosomes:** Structure of chromatin and nucleosome, heterochromatin, euchromatin. Cell division and cell cycle: Mitosis and meiosis, cell cycle and regulation.

**Cell signaling:** Peptide and steroid hormones and their receptors, signal transduction pathways, secondary messengers, regulation of signaling pathways.

**Cellular communication:** Cytoskeletal elements, cell adhesion molecules, extracellular matrix, neurotransmission and its regulation.

**Cancer:** Oncogenes, tumor suppressor genes, cancer and cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, Neoplasms, tumor-associated antigens, immune response to tumor antigens, immunologic factors favouring tumor growth, immunotherapy and chemotherapy.

## **Unit 9: Molecular Tools for Gene Cloning**

Nucleases: Exonucleases and Endonucleases, Restriction Enzymes (Type I, Type II, Type III, Type IV & Type V), RNases Methylases: CpG Methylase, Dam Methylase, Dcm Methylase Polymerases: DNA Pol I, Klenow Fragments, Reverse Transcriptase, Taq & Pfu Polymerases Ligases: T4 DNA Ligase, E.coli DNA Ligase, T4 RNA Ligase Topoisomerases: Type I(A, B) & Type II(A,B) End Modifying Enzymes: Terminal Transferase, T4 Polynucleotide Kinase, Alkaline Phosphatases.



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Construction of Genomic & cDNA Libraries, DNA Sequencing, Protein Engineering: Site Directed Mutagenesis, Reporter Gene Assays, DNA Protein Interactions: EMSA, DNA Foot printing, Protein-Protein Interactions: Y2H, Y3H, B1H, B2H

**Vectors and Gene Cloning:** Introduction to cloning vectors, Desirable properties of vectors, Prokaryotic & Eukaryotic Expression Systems (Constitutive & Inducible,) Plasmid Vectors, Phage Vectors, Cosmids, Phagemids, BACs, Yeast Vectors, YACs, Lentiviral Vectors, Adenoviral Vectors, Plant Vectors

**Unit 10: Bioinformatics and Biostatistics tools:** Major bioinformatics resources (NCBI, EBI, ExpASY); Sequence and structure databases and analysis, Sequence analysis, Phylogeny, Comparative genomics; Molecular docking, Identification of active site binding, DFT calculation, 3D-QSAR, Molecular modeling and simulations. Overview and functions of a computer system, Statistics: Descriptive statistics, Correlation and regression, Hypothesis Testing, Probability theory.

## Microbiology Syllabus

### Unit 1: Microbial Taxonomy and Diversity

Concepts and scope, classifying and naming microorganisms, ICNB rules, major characteristics used to classify microorganisms. Taxonomy of bacteria - Bergy's manual of systematic bacteriology. Taxonomic problems associated with variation in fungi. Classification of fungi. Conventional and molecular methods of studying microbial diversity. Microbes in extreme environments. Extremophiles - Psychrophilic, thermophilic, acidophilic, alkalophilic, halophilic and barophilic. Mechanism of adaptation in extremophilic microorganism. Importance and conservation of microbial diversity, metagenomics, In situ conservation and Ex situ conservation.

### Unit 2: Microbial Physiology and Enzymology

Microbial energetics, The role of ATP in metabolism. Metabolism of Carbohydrate: Glycolysis, citric acid cycle and oxidative level phosphorylation, fates of pyruvate, fermentation. Alternate pathways of carbohydrate metabolism, gluconeogenesis. Utilization of sugars other than glucose: lactose, galactose, maltose, mannitol. Degradation of cellulose, starch and glycogen.

**Lipid metabolism:**  $\beta$ -oxidation, biosynthesis of fatty acids, degradation of fatty acids.

**Nitrogen metabolism:** Nitrogen metabolism, biological nitrogen fixation process, symbiotic and non-symbiotic nitrogen fixation. urea cycle, degradation and biosynthesis of essential and non-essential amino acids.

**Nucleic acid metabolism:** Biosynthesis and degradation of purines and pyrimidines.

Photosynthetic bacteria, Autotrophic mechanisms in bacteria, microbial stress responses to different conditions (oxidative stress, thermal stress, starvation stress, aerobic to anaerobic transitions).



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**Microbial enzymes:** Isolation and purification of microbial enzymes. Structure and classification, mechanism of enzyme actions: lock and key model, induced fit theory. Factors affecting enzyme activity - pH, temperature and substrate and enzyme concentration. Enzyme inhibition and enzyme regulation. Significance and applications of enzyme inhibitors. Isoenzymes.

### Unit 3: Microbial Genetics

**Generalized reproductive cycles of microbes:** Viruses, Bacteria, Neurospora, Saccharomyces, Chlamydomonas and Acetabularia.

**Viral Genetics:** Lytic and lysogenic cycles, phage phenotypes, phenotypic mixing, recombination in viruses: Mapping of rII loci.

**Bacterial Genetics:** Bacterial Transformation, Bacterial Conjugation, Hfr conjugation.

**Transduction:** Generalized and specialized transduction, Mutation and mutagenesis, Fungal and algal genetics.

**Transposable elements:** insertion sequences, transposons, and integrons. Use of transposons.

**Mutation:** Types, causes and detection, mutant types - lethal, conditional, biochemical, loss of function, gain of function, insertional mutagenesis.

### Unit 4: Environmental Microbiology

Microbiology of air, water and soil, Sources of water pollution, Biological indicators of water pollution, Water and air borne diseases. Determination of potable quality of water. Eutrophication - causes, consequences and prevention. Microbes in extreme environment and their survival mechanisms, Microbes in the degradation of wastes, Microbial degradation of pesticides, Xenobiotics, bioremediation - advantages and disadvantages, Geomicrobiology: Microbes in metal extraction, mineral leaching and mining.

### Unit 5: Food Microbiology

Detection of food-borne microorganisms, Microbial spoilage of foods, Food poisoning and intoxication, Food borne diseases, Food preservation, Food Packaging - types of containers, Food packaging materials and forms, Package testing, Packages with special features, Safety of food packaging. Microbial indicators of food safety and quality, Food laws and standards.

### Unit 6: Agricultural Microbiology

Plant pathology, Diagnosis of plant diseases, Parasitism and disease development, Entry of pathogens to the host, Effect on physiology of host, Plant disease epidemiology, Environment and Plant diseases, Defense Mechanism of Plant Disease, Plant Diseases and their management, Host-pathogen interaction, Biofertilizer, PGPR, Biopesticides. Biodeterioration and Biomagnification.



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## Unit 6: Medical Microbiology

Milestones in the development of Medical Microbiology, Microbial Infections, Urinary tract infections, sexually transmissible infection, Oral cavity and respiratory infection, Gastrointestine infection, Nosocomial infections, General concepts for specimen collection and handing of specimen, Epidemiology, Pathogenesis, Spectrum of disease, Laboratory diagnosis and Prevention. Diseases caused by Viruses, Bacteria, Fungi, Chlamydiae, Protozoa and emerging diseases.

**Viruses and the future:** Promises and problems. Emerging diseases, sources and causes of emergent virus diseases. Silver lining: viruses as therapeutic agents, viruses for gene delivery, viruses to destroy other viruses. Importance of studying modern virology.

## Unit 7: Industrial Microbiology

Fermentation, Development of inocula, Fermenters, Batch and Continuous fermentation, Industrially important microorganisms, strain improvement and preservation, Media for industrial fermentation, sterilization, upstream processing, downstream processing, Industrial production of energy fuels (solvents), organic acids, enzymes (amino acids), food additives, Health care products (antibiotics, vitamins), probiotics, biomass production (SCP), hydrocarbons, recombinant proteins, quality control of fermented products, IPR, Patents, Biosafety and Entrepreneurship.

## Unit 8: Molecular Biology and Genetic Engineering

**Molecular Biology:** Central dogma of molecular biology. Microbes in Molecular Biology, DNA as Genetic material, Mechanism of replications, enzymes, fidelity of replication, Differences in prokaryotic and eukaryotic DNA replication. Post transcriptional modifications - splicing, adenylation, capping, polyribosomes, polycistronic and monocistronic mRNA. Transcriptional inhibitors. Protein synthesis, Gene expression, Regulation of gene expression in prokaryotes, eukaryotes and bacteriophages. Gene silencing. Post translation modifications.

**Genetic recombination:** transformation, transduction and conjugation.

**Genetic Engineering:** Restriction-modification systems, restriction enzymes- type I, II and III, specificity, sticky ends and blunt ends.

**Gene cloning:** genomic cloning, shot gun cloning, cDNA cloning.

**Vectors:** Plasmids, phage, cosmids and phagemid. Yeast cloning vectors, plant vectors, bacterial artificial chromosome, SV40, shuttle vectors, construction of expression vectors.

**Ligation:** Blunt end and sticky end ligation, use of linkers and adopters, homo polymer tailing, colony hybridization, plaque hybridization.

**Transformation:** Micro injection, electroporation, lipofection, calcium phosphate method, protoplast fusion/somatic cell hybridization and biolistic methods.

**Identifying the right clones:** Direct screening, insertional inactivation of marker gene, visual screening, plaque phenotype. Indirect screening; immunological techniques,



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hybrid arrest translation and hybrid select translation. Screening using probes; construction of gene probes, hybridization and labelling.

Applications of Genetic Engineering, Antisense technology, Safety of rDNA technology, Restriction and regulation for the release of GMOs into Environment, Ethical, Legal, Social and Environmental Issues related to rDNA technology.

## Unit 9: Immunology

Innate and acquired immunity. Cells and molecules involved in innate and adaptive immunity. Antigens, antigenicity, immunogenicity, antibodies, haptens, epitopes and paratopes. B and T cell epitopes, structure and function of antibody molecules. Structure of immunoglobulins, hyper variable region, isotypic, allotypic and idiotypic variations. Generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity.

**Cellular basis of immunity:** Primary and secondary immune response. T, B and accessory cells. Development of T and B cells. Sub sets of T and B cells. T helper cells, T-killer cells, T-suppressor cells. T and B cell receptors, antigen processing and presentation. T and B interaction.

**In vitro antigen-antibody reaction:** Precipitation, agglutination, complement fixation, immuno diffusion, immunoelectrophoresis, immunofluorescence, RIA and ELISA.

## Unit 10: Microbial techniques and Biostatistics

**Microscopy:** Working principle, construction and operation of different types- simple, compound, Phase contrast, Fluorescent and Electron microscopes. Sample preparation for electron microscopy. Confocal microscopy. Micrometry and photomicrography.

**Sterilization and disinfection:** Principles, types and techniques. Physical, chemical, radiation and mechanical methods.

**Isolation techniques:** Isolation of pure cultures- dilution, spread plate, streak plate, pour plate and micromanipulator method. Colony morphology and other characteristics of cultures. Maintenance and preservation of pure cultures, culture collection center - National and International. Direct microscopic count and standard plate count. Membrane filtration.

**Pure culture techniques** (spread plate, pour plate and streak plate methods).

**Microbiological stains and staining techniques:** Types of stains and principles of staining. Stains for bacteria, fungi, algae and protozoa, spirochetes, stains for mycoplasma. Preparation of bacterial smears for light microscopy: fixation, simple staining, differential staining, structural staining (capsule, flagella, cell wall and endospore of bacteria), and nuclear staining.



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**Molecular techniques for genome analysis:** RFLP, RAPD, AFLP and ISSR. Blotting techniques- Southern, Northern and Western blotting techniques. PCR, nested PCR, RT-PCR and Real time PCR technique and their applications.

**Biostatistics:** Measures of Central tendency and Dispersion.

**Probability distribution:** Binomial, Poisson and Normal. Parametric and Nonparametric statistics, Confidence Interval, Errors.

**Quantitative Techniques:** Levels of significance, Regression and Correlation, t-test; Analysis of variance and multiple range tests, chi-square test, experimental design, data transformation. Use of Statistics in Biosciences, Use of Computers in Quantitative analysis.

**Biochemical calculations:** Specific gravity, percent solution, dilution and dilution factors, ionic strength; molarity, normality, mole concept, Avogadro principles. Acids and bases, buffers, pH, pKa, Henderson-Hasselbach equation, buffer capacity, buffering capacity of amino acids.

Determination of LD50, ED50, IC50.

## Molecular Biology Syllabus

### Unit I: Fundamentals and cell organization

Structure of atoms, molecules and chemical bonds.

Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).

Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).

Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).

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

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

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

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



## Unit II: Biomolecules and Metabolism

Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).

Stability of proteins and nucleic acids.

Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structures, domains, motifs and folds).

Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA and other noncoding RNA's).

Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins.

Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.

## Unit III: Biochemical and Biophysical Techniques

**Cell fractionation techniques:** Cell lysis, homogenization, extraction, salting in, salting out, dialysis and ultra-filtration.

Centrifugation, Analytical Centrifugation and Marker enzyme analysis,

**Flow Cytometry:** Principle and design of flow cytometer, cell sorting. Detection strategies in flow cytometry and parameters measured by flow cytometry.

Chromatographic techniques, HPLC and RP-HPLC - Principle, instrumentation, application FPLC, LC, Peptide mapping and N-terminal sequencing of proteins.

**Spectroscopic Techniques:** Beer-Lambert's Law and its limitations, Extinction coefficient,

Mass spectrometry - Principle and application, ESI, fragmentation, MALDI-TOF, LC-MS, LC- MS-MS, Physical methods of determining size, shape and structure of molecules - NMR, ESR, X-Ray Diffraction and crystallography. Principles and applications: Vibration Spectra - IR and Raman, principles and applications: Polarized Light: Plane and circularly polarized light, ORD and CD and their applications.

Radioisotopes, Labeling and Applications of radioactivity

## Unit IV: Molecular Biology Techniques and Genetic Engineering

**Electrophoretic Techniques:** Principle, denaturing, Non-denaturing electrophoresis, agarose gel electrophoresis, isoelectric focusing, Chromatofocusing, pulsed field electrophoresis, capillary electrophoresis, Visualising separated proteins - staining for proteins and nucleic acids, fluorescence, PAS staining, zymogram and reverse zymogram.

**Blotting Techniques:** Dot blot, Southern, Northern, Western blot, DNA foot print assay, DNA finger print assay, gel retardation assay, EMSA, nuclease protection assay. PCR, RT-PCR, RFLP, RAPD, AFLP.

Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods.



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Analysis of RNA, DNA and proteins by one- and two-dimensional gel electrophoresis, Isoelectric focusing gels.

Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Expression of recombinant proteins using bacterial, animal and plant vectors.

Isolation of specific nucleic acid sequences

Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors.

*In vitro* mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms.

Protein sequencing methods, detection of post translation modification of proteins. DNA sequencing methods, strategies for genome sequencing.

Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array-based techniques.

## Unit V: Cell Signaling and Immunology

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

Cell signalling, Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.

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

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

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



## Unit VI: Enzymology and Molecular Physiology

Nomenclature and classification of enzymes. Nature of enzymes, localization, isolation, purification and characterization of enzymes. Criteria of purity of enzymes and fold purity. Specificity and active site. Units of enzyme activity

**Enzyme Kinetics:** Rate of reaction, order and molecularity. Michaelis-Menton equation, initial velocity approach and steady state approach.  $V_{max}$ ,  $K_m$  and their significance. Linear transformation of Michaelis-Menton equation - Line weaver Burk plot, Eddie Hofstee, Haynes - Wolf and Cornish - Bowden plot. Turnover number. Factors affecting enzyme kinetics - Effect of enzyme concentration, substrate concentration, pH, temperature and activators and inhibitors.

Kinetics of bi-substrate reactions, Mechanisms of enzyme catalysis

**Mechanisms of Action of Specific Enzyme:** Chymotrypsin, zymogen activation, acid-base catalysis, charge relay network. Lysozyme, alcohol dehydrogenase, ribonuclease, carboxypeptidase A, RNA as an enzyme and Coenzymes.

**Photosynthesis:** Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms;  $CO_2$  fixation- $C_3$ ,  $C_4$  and CAM pathways.

**Respiration and Photorespiration:** Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

**Nitrogen Metabolism:** Nitrate and ammonium assimilation; amino acid biosynthesis.

**Plant Hormones:** Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

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

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

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

**Nervous System:** Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.

**Sense Organs:** Vision, hearing and tactile response.

**Excretory System:** Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

## Unit VII: Molecular Genetics and Developmental Biology

**Mendelian Principles:** Dominance, segregation, independent assortment.



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**Concept of Gene:** Allele, multiple alleles, pseudoallele, complementation tests.

**Extensions of Mendelian Principles:** Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

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

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

**Microbial Genetics:** Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.

**Human genetics:** Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

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

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

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

**Morphogenesis and Organogenesis in Plants:** Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum

## Unit VIII: Molecular Cell Biology and Gene Expression

**Extracellular matrix and cell-cell interaction:** Extracellular components - cell matrix adhesion, collagens – types of collagens, elastin, fibronectins, basal lamina and its components, connective tissues, proteoglycans and laminin. Cell - cell adhesion, cadherins, CAMS (NCAMS), selectins, integrins, desmosomes, hemidesmosomes, tight junction, gap junction, Catenins, actins, Tubulins, intermediate filaments, glycosaminoglycans.



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**Cell Cycle:** Cell division types, phases of cell cycle, mitosis and meiosis, role of centrioles, role of spindle fibres, comparison of cell division in prokaryotes and eukaryotes. Cell cycle events in yeasts and animal cells; Cell cycle check points, cell cycle regulatory genes, different types of cyclins (D, E, A, and B), cdk's & their role, phase transition regulation (G1-S, S-G2, G2-M), cell cycle checkpoints, synthesis and degradation of cyclins, structural features of CDKs and cyclins, activation and inactivation of cyclin dependent kinases.

**Cell Death:** Apoptosis, necrosis and autophagy role and mechanism, caspases, calpains and cathepsins. Cell death signals, survival factors, pro-survival pathways, cell death genes. Cell death pathways, role of cytochromes, APAF, pro & anti apoptotic molecules.

**Molecular markers for Apoptosis:** Membrane markers, Caspase substrate (PARP) cleavage and DNA ladders.

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

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

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

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

## Physics Syllabus

### 1. Mathematical Methods of Physics

Matrices, Eigenvalues and eigenvectors. Special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier transforms and integral equations: Integral transforms, Fourier integral. inversion theorem. Convolution theorem. Integral equations: Types of linear integral equations. Neumann series. Tensor analysis: Algebra of Tensors, Metric tensor. Raising and lowering of indices. Christoffel symbols. Covariant differentiation.

### 2. Classical Mechanics

Mechanics of a system of particles: Center of mass. Conservation of linear and angular momentum in the absence of (net) external forces and torques. The energy equation and the total potential energy of a system of particles. Motion of a particle in a central force



field: Binet equation for central orbit, Kepler's problem. Poisson brackets and canonical transformations.

Constraints and their classifications, Generalized co-ordinates, virtual displacements, Lagrangian equation of second kind, examples. Generalized momenta, Hamilton's equations, examples; cyclic co-ordinates. Poisson brackets; equations of motion in the Poisson bracket notation.

### 3. Electromagnetic Theory

Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Fresnel's law, interference, coherence, and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields. Dispersion relations in plasma. Lorentz invariance of Maxwell's equation. Radiation from moving charges and oscillating dipoles.

### 4. Quantum Mechanics

Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box and harmonic oscillator). Tunneling through a barrier. Wave-function 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. Variational method. Fermi's golden rule, selection rules. Identical particles, Pauli exclusion principle. Elementary theory of scattering: Born approximation. Relativistic quantum mechanics: Klein-Gordon equation and Dirac equation.

### 5. Thermodynamic and Statistical Physics

Laws of thermodynamics. Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria. Phase space, micro- and macro-states, ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics, distribution functions. Ideal Bose and Fermi gases. First- and second-order phase transitions. Bose-Einstein condensation. Diffusion equation.

### 6. Atomic and Molecular Physics

Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Zeeman, Paschen-Bach & Stark effects. Electron spin resonance. Nuclear magnetic resonance, chemical shift. Frank-Condon principle. Born-Oppenheimer approximation. Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. The diatomic vibrating rotator, example of the CO molecule.

### 7. Special Theory of Relativity

Relativistic kinematics and mass-energy equivalence. Real coordinates in Minkowski space time. The Minkowski scalar product. Orthogonality of 4-vectors. Time like, null, and space like vectors and world-lines. The light-cone at an event. The proper-time interval along the world line of a material particle. The instantaneous (inertial) rest-frame of a material particle and the components of 4-velocity, 4-acceleration and the 4-momentum vector in this frame. Statement of Newton's second law of motion in this frame. Determination of the fourth component of the 4-force along the world line of the particle.



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Motion of a particle under the conservative 3-force field and the energy integral. The rest energy and the relativistic kinetic energy of a particle.

## 8. Nuclear and Particle Physics

Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semi-empirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge-independence and charge-symmetry of nuclear forces. Deuteron problem. Evidence of shell structure, single-particle shell model, its validity and limitations. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions, reaction mechanism, compound nuclei and direct reactions. Gas filled detectors and scintillation detectors. Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann-Nishijima formula. Quark model, baryons and mesons. C, P, and T invariance. Parity non-conservation in weak interaction.

## 9. Condensed Matter Physics

Crystal systems and Bravais lattices. Space groups; Diffraction of X-rays by crystals: Laue equations. Reciprocal lattice. Bragg equations. Diamagnetism, Paramagnetism. Ferromagnetism. Curie's law, Curie-Weiss law. Spontaneous magnetisation. Ferromagnetic domains. Antiferromagnetism. Type I and type II superconductors. London equations. Meissner effect. High frequency behaviour. Entropy and Specific heat in the superconducting state. Expressions for carrier concentrations. Fermi energy, electrical conductivity and energy gap in the case of intrinsic semiconductors.

## 10. Electronics

Operational amplifiers: inverting amplifier, noninverting amplifier, Summing, scaling and averaging amplifiers, voltage to current converter with grounded load, current to voltage converter, integrator, differentiator. Log and antilog amplifiers, Wave form generators, phase shift oscillator, Wein bridge oscillator. mono-stable and astable multivibrators, First and second order Low pass and High pass filters.

Digital electronics: Boolean Laws and Theorems, Families of gates, RS and JK flip-flops. The Master-Slave JK Flip-Flop, D and T flipflops. Decoders-BCD decoders, Encoders.

## Chemistry Syllabus

### INORGANIC CHEMISTRY

- 1. Chemical Periodicity-** 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, boranes, carboranes, silicones, diamond and graphite. Hydrides and oxoacids of N, P, S and halogens. Boron nitride, boranes, carboboranes, borazines, phosphazenes. Xenon compounds and Spinels.
- 2. 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.



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- 3. Organometallic Compounds:** Synthesis, bonding and structure, and reactivity. Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.
- 4. Bioinorganic Chemistry:** Nitrogen fixation, haemoglobin, myoglobin, cytochrome and other metal ions of biological system.

## PHYSICAL CHEMISTRY

- 5. 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; tunnelling.
- 6. Approximate Methods of Quantum Mechanics:** Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules.
- 7. Chemical Thermodynamics:** Laws, state and path functions and their applications; thermodynamic description of various types of processes; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.
- 8. Statistical Thermodynamics:** Nernst equation, redox systems, electrochemical cells; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.
- 9. Polymer Chemistry:** Polymerisation and its kinetics. Molecular weight of a polymer (Number and mass average) Degree of polymerization and molecular weight, methods of determining molecular weights.

## ORGANIC CHEMISTRY

- 10.** Reactions, Synthesis and mechanism involving- Alkanes, Alkenes, Alkynes, Arenes, Alcohols, Phenols, Aldehydes, Carboxylic acids & their derivatives, Halides, Ketones, Nitro compounds, Amines. Aliphatic and Aromatic Substitution reactions: Nucleophilic and Electrophilic. Conjugation, resonance, reactive intermediates. Taft and Hammett Equation.
- 11. Stereoisomerism:** Enantiomers, Diastereomers, Racemic Mixture, Stereochemistry in compounds with no stereogenic centre, Stereochemical and conformational effects on reactivity and specificity.
- 12. Heterocyclic Chemistry:** Synthesis and chemical reactions. Carbohydrates, lipids, amino acids and proteins, biomolecules. Aromaticity: Huckel rule and concept of aromaticity, annulenes and hetero annulenes, fullerenes (C<sub>60</sub>).
- 13. Organic Reagents:** organozinc, organolithium reagents, phosphorus containing reagents, organosulphur compounds, etc, organometallic reactions.



- 14. Chemistry of Natural Products:** Familiarity with methods of structure elucidation and biosynthesis of alkaloids, terpenoids, steroids. Pericyclic reactions; Mobius Huckel Approach, Sigmatropic rearrangements, Photochemistry of alkenes, carbonyl compounds. Medicinal Chemistry: Drugs, Mechanism of drug action, anesthetics, analgesics.

## ANALYTICAL CHEMISTRY

- 15.** Accuracy, precision, classification of errors. Volumetric analysis, gravimetric analysis, TGA, Optical analytical methods, electro analytical methods, spectroscopic methods-UV, Vis, FTIR, <sup>1</sup>H NMR, <sup>13</sup>C NMR, ESR, Mass, X-ray diffraction techniques. Separation techniques. Chromatographic techniques. Electro analytical Techniques: Voltametry, polarography, amperometry, coulometry and conductometry.

## Materials Science Syllabus

### Unit 1: Materials

**Metals & Alloys:** Aluminum & Its Alloys, Properties and Application; Copper & Its Alloys, properties and applications; Titanium & Its Alloys, Properties and Application.

**Ceramic Materials:** Definition, Classification of Ceramic Materials, Processing Methods, Properties and Its Industrial, Medical and Commercial Applications.

**Polymer Materials:** Definition, Classification of Polymers, Processing Methods, Properties and Its Industrial, Medical and Commercial Applications.

**Composites:** Definition, Types of Matrix Materials, Types of Reinforcements, Selection of Composites, Properties, Applications. Numericals on Rule of Mixture for density, elastic modulus and tensile strength.

### Unit 2: Processing of Materials

Processing of bulk, thin film, powders, crystals and amorphous materials; Top seeded solution growth; sol-gel techniques; high temperature solution; hydrothermal and solvothermal methods; Melt methods- CVD; CVT; MBE; Plasma; Laser ablation. Crystal growth of selected functional materials - quartz, diamond, chalcogenides, GaAs, Si.

### Unit 3: Characterisation Techniques

X-ray diffraction, spectroscopic techniques like UV-vis, FT-IR, Raman, Photoluminescent and XPS ; Thermal analysis : TGA ; DTA ; DSC ; dilatometry ; (Thermal expansion) Principles and applications. Electron imaging techniques; SEM; TEM; FESEM; STM; AFM; SPM; HRTEM; HRSEM, Particle size measurement, surface area measurement and Vibrating sample Magnetometer.



## Unit 4: Crystal Structure of Materials

Periodic Array of Atoms Crystal Lattice-Lattice translation Vectors - United-Basis Symmetry Consideration- Bravis Lattice – Crystal Planes and Millers Indices- Simple Crystal Structure (HCP, FCC, BCC, SC, Diamond), Bragg's Law, Laue Equations, Reciprocal Lattice, Braggs Condition, Experimental X-Ray Diffraction, Methods of Crystal Structure determination, Laue Method, Rotary Crystal Method, Powder or Debye Scherrer Method, Rietveld Method.

## Unit 5: Thermodynamics and Kinetics

Kinetic Theory of Matter, Different States of Matter, Concept of Ideal or Perfect Gas, Kinetic Theory of Gases, Expression for the Pressure of a Gas, Kinetic interpretation of Temperature. Thermal Equilibrium Concept of Temperature (Zeroth Law of Thermodynamics), Concept of Heat-Heat: S Path Function Work; A Path Function, Comparison of Heat and Work – First Law of Thermodynamics, Isothermal Process, Adiabatic Process, Isobaric Process, Isochoric Process, Second Law of Thermodynamics, Entropy, Third law of Thermodynamics.

## Unit 6: Properties of Materials

**Mechanical Properties:** Stress-strain response of metallic, ceramic and polymer materials, yield strength, tensile strength and modulus of elasticity, toughness, plastic deformation, fatigue, creep and fracture.

**Electronic Properties:** Free electron theory, Fermi energy, density of states, elements of band theory, semiconductors, Hall effect, dielectric behaviour, piezo, ferro, pyroelectric materials.

**Magnetic Properties:** Origin of magnetism in metallic and ceramic materials, paramagnetism, diamagnetism, ferro and ferrimagnetism.

**Thermal Properties:** Specific heat, thermal conductivity and thermal expansion, thermoelectricity.

**Optical Properties:** Refractive index, absorption and transmission of electromagnetic radiation in solids, electrooptic and magneto-optic materials, spontaneous and stimulated emission, gas and solid-state lasers.

## Unit 7: Nanomaterials

Definition, Classification of Nano-materials, Synthesis of Nano-materials – ball milling, plasma synthesis and their characterization. Chemical Functionalization and surface modification (*insitu* and *exsitu*)-Recent advances in Thiol-Au and Silane Chemistry-Layerby-Layer synthesis of multilayer assemblies Applications-Quantum dots-nanocores and applications. Detailed description of the fabrication of functionalised Gold Nanocores and their applications in cancer therapy. Devices, Nanodevices. Applications of nanomaterials in catalysis, water treatment, solar cells, sensors, energy storage devices, nanomedicine, food packaging and nanocomposites.



## Nursing Faculty

## Nursing Syllabus

### 1. Health care delivery

Health care environment, economics, constraints, planning process, policies, political process vis a Nursing profession. Patterns of Nursing care delivery in India. □ Health care delivery concerns, national health and family welfare programs, inter-sectoral

### 2. Epidemiology

Scope, epidemiological approach and methods, Morbidity, mortality, Concepts of causation of diseases and their screening, Application of epidemiology in health care delivery, Health surveillance and health informatics.

### 3. Bio-Psycho social pathology

Pathophysiology and Psychodynamics of disease causation. Life processes, homeostatic mechanism, biological and psycho-social dynamics in causation of disease, life style.

**Common problems:** Oxygen insufficiency, fluid and electrolyte imbalance, nutritional problems, hemorrhage and shock, altered body temperature, unconsciousness, sleep pattern and its disturbances, pain, sensory deprivation.

**Treatment aspects:** pharmacological and pre- post-operative care aspects, Cardio pulmonary resuscitation. End of life Care. Infection prevention (including HIV) and standard safety measures, bio-medical waste management. Role of Nurse- Evidence based Nursing practice; Best practices. Innovations in Nursing.

### 4. Philosophy and Theories of Nursing

Values, Conceptual Models, Approaches.

**Nursing theories:** Nightingale's, Henderson's, Roger's, Peplau's, Abdella's, Lewine's, Orem's, Johnson's, King's, Neuman's, Roy's, Watson Parsce, etc and their applications, Health belief models, communication and management, etc. Concept of Self health. Evidence based practice model.

### 5. Psychological aspects and Human relations

Human behavior, Life processes & growth and development, personality development, defense mechanisms, organizational behavior Basic human needs, Growth and development, (Conception through preschool, School age through adolescence, Young & middle adult, and Older adult), Sexuality and sexual health. Stress and adaptation, crisis and its intervention, Coping with loss, death and grieving, Principles and techniques of Counseling.

### 6. Computer applications for patient care delivery system and Nursing Practice

Use of computers in teaching, learning, research and Nursing practice. Windows, MS office: Word, Excel, Power Point, Internet, literature search, Statistical packages, Hospital management information system: software.



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## **7. Introduction to Mental Health and Mental Illness**

Historical perspectives ,Trends, issues and magnitude ,Contemporary practices. Mental health laws /Acts. National mental health program -National mental health authority, state mental health authority. Human rights of mentally ill Mental Health/ Mental Illness Continuum .Classification of mental illnesses-ICD, DSM.

## **8. Theories of Personality Development and relevance to Nursing practice**

Psychoanalytic Theory- Freud's. Interpersonal Theory-Sullivan's. Theory of Psychosocial Development-Erikson's. Theory of object relations. Cognitive Development Theory. Theory of Moral Development .A Nursing Model-Hildegard E. Peplau

## **9. Stress and its management**

An introduction to the concepts of stress, Psychological Adaptation to stress ,Stress as a Biological Response. Stress as an Environmental Event. Stress as Transaction between the Individual and the Environment. Stress management.

## **10. Therapeutic communication and interpersonal relationship**

Review communication process, factors affecting communication, Communication with individuals and in groups, Techniques of therapeutic communication-touch therapy, Barrier of communication with specific reference to psychopathology, Therapeutic attitudes. Dynamics of a therapeutic Nurse-client relationship; Therapeutic use of self. Gaining self-awareness, Therapeutic Nurse-patient relationship its phases; Conditions essential to development of a therapeutic relationship. Therapeutic impasse and its management.

## **11. Therapies in Psychiatry**

Psycho social and physical therapies, Electroconvulsive Therapy, Psychopharmacology.

## **12. Management of various psychiatric disorders**

Childhood disorders, schizophrena, mood disorders, substance use disorders, delirium, dementia, phobia and conversion disorder, Gender identity disorders.



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## Education Faculty Education Syllabus

### Unit 1: Philosophical Foundation of Education.

- i. Relationship of Education and Philosophy
- ii. Western Schools of Philosophy: Idealism, Realism, Naturalism, Pragmatism, Existentialism, Marxism with special reference to the concepts of knowledge, reality and values their educational implications for aims, contents and methods of education.
- iii. Indian Schools of Philosophy (Sankhya, Vedanta, Buddhism, Jainism, Islamic traditions) with special reference to the concept of knowledge, reality and values and their Educational implications.
- iv. Contributions of Vivekananda, Tagore, Gandhi and Aurobindo to Educational Thinking. National values as enshrined in the Indian Constitution, and their Educational implications.
- v. Modern concept of Philosophy: Analysis-Logical analysis, Logical Empiricism and Positive relativism - (Morris L. Prigge).

### Unit 2: Sociological Foundations of Education.

- i. Relationship of Sociology and Education.
- ii. Meaning, nature of Educational sociology and Sociology of education. Education-as a social sub-system-specific characteristic, Education and the home Education and the community with special reference to Indian society.
- iii. Education and Modernization.
- iv. Education and Politics.
- v. Education and Religion.
- vi. Education and Culture.
- vii. Education and Democracy.
- viii. Socialization of the Child.
- ix. Meaning and nature of Social change.
- x. Education as related to social stratification and social mobility.
- xi. Education as related to social equity and equality of Educational opportunities.
- xii. Constraints on social change in India (Caste, ethnicity, class, language, religion, regionalism).
- xiii. Education of the socially and economically disadvantaged sections of the society with special reference to scheduled castes and scheduled tribes, women and rural population



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## **Unit 3: Psychological Foundations of Education.**

- i. Relationship of Education & Psychology. Scope of Educational Psychology, Methods of Educational Psychology: - Experimental, Clinical and Differential.
- ii. Concept of Growth and Development - Physical Development during Childhood and Adolescence, Social Development during Childhood and Adolescence, Emotional Development during Childhood and Adolescence and Intellectual Development during Childhood and Adolescence.
- iii. Individual Differences - Meaning and Areas, Determinants: Role of Heredity and Environment in Developing Individual Differences. Implications of Individual Differences for organizing Educational Programmes.
- iv. Gifted and Mentally Challenged - Meaning and characteristics.
- v. Creativity - Concept, Characteristics, Role of Teacher in Igniting and Developing Creativity, Importance of Creativity in Education.
- vi. Theories of Intelligence, types of intelligence test; Emotional intelligence, Multiple Intelligence, Creativity (Verbal and Non - Verbal).
- vii. Personality and Mental Health – Concepts, major theories of personality, Personality assessment; Adjustment and Mental health.
- viii. Learning - Concept and Meaning. Theories of Learning - Pavlov's Classical Conditioning, Skinner's Operant Conditioning and Learning by Insight.
- ix. Hull's Reinforcement Theory, Lewin's Field Theory, Gagne's Hierarchy of Learning Types and Factors Influencing Learning.
- x. Motivation - Concept of Motivation, Theories of Motivation: Physiological, Psycho-analytical Theory, Murray's Need Theory, Maslow's Theory of Hierarchy of Needs, Theory of Achievement Motivation and Factors affecting Motivation.

## **Unit 4: Information and Communication Technology in Education.**

- i. Educational Technology as systems approach to Education.
- ii. Systems approach in educational technology and its characteristics.
- iii. Components of educational technology, software, hardware, Multi-media approach in Educational Technology.
- iv. Concept of E- learning, Approaches to E- learning (Offline, Online, Synchronous, Asynchronous, Blended learning, mobile learning).
- v. Emerging Trends in E- learning: Social learning (concept, use of web 2.0 tools for learning, social networking sites, blogs, chats, video conferencing, discussion forum), Open Education Resources (Creative Common, Massive Open Online Courses; Concept and application), E-Inclusion - Concept of E-Inclusion, Application of Assistive technology in E-learning, Quality of E-Learning - Measuring quality of system: Information, System, Service, User



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Satisfaction and Net Benefits (D&M IS Success Model, 2003), Ethical Issues for E Learner and E Teacher - Teaching, Learning and Research

- vi. Use of ICT in Evaluation, Administration and Research: E portfolios, ICT for Research - Online Repositories and Online Libraries, Online and Offline assessment tools (Online survey tools or test generators) - Concept and Development.

## Unit 5: Teacher Education.

- i. Meaning, Nature and Scope of Teacher Education; Types of Teacher Education Programs, The Structure of Teacher Education Curriculum and its Vision in Curriculum Documents of NCERT and NCTE at Elementary, Secondary and Higher Secondary Levels, Organization of Components of Pre-service Teacher Education Transactional Approaches (for foundation courses) Expository, Collaborative and Experiential learning.
- ii. Understanding Knowledge base of Teacher Education from the view point of Schulman, Deng and Luke & Habermas, Meaning of Reflective Teaching and Strategies for Promoting Reflective Teaching, Models of Teacher Education - Behaviouristic, Competency-based and Inquiry Oriented Teacher Education Models.
- iii. Concept, Need, Purpose and Scope of In-service Teacher Education, Organization and Modes of In-service Teacher Education, Agencies and Institutions of In-service Teacher Education at District, State and National Levels (SSA, RMSA, SCERT, NCERT, NCTE and UGC), Preliminary Consideration in Planning in-service teacher Education programme (Purpose, Duration, Resources and Budget).
- iv. Concept of Profession and Professionalism, Teaching as a Profession, Professional Ethics of Teachers, Personal and Contextual factors affecting Teacher Development, ICT Integration, Quality Enhancement for Professionalization of Teacher Education, Innovation in Teacher Education.

## Unit 6: Methodology of Educational Research.

- i. Characteristics of Educational research.
- ii. Planning the research study; review of the literature – purpose and references, using database and internet; formulation of objectives and hypotheses (different types), variables - types and inter-relationship, preparation of research proposal.
- iii. Research Paradigms in Education: Quantitative, Qualitative and Mixed - Characteristics and types Quantitative methods- Experimental (True experimental designs and quasi-experimental designs), internal and external validity of results in experimental research; descriptive (survey, casual comparative, correlational programme evaluation), Qualitative Methods- Ethnography, Phenomenology, Case study, Historical Research, Mixed Research-strengths and weakness Characteristics of Educational Research.



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## Unit 7: Sampling and Tools/ Techniques of data collection.

- i. Sampling: Representative and biased sample; Random sampling techniques - simple, systematic, stratified, cluster sampling and multi - stage sampling; Non - Random Sampling, technique - convenience sampling, proportionate sampling, Quota sampling and snowball sampling; sampling in qualitative research.
- ii. Tools / Techniques data collection: Characteristic of a good research tool, tests inventories and scales-Types-construction and uses, Questionnaire-Forms, Principles and Construction, Administration of Questionnaires. Interview -Types Characteristics and Guidelines for conducting Interviews. Observation-Types, Rating Scale, Check List, Schedules, Focus group discussion.

## Unit 8: Analysis of Data.

- i. Data types - Nominal, Ordinal, Interval and Ratio data levels individual and group.
- ii. Description and Comparison of Groups, Measures of Central Tendency, Dispersion, Characteristics and Uses. Normal distribution (NPC)-characteristics. Deviation from normality and underline causes. Correlation-Types (Spearman, Pearson, Biserial, Point-biserial, Tetrachoric, Partial and Multiple). Regression analysis.
- iii. Testing of hypotheses; levels of significance, types of error, sampling distribution, sampling error, standard error: parametric test: t-test, f-test, ANOVA, ANCOVA- Concepts, assumption and uses. Non -Parametric tests- chi-square, sign test, median test. Analysis of Qualitative data-content analysis, transcription.







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## QUESTION PAPER PATTERN

The Ph.D. entrance examination question paper pattern is as follows:

- (i) 40% of questions will be on Basics of Research Methodology and 60% of questions will be on respective core subject covering respective Masters course syllabus.
- (ii) Duration of the examination is 3 hours.
- (iii) Under research methodology, the candidate has to answer  
20 questions out of 30 questions. Each question carries 1 =20 mark.  
10 questions out of 15 questions. Each question carries 2 =20 marks
- 
- Total =40**
- (iv) Under core subject, the candidate has to answer  
20 questions out of 30 questions. Each question carries 1 =20 mark  
10 questions out of 15 questions. Each question carries 2 =20 marks  
05 questions out of 10 questions. Each question carries 4 =20 marks
- 
- Total =60**

### Penalty for false and incorrect statements:

Where an applicant has furnished any false and incorrect statement in the application or where the affidavit filed by him or the certificate furnished by him contains any false or incorrect statement, the application shall be liable for rejection and his selection for admission to the Ph.D. course shall be cancelled after providing a reasonable opportunity to explain by the Entrance Test Committee.

**Malpractice:** Any candidate indulging in malpractice of any sort shall be viewed seriously and punished and also is liable for criminal proceedings. The committee can make guidelines in this regard.

**Registrar**