



**Syllabus for the Entrance Examination for Admission to  
Ph.D.2024**

**Research Methodology (common to all discipline)**

**1. Introduction to Research:**

Basics of Research and Methods, importance of scientific research, classifications of research, essential qualities of a researcher, Types of research – Quantitative vs. Qualitative, Descriptive vs. Analytical, Use of tools/techniques for research

**2. Experimental Research and Data Collection methods:**

Data classification, Data Processing, Hypothesis-formulation, sampling techniques, Survey methods, Methods for standard classification of crops in India, Aspects of Experimental Research including purpose of the report, abstracts, introduction and results and discussion. Structure and components of scientific reports, types of report, developing successful research proposals.

**3. Research Design:**

Problem Identification & Formulation – Questions for investigation – Data, Measurements, Hypothesis – Qualities of a good Hypothesis – Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.

**4. Research ethics, IPR and scholarly publishing:**

Environmental impacts, Ethical issues, ethical committees, Commercialization – Copy right, royalty - Intellectual property rights and patent law, Reproduction of published material, Plagiarism - Citation and acknowledgement, Reproducibility and accountability. Use of Internet in Research – E-Journal, E-Library, INFLIBNET.

## **Aero Engineering**

1. **Aerodynamics:** Subsonic, Transonic, Supersonic, Hypersonic, Rarefied Gas flows (Theoretical and Experimental), Boundary Layers and Stability of Flows, Turbulent Flows, Shock Tubes and Related Problems, Development of Algorithms and Code for Numerical Methods in Gas Dynamics and Computational Fluid Dynamics, Vortex Dynamics, Supersonic Mixing and Combustion, Optical Flow Diagnostics.
2. **Aircraft Structures:** Finite Element Methods, Numerical Methods, Photo Elasticity, Moire and Holographic Methods of Structural Analysis. Composite Structures, Fatigue and Fracture Mechanics, Contact Mechanics, Vibrations and Impact Mechanics.
3. **Aerospace Propulsion:** Rocket Propulsion and Solid Propellant Combustion, Air breathing Propulsion and Combustion, Cascade Flows, Multiphase Flow Simulation, Combustion Instability, Optical Flow/Combustion Diagnostics.
4. **Dynamics and Control:** Nonlinear Dynamics in Aerospace Applications, Computational Methods in Nonlinear Dynamics, Nonlinear Control Theory and Applications, Flight Simulations and Controller Development, Design Development of Autonomous Flying Vehicles. Laplace transform, response of LTI, transfer functions, feedback systems, open loop and closed loop gains, types of systems, poles and zeros, state space form, stability, controllability, observability. Free body diagram, point mass model, Airplane performance, rigid body dynamics, trim and stability, static margin, longitudinal and lateral-directional dynamics, longitudinal and lateral modes.

## COMPUTER APPLICATION

- 1. Discrete Structures:** Sets, Relations, Functions, Pigeonhole Principle, Inclusion-Exclusion Principle, Equivalence and Partial Orderings, Counting Techniques. Probability, Measure(s) for information and Mutual information. *Computability:* Finite Automata, NFA, DPDA and PDAs and Languages accepted by these structures, Grammars. *Graph Theory:* Tree and rooted tree. Hamiltonian and Eulerian graphs, Planar graphs. Groups: Finite fields and Error correcting/detecting codes.
- 2. Computer Arithmetic:** Propositional (Boolean) Logic, Predicate Logic, Well-formed formulae  
(WFF), Satisfiability and Tautology. Logic Families : TTL, ECL and C-MOS gates. Boolean Algebra, Flip-flops-types, race condition and comparison, Design of combinational and sequential circuits. Representation of Integers
- 3. Programming in C and C++ :** *Programming in C:* Data types in C. Control structures in C. Sequence, selection and iteration(s), Structured data types in C arrays, struct, union, string and pointers. *O-O Programming Concepts:* Class, object, instantiation, Inheritance, polymorphism and overloading. Constructors and destructors, Overloading, Inheritance, Templates, Exception handling.
- 4. Relational Database Design and SQL:** E R diagrams and their transformation to relational design, normalization and its forms. SQL : Data Definition language (DDL), Data Manipulation Language (DML), Data Control language (DCL) commands. Database objects like-Views, indexes, sequences, synonyms, data dictionary.
- 5. Data and File structures** Data, Information, Definition of data structure, Arrays, stacks, queues, linked lists, trees, graphs, priority queues and heaps. File Structures : Fields, records and files, Sequential, direct, index-sequential and relative files, Hashing, inverted lists and multi-lists B trees and B+ trees.
- 6. Computer Networks** Network fundamentals: LAN, WAN, MAN. The OSI model, TCP/IP model, Data Communication, Internetworking, Routing, Network Security, Cryptography, Electronic Mail and Worldwide Web (WWW), E-mail architecture and Serves.
- 7. System Software and Compilers:** Assembly language fundamentals (8085 based assembly language programming). Loading, linking, relocation, Compilation and Interpretation, Phases of compilation process, Lexical analysis, Context free grammars, Intermediate code generation, Code generation, Code optimization.
- 8. Operating Systems (with Case Study of Unix):** Main functions of operating systems, Types of Operating Systems, Memory Management, Concurrent Processing, Scheduling.  
**The Unix System :** Introduction. Working on various commands, Shell Scripting.
- 9. Software Engineering:** System Development Life Cycle (SDLC), Software Metrics, Software Design Coding and testing.
- 10. Current Trends and Technologies:**
  - a) Parallel Computing,**
  - b) Mobile Computing**
  - c) E-Technologies:** Electronic Commerce, Digital Libraries and Data Warehousing, Software Agents, Broadband Telecommunications, Main concepts in Geographical Information System (GIS), E-cash, E-Business, ERP packages. Data Mining
  - d) Windows Programming,**
  - e) Advanced Windows Programming**

# MECHANICAL ENGINEERING

## 1. Materials Science & Metallurgy:

Classification of engineering materials, crystallography, solid solutions, eutectic, eutectoid, peritectic and peritectoid transformations, iron carbon diagrams, TTT diagrams, alloys and composite materials.

## 2: Manufacturing Processes and Machine Tools:

Manufacturing Processes: Casting, forging, sheet metal working, rolling, extrusion, metal joining processes (welding, soldering, and brazing).

Machine Tools: Lathe machine, drilling machine and grinding machine (basic elements, working and types of operations). Non-conventional machining methods, Introduction to NC, CNC, and DNC.

## 3: Introduction to Thermodynamics:

System, process, properties, specific properties, concept of mechanical work & heat, heat engine, heat pump and refrigerator, efficiency and COP terms, Laws of Thermodynamics (Zeroth, First and Second laws), various power cycles, refrigeration and air-conditioning.

## 4: Energy Producing Devices/Thermal Engineering Devices:

Boilers, working principle of two stroke and four stroke IC engines (diesel and petrol).

Power absorbing devices: pumps (reciprocating and centrifugal, rotary pumps), compressors (reciprocating and centrifugal compressors), fans, blowers.

## 5: Design of Machine Elements:

Design Fundamentals: Design concept, need, design considerations, design of machine elements.

Mechanisms: Kinematic link, kinematic pair, kinematic chain, mechanisms (four bar and slider crank). Machine Elements: Shaft, axle, keys, coupling (rigid & flexible), drives (belt, chain & gear), brakes.

## 6: Fluid Mechanics and Machinery:

Fluid statics, dynamics and kinematics, dimensional analysis and model testing, water turbines, pumps, and hydraulic couplings, computational fluid dynamics.

## 7: Industrial Engineering:

Productivity, method study and work measurements, types of production systems, plant layouts, aggregate planning, master production scheduling, materials requirement planning, facility layouts, sequencing and scheduling, CPM and PERT, inventory management and quality control.

## **MANAGEMENT STUDIES:**

### **1: Organisational behaviour**

The concept and significance of organisational behaviour – Skills and Roles in an organisation

– Classical, Neo – Classical and Modern Theories of Organisational Structure – Organisational Design – Understanding and Managing individual behaviour personality – Perception – Values – Attitudes – Learning – Motivation.

### **2: Human Resource Management**

Concepts and perspectives in HRM; HRM in changing environment, Human Resource Planning

– Objectives, Process and Techniques, Job analysis – Job Description, Selecting Human Resources. Induction, Training and Development. Exit policy and Implications. Performance Appraisal and Evaluation, Potential Assessment,

### **3: Financial Management**

Nature and Scope, Valuation Concepts and Valuation of Securities, Capital Budgeting Decisions – Risk Analysis, Capital Structure and Cost of Capital, Dividend Policy – Determinants, Long – Term and Short – Term Financing Instruments, Mergers and Acquisitions.

### **4: Marketing Management**

Marketing Environment and Environment Scanning; Marketing Information Systems and Marketing Research; Understanding Consumer and Industrial Markets; Demand Measurement and Forecasting; Market Segmentation – Targeting and Positioning; Product Decisions, Product mix, Product Life Cycle; New Product Development; Branding and Packaging; Pricing Methods and Strategies. Promotion Decisions – Promotion mix; Advertising; Personal Selling; Channel Management. Customer Relation Management; Uses of Internet as a Marketing Medium – Other related issues like branding, market development, Advertising and retailing on the net. New issues in Marketing.

### **5: Quantitative methods & Techniques**

Overview of Statistics, Classifying Data to convey meaning, Measures of Central Tendency – Mean, Median & Mode, Measures of Variation – Range, Average Deviation, Standard Deviation, Probability Theory; Probability distributions – Binomial, Poisson, Normal and Exponential; Correlation and Regression analysis; Sampling theory; Sampling distributions; Tests of Hypothesis; Large and small samples; t z, F, Chi – square tests.

# Commerce

## 1. Business Administration-

- Principles of Management
- Functions of management: Planning, Organizing, Staffing, controlling, Communication, Leadership, Motivation
- Corporate Governance
- Corporate Social Responsibilities

## 2. Marketing –

- Marketing Task, Concept, Tools
- Marketing Environment
- Consumer Behaviour and Market Segmentation Product and Pricing Decisions
- Direct and Online Marketing

## 3. Business Environment-

- Legal, Political and Economic Environment E-Commerce
- E-Governance
- Corporate Governance
- Social Responsibilities of Business
- Public and Private Partnership (PPP)
- Knowledge Management

## 4. Accountancy-

- Accounting Concepts
- Accounting Conventions
- Financial Statements
- Accounts of Non Trading Concerns
- Company Accounts – Issue of Shares
- Management Accounting – Ratio Analysis
- Income Tax – Concepts, Computation and Tax Planning by individuals

## 5. Cost and Works Accounting -

- Elements of Cost
- Classification of Cost
- Cost Unit
- Cost Centre
- Methods of Costing
- Techniques of Costing
- Cost Audit

## 6. Goods & Service Tax (GST)

- Basics of GST
- CGST, SGST, IGST,
- UTGST

- Threshold limit of GST
- Documentation under GST

### **7. Indian Companies Act-**

- Formation and Incorporation of Companies
- Memorandum of Association
- Articles of Association
- Prospectus
- Consumer Protection Act
- Negotiable instrument Act
- Sale of Goods Act

### **8. Insurance and Transport- Insurance**

- Introduction
- Types of Insurance
- Principles
- Actuarial
- Role of IRDA Transport-
- Transport
- Transport system in India
- Documentation in Transit and Transport
- Role of Transport in Indian Economic Growth

### **9. Business Economics-**

- Nature and uses of Business Economics
- Concept of Profit and Wealth Maximisation Demand Analysis
- Elasticity of Demand
- Curve Analysis
- Law of Demand
- Cost Revenue
- Price
- Determination in Different Market Situation Pricing Strategy

### **10. Banking-**

- Importance of Banking to Business
- Types of Banks and their functions
- Role and functions of RBI

### **11. Co-operation and Rural Development Co- operation**

- Concept and Principles of Co-operation
- Co-operative Credit System
- Co-operative Banks
- Rural Development
- Concepts and Approaches
- Role of Govt. agencies in Rural Development

## Fashion Design

### MARKETING AND RETAILING:

- Introduction to marketing, marketing process and marketing in modern economy, trends in marketing environment, Consumer market trend, overview of market research process and research design, Concept of product, product positioning, Branding, factor affecting price determination, distribution channels, nature and function of distribution channels and physical distribution decision, 4Ps of promotion mix, retailing concept, social and economic significance of retailing, opportunities in retailing, historical perspective of retail in India, types of retailers, retail Strategy, building sustainable competitive advantage, global growth strategies, retail planning process, retail value chain, ethics and social responsibility
- Concept of Quality, managing quality through inspection and testing, tools of quality. Inspection and its significance. Defects at different stages of manufacturing like yarn defects, weaving & knitting defects, dyeing, printing and finishing defects, Quality standards as applicable to various types of textiles. ISO 9000, Textile testing, ISO 9000 Series Standards, Introduction to AATCC, ASTM, ISO, BIS, INDIA, Introduction to ecofriendly textiles and environmental impact of Textile Industries, Care labeling & its Importance, terminology, symbols and usage, International care labeling, elementary knowledge of wool & silk marks, laundry aids

### ENTREPRENEURSHIP:

- Concepts, nature and traits, leadership, risk taking, decision making, business planning Barriers, Economic and non-economic, Institutional support for new ventures, support organizations like RFC, RIICO, DIC, Financial organizations like IFCI, IDBI, SIDBI and other Banks, Role of government in Entrepreneurial development: government incentives, subsidy and assistance, Promotion of a new venture: search for a business idea, preparation of plan, analysis of entrepreneurial opportunities, assessing the impact of opportunities and threats

### Fashion Design

- Structural and applied design variation in fiber, yarn and fabric construction, embroidery, dyeing, printing and finishes.
- **Process of Designing:** Developing textile motifs inspired by nature, Religion, Mythology, Arts & Crafts, Architecture applying elements and principles of design, Motif Development, Big and Small Motifs: Enlargement and Reduction, Growth of a motif, Color harmonies, Combining Motifs from different sources, placements and repeats for all over patterns, **Sustainable fashion:** Meaning & concept, importance and need of sustainability in future market, approaches towards sustainability, global paradigm of green fashion, developments in sustainable fashion, green fashion, key Issues in preventing change, role of retailer in selling socially responsible fashion.
- Developing visual diaries and look book and focus on research and developing 2d/3d explorations



- Origin of Fashion, Fashion terminology, Various fashion centers, elements of design, basics principles of designs, sources of inspiration and design, forecasting trends, theories of fashion, seasons, fashion cycle, strengths of Indian fashion Industry.

#### **UNDERSTANDING TEXTILES:**

- Chemistry of polymers, types & characteristics, Structure of textile fibers- molecular bonding, length, orientation, and requirements of fiber forming substances, Microscopic structure, manufacturing process, physical & chemical properties of natural fiber, manmade fiber, Basic principles of yarn manufacturing, yarn types & properties, twist and sewing threads, Weaving- terminology, parts of loom, basic weaves, Knitting- warp & weft knits, knitting machines, Other fabric production methods - felting, bonding, knotting, braiding and lacing

#### **TEXTILE COLOURATION & FINISHING:**

- Concept of color and its relation to light; classification and its types of dyes/coloring matter, Eco-friendly natural dyes, role of mordants, Chemistry of dyes and composition, method of application, fastness properties, Mechanism of dyeing, Dyeing auxiliaries, Thickening agents, Dyeing machines, Styles & methods of printing.
- Pretreatment processes for Cellulosic, Protein, Manmade fibers like singeing, scouring, bleaching, desizing, degumming, milling, heat setting etc, Finishing — chemistry, method of application and evaluation of softening and stiffening finishes, Types of finishes : Chemical, Mechanical finishes and functional finishes

#### **Merchandising**

- Fundamentals of merchandising, responsibilities, planning, controlling and control tools, pricing strategies, pricing formula. Costing principles and strategies, Sourcing strategies, types of sourcing, merchandiser's roles, customer/vendor relationship, global sourcing process, Visual Merchandising, its elements and functions.

#### **Apparel Production Technology**

- Taking body measurements for: men, women & children. Methods of pattern making, Fabric preparation, Pattern layout, Marker planning, marker types, efficiency, spreading and cutting tools, equipment, ticketing and bundling, Components of sewing, garment accessories and post production processes, Types of production system
- CAD/CAM in different stages of apparel manufacturing process

## Beauty Cosmetology

### Nanotechnology

Encapsulation techniques for topical delivery eg spray drying. Liposomes and Proliposomes to Enhance Cosmetics Delivery and its approaches.

Techniques of manufacturing: physical, physicochemical, chemical methods, Release methods and patterns, safety aspects, and applications. Nanoparticles: Techniques of manufacturing, safety aspects, and applications. Liposomes: Classification, Techniques of manufacturing, safety aspects, and applications. Niosomes and Transfersomes: Aloe beads.

Classification, Techniques of manufacturing, safety aspects, and applications.

**Hair Care Cosmetics:** Hair Cleansers shampoo, Cream shampoo, shampoo cakes, Hair nutrients, hair tonics, hair oils, Brilliantine's, Gels, Hair conditioners, hair loss, Dandruff, hair grooming preparation, hair waver, hair straighteners, hair setters, hair softeners (shaving creams & gels) Quality control studies & stability. Depilatories

**Skin Care Cosmetics:** Development of formulations & manufacturing consideration for creams & lotions, suntan & anti sunburn preparations skin bleaches, Skin tonics & astringents. Antiperspirant & deodorants face powder & colored makeup preparation. face pack & masks Lipsticks & bath preparation. The latest ingredients be used in the formulation.

**Eye Makeup Preparation;** General, Eye shadows, eyeliners, eyebrow cosmetics, and mascara. Study of recent cosmetics such as high lighters, different colors eyeliners, and Surma.

**Spectroscopic techniques:** Introduction, instrumentation, basic principle, interpretation of spectra and applications of UV-visible spectroscopy, Infrared spectroscopy, NMR spectroscopy, and Mass spectrometry in pharmacy.

**Chromatographic techniques:** Introduction, instrumentation, basic principle and applications of paper chromatography, thin layer chromatography, ion exchange chromatography, column chromatography, affinity chromatography, GC, HPLC, and HPTLC in pharmacy.

**Preformulation studies:** Introduction, goals of preformulation, physicochemical properties, criteria for selection of drug and excipients, compatibility tests.

**Quality assurance:** Concept of total quality management, requirements of GMP, GLP, GCP, regulatory requirements of drugs and pharmaceuticals.

**Pharmacological studies:** General methods of extraction, isolation, purification, and preliminary phytochemical screening methods. Factors affecting cultivation, collection, processing, and storage of crude drugs. Pharmacognostic study of drugs under glycosides and alkaloids. Organoleptic evaluation of crude drugs.

## Botany

- 1. Biodiversity and Taxonomy:** Identification, Nomenclature and classification. Taxonomic literature, Evolutionary trends and variations, ICN, phylogenetic classifications, species concepts, speciation, Biosystematics, Paleobotany. DNA finger printing, numerical taxonomy, Biodiversity, Magnitude and distribution of biodiversity, economic value, conservation strategies
- 2. Biochemistry:** Structures and Metabolism of Carbohydrates, Lipids, Proteins, Nucleic acid, Enzymes, Enzyme kinetics
- 3. Cell and Molecular Biology:** Organization of plant cell and chloroplast, mitochondria, Golgi complex, Nucleus, Ribosome's, ER, Cell wall, Cell membrane, vacuoles, cytoskeleton, Totipotency differentiation and cell death, cell cycle, apoptosis, signal transduction in cells. Chromosome organization, DNA replication and repair, Chromatin organization, protein synthesis, transcriptional and translational regulation, Protein targeting.
- 4. Inheritance Biology:** Mendelian genetics, concept of gene, Linkage and recombination, genetic mapping, extra chromosomal inheritance, chromosome banding, FISH and GISH, crossing over, recombination, 3 point test cross, tetrad analysis in Yeast and *Neurospora*.
- 5. Plant Breeding:** Selection – Mass and Pure line selection, hybridization – Backcross and Test cross, Heterosis breeding, Mutation breeding, role of polyploidy in plant breeding, genetically engineered plants.
- 6. Plant Physiology:** Water relations and membrane transport, photosynthesis and respiration, nitrogen metabolism, hormones, Stress physiology and tolerance mechanisms, strategies used for development of stress resistant / tolerant plants.
- 7. Development:** Vegetative and reproductive development in plants, organization of plant structures, Regulation of plant development by intrinsic and extrinsic factors.
- 8. Ecology:** Ecosystem- structure, types and functions, Ecological succession, habitat, biomes, Biomes, population ecology, plant interactions, phytogeography, endemism, RET species, IUCN categories, Ecological modelling Niche, evolution and co-evolution, Pollution ecology, Pollution indicator organisms, restoration ecology with reference to plants and microbes, Environmental Impact Assessment, Ecotoxicology, sewage treatment, carbon sequestration. National and International conventions and laws for protection and conservation of biological resources.
- 9. Plant Biotechnology:** Plant tissue culture techniques, Micro-propagation, cell, tissue and organ culture, Elicitation and secondary metabolites production. Genetic Engineering, Gene libraries, DNA sequencing.
- 10. Bioprospecting:** Ethno botany, types of Bioprospecting, Phytochemicals used in aroma, flavour and medicines, plant resources and natural products, Exploration of lower and higher plant for standardization of herbal medicines as per US-FDA.

**11. Tools and Techniques:** Microscopy, Microtomy, Chromatography, Electrophoresis, Centrifugation, Radioactive techniques, Spectroscopy, SEM and TEM.

**12. Biostatistics and Bioinformatics:** Experimental Design – Completely Randomized Block and Factorial Experimental Design. Analysis of variance, Populations and samples, Graphical representation of data, frequency distribution, central tendency and dispersion, Introduction to databases and retrieving information from databases, Molecular tools in protein and nucleotide sequence analysis.

## PHYSICS

**1. Mathematical Physics and Numerical Analysis:** Curve fitting, data analysis, Probability theory. Vector algebra and vector calculus. Linear algebra, Matrices. Linear differential equations. Fourier series, Fourier transforms Elementary complex analysis.

**2. Classical Mechanics:** Newton's laws, Lagrangian and Hamiltonian formalisms. Symmetries and conservation laws, Motion in the central field of force. Collision and scattering, Mechanics of system of particles. Rigid body dynamics. Non-inertial frames and pseudo forces. Small oscillations and normal modes. Wave equation, phase velocity, group velocity, dispersion.

**3. Electromagnetics:** Laplace and Poisson equations, Ampere's theorem, Biot-Savart Law, electromagnetic induction. Maxwell's equation Scalar and vector potentials. Reflection and refraction, dispersion, Rectangular wave guides.

**4. Quantum Mechanics:** Wave-particle duality. Heisenberg's Uncertainty Principle. Schrodinger equation. Particle moving in a one-dimensional potential. Orbital angular momentum. Motion in a central potential symmetry conservation laws and degeneracy. Operator formalism of quantum mechanics. Angular momenta algebra, spin. Addition of angular momenta.

**5. Thermodynamics and Statistical Physics:** Chemical potential, phase equilibria. Phase space, Microstates and macrostates. Ensembles. Partition function, Free energy and connection with thermodynamic quantities. Classical and quantum statistics. Degenerate electron gas, Blackbody radiation and Planck's distribution law.

### **7. Electronics:**

Semiconductor devices (diodes, junctions, transistors, field effect devices, homo- and hetero- junction devices), device structure, device characteristics, frequency dependence and applications. Optoelectronic devices (solar cells, photo-detectors, LEDs).

### **8. Atomic and Molecular Physics:**

Quantum states of an electron in an atom. Electron spin. Spectrum of hydrogen, helium and alkali atom. Lasers: spontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping, population inversion, rate equation. Modes of resonators and coherence length.

### **9. Condensed Matter Physics:**

Bravais lattices. Reciprocal lattice. Bonding of solids. Phonons, lattice specific heat. Drude model of electrical and thermal conductivity. Hall Effect. Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors.

### **10. Nuclear and Particle Physics:**

Nuclear size, shape and charge distribution, spin and parity. Binding energy, Semiempirical mass formula, liquid drop model. Shell model. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions, reaction mechanism.

## MICROBIOLOGY

- 1. Microbial Diversity, Physiology and Metabolism:** Archaea, Bacteria, Fungal Systematic and diversity, fungal endophytes, mycorrhizal fungi, agriculturally important toxigenic fungi, secondary metabolites from fungi, genomics and diversity of yeast, algal diversity. Growth and cell division, solute transport, central metabolic pathways and regulation, metabolism of nitrogen, lipids, hydrocarbons and nucleotides, physiological adaptations and intracellular signaling.
- 2. Enzymology and Instrumentation:** Enzyme assay, enzyme kinetics. Cell disintegration and extraction techniques, separation of proteins by fractionation Ion exchange chromatography, molecular sieve chromatography, affinity chromatography, paper chromatography, thin layer chromatography, ultra filtration, Ultracentrifugation. Electrophoresis and types, Microscopy, HPLC, HPTLC, GC-MS, FTIR, SEM/TEM, NMR, AAS.
- 3. Virology:** Animal Viruses-Classification, properties, cultivation. Viral replication strategies, replication pattern of specific viruses, subviral pathogens, anti-viral strategies – prevention and control of viral diseases. Plant and Microbial Viruses- History and development of plant virology, cryptograms and classification of plant viruses and viroids. Propagation, purification, characterization, isolation and genomics of plant viruses. Symptoms, transmission and control of plant viruses.
- 4. Immunology and Medical Microbiology:** Immunoprophylaxis and Immunotherapy, Immune cell receptors, Genetic organization, Regulation of Immune response, autoimmunity, Immunological disorder and hypersensitivity, transplantation and tumor immunology, immunoassays. Monoclonal antibody technology, Pathophysiology of Infectious diseases – diseases of respiratory tract, digestive system, skin and soft tissues. Host-pathogen interaction, recent developments in aetiology, pathogenesis, diagnosis and control of AIDS. Emerging and reemerging pathogens, epidemiology, chemotherapy and antimicrobial resistance, newer vaccines, rapid diagnosis of pathogens.
- 5. Cell and Molecular Biology:** Cell structure, function and organization, genetic material, DNA replication, Recombination and DNA repair, transcription and post transcriptional process, translation, post-translational process, molecular basis of cell physiology. Microbial genetics- gene transfer and mapping by conjugation, lytic and lysogenic bacteriophages, gene transfer by transformation and transduction, transposons, gene regulation
- 6. Recombinant DNA technology:** Basics of DNA cloning, methods of DNA and protein analysis, PCR and types, construction of DNA and genomic DNA libraries, genome sequencing, transcriptional analysis of gene expression and transcriptomics, overexpression of recombinant proteins, analysis of protein DNA and protein – protein interaction, protein engineering and protein analysis, pharmaceutical products of DNA technology, transgenics and animal cloning
- 7. Industrial and Food Microbiology:** Introduction to industrial microbiology, downstream processing of microbial products, fermentation economics and production aspects, microbiology of food, microbial spoilage of food, food preservation concepts and techniques, fermentation processes, food borne diseases.
- 8. Ecology and Environmental Microbiology:** History and development of environmental microbiology, New Directions and Importance of Microbial Ecology, Microbiology of the normal and extreme environment. Geomicrobiological processes, Lignin degradation, Waste management treatment, bioremediation, microbes and mineral recovery.

**9. Recent Trends in Biological Sciences:** Gene Technology, Application of gene technology, Gene Silencing, Gene knock out and gene therapy, Tissue culture Techniques- Animal Culture, Stem cells, Plant tissue culture, Biosensors, Nanotechnology.

## **LIFE SCIENCE/Zoology**

### **1. Biomolecules**

Structure of atoms, molecules and chemical bonds Classification, Structure, Properties, Functions of Carbohydrates, Proteins and Lipids, Characteristics & Physico - Chemical properties of nucleic acids, Conformation of nucleic acids, vitamins.

### **2. Plant Physiology**

Photochemistry and Photosynthesis, Photosynthetic Pigments, Light harvesting complexes, Photo Oxidation of Water, mechanism of electron & Proton transfer, Carbon assimilation, Calvin cycle, Photorespiration and its significance, C<sub>4</sub> cycle and CAM Pathway, Plant hormones, Phytochromes

### **3. Animal Physiology and Hormones**

Digestion, Excretion, respiration, circulation, sensory physiology, muscle contraction, Thermoregulation, Endocrine & its regulation in man.

### **4. Biophysics & Biochemical Techniques**

Principles and techniques of Chromatography, Electrophoresis, Spectroscopy (Visible, UV, NMR, ESR, IR, Mass Spectroscopy), Centrifugation, Biological Solutions, X-ray Diffraction, Radiation Biology (Radioisotopes detection & measurement).

### **5. Advanced Cell Biology & Cell Biology Techniques**

Origin of Life & evolution of cell, cell cycle & its regulation, ultra structure of eukaryotic chromosome, cell-cell interaction, transport across membranes, cytoskeleton, and microscopy. Mitotic and meiotic chromosome preparations, karyotyping, ideogram, camera Lucida, flow cytometry, FISH, chromosome painting.

### **6. Genetics**

Drosophila & mouse as model organisms, Mendelian principles, deviations from Mendelism, extra nuclear inheritance, Molecular mechanism of Sex determination, Transposable elements, mutations & genotoxicity screening in different organisms, genetic repair mechanisms. Syndromes and genetic diseases of human.

### **7. Molecular Biology**

Central dogma, DNA replication, Transcription, Translation, Post transcription & translation modification, gene regulation, Oncogenes & proto-oncogenes. Cancer therapy.



# Forensic Science

## 1. General forensic science

Definition, Fundamental concepts, and Basic principles of forensic science, Frye case and Daubert's standard, Duties and Qualifications of forensic scientists, Historical and Developmental aspects of Forensic Science, Ethics in Forensic Science, Need & Scope of development of forensic science in India. Evidence Applicability in Court, Expert's testimony and admissibility of scientific evidence in court of Law, Code of conduct for forensic scientists

## 2. Criminology

Definition: Criminology; Criminology as Science, The field and scope of Criminology; Victimology; Organized crime; White – collar crimes/ Occupational crimes; Crime against women and children. Definition, Elements, nature, causes of crime. Classification of crimes; Concept of a criminal and classification of criminals, Miranda rights, FIR, Acceptance of evidence in the Court of Law; McNaughton Rule; child witness in the court, State and central police forces – organizational structure, field establishment; Duties and Responsibilities of the Police, Code of Conduct for the Police; Policing styles and principles. Police's power of investigation. Interrogation of suspects and offenders.

## 3. Forensic physics

Glass evidence – collection, packaging, analysis. Matching of glass samples by mechanical fit and refractive index measurements. Analysis by spectroscopic methods. Fracture analysis and direction of impact.

Paint evidence – collection, packaging and preservation. Analysis by destructive and non-destructive methods. Importance of paint evidence in hit and run cases.

Cloth evidence – importance, collection, analysis of adhering material. Matching of pieces. Tool mark evidence. Classification of tool marks. Forensic importance of tool marks. Collection, preservation and matching of tool marks. Restoration of erased serial numbers and engraved marks.

## 4. Forensic chemistry and toxicology

Poisons--Classification of poisons. Physico-chemical characteristics and mode of action of poisons. Accidental, suicidal and homicidal poisonings. Signs and symptoms of common poisoning and their antidotes. Metabolism and excretion of poisons. Definition, Broad classification – Narcotics, stimulants, depressants and hallucinogens, Collection and preservation Toxicological Samples (viscera, blood and urine) for various poison and drug cases. Introduction to Alcohol and Alcoholic Beverages, Fate of ethyl alcohol in the body, alcohol in the circulatory system, breath test instruments, field sobriety testing, analysis of blood for alcohol Arsenic, Mercury: Nature, administration, symptoms, postmortem findings,

Detection and medico-legal aspects; Barbiturates: Classification, administration, symptoms, post-mortem findings, detection and medico-legal aspects; Corrosive poisons: Acids- HCl, H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub> and Alkalis- NaOH, KOH.

Chemistry of fire. Conditions for fire. Fire scene patterns. Location of point of ignition. Recognition of type of fire. Searching the fire scene. Collection and preservation of arson evidence. Analysis of fire debris. Analysis of ignitable liquid residue. Post-flashover burning. Scientific investigation. Classification of explosives – low explosives and high explosives. Military explosives.

## 5. Forensic Biology and Anthropology

Forensic Biology-- Introduction, Evidences of Biological Importance, Nature, scope of crime scene presence and characterization (blood, semen, vaginal fluids, saliva, urine, sweat, skin, nails, tissue, tooth, bones, uterine fluid, vomit, vitreous humor, CSF, colostrums). Recognition of Biological evidences encountered in various cases, Search, Collection, protection, documentation and chain of custody of Biological

Evidences, Packaging & transportation of Biological Evidences

Basics of forensic entomology. Insects of forensic importance. Collection of entomological evidence during death investigations. Significance of Entomological evidence

Determination of race, age, sex, stature from long bones, skull, pelvis and other skeletal material of forensic significance, Somatoscopy – observation of hair on head, forehead, eyes, root of nose, nasal bridge, nasal tip, chin, Darwin's tubercle, ear lobes, supra-orbital, ridges physiognomic ear breadth, circumference of head. Scar marks and occupational marks.

Somatometry – measurements of head, face, nose, cheek, ear, hand and foot body weight, height. Indices - cephalic index, nasal index, cranial index, upper facial index.

## **6. Forensic Ballistics**

History and development of firearms. Classification of firearms. Weapon types and their operation. Firing mechanisms of different firearms.

Internal ballistics – Definition, ignition of propellants, shape and size of propellants, manner of burning, and various factors affecting the internal ballistics: lock time, ignition time, barrel time, erosion, corrosion and gas cutting

External Ballistics – Vacuum trajectory, effect of air resistance on trajectory, base drag, drop, drift, yaw, shape of projectile and stability, trajectory computation, ballistics coefficient and limiting velocity

Effect of projectile on hitting the target: function of bullet shape, striking velocity, striking angle and nature of target, tumbling of bullets, effect of instability of bullet, effect of intermediate targets, and influence of range. Ricochet and its effects, stopping power.

Types of ammunition. Constructional features and characteristics of different types of cartridges and bullets. Different types of marks produced during firing process on cartridge – firing pin marks, breech face marks, chamber marks, extractor and ejector marks.

## **7. Questioned Documents and Fingerprint Examination**

Definition and types of questioned documents. Preliminary examination of documents. Basic tools needed for forensic documents examination – ultraviolet, visible, infrared and fluorescence spectroscopy, video spectral comparator, electrostatic detection apparatus.

Definition, Development of individuality in handwriting. Natural variations and fundamental divergences in handwritings. Class and individual characteristics. Comparison of handwriting. Comparison of paper, ink, printed documents, typed documents, documents. Examination of counterfeit Indian currency notes, passports, visas and stamp papers.

Biological basis of fingerprints. Formation of ridges. Types of fingerprints. Fingerprint patterns and Ridge Characteristics. Plain and rolled fingerprints, Ridge counting and ridge tracing. Classification and cataloguing of fingerprint record., Henry's system of classification and Extension, Batley's Single Digit Classification. Analysis and comparison of fingerprints using ridge characteristics. Chance prints and types. Constituents of sweat residue. Latent fingerprints detection by physical and chemical techniques. Mechanism of detection of fingerprints by different developing reagents. Application of light sources in fingerprint detection. Preservation of developed fingerprints.

## **8. Instrumentation and Analytical Techniques**

Fundamental principles of Different types of microscopes: Simple and Compound microscope, Comparison microscope, Phase contrast microscope, Stereoscopic microscope, Polarizing microscope, Fluorescent Microscopy, Electron microscope. Forensic applications of microscopy. Electrophoresis, Sodium dodecyl sulphate (SDS) polyacrylamide gel electrophoresis, Agarose gel electrophoresis, Gel immune-diffusion, Immuno- electrophoresis. Principle, Instrumentation, Working procedure and

Forensic Applications of thin layer chromatography, gas chromatography and liquid chromatography. Spectroscopic methods. Fundamental principles and forensic applications of Ultraviolet- visible spectroscopy, infrared spectroscopy. Atomic absorption spectroscopy, atomic emission spectroscopy and mass Spectroscopy, X-ray spectrometry.