ANDHRA PRADESH PUBLIC SERVICE COMMISSION :: VIJAYAWADA
BRIEF NOTIFICATION NO. 11/2026, Dated: 15/09/2026

DIRECT RECRUITMENT TO THE POST OF ASSISTANT DIRECTOR IN (FORENSIC ENGINEERING / PHYSICS / CHEMISTRY / BIOLOGY) IN A.P. STATE FORENSIC SCIENCE LABORATORY SERVICE

(General Recruitment)

1. Applications are invited online through the Commission's Website (https://psc.ap.gov.in) from eligible candidates **from 06/10/2026 to 27/10/2026 up to 11:59 P.M** for Recruitment to the post of Assistant Director in (Forensic Engineering / Physics / Chemistry / Biology) in A.P. State Forensic Science Laboratory Service.

2. The eligible candidates desirous of applying shall apply online after satisfying themselves with regard to the terms and conditions of this Recruitment Notification. The details of provisional vacancies are notified hereunder and the number of vacancies is subject to variation upon confirmation being received from the concerned Department.

PC. No.	Name of the Post	No. of vacancies	Scale of Pay Rs.
01	Assistant Director in Forensic Engineering	01 CF	57,100 – 1,47,760
02	Assistant Director in Physics	02	
03	Assistant Director in Chemistry	02	
04	Assistant Director in Biology	03	
TOTAL		**08 (07 + 01 CF)**	

3. Educational Qualification:

Applicants must possess the requisite Educational Qualification as on the date of Detailed Notification.

The Qualifications are as follows:

Pc. No.	Name of the Post	Educational Qualifications
01	Assistant Director in Forensic Engineering	B.E. in Mechanical or Structural Engineering or its equivalent i.e., B.E/B.Tech in Civil or Production Engineering.
02	Assistant Director in Physics	M.Sc. Degree in First or Second Class in Physics or its equivalent i.e. Tech. Physics or Material Science or Nuclear Physics or Electronics or Electronics & Instrumentation or Applied Physics or Instrumentation or Five Integrated M.Sc. Physics or Geo Physics or Nano Science or Nano Technology or Electronic Communications.
03	Assistant Director in Chemistry	M.Sc. Degree in First or Second Class in Chemistry or its equivalent qualification or B.Sc. Degree with A.I.C by examination in Forensic Sciences.
04	Assistant Director in Biology	M.Sc. Degree in 1st or 2nd Class in either Botany/Zoology/Microbiology/Biochemistry or its equivalent i.e Bio-Technology or Genetics or Forensic Science or a Degree in Medicine with a Bachelor's Degree in Science (Chemistry, Botany, Zoology, Physics).

NOTE: 1) Exceptionally good eye-sight (Colour blindness will be a disqualification); and

2) Must have practical experience in a Forensic Science or Chemistry or Analytical or Police Laboratory for at least five Years.

3) The experience in relevant field is desirable.

4. Detailed Notification with breakup of vacancies, Scale of pay, Age, Community, Educational Qualifications and any other information with instructions will be available on the Commission's Website (https://psc.ap.gov.in) on or before **06/10/2026.**

5. The date of Detailed Notification will be reckoned as the crucial date in all aspects.

IMPORTANT:

(i) Applicants/candidates should read the Commission's Detailed Notification and other instructions carefully before applying for this Recruitment and enter the particulars properly in the Online Application Form.

(ii) Applicants/candidates have to submit applications only through online mode. Any application sent through any mode other than the prescribed online mode will not be entertained under any circumstances.

(iii) Applicants/candidates are advised to submit their applications through online well in advance of the last date to avoid last-minute rush.

6. The examination for this recruitment shall consist of a single-level examination only, and no Screening Test shall be conducted, irrespective of the number of applications received. The examination shall be conducted in online (CBRT) mode. In case the single-level examination is conducted in multiple sessions, the Commission will adopt a process of normalisation of marks, wherever considered necessary and applicable, in accordance with the methodology and procedure decided by the Commission. The details of such normalisation, if applicable, shall be notified by the Commission in due course.

7. The detailed Scheme and Syllabus of this Examination is annexed to this Notification to facilitate the candidates.

Date:15/09/2026 Sd/-

Place: Vijayawada SECRETARY

ANNEXURE

SCHEME AND SYLLABUS TO THE POST OF ASSISTANT DIRECTOR IN (FORENSIC ENGINEERING / PHYSICS / CHEMISTRY / BIOLOGY) IN A.P. STATE FORENSIC SCIENCE LABORATORY SERVICE

SCHEME FOR THE EXAMINATION

1) ASSISTANT DIRECTOR, FORENSIC ENGINEERING:

Written (Objective type) Examination			
Paper – I: General Studies and Mental Ability	150 Questions	150 Minutes.	150 Marks
Paper – II: Mechanical Engineering or Structural Engineering or Civil Engineering or Production Engineering	150 Questions	150 Minutes.	300 Marks
Total			**450**

2) ASSISTANT DIRECTOR, PHYSICS:

Written (Objective type) Examination			
Paper – I : General Studies and Mental Ability	150 Questions	150 Minutes.	150 Marks
Paper – II : Physics or Material Science or Nuclear Physics or Electronics or Electronics & Instrumentation or Applied Physics or Instrumentation or Five Integrated M.Sc. Physics or Geo Physics or Nano Science or Nano Technology or Electronic Communications"	150 Questions	150 Minutes.	300 Marks
Total			**450**

3) ASSISTANT DIRECTOR, CHEMISTRY:

Written (Objective type) Examination			
Paper – I : General Studies and Mental Ability	150 Questions	150 Minutes.	150 Marks
Paper – II : Chemistry or Forensic Science	150 Questions	150 Minutes.	300 Marks
Total			**450**

4) ASSISTANT DIRECTOR, BIOLOGY:

Written (Objective type) Examination			
Paper – I : General Studies and Mental Ability	150 Questions	150 Minutes	150 Marks
Paper – II :Botany or Zoology or Microbiology or Biochemistry or Bio-Technology or Genetics or Forensic Science or a Degree in Medicine with a Bachelor's Degree in Science (Chemistry, Botany, Zoology, Physics).	150 Questions	150 Minutes	300 Marks
Total			**450**

Syllabus for the Examination

Paper-I

GENERAL STUDIES AND MENTAL ABILITY (Common for all Posts)

1. Major Current Events and Issues pertaining to International, National and State of Andhra Pradesh.
2. General Science and its applications to the day to day life Contemporarydevelopments in Science & Technology and Information Technology.
3. History of India – emphasis will be on broad general understanding of the subject in its social, economic, cultural and political aspects with a focus on AP and Indian National Movement.
4. Geography of India with focus on Andhra Pradesh.
5. Indian polity and Governance: constitutional issues, public policy, reforms and e-Governance initiatives.
6. Indian Economy and planning
7. Sustainable Development and Environmental Protection
8. Disaster management: vulnerability profile, prevention and mitigation strategies,Application of Remote Sensing and GIS in the assessment of Disaster
9. Logical reasoning, analytical ability and logical interpretation.
10. Data Analysis: Tabulation of data Visual representation of data Basic dataanalysis (Summary Statistics such as mean, median, mode and variance)and Interpretation.

ASSISTANT DIRECTOR FORENSIC ENGINEERING

Paper-II

A. MECHANICAL ENGINEERING:

1. THERMODYNAMICS:

- Basic concepts, Open and closed systems. Heat and work, Zeroth, First and second law, application to flow and non-flow processes. Entropy;, Availability, Irreversibility, T-S relations, Clapery on and real gas Equations. Properties of ideal gases and vapours. Air standard cycles, Two stage air compressor, CI and SI engines, Valve travel diagram, Pre ignition, Detonation and Diesel knock, Fuel injection, Carburetion, Super charging, Turbo prop and Rocket engines. Cooling, Emission and Control. Measurement of calorific value of fuels. Conventional and Nuclear fuels.

2. HEAT TRANSFER:

- Modes of heat transfer. One-dimensional steady and unsteady conduction. Composite slab and equivalent resistance. Heat dissipation from extended surfaces. Heat exchangers, Over all heat transfer coefficient, Empirical correlations for heat transfer ;in laminar and turbulent flow, Heat transfer in free and forced convection. Thermal boundary layer over a flat plate. Fundamentals of diffusive and convective mass transfer. Black body and fundamental concepts of radiation. Shape factor, Network analysis.

3. REFRIGERATION AND AIR CONDITIONING:

- Heat pump, Refrigeration cycles and systems, Refrigerants, Condensers, Expansion devices, Psychrometry, Charts and application to air conditioning, Sensible heating and cooling. Effective temperature, Comfort indices, Load calculations. Solar refrigeration, Duct design.

4. STEAM GENERATORS AND TURBINES:

- Fire tube and water tube boilers. Binary vapour system. Flow of steam through nozzles and Diffusers. Dryness fraction, Condensation. Various types of turbines, Compounding, Velocity triangles, Partial admission, Reheat, Regeneration, Efficiency and Governance. Gas Turbines, Role of Mach number.

5. THEORY OF MACHINES:

- ✧ Kinematic and DYNAMIC ANALYSIS OF PLANAR MECHANISMS CAMS Gears and Gear trains. Fly wheels, Governors, Balancing of rotating masses, Balancing of single and ;multi cylinder engines. Linear Vibrations of mechanical systems, Transmissibility and Vibration Isolation. Critical speeds. Two rotor and Three rotor systems. Automatic controls - Order and Type of system, 2nd order system and its characteristics. Frequency analysis. Stability, RouthHurwitz criterion, Nyquist criterion.

6. MACHINE DESIGN:

- ✧ Theories of failure, Design of Cotter joint, Keys, Splines, Welded Joints, Threaded fasteners, Bolt of uniform strength, Screw Jack. Design of Bearings, Couplings, Clutches, BELT DRIVES and Spur gear system. Hydrodynamic and Antifriction bearings. Design of shafts for combined loads. Helical and Leaf Springs. Thin and Thick walled pressure vessels.

7. ENGINEERING MATERIALS:

- ✧ Basic concepts of structure of solids. Crystalline Materials. Defects in Crystalline materials. Alloys and Binary Phase diagrams. Structure ;and properties of common Engineering Materials. Heat treatment of Steels. Plastics, Ceramics and Composite materials. Common applications of various materials.

8. PRODUCTION ENGINEERING:

- ✧ Metal Forming: Basic principles of Forging, Drawing and Extrusion. High energy rate forming. Powder Metallurgy. Metal Casting: Die casting, Investment Casting, Shell molding, Centrifugal casting, Gating and Rising design, Melting furnaces. Fabrication processes: Principles of Gas, Arc and Shielded Arc welding. Advanced welding processes. Weldability, Metallurgy of Welding. Metal cutting: Turning, Methods of Screw production, Drilling, Boring, Milling, Gear Manufacturing, Production of Flat surfaces, Grinding and Finishing processes. Computer controlled manufacturing systems-CNC, DNC, FMS, Automation and Robotics. Cutting Tool Materials, Tool geometry, Mechanism of Tool Wear, Tool Life and Machinability. Measurement of Cutting Forces. Economics of Machining. Uncoventional Machining processes. Jigs and Fixtures. Fits and Tolerances. Measurement of Surface texture. Comparators Alignment Tests and Reconditioning of Machine Tools.

9. INDUSTRIAL ENGINEERING:

- ✧ Production planning and Control: Forecasting, Moving Averages, Exponential Smoothing, Operations, Scheduling, Assembly line balancing. Product Development, Break-even analysis, Capacity Planning, PERT and CPM. Control Operations: Inventory Control, ABC analysis, EOQ model, Material requirement Planning. Job Design, Job standards, Work Measurement, Quality Management, Quality Analysis and Control. Operations Research: Linear Programming – Graphical and simplex methods. Transport and Assignment Models. Single server Queuing Model. Value Engineering: Value analysis for Cost value.

10. ELEMENTS OF COMPUTATION:

- ✧ Computer Organization, Flow charting, Features of Common Computer Languages – FORTRAN, d Base III, Lotus1-2-3,C and Elementary Programming.

B.STRUCTURAL ENGINEERING

a) Strength of Materials: Simple Stresses and Strains, Elastic Constants, Shear Force and bending moment diagrams for beams, Compund stresses – Principal Planes and Principal stresses - Mohr's circle method, Theory of bending, Distribution of shear stresses, Deflections – Macaulay method of double integration, Theory of torsion, Thin and Thick cylinders, Shear centre, Unsymmetrical bending.

b) Theory of Structures: Direct and bending stresses, Columns & Struts, Strain energy method, Moving loads and influence lines, Arches, Suspension bridges – static and kinematic indeterminacy, Analysis of Continuous beams and portal frames - Moment distribution method, Slope deflection method and Kani's method, Coloumn analogy method and Matrix methods.

c) Concrete Structures: Materials and stresses, Stress blocks, Limit state and working stress methods of design of Beams, Slabs, Columns and Footings. Retaining walls, Water tanks, Slab and T-Beam bridges, Design for Shear and Torsion, Yield line theory.

d) Steel Structures: Riveted and Welded joints and connections, Simple and compound columns, Column bases, Roof trusses, Plate and Gantry girders, Plate girder and Lattice girder railway bridges, Bearings. Plastic analysis and design of beams and frames.

e) Prestressed concrete: Basic concepts, Material losses, System of Prestressing, Analysis and design of beams.

C.CIVIL ENGINEERING

1. BUILDING MATERIALS:

- Timber: Different types and species of structural timber, density – moisture relationship, strength in different directions, defects, preservations, plywood.
- Bricks: Types, Indian standard classification, absorption, saturation factor, strength in masonry, influence of mortar strength on masonry strength.
- Cement: Compounds of different types, setting times, strength.
- Cement mortar: Ingredients, proportions, water demand, mortars for plastering and masonry.
- Concrete: Importance of w/c ratio, strength, ingredients including admixtures, workability, testing for strength, mix design methods, non-destructive testing.

2. STRUCTURAL ANALYSIS:

- Analysis of determinate structures – different methods. Analysis of indeterminate skeletal frames – Moment distribution, Slope deflection, Kani's, Stiffness and force methods, Energy methods, Muller Breslan principle and application. Plastic analysis of indeterminate beams and simple portal frames – Shape factors.

3. DESIGN OF STEEL STRUCTURES:

- Principles of working stress method. Design of connections, Simple members, Built-up sections and Frames, Design of industrial roofs. Principles of ultimate load design. Design of simple members.

4. DESGIN OF CONCRETE AND MASONRY STRUCTURES:

- ✧ Limit state design for bending, Shear, Axial compression and combined forces. Codal provision for slabs, Beams, Columns and footings. Working stress method of design of R.C. members. Principles of pre-stressed concrete design, Materials, Methods of pre-stressing, losses. Design of simple members and determinate structures. Design of brick masonry as per IS codes.

5. CONSTRUCTION PLANNING AND MANAGEMENT:

- ✧ Bar chart, Linked bar chart, Work break down structures, Activity – on – arrow diagrams. Critical path, Probabilistic activity durations, Event based networks. PERT network: Time-cost study, Crashing, Resource allocation.

6. HYDROLOGY AND WATER RESOURCE ENGINEERING:

- ✧ Hydrological cycle, Precipitation and related data analysis, Unit hydrographs, Evaporation and transpiration. Floods and their management, Stream gauging, Routing of floods, Capacity of reservoirs. Multi purpose uses of water: Soil-plant – Water relationships, Irrigation systems. Water demand assessment: Storages and their yields. Ground water yield and well Hydraulics. Water logging and drainage design. Design of rigid boundary canals, Lacey's and tractive force concepts in canal design, Lining of Canals, Sediment transport in canals, Non-overflow and overflow dams and their design, Energy dissipators, Design of head works, Distribution works, Falls, Cross-drainage works, Outlets, River training.

7. ENVIRONMENTAL ENGINEERING:

a. Water Supplying Engineering: Sources of supply, Yields, Design of intakes and conductors, Estimation of demand. Water quality standards, Control of water borne diseases. Primary and secondary treatment. Conveyance and distribution systems of treated water, Leakages and control. Rural water supply. Institutional and industrial water supply.

b. Waste Water engineering: Urban rain water disposal, Systems of sewage collection and disposal. Design of sewers and sewerage systems, Pumping. Characteristics of sewage and its treatment. Disposal of products of sewage treatment. Plumbing systems. Rural and semi-urban sanitation.

c. Solid Waste Management: Sources and effects of air pollution, Monitoring of air pollution, Noise pollution, Standards, Ecological chain and balance. Environmental assessment.

8. SOIL MECHANICS AND FOUNDATION ENGINEERING:

- Properties and classification of soil, Compaction, Permeability and Seepage, Flow nets, Inverted filters, Compressibility and consolidation. Shearing resistance, Stresses and failure. Soil testing in laboratories and in-situ, Earth pressure theories, Stress distribution in soils, Soil exploration, Samplers, Load tests, Penetration tests. Types of foundations, Selection criteria, Bearing capacity, Settlement, Laboratory and field tests, Types of piles and their design and layout. Foundations on expansive soils, Swelling and its prevention, Foundation on swelling soils.

9. SURVEYING AND TRANSPORT ENGINEERING:

- Classification of surveys, Scales, Accuracy, Measurement of distances, Direct and indirect methods, Optical and electronic devices, Measurement of directions, Prismatic compass, Local attraction, Theodlytes, Types, Measurement of elevations, Spirit and trigonometric leveling, Contours, Digital elevation modeling concept, Establishment of control by triangulations and traversing, Measurement and adjustment of observations, Computation of coordinates, Field astronomy, Concept of global positioning system, Map preparation by plane tabling and by photogrammetry, Remote sensing concepts, Map substitutes. Planning of Highway systems, Alignment and geometric design, Horizontal and vertical curves, Grade separation, Materials and construction methods for different surfaces and maintenance. Principles of pavement design, Drainage. Traffic surveys, Intersections, Signaling, Mass transit systems, Accessibility, Networking.

D.PRODUCTION ENGINEERING

UNIT – I

CASTING:

- Steps involved in making a casting – Advantage of casting and its applications. – Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Principles of Gating, Gating ratio and design of Gating systems. Solidification of casting – Concept – Solidification of pure metal and alloys, short & long freezing range alloys. Risers – Types function and design, casting design considerations, special casting processes 1) Centrifugal, 2) Die, 3) Investment. 4) Methods of Melting: Crucible melting and cupola operation, steel making processes, special.

UNIT – II

WELDING:

- Classification of welding process types of welds and welded joints and their characteristics, design of welded joints, Gas welding, ARC welding, Forge welding, resistance welding, Thermit welding and Plasma (Air and water) welding. Cutting of Metals: Oxy – Acetylene Gas cutting, water plasma. Cutting of ferrous, non-ferrous metals.

UNIT – III

- Inert gas welding, TIG & MIG, welding, Friction welding, Induction welding, Explosive welding, Laser welding, Soldering & Brazing. Heat affected zones in welding; welding defects – causes and remedies – destructive non destructive testing of welds.

UNIT – IV

- Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth, Comparison of properties of Cold and Hot worked parts, rolling fundamentals – theory of rolling, types of Rolling mills and products. Forces in rolling and power requirements.

UNIT – V

- Elementary treatment of metal cutting theory – Element of cutting process – Geometry of single point tool and angles chip formation and types of chips – built up edge and its effects chip breakers. Mechanics of orthogonal cutting – Merchant's Force diagram, cutting forces – cutting speeds, feed, depth of cut, tool life, coolants, machinability – Tool materials. Kinematic schemes of machine tools – Constructional features of speed gear box and feed gear box.

UNIT – VI

- Engine lathe – Principle of working, specification of lathe – types of lathe – work holders tool holders – Box tools Taper turning thread turning – for Lathes and attachments. Turret and capstan lathes – collect chucks – other work holders – tool holding devices – box and tool layout. Principal features of automatic lathes – classifications – Single spindle and multi-spindle automatic lathes – tool layout and cam design.

UNIT – VII

- ✧ Shaping slotting and planning machines – Principles of working – Principal parts – Specification classification, operations performed. Kinematic scheme of the shaping slotting and planning machines, machining time calculations.

UNIT – VIII

Drilling and Boring Machines – Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring machines – Fine boring machines – Jig Boring machine. Deep hole drilling machine. Kinematics scheme of the drilling and boring machines.

ASSISTANT DIRECTOR, PHYSICS

Paper-II

✧ **Mathematical Methods of Physics**

Dimensional analysis. Vector algebra and vector calculus. Linear algebra, matrices, Cayley-Hamilton Theorem. Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order. Special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem.

Data interpretation and analysis. Precision and accuracy. Error analysis, propagation of errors. Least squares fitting, Linear and non-linear curve fitting and Chi-Square Test.

Green's function. Partial differential equations (Laplace, wave and heat equations in two and three dimensions). Elements of computational techniques: root of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule. Solution of first order differential equation using Runge-Kutta method. Finite difference methods. Tensors. Introductory group theory.

✧ **Classical Mechanics**

Newton's laws. Dynamical systems, Three space dynamics, stability analysis. Central force motions. Two body Collisions – scattering in laboratory and Centre of mass frames. Rigid body dynamics-moment of inertia tensor. Non-inertial frames and pseudoforces. Variational principle. Generalized

coordinates. Lagrangian and Hamiltonian formalism and equations of motion. Conservation laws and cyclic coordinates. Periodic motion: small oscillations, normal modes. Special theory of relativity-Lorentz transformations, relativistic kinematics and mass-energy equivalence.

Poisson brackets and canonical transformations. Symmetry, invariance and Noether's theorem. Hamilton-Jacobi theory.

✧ **Electromagnetic Theory**

Maxwell's equation : Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics : Biot-Savart law, Ampere's theorem. Electromagnetic induction, Maxwell's equations in free space isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields. Charged particles in inhomogeneous fields.

Dispersion relations in plasma. Lorentz invariance of Maxwell's equation. Transmission lines and wave guides. Radiation- from moving charges and dipoles and retarded potentials.

✧ **Quantum Mechanics**

Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator, etc.). Tunneling through a barrier. Wave-function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac notation for state vectors. 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. Time dependent perturbation theory and Fermi's golden rule, selection rules.

Identical particles, Pauli exclusion principle, spin-statistics connection.

Spin-orbit coupling, fine structure. WKB approximation. Elementary theory of scattering : phase shifts, partial waves, Born approximation. Relativistic quantum mechanics : Klein-Gordon and Dirac equations. Semi-classical theory of radiation.

✧ **Thermodynamics and Statistical Physics**

Laws of thermodynamics and their significance. Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria. Phase space, micro- and macro-states. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with

thermodynamic quantities. Classical and quantum statistics. Bose and Fermi gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law.

First- and second-order phase transitions. Diamagnetism, paramagnetism, and ferromagnetism. Ising model. Bose-Einstein condensation. Diffusion equation. Random walk and Brownian motion. Introduction to nonequilibrium processes.

✧ **Electronics**

Semiconductors devices (diodes, junctions, transistors, field effect devices, homo- and hetero-junction devices), device structure, device characteristics, frequency dependence and applications. Opto-electronic devices (solar cells, photo-detectors, LEDs). Operational amplifiers and their applications. Digital techniques and applications (Logic circuits, registers, counters and comparators). A/D and D/A converters. Microprocessor microcontroller basics. Fundamentals of communication electronics, modulation techniques.

✧ **Atomic & Molecular Physics**

Quantum states of an electron in an atom. Electron spin. Spectrum of helium and alkali atom. 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. Franck-Condon principle. Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Lasers : spontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping, population inversion, rate equation. Modes of resonators and coherence length.

✧ **Condensed Matter Physics**

Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids : metals, insulators and semiconductors. Superconductivity : type-I and type-II superconductors. Josephson junctions. Superfluidity. Defects and dislocations. Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order. Quasi crystals.

Electron spin resonance, Nuclear magnetic resonance, chemical shift and applications. X-ray diffraction technique, scanning electron microscopy and transmission electron microscopy.

✧ **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.

Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Quark model, baryons and mesons. C, P, and T invariance. Application of symmetry arguments to particle reactions. Parity non-conservation in weak interaction. Relativistic kinematics.

ASSISTANT DIRECTOR, CHEMISTRY
Paper-II
A. CHEMISTRY

A.Inorganic Chemistry:-

1. **Atomic structure & Chemical Bonding** – Quantum theory Schrodinger – wave equation – Hydrogen atom,Hydrogen molecule – Elements on valence bond – molecular orbital theories.
2. **Determination of molecular structure** – X – ray and electron diffraction methods.
3. **Periodic classification** (Classical and modern) periodic functions of elements – atomic volume – atomic radious electronegativity-oxidation states – lattice energy and their applications.
4. **Chemistry of d-block elements** – Physical and chemical characteristics of the transition elements – Characteristics related to electronic arrangements oxidation states – colow magnetic properties – Complex formation – interstitial L-S couping – Hund's rule. A General study of the first transition series.
5. **Chemistry of F-block elements** – Lanthanons and Actinons – electronic configurations – oxidation's states – Separation of Lanthanons and Actinons.

6. **Chemistry of complex compounds:** Jourgenson and werner's views – effective atomic number – valence bond theory – Introductory treatment of crystalfield theory applied to complexes with co-ordination number 6.
7. **Isomerism in complexes:** Geometrical and optical isomerism of four and six co-ordinated complexes. Pearson's theory of hard and soft acids and bases.
8. **Study of the following elements and their modern Chemistry** Be, Ti, Zr, Hf, V, Mo, W, U, and Th.
9. **Alloys:** Interimettalic compounds.

B.Physical Chemistry:

10. **Radio activity:** Elementary account of nuclear structure natural and artificial radio activity – characterization of relations – decay chains-half-life-decay constant and average life. Radio-active series, atomic transmutation – atomic fission and fusion reactions and their applications – nuclear isomers and their separations.
11. **Kinetic theory of gases:** Equations of state – critical constants – States of aggregation – liquid states – viscosity – physical properties an chemical constitution – collision theory of derivation of the collision – number from Kinetic theory of gases.
12. **Chemical Kinetics:** order and molecularity of reaction first order and second order reactions – law of mass action – influence of temperature and pressure – thermo-dynamic derivation of Law of mass action – unimolecular reactions Lindemann's theory.
13. **Thermodynamics:** First law of thermodynamics and its applications to ideal gases, energy and enthalpy changes in gases, heat capacities of gases and their inter-relation.

    Isothermal and adiabatic processes – Kirchoff's equation and its applications – Vant Hoff's isotherm isochore equilibria in heterogeneous system. Second Flaw of thermo dynamics (Joules and Joule Thomson experiments). Entropy change in an isolated system for reversible and irrevbersible processes – Variation on entropy of a system with temperature and pressure.

C.Organic Chemistry:

14. **Heterocylic compounds and chemistry of neutral products** – Importance of heterocyclic compounds – classification based on the natury of heterocetom, size of the ring and II excessive and II deficient nature of the ring.

A general and comparative study of Furan pyrole and thiophene Ring transformations. General comparison with benzenoidd compounds, pyridine, quinotine, Isoquinoline and acrdine-fII deficient nature of heterocylic rings – case of nucleophilic substitution.

15. **Methods of synthesis, reactivity and properties of the following polynuclear aromatic compounds:** anthracene, Benzanthracene, Phenontherene Chryeneand picene.
16. **Benzopyrones:** Couamarins and Chromones.
17. **Alkaloids:** General occurrence, reactions and degradations. Chemical and Physico-Chemical methods for the elucidation of structures-synthesis and structural elucidation of the following alakaloids – atropine – cocaine - quinene – Narcotine – papaverine.
18. **Organic reaction mechanism:** Structure and reactivity of organic molecules – Factors affecting Electron density in a band-inductive, induct rometric, mesomeric, (reasonance) and electrometric effects, hyperconjugation – Dipole moments-acedic and basic strength of organic Compounds.

    Modern concepts of organic reaction mechanisms – Addition, substitution and elimination reactions – simple examples and their mechanism. The intermediate carboniumion formation and its participation in organic reactions. Addition C-C, system-pinocol-pincolene rearrange rearrangements. Automatic substitution – Formation and hydrolysis of esters.
19. **Some name reactions:** Wurtz-Friedel-Crafts, Fries Gatter-mann – Perin – Beckmann's rearrangements and Grignard reactions.
20. **Carbohydrates:** General reactions of monosaccha rides – configurational studies on glucose, fructose, sucrose, Recent advances in the Chemistry of cellulose and starch.
21. **Proteins** – Introduction to proteins – their classification – Nomenclature and distribution in nature simple, amino acids – Isolation and their synthesis.
22. **General Ideas regarding the chemistry of vitamins & Harmones** nicotine, B-Carotene and Vitamin C.
23. **Alicyclic compounds:** Synthesis and reactions Bayers strain theory – Factors affecting stability of conformation – terpenes – citral – gerniol – limonenene – terpinol – pinene and camphor.
24. **Stereo Chemistry:** Opticnal and geometrtic isomerism configuration of saturated molecues – DL and RS configuration of optically active compound-racemic – mixtures – racemisation and resolution.

25. **Molecular spectra:** NMR, Chemical shift – Spin – Spincoupling – ESR of simple radicals – Rotational Spectra, diatomic molecules, linear triatomic molecules, isotopic substitution – Vibrational and Raman Spectra.

Physical Chemistry:

26. **Electro-Chemistry:** Equivalent conductance and its measurement. The independent migration of jons – kholraush's Law. Transport number and their determination. Ionic mobilities. Equivalent conductance of weak and strong electrolytes. Inter-ionic attraction theory treated quantitatively-Debye-huckle-onsager equation. Determination of solubilities from conductance measurements -–Conductometric titration's.

    Ionic product of water and its determination from conductance and EMF methods – theories of acids and bases – Hydrogen ion concentration and its measurements from E.M.F.measurements using Hydrogen quin – hydroen and glass electrodes – Buffer solutions – Henderson's equation potentiometric titration's – Determinations of equilibrium constant and solubilities from E.M.F.measurements – Gibbs – Helmbholtz equation and its application to chemical cells.

27. **Photo – Chemistry:** Laws on absorption of light – Gretius – Draper Laws – Einstiens Law in Chain reactions – Hydrogen chlorine reactions – absorption – Laws of absorption.

28. **Surface Chemistry and catalysis** – Absorption isotherms, surface area determination, heterogeneous catalysis, acid-base and enzyme cotolysis.

B. FORENSIC SCIENCE

✧ **Introduction to forensic science:**

Definition of forensic science – History of forensic science – Organization of forensic science laboratories and other allied institutions – Duties of forensic scientists – Physical evidence and Loccard's exchange principle – Classification of physical evidence – Role of forensic science in crime investigation – Crime scene – Crime scene management – Searching of crime scene for physical evidence – Collection, preservation, packing and forwarding of physical evidence to forensic science laboratory – Chain of custody – Reconstruction of scene of crime.

✧ **Basic wet analytical chemistry:**

Nature and scope of analytical chemistry – Classification of analytical methods – Macro, semi-micro, micro and ultra micro analytical methods

– Conventional and instrumental methods of analysis – Comparative, absolute, qualitative and quantitative methods of analysis.

Theoretical principles of analytical chemistry – Law of mass action and its application – Le Chatlier and Braun principle – van't Hoff reaction isotherm –

Dissociation theory – Electrolytes and non electrolytes – Classification of acids, bases and salts according to their degree of dissociation – Dissociation of acids, bases and salts – Dissociation constants – Common ion effect – Solubility product – Conditions for precipitation – Order of precipitation – Factors affecting precipitation – Diverse ion effect – Ionization of water – pH value – pOH value, Relation between pOH: pH scale – pH scale - Salt hydrolysis – Degree of hydrolysis and hydrolysis constant – Buffer solutions - Buffer action - Calculation of pH of a buffer solution – preparation of buffer solutions – Completeness of a chemical reaction – Complex compounds – Oxidation reduction reactions – Oxidation reduction potentials.

Organic reagents in detection of inorganic ions – Oxidizing and reducing agents in organic chemistry – Inorganic and organic spot tests – Micro chemical tests – Physical tests – Qualitative inorganic analysis – Group separations for cations and anions – Interfering radicals - Elemental analysis of organic compounds – Functional group analysis – Schemes of identification of unknown solids, liquids and gases (inorganic and organic) – Confirmation tests and their importance – Sensitivity and limit of detection – Alternative methods of analysis – Physical separation methods – Distillation – Extraction – Precipitation – Crystallization – Chromatographic methods.

Volumetric / Titrimetric methods of analysis:

Volumetric / Titrimetric methods of analysis – General principle – Equivalence point and end point – Fundamental requirement of a titrimetric method – Standard solution – Detection of end point – Indirect titrations – Types of reactions – Calculations in titrimetry – Aqueous acid-base titrimetry – Acids and bases –Preparation of standard solutions – Primary standards – Indicators – Theory of indicators – Strong acid-strong base; weak acid-strong base; weak base-strong acid and weak acid-weak base titrations – Acid-base titrimetry in nonaqueous solvents – Redox titrimetry – Oxidation and reduction – Oxidant and reductant – Iodimetry and iodometry – Permanganometry – Dichromatometry – Precipitation methods – Argentometry – Complexometry – EDTA methods – Instrumental methods and automated volumetric analysis.

- **Gravimetric methods of analysis:**

  Gravimetric methods of analysis – Basic Digestion of precipitates – Washing of precipitates – Drying and ignition of precipitates – Thermal decomposition of precipitates – Organic precipitants - Extraction methods in gravimetry – Determination of chloride, suphate, iron, calcium and nickel as examples principles – Factors affecting gravimetric analysis – Requirements of quantitative separation – The process of precipitation – Saturated and supersaturated solution – Nucleation – Crystal growth – Conditions of precipitation – Completeness of precipitation – factors influencing solubility – Purity of a precipitate – Adsorption of ions on precipitates – Co precipitation – Occlusion and post precipitation.

- **Instrumental methods of analysis:**

  Unit Measurements, signals and data – Introduction – Signal to noise ratio – Sensitivity and detection limit, sources of noise – Evaluation and measurement – Accuracy and instrument calibration.

- **Atomic Spectrometry** - Spectrometric methods – General properties of Electromagnetic Radiation – Wave and quantum mechanical properties of radiation – Optical Atomic Spectra – Principles, instrumentation , techniques and forensic applications of: Atomic Absorption Spectrometry – Atomic Emission Spectrometry – Atomic Mass Spectrometry.

- **Molecular Spectroscopy** – Introduction to UV-Visible Molecular Absorption Spectrometry – Measurement of Transmittance and Absorbance – Beer's Law – Instrumentation of UV- Visible Molecular Absorption Spectrometry – Molar Absorptivities – Absorbing Species – Application to Qualitative Analysis – Quantitative Analysis – Photometric Titrations –Molecular Luminescence Spectrometry – Theory of Fluorescence and Phosphorescence – Instrumentation for Fluorescence and Phosphorescence Measurements – Applications of Photoluminescence methods – Chemiluminescence - Infrared Spectrometry – Theory – Infrared Sources and Transducers – Instrumentation –Dispersive and FT instruments -Techniques and Applications –IR Micro spectrometry – Forensic Applications of IR Spectrometric methods.

- **Nuclear Magnetic Resonance Spectrometry** – Principles, Instrumentation, Techniques and Forensic Applications.

- **Chromatographic Techniques** – Introduction – History of Chromatography - Theoretical principles of Chromatography – Classification of Chromatographic Methods – Adsorption and Partition Chromatography - Principles, instrumentation, techniques and

applications of Thin Layer and High Performance Thin Layer Chromatography, Method Development in Planar Chromatography - Gas Chromatography – Instrumentation – Detectors - Adsorption, Partition, Gas Solid, Gas Liquid, Isothermal, Linear Temperature Programming, Chiral, Pyrolysis and Derivatization Chromatography - Columns and Stationary Phases – Column Efficiency –Method Development - Forensic Applications of Gas Chromatography - High Performance Liquid Chromatography – Instrumentation Detectors – Columns and Stationary Phases - Isocratic, Gradient, Adsorption, Partition, Ion and Derivatization Chromatography – Method Development – Applications of Liquid Chromatography- Super Critical Fluid Chromatography – Properties of Super Critical Fluids – Instrumentation – Columns – Detectors – Applications - Capillary electrophoresis – Principles – Instrumentation – Techniques and Applications.

- **Molecular Mass Spectrometry** – Molecular Mass Spectra – Ion Sources – Mass Spectrometers – Qualitative and Quantitative Applications of Molecular Mass Spectrometry – Interpretation of Mass Spectra Hyphenated techniques – Principle, instrumentation, techniques and applications of GC-FTIR, GC-MS, LC-MS, MS-MS.

- **Thermal Methods:**

- Principles, Instrumentation, Techniques and Applications of: Thermogravimetric Methods – Differential Thermal Analysis – Differential Scanning Calorimetry.

  - Radiochemical Methods:

  - Radioactive Isotopes - Principles, Instrumentation, Techniques and Application of Neutron Activation Analysis and Isotope Dilution Methods.

  - Electrochemical Techniques:

  Introduction – Principles, instrumentation, techniques and applications of Potentiometry, Ion-selective electrodes, Coulometry and Polarography.

- **Forensic Chemistry:**

  Forensic Chemistry - Introduction - Types of cases / exhibits - Preliminary screening - presumptive tests (colour and spot tests) - Examinations procedures involving standard methods and instrumental techniques.

Qualitative and quantitative forensic analysis of inorganic and organic material - Chemical fertilizers (N,P,K) _ Insecticides (Endosulfan, Malathion, Carbaryl) - Metallurgical analysis (Fe, Cu, Zn, Au, Ag) – Natural products (tobacco, tea, sugars, rubber) – Industrial chemicals - Sulphuric, Nitric and Hydrochloric acids, Sodium, Potassium hydroxide, Ammonium nitrate, Potassium chlorate, Organic solvents like Methanol, Ethanol, Acetone, Chloroform and Ether Organic chemicals like Acetanilide, P- Aminophenol, Nitrobenzene etc. with reference to forensic work.

- **Examination of petroleum products** - Distillation and fractionation - various fractions and their commercial uses - Standard method of analysis of petroleum products – Analysis if petroleum products for adulteration and arson residues.

- **Chemistry of fire** - Investigation and evaluation of fires – Causes of fire - Analysis of arson residues by conventional and instrumental methods.

- **Analysis of trace evidence** - Cosmetics, Dyes, Trap related evidence materials, Paints, Pigments, Fibres, Oils fats, Greases, Industrial dusts, Chemicals and Plant materials.

- **Analysis of beverages:** Composition and analysis of alcoholic and non-alcoholic beverages, country made liquor, illicit liquor and medicinal preparations containing alcohol – Common adulterants and toxic substances in alcoholic beverages.

- **Analysis of Narcotic Drugs and Psychotropic Substances** - Introduction - classification of NDPS / drugs of abuse – Drug abuse - Drugs of abuse in sports - Designers drugs - Forensic examination of NDPS – Clandestine laboratories – Drug profiling.

  The study of NDPS should be exemplified by Opiates, Cannabis, Cocaine, Amphetamines, Benzodiazepines, Disubstituted Quinazolones, Barbiturates and LSD, Psylocybin, Mescaline and MDMA.

  Drugs and Cosmetic Act, Excise Act, NDPS Act.

- **Explosives and Explosion residues:**

  Explosives and Explosion residues – composition, Classification, and characteristics of explosives, pyrotechnics, IEDs - Explosion process and effects - Approach to scene of explosion - post-blast explosion residue collection - Reconstruction of sequence of events - Evaluation and assessment of scene of explosion - Systematic analysis of explosives and

explosion residues in the laboratory using chemical and instrumental techniques (exemplified by country bomb compositions, Picric acid, Gun powder, Ammonium nitrate, NG, NC, TNT, PETN, TETRYL, RDX and HMX) - Synthesis of above organic explosives – Profiling and tagging of explosives- Interpretation of results, Explosives Act and Explosive Substances Act.

✧ **Forensic toxicology:**

Toxicology- Introduction- History- Scope- Areas of Toxicology- Role of forensic toxicologist- Poisons-Classification of poisons- Types of poisoning- Sample collection and preservation of toxicological exhibits in fatal and survival cases- Storage of samples- Signs and symptoms of poisoning-Toxicological investigation/examination of poisoned death-Interpretation of toxicological data-Courtroom testimony in toxicological cases. Case Histories.

Pharmacokinetics - Methods of transportation of toxicant- Absorption-Distribution- Storage of toxicants- Redistribution - Metabolism-Oxidation – Reduction – Hydrolysis – Conjugation - Excretion-Other routes of elimination- Toxicokinetics- one and two compartmental model – Toxicodynamics-Spectrum of undesired (toxic) effects- Interaction of chemicals- Tolerance- Dose response relationship-Developmental and reproductive toxicity-Mutagenicity- Toxicity testing.

Introduction- Extraction, Isolation and Clean-up procedures in toxicological analysis- Identification and quantitation of poisons by physical, chemical, chromatographic, spectrophotometric, electrophoretic, immunoassay- and other methods.

(Metals, anions, volatile poisons, gases, drugs, pesticides and miscellaneous poisons such as plant poisons, radioactive materials, animal toxins). Field testing in toxicological work – Therapeutic drug monitoring – Analysis of drug abuse in sports – Emergency hospital toxicology.

Management of acute poisoning- Introduction- Maintenance of vital functions- Measures to enhance elimination of poisons- Removal of unabsorbed poisons- Antidotes- Classification of antidotes-Mechanism of action of antidote (cyanide, methanol, arsenic, opiate, carbon monoxide, nitrite, acetaminophen and pesticides) Identifying route of administration of poison- Estimation of time and dose after administration of poison- Recovery and after care of patients- Poison Information/Control Centre. Case Histories.

ASSISTANT DIRECTOR, BIOLOGY

Paper-II

A.BIOTECHNOLOGY

1) CELL BIOLOGY: Diversity of cell size and shape. Cell theory, microscopic techniques for study of cells. Sub-cellular fractionation and criteria of functional integrity. Cellular organelles-Plasma membrane, cell wall, Mitochondria, Chloroplast, Nucleus and other organelles and their organization, structure and functions. Cell motility-cilla, flagella of eukaryotes. Transport of nutrients, ions and macromolecules across membranes. Liposomes, drug delivery systems, cellular energy transactions-role of mitochondria and chloroplast. Molecular assemblies like membranes; structure and functional aspects. Ribosome's, extra cellular matrix. Cell cycle – Overview of eukaryotic cell cycle, regulation of cell cycle by cell growth and extra cellular signals. Cell cycle check points. Regulators of cell cycle progression – MPF, cyclins and cyclin-dependent kinases. Cell death and proliferation – Apoptosis: definition, differences between apoptosis and necrosis and mechanism. Cancer: Types and Classification, Development and Properties of Cancer cells. Somatic mutations in cancer cells. Biotic and abiotic stress in plants. Signal transduction: types of receptors, second messengers (calcium, phoshoinositides and Nitric oxide). Meiosis, Gametogenesis, fertilization and Development of chick embryo.

2) BIOMOLECULES AND ANALYTICAL TECHNIQUES: Chemical foundations of Biology water, pH, pK, acids, bases, buffers, weak bonds, covalent bonds. Principles of thermodynamics. Classification, structure and functions of carbohydrates, amino acids, proteins, nucleic acids and lipids. Chromatography Methods; partition, ion exchange, and affinity methods, criteria for purity, proteins and nucleic acids sequencing methods, Hormones, vitamins and minerals.

Analytical techniques: Principle, instrumentation and applications of VIS/UV, IR, NMR, LASER Raman Spectroscopy MASS Spectroscopy, Fluorescence Spectroscopy, Differential colorimetry, X-ray Crystallography, Ultra centrifugation, Electron Cryomicroscopy and Scanning Tunneling microscopy. Methods of cell study; confocal microscopy, Flowcytometry and FACS (fluorescence activated cell sorter) and atomic force microscopy. Radiochemical methods; Stable and radioactive isotopes, measurement of radioactivity by Liquid scintillation counting, GM counters and autoradiography. Specific activity and precursor-product relationship. Tracer studies and Effect of radiation on cells.

3) MOLECULAR BIOLOGY: DNA Structure, replication, repair and recombination, Transcripition, regulation and post transcriptional modifications in Prokaryotes and Eukaryotes. Transcriptional and post-

transcriptional gene silencing. Translation and regulation in Prokaryotes and eukaryotes, co-translation and post-translational modifications of proteins. Protein Localization-Synthesis of secretory and membrane proteins, import into nucleus, mitochondria, chloroplast and peroxisomes, Biology of Cancer-Oncogenes and Tumour Suppressor genes, Structure, function and mechanism of action of pRB and p53 tumor suppressor proteins.

Antisense oligonucelotides, molecular targets of drug action and Ribozyme Technology. Homologous Recombination-Holliday model gene targeting, gene disruption, FLP/FRT and Cre/Lox recombination RecA and other recombinases. Molecular Mapping of Genome, Genes, mutation and mutagenesis, site directed mutagenesis and Human genome project, Transposons.

4) BIOSTATISTICS: Frequency distribution, Distribution of data bionomial, poission and normal. Measures of central tendency-mean, median, mode and standard deviation-probability distribution-regression-correlation-Analysis of variance-tests of significance- T-test, F-test, Chi-square test.

5) MICROBIOLOGY: Discovery of the microbial world; Distinguishing features of prokaryotes and eukaryotes; general role of microorganisms in transformation of organic matter and in the causation of diseases; Microbial taxonomy; Classification, Nomenclature and new approaches to microbial taxonomy; Pure culture techniques; sterilization methods; Principles of microbial nutrition and composition of culture media; culture enrichment techniques; Growth and its mathematical expression; synchronized cultures, Culture collection and maintenance of cultures; Purple and green bacteria Ricketsias; Chlamydia and Mycoplasma. Archea; Viruses: structure and replication of viruses; DNA viruses and RNA viruses; Viroids and Prions; Viruse and their Genetic System; Bacteriophages; RNA phages; Retroviruses, Biomass and Bioenergy.

6) IMMUNOLOGY: Phylogeny of immune System; Innate and acquired immunity; Hematopoietic and differentiation, cells and organs of the immune system; Lymphocyte trafficking; Antigencity and super antigens; Immunoglobulin types, structure and function, Antigen-antibody interactions; Blood groups, Cell migration and Homing, Immunoglobulin and gene organization. Major histocompatibility complex, BCR and TCR and generation of diversity; Complement system, Antigen processing and presentation, generation of humeral and cell mediated immune responses; Activation of B- and T-lymphocytes, Cytokines and their role in immune regulation; Cell mediated cytotoxic, Hypersensitivity, Autoimmunity, Transplantation, Tumor Immunology, AIDS and other Immunodeficiency; Hybridoma Technology, Psychoneuro-immunology,

Single chain antibodies, theories of antibody diversity, Vaccines – Concept of immunization, routes of vaccination. Types of vaccines – Whole organism

(attenuated and inactivated) and component vaccines (synthetic peptides, DNA vaccines, recombinant vaccines, subunit vaccines, conjugate vaccines. Vaccine delivery systems.

7) BIOPROCESS ENGINEERING: Fermentation-types of 27odelling27 and bioreactor design, cell concentration and stirring. Filtration, methods of cell disruption. Downstream processing, industrial applications of bioprocess. Synchronized and continuous culturing. Industrial production of glutamic acid, citric acid, ethanol, penicillin and riboflavin. Purification and crystallization of products.

8) ENZYME TECHNOLOGY: Discovery classifications and nomenclature of enzymes. Techniques of enzymes isolation and assay, Intracellular localization of enzymes, Isoenzymes, Multienzyme complexes and multifunctional enzymes Physico-chemical characterization of enzymes, Enzymes kinetics, kinetic of enzymes of inhibition. Allosterism, Enzyme memory and mnemonic enzymes, Various techniques used for the immobilization of enzymes and their applications in Biotechnology. Purification of enzymes and their applications, Single cell proteins. Industrial application of enzyme, applications in biosensors.

9) ENVIRONMENTAL BIOTECHNOLOGY: Ecological balance, resiliency of ecosystem and sustainable development, environmental pollution and global problems, water, air, soil pollution and their impacts on environment and biotechnological approaches for management, waste water treatment: aerobic and anaerobic processes, bioremediation of contaminated soils and waste land, biotechnological treatment for industrial effluents and solid wastes. GM microbes.

10) GENETIC ENGINEERING: Discovery, properties and application of Restriction enzymes, Cloning and expression vectors, Purification of plasmids, genomic DNA and mRNA. Genomic and cDNA Library construction and screening of recombinants by hybridization methods, Reporter assays, protein engineering- site directed mutagenesis, adding disulfide bonds – changing asparagines to other amino acids modification of metal cofactor requirements. Increasing of specific activity Stability to thermal and salinity conditions, Phage Display library and yeast two hybrid system. Gene transfer methods Tagging, Role of gene tagging analysis; Gene Therapy, Gene silencing methods, Biochips.

11) BIOINFORMATICS: Biological databases, ORF finding, EST analysis, gene identification, microsatellite repeat patterns, Blast all flavours, Mutation matrix, global Vs local alignments, Dot plots, PAM and BLOSUM matrices, Multiple sequence 27odelling, alignments dendrograms, phylograms, protein structure prediction methods, molecular 27odelling, Primer design, QSAR, Drug designing

12) PLANT BIOTECHNOLOGY: Selection of explants, micro and macro Propagation techniques in plant tissue culture suspension culture, single cell. Anther, pollen and ovary culture for production of haploid plants. Cryopreservation for germplasm conservation. Plant Transformation technology, Transgene stability and gene silencing. Application of plant Transformation for productivity and performance. Metabolic Engineering and Industrial products: Plant secondary metabolites, industrial enzymes, biodegradable plastics, therapeutic proteins, antibodies, edible vaccines. Molecular marker assisted selection and Breeding: RFLP maps, RAPD markers, STS, microsatellites, SCAR (sequence characterized amplified regions), SSCP (single stand conformational polymorphism), AFLP, GM Crops

13) ANIMAL BIOTECHNOLOGY: Animal cell culture technology, simple and complex growth media, cell culture techniques, primary and established cell lines. Biology and characterization of the cultured cells, measuring growth parameters, maintenance of cell culture, Measurement of viability and cytotoxicity, cell separation. Scaling–up of animal cell culture. Cell synchronization. Cell cloning and micromanipulation. Cell transformation. Stem cell cultures, embryonic stem cells and their applications. Cell culture based vaccines. Organ and histotypic cultures. Apoptosis, measurement of cell death. Biodegradation of Toxicants, Diagnostic aids, organ perfusion studies., GM animals.

Principles and preparation of DNA and RNA probes and their applications: Study and expression of cloned genes in prokaryotes and eukaryotic systems. Microbial production of interferon, human growth hormone, insulin in *E.coli*. Genetic Engineering – Social and moral implications, national and international guidelines/regulations. Biotechnology patents and safeguarding human health.

B.BOTANY

1) CELL AND MOLECULAR BIOLOGY OF PLANTS:

- **Cell Wall:** Structure and functions, biogenesis, growth.
- **Plasma membrane:** Structure, models and functions: Sites for ATPases, Ion carriers, Channels and pumps, Receptors.
- **Plasmodesmata:** Structure, Role in movement of molecules and macromolecules, Comparison with gap junctions.
- **Chloroplast:** Structure, genome organization, gene expression, RNA editing, nucleo-chloroplastic interactions.
- **Mithochondria:** Structure, genome organization, Biogenesis.

- **Plant Vacuoles:** Tonoplast membrane, ATPases, transporters, as storage organelle.
- **Nucleus:** Structure, nuclear pores, nucleosome organization, DNA structure: A, B and Z forms, replication, damage and repair, transcription, Plant promoters and transcription factors, splicing mRNA transport, nucleolus, rRNA biosynthesis.
- **Ribosomes:** Structure, site of protein synthesis, mechanism of translation, initiation, elongation and termination; structure and role of tRNA.
- **Protein sorting:** Targeting of proteins to organelles.
- **Cell shape and motility:** The cytoskeleton; organization and role of microtubules and microfilaments; motor movements; implications in flagellar and other movements.
- **Cell cycle and apoptosis:** Control mechanisms; role of cyclins and cyclin dependent kinases; retinoblastoma and E2F proteins; cytokinesis and cell plate formation; mechanisms of programmed cell death.
- **Other cellular organelles:** Structure and functions of microbodies, Golgi apparatus, lysosomes, endo plasmic reticulum.
- **Techniques in cell biology:** Immuno techniques; in situ hybridization, FISH, GISH; confocal microscopy.

2) CYTOLOGY, GENETICS AND CYTOGENETICS:

- **Chromatin organization:** Chromosome structure and Packaging of DNA, molecular organization of centromere and telomere; nucleolus and ribosomal RNA genes; euchromatin and heterochromatin; karyotype analysis; banding patterns; specialized types of chromosomes; polytene, lampbrush, B-chromosomes and sex chromosomes ; molecular basis of chromosome pairing.
- **Structural and numerical alterations in chromosomes:** Duplication, deficiency, inversion and translocation; autopolyploids ; allopolyploids ; evolution of major crop plants.
- **Genetics of prokaryotes and eukaryotic organelles:** Genetic recombination in phage; genetic transformation, conjugation and transduction in bacteria; genetics of mitochondria and chloroplasts cytoplasmic male sterility.
- **Gene structure and expression:** Genetic fine structure; cis – trans test; Benzer's experiment; introns and their significance; RNA splicing; regulation of gene expression in prokaryotes and eukaryotes.
- **Genetic recombination and genetic mapping:** Recombination; independent assortment and crossing over ; molecular mechanism of recombination; role of RecA and RecBCD enzymes ; site-specific recombination ; chromosome mapping, linkage groups, genetic markers, construction molecular maps.

- **Mutations:** Spontaneous and induced mutations; physical and chemical mutagens; molecular basis of gene mutations; transposable elements in prokaryotes and eukaryotes; mutations induced transposons; site-directed mutagenesis ; DNA damage and repair mechanisms.
- **Plant Breeding:** Principles and methods of plant breeding; Marker assisted breeding.
- **Biostatistics:** Mean, Variance, Standard deviation, Standard error, Student't' test, chi-square and ANOVA.
- **Molecular cytogenetic:** Nuclear DNA content; C-value paradox; cot curve and its significance; restriction mapping – concept and techniques; multigene families and their evolution.
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3) BIOLOGY AND DIVERSITY OF LOWEER PLANTS: CRYPTOGAMS:

- **Microbiological techniques:** Pure culture, enrichment and anaerobic culture.
- **Importance of microorganisms:** Microbes in medicine, agriculture and environment.
- **Microbial growth:** Nutritional requirements of microorganisms and methods to measure growth.
- **Microbial Ecology:** Genetrification; phosphorous solubilization; nitrogen fixation
- **Phycology:** Thallus organization; cell ultra structure; reproduction (vegetative, sexual, asexual); criteria for classification of algae: pigments, reserve food, flagella; classification, salient features of Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta; algal blooms, algal biofertilizers; algae as food, feed and uses in industry.
- **Mycology:** General characters of fungi; substrate relationship in fungi; cell ultrastructure; unicellular and multicellular organization; cell wall composition; nutrition (saprobic, biotropic, symbiotic); reproduction (vegetative, asexual, sexual); heterothallism; heterokaryosis parasexuality; Molecular aspects in classification.
- General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina; fungi in industry, medicine and as food; fungal diseases in plants and humans; Mycorrhizae; fungi as biocontrol agents.
- **Bryophyta:** Morphology, structure, reproduction and life history; distribution; classification, general account of Marchantiales, Junger maniales, Anthoceratales, Sphagnales, Funariales and Polytrcales; economic and ecological importance.
- **Pteridophyta:** Morphology, anatomy and reproduction; classification; evolution of stele; heterospory and origin of seed habit; general account of

fossil pteriodophyta; introduction to Psilo psida, Lycopsida, Sphenopsida and Pteropsida.

4) TAXONOMY AND DIVERSITY OF SEED PLANTS:

- **Introduction and classification of Gymnosperms**
- **Structure and reproduction in** Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales and Gnetales.
- **The species concept:** Taxonomic hierarchy, species, genus, family and other categories; principles used in assessing relationship, delimitation of taxa and attribution of rank.
- Salient features of the International Code of Botanical nomenclature.
- **Taxonomic tools:** Herbarium; floras; histological, cytological, phytochemical, serological, biochemical and molecular techniques; computers and GIS.
- **Systems of angiosperm classification:** Phenetic versus phylogenetic systems; cladistics in taxonomy; relative merits and demerits of major systems of classification.
- **Concepts of phytogeography:** Endemism, hotspots; plant explorations; invasions and introductions.

5) PLANT PHYSIOLOGY AND METABOLISM:

- **Energy flow:** Principles of thermodynamics, free energy and chemical potential, redox reactions, structure and functions of ATP.
- **Fundamentals of enzymology:** General aspects, allosteric mechanism, regulatory and active sites, isoenzymes, kinetics of enzymatic catalysis, Michaelis – Menton equation and its significance.
- **Membrane transport and translocation of water and solutes:** Plant water relations, mechanism of water transport through xylem, passive and active solute transport, membrane transport proteins.
- **Signal transduction:** Receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, calcium calmodulin cascade, diversity in protein kinases and phosphatases.
- **Photochemistry and photosynthesis:** Photosynthetic pigments and light harvesting complexes, photo oxidation of water, mechanisms of electron and proton transport, carbon assimilation – the Calvin cycle, photorespiration and its significance, the C4 cycle, the CAM pathway, biosynthesis of starch and sucrose.
- **Respiration and lipid metabolism:** Glycolysis, the TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, glyoxylate cycle, alternative oxidase system, structure and function of lipids, fatty acid biosynthesis, synthesis of membrane lipids, structural lipids and storage lipids and their catabolism.

- **Nitrogen fixation and metabolism:** Biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation.
- **Photobiology:** Photochromes and cryptochromes, photophysiology of light –induce responses, cellular localization.
- **Plant growth regulators and elicitors:** Physiological effects and mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, polymines, jasmonic acid and salicyclic acid.
- **The flowering process:** Photoperiodism, endogenous clock and its regulation, floral induction and development – genetic and molecular analysis, role of vernalization.
- **Stress physiology:** Plant responses to biotic and abiotic stress; mechanisms of biotic and abiotic stress tolerance, HR and SAR, water deficit and drought resistance, salinity stress, metal toxicity, freezing and heat stress, oxidative stress.
- **Coping with biotic stress:** Chemical control, Biological control, IPM

6) PLANT DEVELOPMENT AND REPRODUCTION:

- **Shoot development:** Organization of the shoot apical meristem (SAM); control of cell division and cell to cell communication; control of tissue differentiation especially xylem and phloem: secretory ducts and laticifers.
- **Phyllotaxy and leaf differentiation**
- **Root development:** Organization of root apical meristem (RAM); cell fates and lineages; vascular tissue differentiation; homeotic muntants in Arabidopsis and Antirrhinum, sex determination.
- **Male gametophyte**: Structure of anthers; microsporogenesis, role of tapetum; pollen development and gene expression; male sterility; sperm dimorphism and hybrid seed production; pollen germination, pollen tube growth and guidance; pollen storage; pollen allergy, pollen embryos.
- **Female gametophyte:** Ovule development; megasporogenesis; organization of the embryo sac, structure of the embryo sac cells.
- **Pollination, pollen – pistil interaction and fertilization:** Floral characteristics, pollination mechanisms and vectors; self-incompatibility; double fertilization.
- **Seed development and fruit growth:** Endosperm development during early, maturation and desiccation stages; embryogenesis, cell lineages during late embryo development; storage proteins of endosperm and embryo; polyembryony; apomixes; embryo culture; fruit maturation.
- **Dormancy:** Seed dormancy; overcoming seed dormancy; bud dormancy.
- **Senescence and programmed cell death (PCD):** Types of cell death, PCD in the life cycle of plants, metabolic changes associated with senescence

and its regulation; influence of hormones and environmental factors on senescence.

7) PLANT ECOLOGY:

- **Climate, soil and vegetation patterns of the world:** Life zones; major biomes and major vegetation and sol types of the world.
- **Vegetation organization:** Concepts of community and continuum; analysis of communities (analytical and synthetic characters)
- **Ecological succession**: Hydrosere and xerosere.
- **Ecosystem organization**: Structure and functions; primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow Pathways, ecological efficiencies); litter fall and decomposition (mechanism, substrate quality land climatic factors); global biogeochemical cycles of C,N,P and S; mineral cycles (pathways, processes, budgets) in terrestrial and aquatic ecosystems.
- **Biological diversity**: Concept and levels; role of biodiversity in ecosystem functions and stability; speciation and extinction; IUCN categories of threat; distribution and global patterns, terrestrial biodiversity hot spots; inventory.
- **Air, water and soil pollution:** Kinds, sources, quality parameters; effects on plants ecosystems.
- **Climate change:** Green house gases (CO_2, CH_4, N_2O, CFCs: sources, trends and role); ozone layer and ozone hole; consequences of climate change (CO_2 fertilization, global warming, sea level rise, UV radiation).
- **Ecosystem stability:** Concept (resistance and resilience); ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems; ecology of plant invasion; environmental impact assessment; ecosystem restoration.
- **Ecological management:** Concepts; sustainable development; sustainability indicators.

8) PLANT RESOURCE UTILIZATION AND CONSERVATION:

- **Plant Biodiversity and sustainable development**
- **Origin, evolution, botany, cultivation and uses of** (i) Food forage and fodder crops (ii) fibre crops (iii) medicinal and aromatic plants and (iv) vegetable oil-yielding crops. Ethnobotany
- **Important fire-wood and timber – yielding plants and non-wood forest products (NWFPs)** such as bamboos, rattans, raw materials for paper-making, gums, tannins, dyes, resins and fruits.
- **Green revolution:** Benefits and adverse consequences.
- **Plants used as avenue trees** for shade, pollution control and aesthetics.

- Principles of conservation; extinctions; environmental status of plants based on International Union for Conservation of Nature.
- **Strategies for conservation – in situ conservation:** International efforts and Indian initiatives; protected areas in India – sanctuaries, national parks, biosphere reserves, wetlands, mangroves and coral reefs for conservation of wild biodiversity.
- **Strategies for conservation – ex situ conservation:** Principles and practices; botanical gardens, field gene banks, seed banks, in vitro repositories, cryobanks; general account of the activities of Botanical Survey of India (BSI), National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Council of Scientific and Industrial Research (CSIR) and the Department of Biotechnology (DBT) for conservation, non-formal conservation efforts.

9) BIOTECHNOLOGY AND GENETIC ENGINEERING OF PLANTS AND MICROBES:

- **Plant Biotechnology –** Principles, scope and applications.
- **Plant cell and tissue culture:** General introduction, scope, cellular differentiation, and totipotency.
- **Organogenesis and adventives embryogenesis:** Morphogenesis; somatic embryogenesis.
- **Somatic hybridization:** Protoplast isolation, fusion and culture.
- **Applications of plant tissue culture:** Clonal propagation, artificial seed, production of hybrids and soma clones, production of secondary metabolites / natural products, cryopreservation and germplasm storage.
- **Recombinant DNA technology:** Gene cloning principles and techniques, genomic / c DNA libraries, vectors, DNA synthesis and sequencing, polymerase chain reaction, DNA fingerprinting and DNA markers.
- **Genetic engineering of plants:** Transgenic plants, Methods of gene transfer – *Agrobacterium* – medicated and microprojectile, chloroplast transformation, intellectual property rights, ecological risks and ethical concerns.
- **Microbial genetic manipulation:** Bacterial transformation, selection of recombinants and transformants, genetic improvement of industrial microbes.
- **Genomics and proteomics:** High throughput sequencing, genome projects, bioinformatics, functional genomics, microarrays.

C.MICROBIOLOGY

- **General Microbiology and Microbial Physiology:** History of Microbiology. Contributions of Scientists. Types, applications and importance of microscopy. Structure of microbial cells. Methods of sterilization: Physical methods –chemical methods and their application. Pure culture techniques. Preservation methods and Maintenance of Microbial cultures. Microbiological media and cultivation of microorganisms. Microbial identification methods. Principles of bacterial taxonomy and classification. Microbial growth curve. Measurement of Growth. Synchronous cultures – methods of synchronous culturing. Continuous culturing methods, factors effecting growth. Phenomenon of bacterial sporulation.

- **Cell and Molecular Biology, Virology:** DNA structure, types and replication, Structure and types of RNA. Transcription and translation. Concept of ribozyme. Genetic code and Wobble hypothesis, Gene regulation. Cloning and expression vectors. Construction and screening of genomic and cDNA libraries. Types of mutagens, molecular basis and analysis of mutations, site directed mutagenesis. DNA damage and repair mechanisms. Recombination in bacteria by Transformation, Conjugation, Transduction. Transposable elements. Cell cycle and programmed cell death. Signal transduction, Protein folding & roles of Molecular chaperones.

- Structure of viruses. Cultivation of viruses. Structure, genetics and Replication of Bacteriophages (Lytic and Lysogenic cycle), Plant Virus (TMV), Animal/human viruses (eg. Influenza virus, HIV and Adeno virus). Viral Interference and Interferons. Biochips. DNA markers: RFLP, Micro/mini satellites, SNPS, RAPDs and AFLP. Finger printing. DNA sequencing. Expression of recombinant proteins Protein-protein and protein-DNA interaction. Applications of recombinant DNA technology and Gene therapy.

- **Biochemistry and Techniques:** pH and its biological relevance. Redox potentials, Electron transport, oxidative phosphorylation. Microbial respiration and fermentation. Classification, properties and chemical structure of carbohydrates and lipids. Classification, Properties and structure of amino acids and proteins. Biosynthesis and degradation of amino acids and proteins. Metabolism of carbohydrates and lipids – glycolytic pathways, TCA cycle, gluconeogenesis, glycogenesis. Biosynthesis of triacyl-glycerols and oxidation of fatty acids. Enzymes - nomenclature, classification, methods for determination of enzyme activity. Enzyme kinetics - Michelis-Menton kinetics. Optical methods - colourimetry and spectrophotometry, fluorimetry, optical rotation, Circular dichroism, NMR, ESR spectroscopy, X-ray diffraction, types of mass spectrometry. Chromatographic techniques , diffusion, dialysis, cell disruption methods, centrifugation techniques, electrophoreses and blotting techniques. Radio isotopes – detection and measurement.

- **Immunology:** Components of immune system, Clonal selection theory. Antigen and antibody structure. Major Histocompatibility Complex (MHC) and transplantation. Antigen and antibody reactions. Immune response to infectious diseases. Hybridoma technology. Hypersensitivity, Tumor immunology, Immunological tolerance and immuno-suppression. Immune deficiency diseases. Immunotherapy of infectious diseases. Vaccines and Immunization.

- **Biostatistics:** Variations and frequency distributions, measures of central tendency and dispersion, standard deviation, standard error, elements of probability, correlation and linear regression. Normal curve test, 't' test, 'F' test, 'Z'-test, ANOVA, Chi-square test, and confidence intervals. Experimental designs using statistical tools.

- **Bioinformatics:** Basics of computers, Disk operating systems (DOS), Windows, MS office, information networking. Databases, Sequence and structure analysis of DNA and Proteins. Primer design. Protein engineering and drug designing. Tools and packages of networking.

- **Industrial Microbiology:** Exploitation of microbes and industrial products. Types of fermentations, Detection and assay of fermentation products. Scale up of fermentations, Product recovery methods, Strain development strategies. Immobilization methods. Fermentative production of Ethanol , beer, wine, Antibiotics, citric acid, Vitamin B12, Glutamic acid and microbial enzymes. Steroid Biotransformations – Principles of vaccine production. Microbial biopesticides, Microbial products from genetically modified (cloned) organisms eg. Insulin. QA, QC, GLP, GMP, Patents & IPR.

- **Medical Microbiology:** Principles of Medical Microbiology, Normal flora of human body. Properties of pathogenic microorganisms. Bacterial, viral, fungal and parasitic infectious diseases (air born, water born, food born, insect born and zoonotic infections). Principles of diagnostic microbiology. Systematic Medical Microbiology - β-Haemolytic streptococci, Mycobacterium tuberculosis, Neisseria gonorrhoea, E.coli, Salmonella typhi. Staphylococcus aureus, Clostridiuym tetani, Pseudomonas, HIV, Polio, Rabies and Amoebiasis, Malaria and Trichomoniasis and Fungal diseases. Medical diagnostics.

- Mode of action of important drugs – Cell wall inhibitors (Betalactum – eg. Penicillin), membrane inhibitors (polymyxins), macromolecular synthesis inhibitors (streptomycin), Antifungal antibiotics (nystatin). Drug resistance. Antiviral agents. Microbiological assays.

- **Food, Environment and Agriculture Microbiology:** Dairy Microbiology. microbiological examination of fresh and canned foods. Fermented foods, spoilage of foods and food preservation methods. Current and future implications concerning food safety, hazards and risks. Microbes and animal interactions – Rumen Microbiology, termite microbial communities.

Probiotics, Prebiotics and their significance in human beings and animals. Microorganisms in air, water and soil and their importance. Microbial diversity in the environment. Microbial mineralization and C, N, S, P and Fe cycles. Soil humus formation. Rhizosphere, mycorhiza and phyllosphere. Microbial degradation of carbonaceous materials in soil. Biology and biochemistry of Nitrogen fixation. Biofertilizers, Biopesticides, Persistance and degradation of pesticides, herbicides, fungicides and insecticides. Sewage treatment and bioremediateion.

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D.ZOOLOGY

1) *GENERAL CONCEPTS:*

- Levels of structural organization: Unicellular, colonial and multicellular forms. Prokaryotic and Eukaryotic cells. Levels of organization of tissues, organs & systems.
- Acoelomata, Pseudocoelomata, Coelomata, Proterostomia and Dueterostornia.

2) Concepts of species and hierarchical taxa, biological nomenclature, classical methods of taxonomy of animals.

- NON-CHORDATA:
- General characteristics and classification of invertebrates up to class level.
- **Protozoa:** Locomotion, Nutrition and Reproduction in protozoa, Protozoan diseases of man.
- **Porifera:** Canal system in porifera, skeleton in porifera, Reproduction in sponges.
- **Coelenterata :** Polymorphism, Metagenesis, coral formation, Etenophora.
- **Hemlinths:** Common Helminthic parasites of Man – *Taenia solium, Schistosoma sp., Ascaris, Ancylostoma, Oxyuris, Loa, Trichinella, Strongyloides* – their life cycles. Parasitism and parasitic adaptations.
- **Annelida:** Excretory system, Coelom formation, coelom and coelomoducts.
- **Arthropoda**: Mouthparts of Insects, useful and harmful insects, Metamorphosis in insects. Apiculture and sericulture in India, crustacean larvae.
- **Mollusca:** Respiritation, Torsion and De-torsion, pearl formation and Pearl industry.
- **Echinodermata:** Echinoderm larvae, Water vascular system.

3) **CHORDATA**:

- General Characters and classification of chordates upto class, Origin of Chordates, phylogeny and affinities of Hemichordata, Retrogressive metamorphosis.

- ✧ Vertebrate integument and derivatives, Comparative account of Digestive, Respiratory,Circulatory, Excretory and Reproductive systems of Vertebrates.
- ✧ Pisciculture in India, Common edible fishes of Andhra Pradesh.
- ✧ Origin and evolution of Amphibia, Paedogenesis, Neotony.
- ✧ Important Snakes of India, Dinosaurs.
- ✧ Flight adaptations and Migration in birds. Archeopteryx, Poultry in India.
- ✧ Adaptive radiation and Dentition in Mammals.

4) **CELL BIOLOGY**:

- ✧ Prokaryotic and Eukaryotic cell, Plasma Membrane-Ultrastructure, Permeability, intercellular communication, Endocytosis, Exocytosis, Phagocytosis, Active transport, membrane pumps.
- ✧ Structure & function of Intracellular organelles – Nucleus, Mitochondria, Golgi bodies, Iysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, Cell wall, Cytoskeleton and its role in motility.
- ✧ Organization of genes and chromosomes - Operon, unique and repetitive DNA, 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.
- ✧ DNA replication, repair and recombination - Unit of replication, replication origin and replication fork, Recombinant technology, Transgenic and cloned animals, DNA damage and repair mechanisms.
- ✧ **Protein synthesis -** initiation, elongation and termination of Genetic code.
- ✧ **Regulation of gene expression -** Lac operon, Lambda operan**.**
- ✧ **<u>GENETICS:</u>**
- ✧ **Mendel's law of inheritance -** Critical review and Linkage.
- ✧ **Gene mapping methods:** Linkage-complete and Incomplete linkage; Linkage maps, Recombination, mapping with molecular markers, somatic cell hybrids.
- ✧ **Crossing over :** Types (Somatic or mitotic crossing over and Germinal or meiotic crossing over), theories about the mechanism of crossing over, tetrad analysis, and cytological detection of crossing over.
- ✧ **Mutations:** Types (Spontaneous and Induced), causes and detection, mutant types (lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants), Molecular basis of mutations.
- ✧ Chromosomal aberrations (deletion, duplication, inversion and translocation, ploidy and their genetic implications); Autosomal

abnormalities (Down's syndrome, Trisomy-13, -18); Sex anamolies (Turner's syndrome, Klinefelter's syndrome, Hermaphroditism).

- **Human genetics:** Human karyotyping, Genetic disorders due to mutant genes (Huntington's chorea), Inborn errors of metabolism-Pheynylketonuria, alkaptonuria, Sickle cell anemia.

5) **SYSTEM AND CELL PHYSIOLOGY**:

- **Blood and circulation** - Blood corpuscles, haemopoiesis, plasma function, blood groups, haemoglobin, haemostasis.
- **Cardiovascular System :** Neurogenic, myogenic hearts, cardiac cycle, heart as a pump, neural and chemical regulation of all above.
- **Respiratory system** - Transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.
- **Nervous system** - Neurons, action potential, Conduction of nerve impulse, synapse, Neurotransmitters.
- **Muscle :** Ultraa structure and mechanism of muscle contraction.
- **Sense organs** – Eye, Ear.
- **Excretory system** - Comparative physiology of excretion, urine formation, micturition.
- **Osmaregulation** – Osmoregulation in fishes, Hormonal control of osmoregulation.
- **Digestive system** - Digestion, absorption, assimilation and egestion.
- **Endocrinology and reproduction** - Endocrine glands, basic mechanism of hormone action, hormones and diseases, reproduction in mammals.
- Chemical bonds (Covalent, Hydrogen and Ionic bonds, Van der waals interactions).
- Outline classification of organic compounds (carbohydrates, proteins and lipids).
- Order of protein structure, primary, secondary, tertiary and quaternary; Ramachandran plot.
- Glycolysis, TCA cycle and their Biomedical importance. Pentose phosphate pathway, Gluconeogenesis. Redox Potentials, Mitochondrial electron transport system, Oxidative phosphorylation.

6) **EVOLUTION**:

- Origin of life - Modern concepts, theories of Evolution.
- Isolation, Speciation, Natural Selection.
- Hardy weinberg' Law.
- Population Genetics (Gene pool, Gene frequency), Genetic drift and convergent evolution, Adaptive radiation.

- ✧ Evolution of Man.
- ✧ Zoogeographical realms of the world.

7) **DEVELOPMENTAL BIOLOGY**:

- ✧ Speramatogenesis, oogenesis.
- ✧ Fertilization, cleavage, gastrulation formation of germ layers, parthenogenesis.
- ✧ Embryogenesis in vertebrates.
- ✧ Formation and function of foetal membranes.
- ✧ Types of Placenta.
- ✧ Regualtion, genetic control of development.
- ✧ Development of Frog and chick.

8) **HISTOLOGY**:

- ✧ Histology of Mammalian tissues and organs - Epithelial, connective, blood, bone, cartilage, skin, stomach, intestine, liver, pancreas, kidney, Testis and Ovary.

9) **ECOLOGY**:

- ✧ Concept of Ecosystem.
- ✧ Biogeochemical cycles (Carbon, Nitrogen and Phosphorous).
- ✧ Influence of environmental factors on animals, energy flow in Ecosystem, food chains, food web and trophic levels.
- ✧ Community and population ecology. Ecological succession.
- ✧ Environmental pollution-Air, water, land, noise, radioactive, thermal and visual, effects of pollution on ecosystem, prevention of pollution.
- ✧ Wildlife in India-conservation, Chipko movement.
- ✧ Biodiversity-Economic significance, conservation, hot spots of India.

10) IMMUNOLOGY:

- ✧ **Cells of the immune system:** Lymphoid cells, Mononuclear cells, granulocytic cells, Mast cells.
- ✧ **Organs of the immune system -** primary and secondary lymphoid organs, lymphatic system.
- ✧ **Antigens:** Antigenic determinants or epitopes, immunogenicity, Haptens.
- ✧ **Innate (Non-specific immunity):** Anatomical barriers, phagocytosis, NK cells, interferon.
- ✧ Humoral immunity: Immunoglobulins (fine structure of immunoglobulins and immunoglobulin classes); the complement system, Classical and alternate pathway, inflammation.

- ✧ Cell mediated immunity: Mechanism of cell mediated immunity; Brief account on Antigen presentation, Major histocompatability complex.
- ✧ Antigen-Antibody interactions: Affinity, Avidity, Cross-reactivity, precipitation reactions, and Agglutination reactions and ELISA.
- ✧ **Brief account on immunological Hypersensitivity disorders:**
  - Tolerance and Autoimmunity
  - Transplantation.
  - Immunodeficiency diseases - HIV.
  - Immunization (Active and passive immunity).

E.GENETICS

1) Basic Mechanisms of Inheritance

✧ Mendelism – Laws of Segregation and Independent Assortment with specific examples; Extensions to Mendelism – Dominance, Co-dominance and Incomplete dominance – Penetrance, expressivity and Pleiotropism; Lethals and sub lethal. Epistasis – Modified Mendelin ratios – Multiple Alleles – Eye color in Drosophila, coat color in Rabbits, ABO blood groups in humans. Pseudo alleles – Rh blood group incompatibility – Inheritance of quantitative characters – Polygenes – additive effect, multiple factors – grain color in wheat, corolla length in Nicotiana. Height and weight in man – Genes and Environment – Phenocopies.Linkage, Recombination and Mapping in Eukaryotes

Discovery of linkage – phases of linkage – Cytological demonstration of crossing over. Recombination frequency and map construction. Detection of linkage in Drosophila and maize. Detection of linkage by test cross; two point cross, three point cross, coincidence and interference. Correlating genetic and cytological maps. Mapping of genes by tetrad analysis – Neurospora. Mitotic recombination in Aspergillus nidulans, Drosophila melanogaster and mitotic maps.

✧ Sex Determination

Sex determination – Mechanisms of sex determination, - Drosophila melanogaster – Bridge's experiment, molecular basis of genic balance theory. Sex chromosomes – heterogametic and homogametic sex, XO – grasshopper, ZZ/ZW birds, XX/XY – Melandrium and man. Sex differentiation and development in man, aberrant sexual development. Sex-linked traits – X and Y – linkage – red and white eye color in Drosophila, hemophilia and color blindness in man. Sex limited and sex influenced traits.

✧ Extra Chromosomal Inheritance

Non-Mendelian Inheritance: Leaf variegation of higher plants, Corren's studies in Mirabilis jalapa, Maternal inheritance – Poky in Neurosopora – Heterokaryon test Maternal influence – Shell coiling in snails, Extra nuclear genes in Chlamydomonas, Mutants showing uniparental inheritance Mapping chloroplast genome in Chalmydomonas Extra nuclear genes in Baker's Yeast : Petite mutants, Genetic mapping of mitochondrial genes in yeast. Male sterility in maize and its use, S-gene in Nicotiana. Independence of cytoplasmic genes from nuclear genes : Inheritance of iojap in Zea mays, Biogenesis of mitochondria, Biogenesis of chloroplasts.

2) Cytogenetics

✧ **Cell cycle and Cell Communication**

Eukaryotic cell cycle – phases of cell cycle – Restriction points – Cell cycle determining genes chromosome segregation in mitosis – mitotic apparatus, distribution of microtubule organizing centers – Cytokines – Genes affecting mitosis. Chromosome segregation in Meiosis – Formation of synaptonemal complex – Genes affecting Meiosis Cell Communication.

✧ Chromosome structure and chromatin organization

Molecular structure of chromosome – Centromere and Telomere. Specialized chromosomes. Polytene and Lampbrush. Components of Chromatin – Nucleic acids, histones and non-histones, classification and function – Evolutionary importance. Significance of Histone modification in chromatin organization of Nucleosomes, core particle location of H1, organization of nucleosomes in chromatin, Solenodis, loops and scaffolds Nucleosome phasing active and inactive chromatin.

✧ Chromosomal Aberrations (Structural)

Structural chromosomal aberrations – Deletions, Duplications, Inversions – Para and pericentric, translocations, Robertsonian translocations Gene transfer between nonhomologous chromosomes; Translocations – reciprocal translocations, balanced lethals in Oenothera.

✧ Chromosomal Aberrations (Numerical)

Changes in chromosome number : Autopolyploid and Allopolyploid. Aneuploidy-Chromosome non-disjunction at meiosis; Aneuploidy in human. Turner's and Klinefelter's syndrome. Aneuploidy in higher plants-Trisomics and monosomics-cytological and genetic characterization. Evolutionary significance of chromosomal mutations-Gene & karyotypic evolution.

3) Biomolecules and Transport

Biomolecules and Transport across Cell Membrane

Unit 1

- ✧ Amino acids and Proteins
- ✧ Classification, structure and characteristics of amino acids. Acid – Base properties and general reactions of amino acids.
- ✧ Peptide bond stability and formation. Methods for determining Molecular weight, Amino and Carboxy termini.
- ✧ Structural organization of proteins – primary, secondary tertiary, quaternary and subunit structure of proteins.

Unit 2

- ✧ Nucleic acids Structure of puriness, pyramidiness, nucleosides and nucleotides. Stability and formation of phosphodiester bonds.
- ✧ Watson and Crick Model of DNA. Different forms of DNA – Types of RNA – Structure of t-RNA.

Unit 3

- ✧ Membrane Transport
- ✧ Composition and structure of membranes Peripheral and Integral membrane proteins
- ✧ Miscelles and liposomes

Unit 4

- ✧ Movement of molecules across the membranes-Passive diffusion-Membrane channel and pores-Sodium, Potassium channels-Acetyl choline receptor (Chemical controlled channels), Gap junctions-Transporters-Uniport, symport, antiport-Ionophores

4) Microbial Genetics

- ✧ Genetics of Bacteriophages

  Structure and classification Bacteriophages, Lytic cycle – Infection of host cells; formation of viral components; Maturation and release of virus particles. Lysogeny : Nature of lysogeny : λ-phage, Integration of viral genome into host genome Lysogenic stage and prophage cycle; Factors governing lysogeny.

- ✧ Genetics of Eukaryotic Viruses

  General features of Eukaryotic viruses, DNA virues, Adeno viruses, Herpes, SV40, Papilloma viruses, Cauliflower mosaic viruses, Baculo viruses, RNA viruses, Retro viruses – Rous Sarcoma viruses and HIV viruses, Tobacco Mosaic viruses, Polio viruses and Rio viruses

- ✧ Bacterial Recombination and Mapping

  Identification and selection of bacterial mutants, Gene Transfer in bacteria – Transformation : Discovery of transformation – Competence of bacterial cells; mechanism of transformation; Gene mapping by transformation. Transduction : Generalized transduction, Co-transduction and Linkage. Mapping by Co-transduction. Specialized transduction – Formation of specialized transducing particle from a λ-lysogen. High frequency of transducing lysates Specialized transducing phage as a cloning vehicle.

- ✧ Mapping by Conjugation

  Conjugation-Unidirectional gene transfer – F^+ and F^- H fr strains and gene mapping by recombination frequencies and interrupted mating experiment, F-duction

5) <u>Biometry and Population Genetics</u>

- ✧ **Theory of Probability and Probability Distribution**

  Theory of Probability and Probability Distribution; Mutually Exclusive events – Addictive theory, Independent events – Multiplication theory. Random variable – Mean and Variance. Probability distribution with examples. Binomial distribution with examples. Poisson distribution with examples. Normal distribution with examples and problems.

- ✧ **Analysis of Qualitative and Quantitative Variables**

  Test of Hypothesis – Null hypothesis, Alternative hypothesis, Level of significance, confidence intervals and confidence limit

  Application of Chi-square test – testing for genetic segregations, linkage and heterogeneity with examples and problems.

  Small sample test, t – test, testing for single mean, two sample means, paired t – test One-way ANOVA, Two-way ANOVA

  Simple correlation and regression, Test of significance of correlation and regression coefficients.

- ✧ Establishment of Hardy-Weinberg Equilibrium and Departure from Equilibrium

  Genotype and gene frequency, Random mating; Hardy-Weinberg equilibrium – properties of Hardy-Weinberg equilibrium. Estimation of gene and genotype frequencies: Dominance, Co-dominance, Multiple alleles, sex-linked loci.

  Evolutionary forces – Dispersive and systematic forces, Change in gene frequency under mutation – resource mutation, recurrent mutation pressure. Selection – Different types of selection, Balance between

selection and mutation with examples, Inbreeding and assortative mating. Calculation of Inbreeding coefficient (F) from pedigrees, Effect of inbreeding on gene and genotypic frequencies.

✧ Genetics of Quantitative Characters and Phylogenetic Analysis

Population mean, average effect, breeding value, dominance deviation interaction deviation., Components of variance – phenotypic variance, Additive and dominant variance, interaction, variance repeatability. Genetic covariance – Offspring and one parent, Offspring and mid parent, half sibs, full sibs. Heritability – Estimations of heritability from genetic covariance and ANOVA, Phylogenetic analysis UPGMA (Unweighted paired group method of average) method

6) <u>Molecular Genetics Genetics Information</u>

✧ **Process of DNA replication, Replication in prokaryotes and eukaryotes**

DNA Damage and Repair, Molecular mechanisms of mutation – transition, transversion, frame shift and nonsense mutations, Causes of DNA damage, Repair mechanisms – photo reactivation, excision repair, Post replication repair,

✧ Organization of Genes

Structure of prokaryotic genes – organization of prokaryotic genes into operons, Structure of eukaryotic protein coding genes, Structure of eukaryotic non coding RNA genes

✧ Gene Expression : Transcription

Mechanism of transcription in prokaryotes

Regulation of prokaryotic gene expression – Lac and Tryp operon Mechanism of transcription of protein coding genes in eukaryotes Transcriptional regulation of eukaryotic gene expression

Post transcriptional gene silencing – SiRNA, Small RNA, and Micro RNA Post transcriptional modification

Transcription and processing of non coding RNA

✧ Gene Expression : Translation

Genetic code – Characteristics, universal and alternate genetic codes, codon usage and bias. Components of translational machinery – Ribosomes, tRNA, aminoacyl tRNA synthetases and translation factors

Process of translation – initiation, elongation and termination

7) Immunogenetics

✧ Basic Immunology

Immunity – Types of Immunity, Innate and Acquired Immunity. Cells of the Immune System: The B and T lymphocytes; T cell subsets; The antigen – presenting cells, Organs of the Immune system : Primary lymophoid organs (Bone Marrow and Thymus); Secondary lymphoid organs (lymph nodes, spleen and mucosal – associated lymphoid tissue), Antigens : conditions for antigenicity of a substance; chemical nature of antigenic determinants; Haptens and hapten-carrier conjugates

✧ Immunoglobulins : Structure and Functions

Basic structure of Immunoglobulin; The role of multiple myeloma in understanding Ig structure, Fine structure of Immunoglobulin : Immunoglobulin domains – variable region and constant region domains

Immunoglobulin classes : IgG, IgM, IgA, IgD and IgE; functions of Ig classes Organization and expression of Immunoglobulin light and heavy chain genes

Monoclonal antibodies; formation and selection of hybrid cells; production of monoclonal antibodies and their uses

✧ Major Histocompatibility Complex

General organization and inheritance of MHC : MHC haplotypes

The structure of MHC class I and class II molecules : organization of MHC class I and class II genes, peptide binding of MHC molecules

Polymorphism of MHC class I and class II molecules; the role of HLA typing in organ transplantation, Cellular distribution of MHC molecules; MHC molecules and immune responsiveness

✧ The Humoral and Cell – Mediated Immune Responses

Antigen processing by antigen – presenting cells.

The structure and functions of T-cell receptors; the TCR-Peptide-MHC complexes.

B-cell activation and proliferation by Thymus – independent and Thymus – dependent antigens : in vivo sites for induction of humoral response : B cell differentiation, class-switching and generation of plasma cells and memory cells.

Cell-mediated Immune Response: General properties of effector T cells; Direct cytotoxic response, Experimental assessment of Cell – mediated cytotoxicity, Delayed types of hypersensitivity (DTH) and cytokines involved in DTH.

Autoimmunity and Auto-immune disorders – Acquired Immunodeficiency Syndome (AIDS).

8) <u>Recombinant DNA Technology</u>

✧ **Restriction enzymes and cloning vectors**

Host controlled restriction modifications; Restriction endonucleases, types and classification. Modifying enzymes used in molecular cloning, Methylases; Polymerases, Ligases, Kinases, Phosphatases, Nucleases Plasmid and lambda phage vectors Cosmid vectors Yeast and Baculovirus vectors

✧ **Construction of Genomic and cDNA Libraries**

Strategies for DNA cloning

Strategies for construction of genomic libraries Strategies for construction of cDNA libraries Advantages of cDNA libraries

In vitro amplification of target sequences – PCR

✧ **Selection and Analysis of Recombinant Clones**

Labelling of nucleic acids and immunological probes

Selection of recombinant clones : Hybridization techniques (Southern, Northern, Western, North-Western, and Zoo blots) Colony hybridization and library screening

Isolation of individual genes by complementation assay and contig assembly (positional cloning by chromosome walking, chromosome jumping)

✧ **Analysis of Recombinant Clones**

Mapping of restriction sites S 1 mapping

DNA sequencing methods

Screening of cloned genes (Hybrid arrest and hybrid released translation) Site directed mutagenesis

Applications of rDNA technology

9) <u>Human Genetics</u>

✧ **Chromosomal Basis of Genetics Disorders**

Karyotypes and identification of chromosome variation Chromosome pathology of autosomes and allosomes. Chromosome instability syndromes.

Clinical significance of sister chromatid exchanges.

✧ **Gene Transmission in Families**

Criteria for determining inheritance pattern from pedigrees

Segregation analysis of monogenic conditions – complete and incomplete ascertainment Analysis of multifactorial condition – Threshold model and estimation of heritability

Twin studies in genetic ananlysis, Genetic heterogeneity

✧ **Biochemical Basis of Genetic Disorders**

One gene – one enzyme hypothesis Garrod's observations

Metabolic disorders and experimental approaches – Direct and Indirect approaches for prenatal and heterozygote detection

Metabolic disorders – Interallelic and intrallelic heterogeneity. Enzyme defects – amino acid metabolism

✧ **Linkage Analysis**

Detection of Linkage

Estimation of linkage – Y statistic, sib pair analysis, Lod score estimation, homozygosity mapping. (IBD)

Test of linkage of genes with reduced penetrance and epistasis. Resolution of genetic heterogeneity by linkage analysis

Linkage disequilibrium

10) <u>Bioinformatics</u>

✧ **Biology databases**

- Bioinformatics data
- Biological databases – types, design, file formats, access tools with examples. Public and bioinformatics databases
- Nucleotide sequence databank (GenBank, DDBJ, EMBL, MGDB, GSX, NDB) Protein databank (SWISS-PROT, TrEMBL, PIR)
- Database searching, search enines
- General purpose search engines like Google, Alta Vista
- Sequence match engines like FASTA, BLAST and BLAST derivatives

✧ **Comparison methods in Bioinformatics**

- Basics of sequence alignments – Match, mismatch, gaps, scoring alignments, gap penalty, protein versus DNA sequence alignment.
- Pair – wise alignment algorithms-Needleman and Wunch algorithm, Smith Watermann algorithm Multiple sequence alignment – progressive alignment, iterative alignment
- Homology search-BLAST algorithm, FASTA algorithm PAM and BLOSUM matrices

✧ **Genomic and Proteomic Bioinformatics**

- Finding gene in genomes, genome maps and markers Bioinformatics for understanding genome variation Protein structure prediction and classification Bioinformatics in support of proteomics research

✧ **Applications of Bioinformatics**

- Medical application of Bioinformatics-disease genes, drug targets, Pharmacogenomics, drug designing
- Structural biology – homology modeling of proteins
- Bioinformatics for micro array designing and transcriptional profiling Bioinformatics for phylogenetic analysis of genes
- Bioinformatics data – Nucleic acid sequence, protein sequence, protein structure, Genomic, proteomic and metabolomic information.
- Bioinformatics databases – Types, design, file formats, access tools with examples Bioinformatics tools and resources – free online tools, downloadable free tools,
- software packages, internet, Bioinformatics books and journals, Bioinformatics web-portals

F.BIO-CHEMISTRY

✧ **CHEMISTRY, METABOLISM OF PROTEINS AND LIPIDS:** Chemistry of Amino Acids, Peptides and Proteins. Metabolism of Amino Acids, Peptides and Proteins. Chemistry of Lipids and Porphyrins. Metabolism of Lipids and Porphyrins.

✧ **CHEMISTRY, METABOLISM OF CARBOHYDRATES AND NUCLEIC ACIDS:** Chemistry of Carbohydrates. Metabolism of Carbohydrates. Chemistry and Metabolism of Nucleic Acids. Chemistry and Metabolism of Vitamins.

✧ **BIOANALYTICAL TECHNIQUES:** Spectroscopy, Chromatography, Centrifugation and Electrophoresis, Microscopy and Tracer Techniques.

✧ **BIOENERGETICS AND CELL BIOLOGY:** Bioenergetics, Cell Structure of Prokaryotes, Cell Structure of Eukaryotes, Methods of Cell Study.

✧ **ENZYMOLOGY:** Enzymes and coenzymes, Enzyme Kinetics, Catalytic mechanisms, Enzyme regulation

✧ **MOLECULAR BIOLOGY:** DNA replication, DNA repair, Transcription and Translation, Protein sorting, targeting and degradation.

✧ **BIOCHEMICAL GENETICS & MODEL ORGANISMS:** Mendelian Genetics, Linkage and Mapping, Bacterial Genetics, Model Organisms.

- **CELL – CELL COMMUNICATION:** Extracellular matrix and cell surface, Cell signaling, Signal transduction and cancer, Signal transduction in bacteria and plants.

- **REGULATION OF GENE EXPRESSION & RECOMBINANT DNA TECHNOLOGY:** Gene Regulation in prokaryotes and viruses, Gene Regulation in eukaryotes, Recombinant DNA technology, Genetic engineering.

- **IMMUNOLOGY:** Basic immunology, Immune response, Transplantation & Applied immunology, Disorders of the immune system.

- **VIROLOGY AND CLINICAL BIOCHEMISTRY:** Prokaryotic viruses, Eukaryotic viruses, Clinical diagnosis, Pathophysiology & Clinical enzymology.

- **ENDOCRINOLOGY, PHYSIOLOGY AND NUTRITION:** Endocrine systems, Hormones, Body fluids & clinical testing, Physiology of body fluids and Nutrition.

- **BIOTECHNOLOGY:** Microbial biotechnology, Plant biotechnology, Animal biotechnology, Protein engineering.

- **BIOSTATISTICS, COMPUTERS AND BIOINFORMATICS:** Biostatistics, Computers and Bioinformatics, Genomics, Transcriptome and Proteomics.

G.FORENSIC SCIENCE

- **GENERAL FORENSIC SCIENCE:** Historical aspects of forensic science, Definitions, scope and concepts in forensic science, Principles and basics of forensic science. Growth of Forensic Science Laboratories in India – Central and State level laboratories, Services and functionalities provided by various Forensic Science Laboratories. Branches of forensic science, Forensic science in India: Organizational set up of forensic science laboratories, Tools and techniques in forensic science.

- **CRIME:** Definition, types of crimes, Theories of crime causation: Pre-classical and Neo-classical, constitutional, geographical, economic, psychological, sociological, Multiple causation approach, Biological approach, prevention of crime, characteristics of criminals.

- **CRIME SCENE MANAGEMENT:** Types of crime scenes –indoor and outdoor, Securing and isolating the crime scene, Crime scene search methods, Safety measures at crime scenes. Legal considerations at crime scenes, Documentation of crime scenes – photography, videography, sketching and recording notes, Role and duties of Forensic Scientists.

- **FORENSIC PHOTOGRAPHY:** Definition of photography, Cameras and its working, types of camera lenses, crime scene and laboratory photography, UV and IR photography, Photomicrography and macro photography. Digital photography, digital imaging, photogrammetry, basic concepts of videography/high speed videography.

- **CRIME SCENE EVIDENCE:** Classification of crime scene evidence – physical and trace evidence, Locard's Exchange principle, Physical evidence, types and importance in a criminal investigation, Protecting a scene of crime – various steps involved, contamination issues, Preservation, Packaging & transportation of Physical Evidences, Documentation, Chain of Custody, Reconstruction of crime scene.

- **LABORATORY MANAGEMENT SYSTEM:** Laboratory information system, Laboratory information management system, Chain of custody of samples covered by LAN system, Security system, validation and safety equipment.

- **FUNDAMENTALS OF FORENSIC BIOLOGY AND BIOLOGICAL EVIDENCES:** Scope of forensic biology; different domains of forensic biology; types of biological evidences; importance of biological evidences in forensic investigation; procedure for collection, preservation, packing, sealing and forwarding of biological samples. Hair examination: morphological, anatomical and microscopic examination of hair; characteristics of hair to determine species origin, race and sex. Diatoms examination: introduction to diatoms; types and structure of diatoms; importance and examination of diatoms in forensic science.

- **CLASSICAL GENETICS:** Organization of genome; structure and functions of nucleic acids; Griffith's experiments; introduction to Mendelian inheritance and its extensions; pedigree analysis; sex-linked inheritance; linkage and crossing-over; cytoplasmic inheritance and maternal effects; cytogenetics; karyotyping; chromosomal abnormalities.

- **WILDLIFE FORENSICS, ENTOMOLOGY & PALYNOLOGY:** Wildlife Forensics: definition and advances; threats to natural resources and wild species; importance of wildlife conservation; classification of species as per IUCN Red Data Book; CITES; Wildlife (Protection) Act, 1972 of India and other related acts; methods of poaching; conventional methods of species identification; morphological identification and examination of wildlife parts and products; application of DNA technologies in wildlife forensics. Forensic Entomology: basic elements of entomology; importance of insects in forensic investigations; life cycles of insects to determine time since death; applications of forensic entomology. Forensic Palynology: introduction; examination of pollen grains and spores.

- **FORENSIC ANTHROPOLOGY, ODONTOLOGY & DVI:** Forensic Anthropology: introduction; forensic anthropometry; osteometry; identification of individuals (living); identity of missing persons by

superimposition techniques; facial reconstruction; advanced imaging techniques and musculo-skeletal reconstruction; portrait parley. Forensic Odontology: human dentition; structure and types of teeth; definition and dental formula; identification of individuals from teeth; ages of eruption and other individual characteristics; determination of age, sex and race from teeth; role of teeth in mass disaster; forensic significance in individual identification. Disaster Victim Identification: examination and identification of dead bodies in mass disasters; mutilated bodies; fragmentary skeletal remains and bones; determination of age, sex, race and species origin from bones and assessment of stature; identification of burnt bones and skeletal remains in accidents, crimes and mass disasters.

- **BASIC SEROLOGY:** Blood and its composition; hemoglobin and its variants; blood typing/grouping-ABO system and its significance in forensic investigation; other blood group antigens-Rh subtypes, MN, I, P, Kell, Duffy, Kidd, Lewis, Lutheran and Bombay blood group. Identification of other biological fluids such as saliva, urine, semen and vaginal secretion, and their forensic significance.

- **BIOCHEMISTRY & CELL BIOLOGY:** Chemistry of carbohydrates-definition, classification and importance in forensic investigation. Chemistry of lipids-definition, classification and importance in forensic investigation. Types and properties of amino acids; structure of proteins and their importance in forensic investigation. Introduction to plant and animal cells. Eukaryotic cellular organelles; plasma membrane; transport across membrane; endoplasmic reticulum; Golgi complex; mitochondria; chloroplasts and lysosomes. Organization of nucleus and nuclear transport. Cell division-mitosis and meiosis. Barr bodies and their importance in forensic investigation.

- **INTRODUCTION TO FORENSIC DNA ANALYSIS:** History of DNA fingerprinting; DNA polymorphism; genes and DNA markers in forensic DNA analysis; Techniques and equipment for DNA extraction and purification; different methods of DNA quantitation; DNA separation and detection techniques; Polymerase Chain Reaction (PCR). Introduction to mitochondrial DNA and its forensic importance; important case studies of DNA fingerprinting.

- **TECHNIQUES:** Microscopy - Light and Electron, Centrifugation, Chromatography, Eletrophoresis, Calorimetric and Spectrophotometric techniques for the quantification of DNA, RNA, and protein, Blotting techniques, PCR.

- **QUALITY MANAGEMENT:** Introduction to quality system, Quality plan, Inspection and testing, Test records, Control of inspection Handling, storage, packaging, preservation and delivery of the material, Control of quality records, Internal quality audits, Quality assurance Training.

- **LABORATORY ACCREDITATION:** ISO 9000 and ISO 14000 and 17000 series of standards, Accreditation Boards-NABL guidelines for accreditation in India, Proficiency testing system, Internal quality control, Inter and intra laboratory testing programmes, Designing and running the proficiency testing programmes, Confidentiality Advantages of accreditation.

- **FORENSIC STATISTICS:** Types of data, Basic concept of frequency distribution, measure of central values – Mean, median and mode, measure of dispersion, range, mean deviation and standard deviation, Probability: Theory and classical definition of probability, Bayes theorem of probability, conditional probability and coincidence probability, Chi-square test, Biology Data bases.

- **BASIC KNOWLEDGE OF LEGAL PROCEDURES:** Laws in criminal Justice system, Expert witness and his role, Court testimony in forensic cases.

SCHEME & SYLLABUS OF THE COMPUTER PROFICIENCY TEST (CPT)

Scheme for Computer Proficiency Test

(As per G.O.Ms.No.26, G.A. (Ser.B) Dept., dt: 24.02.2023)

Scheme of the examination (Practical Type)					
Test	Duration (Minutes)	Maximum Marks	Minimum Qualifying Marks		
			SC/ST/PBD	B.C's	O.C's
Proficiency in Office Automation with usage of Computers and Associated Software.	60	100	30	35	40

Syllabus for Computer Proficiency Test

PART-A

1. **INTRODUCTION TO COMPUTERS:** Introduction to Computers - Components and their classification - Peripheral devices and their purpose. Input Devices - Keyboard, Mouse, Scanner, Lighten, Touch screens, Joystick, Micro phone, Scanner, Digital camera, Bar code reader, Biometric sensor. Output Devices: Display devices, Printers, Monitor, Speaker, Plotter, Secondary Storage Devices – Feature- Driven Development (FDD),

Magnetic tape, Universal Serial Bus(USB), Pen Drives, Disks - The Role of input Processing / output processing devices - Computing Concepts - Data - Information – Random - Access Memory (RAM) – Read-Only Memory(ROM) - Control Unit - Memory Unit – Arithmetic Logic Unit(ALU).

2. **COMPUTER SOFTWARE TYPES:** System Software, Application Software, Embedded software, Proprietary Software, Open source software (their purpose and characteristics only).

3. **OPERATING SYSTEM:** Purpose of operating system, Single User and Multi User Operating Systems with Examples.

4. **WINDOWS OPERATING SYSTEM:** Interfacing Graphical User Interface (GUI), Differences between Character User Interface (CUI) and Graphical User Interface(GUI) - working With Files and Folders - More About Files - Running An Application Through the File Manager - Running an Application Through the Program Manager - Setting up of Printer, Webcam, Scanner and other peripheral devices.

5. **LINUX/MAC OS (only basic concepts):** Introduction to Linux - Features and advantages of Linux, File handling commands, directory handling commands - User Management - File permissions Macintosh Apple Computer (MAC) OS - Introduction - Advantages of Macintosh Apple Computer (MAC) OS. Basics commands

6. **INTERNET CONCEPTS (only basic concepts):** Minimum Hardware and Software Requirements for a system to use internet, Communication Protocols and Facilities - Various browsers - What is Internet Protocol (IP) Address - Steps required in connecting system to network - Uploading and Downloading Files from Internet

7. **ELECTRONIC MAIL (only basic concepts):** Sending and receiving mails, Basic E-Mail Functions, Using your word processor for E-mail, Finding E-Mail Address, Mailing Lists and lists Servers.

8. **WORLD WIDE WEB (only basic concepts):** WWW advantages of the Web - how to navigate with the Web - Web Searching.

PART – B

1. **OFFICE SUITE**: MSOFFICE or any open source office like Libre Office /Apache Open Office Neo office for Windows/Linux/Macintosh Apple Computer (MAC)OS.

2. **GETTING STARTED WITH OFFICE:** Introduction to Office Software- Starting and Exiting the Office Applications - Introducing the Office Shortcut Bar - Customizing Office Shortcut Bar.

3. **FILE OPERATIONS IN THE OFFICE:** Common Office Tools and Techniques - Opening An Application - Creating Files - Entering And Editing Text - Saving Files - Opening Files - Closing a File - Exiting The Application - Managing Your files With the Office Applications.

4. **TOOLS IN THE OFFICE APPLICATIONS:** Key Combinations - Cut, Copy and Paste - Drag And Drop Editing - Menu Bars And Toolbars - Undo and - Redo - Spell Checking - Auto Correct - Find and Replace - Help And The Office Assistants - Templates and Wizards.

5. **WORD PROCESSING (MS WORD or its equivalent in Libre office** /Apache Open Office / Neo office for Windows/s/Linux/Mac OS): Starting Word

- Title Bar - Menu Bar - Format Bar - Standard Bar - Ruler - Workspace Area - Scroll Bar - Status Bar - Different Toolbars - Option a Menu Bar - Creating New Document When Word is Running - Opening Pre existing Documents When Word is Running - Designing Your Document - Typing Text - Selection text - Deleting Text - Formatting text and document - copying and moving - Saving Document - Page Setup - Properties of a document - Undo-Redo-Cut-Copy a Document - Pasting a Document - Print Preview - Printing - Select All - Find - Replace - Go To - Four Different View Of A Document - Normal, Web Layout, Print Layout, and Outline Layout- Document Map - Full Screen - Zoom - Objects - Page Break - Header and Footer - Page Number - Auto Format - Auto Text - Inserting Date And Time - Working With Header, Footers-footnotes-Fields-Symbols-Caption Cross Reference-Index-Tabs-Table and Sorting - Working With Graphics - Inserting Pictures - Modifying Pictures - Word Art - Inserting Chart - Inserting Files - Hyper Linking - Bookmark - Using Different Fonts - Paragraph – Bullets Borders and Shading-Columns-Drop Cap-Theme-Change Case Background-Frames-Style-Spelling And

Grammar - Set Language - Word Count - Auto Summarize - Auto Correct - Merge Document - Protect Document - Envelopes And Labels - - Templates, Wizards And Sample Documents - drawing Tables - Merge Cell - Spilt Cells - Spilt Table - Table Auto Format - Auto Fit - Sort - Formula - Arrange All-Split-Micro Soft Word Help - Macros - Custom Toolbars - Keyboard Shortcuts - Menus - Mail Merge.

6. **SPREAD SHEET (MS Excel or its equivalent in Libre Office / Apache Open Office / Neo office for Windows/Linux/Mac OS)**:

Features Of Excel - Excel worksheet - Selecting Cell - Navigating With The Mouse And Keyboard - Entering And Editing Text - Text Boxes - Text Notes - Checking Spelling - Undoing And Repeating Action - Entering And Editing Formulas - Referencing Cells - Order Of Evolution in Formulas - Copying Entries And Equations To Minimize Typing - More Auto Fill Examples - Creating Custom Fill Lists Protecting And Un Protecting Documents And Cell - Creating A New Worksheet - Excel Formatting Tips And Techniques - Moving cell - Copying Cells - Sorting Cell Data - Insertion Cells Inserting As You Paste - Deleting Parts Of Worksheet - Clearing Parts Of A Worksheet - Excel Page Setup - Changing Column Width And Row Heights - Auto Format - Manual Formatting - Using style - Format Code Alter A Number's Appearance - Format Painter Speeds-Up Format Copying - Changing Font Size And Attributes - Adjusting Alignments - Cantering Text Across Column - Using Border Buttons And Commands - Changing Color And Shading - Inserting And Removing Page Breaks - Hiding Rows And Columns - Rearranging Worksheet - Entering Formula - Excel Functions - Inserting Rows And Columns - Saving A Worksheet - Printing A Worksheet - Printing Tips For Large Excel Project - Parts Of A Function - Functions Requiring Add-ins - Function Wizard - Example Of Functions By Category - Organizing Your Data - Excel's Chart Features - Chart Parts And Terminology - Instant charts with The chart wizard - Creating Chart On Separating Worksheets - Resizing And Moving Charts - Adding Chart Notes And Arrows - Editing Charts - Rotating 3-D Charts - Printing Charts - Deleting Charts Setting The Default Chart Type - Creating Trend Lines Data Map - Working With Graphics in Excel - Creating And Pacing Graphic objects - Resizing Graphs - Possible Sources Of Excel Graphics - Creating and Running Macro - Sorting Excel Data - Adding Subtotals To Databases - Customizing Excel - Customizing Workspace –

Comma Separated Value (CSV) File format - Using Worksheet As Databases.

7. **PRESENTATION SOFTWARE (MS Power Point or its equivalent in Libre Office/Apache Open office/Neo office for Windows/Linux/Mac Os):** Introduction - Starting Presentation Software - Views in Presentation Software - Slides - Terminology - Color Schemes - Formatting Slides - Creating a Presentation - Using the Auto Content Wizard - Masters- - Using a Template - Creating a Blank Presentation - Working with Text in Power Point - Adding Slides Editing And Working Text - Working in Outlaying view – Spell checking - Finding And Replacing Text - Formatting Text - Aligning Text - Developing Your Presentation - Importing images From The Outside World - The Clipart Gallery - Drawing in Presentation software- Bringing A Presentation to Life - Inserting Objects in Your Presentation - Inserting A Picture - Working With Graphics - Multimedia in Power Point - Animating The Objects, Pictures, Graphics, - Enhancements to the Slide Show Showing Slides Out Of Order Printing Presentation Elements - Finalizing The Presentation - Assigning Transitions And Timings - Setting The Master Slide - Setting Up The Slide Show - Running The Slide Show.

Assessment Pattern:

Part-A: Test may be designed to assess the candidate by means of MCQs.**(20%of Total Marks)**

Part-B: A computer based assessment test where they need to:

1. Prepare a model document and organize the same in a formatted manner. This should cover evaluating the typing speed, organizing the document and covering several other aspects such as inserting tables, inserting Images/WordArt, mail merge, etc.)
2. Evaluating typing speed **(25% of Total Marks)**
   (This may be made mandatory for qualifying based on the norms existing)
3. Organizing and inserting different objects **(15% of Total Marks)**
4. Prepare an Excel Sheet to fill with data and format the sheet, merging/splitting cells, formulae for calculation in the cells, conditional formatting, preparation of different graphs based on the data. **(20% of Total Marks)**
5. Prepare a Power Point presentation using the standard layouts available and filling different slides with content (Formatted text, images, tables, transition effects, animation etc.). **(20%of Total Marks)**