Annexure-1 (Punjabi Syllabus)

Part-A (Punjabi Qualifying Exam)

1. ਜੀਵਨੀ ਅਤੇ ਰਚਨਾਵਾਂ ਨਾਲ ਸਬੰਧਤ ਪ੍ਰਸ਼ਨ:-

   ਸ਼੍ਰੀ ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ, ਸ਼੍ਰੀ ਗੁਰੂ ਅੰਗਦ ਦੇਵ ਜੀ, ਸ਼੍ਰੀ ਗੁਰੂ ਰਾਮਦਾਸ ਜੀ,

   ਸ਼੍ਰੀ ਗੁਰੂ ਅਰਜਨ ਦੇਵ ਜੀ, ਸ਼੍ਰੀ ਗੁਰੂ ਤੇਗ ਬਹਾਦਰ ਜੀ, ਸ਼੍ਰੀ ਗੁਰੂ ਗੋਬਿੰਦ ਸਿੰਘ ਜੀ।

2. ਵਿਰੋਧਾਰਥਕ ਸ਼ਬਦ, ਸਮਾਨਾਰਥਕ ਸ਼ਬਦ।

3. ਮੁਹਾਵਰੇ।

4. ਅਖਾਣ।

5. ਸਬਦ ਦੇ ਭੇਦ।

6. ਅਗੇਤਰ/ਪਿਛੇਤਰ।

7. ਵਚਨ ਬਦਲੋ ਤੇ ਲਿੰਗ ਬਦਲੋ।

8. ਵਿਸ਼ਰਾਮ ਚਿੰਨ੍ਹ।

9. ਸ਼ਬਦਾਂ / ਵਾਕਾਂ ਨੂੰ ਸ਼ੁੱਧ ਕਰਕੇ ਲਿਖੋ।

10. ਅੰਗਰੇਜ਼ੀ ਸ਼ਬਦਾਂ ਦਾ ਪੰਜਾਬੀ ਵਿੱਚ ਸ਼ੁੱਧ ਰੂਪ।

11. ਅੰਕਾਂ, ਮਹੀਨੇ, ਦਿਨਾਂ ਦਾ ਸ਼ੁੱਧ ਪੰਜਾਬੀ ਰੂਪ।

12. ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਨਾਲ ਸਬੰਧਤ ਪ੍ਰਸ਼ਨ।

13. ਪੰਜਾਬ ਦੇ ਇਤਿਹਾਸ ਨਾਲ ਸਬੰਧਤ ਪ੍ਰਸ਼ਨ।

14. ਪੰਜਾਬ ਦੇ ਸਭਿਆਚਾਰ ਨਾਲ ਸਬੰਧਤ ਪ੍ਰਸ਼ਨ।

Annexure-2

Part B Section (I) -- General Knowledge, Logical Reasoning and Mental Ability.

Sr. No.	*Indicative Contents of Syllabus*	*Weightage (Approx.)*
1	***General Knowledge and Current affairs of National and International importance including:*** *(i) Political issues,* *(ii) Environment issues,* *(iii) Current Affairs,* *(iv) Science and Technology,* *(v) Economic issues,* *(vi) Geography* (vii) History of Punjab-14th century onwards *(viii) History of India with special reference to Indian freedom struggle movement.* *(ix) Sports,* *(x) Cinema and Literature.*	*10*
2	***Logical Reasoning & Mental Ability:*** (i) Logical reasoning, analytical and mental ability. (ii) Basic numerical skills, numbers, magnitudes, percentage, numerical relation appreciation. (iii) Data analysis, Graphic presentation charts, tables, spreadsheets.	*10*
3	***English:-*** *Basic Grammar, Subject and Verb, Adjectives and Adverbs, Synonyms, Antonyms, One Word Substitution, Fill in the Blanks, Correction in Sentences, Idioms and their meanings, Spell Checks, Adjectives, Articles, Prepositions, Direct and Indirect Speech, Active and Passive Voice, Correction in Sentences, etc.*	*5*
4.	***ਪੰਜਾਬੀ:-*** **ਸ਼ੁੱਧ-ਅਸ਼ੁੱਧ, ਸ਼ਬਦਜੋੜ, ਅਗੇਤਰ ਅਤੇ ਪਿਛੇਤਰ, ਸਮਾਨਾਰਥਕ/ਵਿਰੋਧੀਸ਼ਬਦ, ਨਾਂਵ, ਪੜਨਾਂਵ ਅਤੇ ਕਿਰਿਆ ਦੀਆਂ ਕਿਸਮਾਂ ਤੇ ਸਹੀ ਵਰਤੋਂ, ਲਿੰਗ ਅਤੇ ਵਚਨ, ਪੰਜਾਬੀ ਅਖਾਣ ਤੇ ਮੁਹਾਵਰੇ, ਅੰਗਰੇਜੀ ਤੋਂ ਪੰਜਾਬੀ ਅਨੁਵਾਦ ਅਤੇ ਬਹੁਤੇ ਸ਼ਬਦਾਂ ਦੀ ਥਾਂ ਇੱਕ ਸ਼ਬਦ ਆਦਿ।**	*5*
	Maximum Marks	30

Annexure-3

Part B Section (II) - Subject Syllabus (Deputy Ranger and Laboratory *Assistant)*

I. Physics

1. Mathematical Methods of Physics

Dimensional analysis; Vector algebra and vector calculus; Linear algebra, matrices, Cayley Hamilton theorem, eigenvalue problems; Linear differential equations; Special functions (Hermite, Bessel, Laguerre and Legendre); Fourier series, Fourier and Laplace transforms; Elements of complex analysis: Laurent series-poles, residues and evaluation of integrals; Elementary ideas about tensors; Introductory group theory, SU(2), O(3); Elements of computational techniques: roots of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, solution of first order differential equations using Runge-Kutta method; Finite difference methods; Elementary probability theory, random variables, binomial, Poisson and normal distributions.

2. Classical Mechanics

Newton's laws; Phase space dynamics, stability analysis; Central-force motion; 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, Lagrangian and Hamiltonian formalisms and equations of motion; Poisson brackets and canonical transformations; Symmetry, invariance and conservation laws, cyclic coordinates; Periodic motion, wave motion, small oscillations and normal modes; Special theory of relativity, Lorentz transformations, relativistic kinematics and mass–energy equivalence, work power energy, gravitation, pressure, motion of fluids, viscosity, surface tension.

3. Electromagnetic Theory Electrostatics:

Gauss' 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 and linear isotropic media; boundary conditions on fields at interfaces,; Scalar and vector potentials; Gauge invariance; Electromagnetic waves in free space, dielectrics, and conductors; Reflection and refraction, polarization, optical instrument, defects of eye. Fresnel's Law, interference, coherence, and diffraction; Dispersion relations in plasma; Lorentz invariance of Maxwell's equations; Transmission lines and wave guides; Dynamics of charged particles in static and uniform electromagnetic fields; Radiation from moving charges, dipoles and retarded potentials, current electricity-Kirchhoff's Law, Wheat Stone Bridge, Potentio meter & Slide Wire Bridge.

4. Quantum Mechanics Wave-particle duality;

Wave functions in coordinate and momentum representations; Commutators and Heisenberg's uncertainty principle; Matrix representation; Dirac’s bra and ket notation; Schroedinger equation (time-dependent and time-independent); Eigenvalue problems such as particle-in-a-box, harmonic oscillator, etc.; Tunneling through a barrier; Motion in a central potential; Orbital angular momentum, Angular momentum algebra, spin; Addition of angular momenta; Hydrogen atom, spin-orbit coupling, fine structure; Time-independent perturbation theory and applications; Variational method; WKB approximation;

Time dependent perturbation theory and Fermi's Golden Rule; Selection rules; Semiclassical theory of radiation; Elementary theory of scattering, phase shifts, partial waves, Born approximation; Identical particles, Pauli's exclusion principle, spinstatistics connection; Relativistic quantum mechanics: Klein Gordon and Dirac equations.

5. Thermodynamic and Statistical Physics

Laws of thermodynamics and their consequences; Thermodynamic potentials, Maxwell relations; Chemical potential, phase equilibria; Phase space, micro- and macrostates; Microcanonical, canonical and grand-canonical ensembles and partition functions; Free Energy and connection with thermodynamic quantities; First- and second-order phase transitions; Classical and quantum statistics, ideal Fermi and Bose gases; Principle of detailed balance; Blackbody radiation and Planck's distribution law; Bose-Einstein condensation; Random walk and Brownian motion; Introduction to nonequilibrium processes; Diffusion equation.

6. Electronics and Experimental methods Semiconductor device physics, including diodes, junctions, transistors, field effect devices, homo and heterojunction devices, device structure, device characteristics, frequency dependence and applications; Optoelectronic devices, including solar cells, photodetectors, and LEDs; High-frequency devices, including generators and detectors; Operational amplifiers and their applications; Digital techniques and applications (registers, counters, comparators and similar circuits); A/D and D/A converters; Microprocessor and microcontroller basics, Logic gates, communication system.

Data interpretation and analysis.Precision and accuracy.Error analysis, propagation of errors. Least squares fitting.

7. Experimental Techniques and data analysis Data interpretation and analysis; Precision and accuracy, error analysis, propagation of errors, least squares fitting, linear and nonlinear curve fitting, chi-square test; Transducers (temperature, pressure/vacuum, magnetic field, vibration, optical, and particle detectors), measurement and control; Signal conditioning and recovery, impedance matching, amplification (Op-amp based, instrumentation amp, feedback), filtering and noise reduction, shielding and grounding; Fourier transforms; lock-in detector, box-car

integrator, modulation techniques. Applications of the above experimental and analytical techniques to typical undergraduate and graduate level laboratory experiments.

8. Atomic & Molecular Physics :

Quantum states of an electron in an atom; Electron spin; Stern-Gerlach experiment; Spectrum of Hydrogen, helium and alkali atoms; Relativistic corrections for energy levels of hydrogen; Hyperfine structure and isotopic shift; width of spectral lines; LS & JJ coupling; Zeeman, Paschen Back & Stark effect, Photoelectric effect, X-ray spectroscopy; Electron spin resonance, Nuclear magnetic resonance, chemical shift; Rotational, vibrational, electronic, and Raman spectra of diatomic molecules; Frank – Condon principle and selection rules; Spontaneous and stimulated emission, Einstein A & B coefficients; Lasers, optical pumping, population inversion, rate equation; Modes of resonators and coherence length.

9. 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; Diamagnetism, paramagnetism, and ferromagnetism; Electron motion in a periodic potential, band theory of metals, insulators and semiconductors; Superconductivity, type – I and type - II superconductors, Josephson junctions; Defects and dislocations; Ordered phases of matter, translational and orientational order, kinds of liquid crystalline order; Conducting polymers; Quasicrystals.

10. Nuclear and Particle Physics Basic nuclear properties: size, shape, charge distribution, spin and parity; Binding energy, semi-empirical mass formula; Liquid drop model; Fission and fusion; Nature of the nuclear force, form of nucleon-nucleon potential; Charge-independence and charge-symmetry of nuclear forces; Isospin; Deuteron problem; Evidence of shell structure, single- particle shell model, its validity and limitations; Rotational spectra; Elementary ideas of alpha, beta and gamma decays and their selection rules; Nuclear reactions, reaction mechanisms, compound nuclei and direct reactions; Classification of fundamental forces; Elementary particles (quarks, baryons, mesons, leptons); Spin and parity assignments, isospin, strangeness; Gell-Mann-Nishijima formula; C, P, and T invariance and applications of symmetry arguments to particle reactions, parity nonconservation in weak interaction; Relativistic kinematics.

II. Chemistry

Physical Chemistry

1. Basic principles of chemistry- lmportance of chemistry, Nature of Matter' Properties of Matter and their measuremen.Uncertainty in measurements, Laws of chemical combinations'

Dalton's Atomic Theory, Atomic and Molecular Masses,Mole concept and molar masses Percentage Composition, Stoichiometry and Stoichiometric Calculations.

2. Atomic Structure: Sub atomic Particles, Atomic models, Developments Leading to the Bohr's model of atom, Bohr's Model for hydrogen atom, towards Quantum Mechanical model of the Atom, Nature of electromagnetic radiation, photoelectric effect limitations of Bohr's model, Dual nature of matter, de-Broglie's relationship, Heisnberguncertaintiy principle, various quantum numbers(principal, angular momentum and magnetic quantum numbers) and their significance, shapes of s,p and d - orbitals, electron spin quantum number, Rules for filling electrons in orbitals-aufbau principle, Paulti's exclusion principle and Hund's rule, electronic configuration of elements, extra stability of half- filled and completely filled orbitals.

3. States of Matter : lntermolecularForces,Thermal Energy, lntermolecular forces vs thermal interactions, The gaseous state, The Gas laws, ldeal gas equation, Kinetic Molecular theory of Gases, Liquifaction of Gases, Liquid state

4. Chemical Bonding and Molecular Structure: Kossel - Lewis approach to chemical bond formation, concept of ionic and covalent bonds, lonic Bonding, Formation of lonic bonds, factors affecting the formation of ionic bonds, calculation of lattice enthalpy, Covalent Bonding, concept of electronegetivity, Fajan's rule, dipole moment, Valence Shell Electron Pair repulsion (VSEPR) theory and shapes of simple molecules, Quantum mechanical approach to covalent bonding, Valence bond theory - its important features, concept of hybridization involving s,p and d orbitals, Resonance, Molecular Orbital Theory, LCAO5, types of molecular orbitals (bonding, antibonding), sigma and pi-bonds, molecular orbitals electronic configurations of homonuclear diatomic molecules, concept of bond order, bond length and bond energy, Elementary idea of metallic bonding, Hydrogen bonding and its applications.

5. Easic principles and applications of spectroscopy: Rotational, vibrational, electronic, Raman, ESR, NMR

6. Thermodynamics;- Fundamental of thermodynamics , System and surroundings, extensive and intensive properties, state functions, types of processes, First law of thermodynamics ,concept of work, heat internal energy and enthalpy , heat capacity, molar heat capacity, Hess's law of constant heat summation , Enthalpies of bond dissociation, combustion ,formation, atomization, sublimation , phase transition, hydration, ionization and solution.

Second law of thermodynamics, Spontaneity of processes, AS of the universe and AG of the system as criteria for spontaneity and equilibrium constant.

7. Equilibrium:- Meaning ot equilibrium concept of dynamic equilibrium. Equilibria involving physical processes: Solid - liquid, liquid - gas and solid - gas equilibria' Henry's law' general characterics of equilibrium involving physical processes. Equilibria involving chemical process: law of chemical equilibrium, equilibrium constants-(kp and Kc)..and their significance,

significance of G and G* in chemical equilibrium factors affecting equilibrium concentration, pressure, temperature, effect of catalyst; Le chatelier's principle. lonic, equilibrium: Weak and Strong electrolytes ionization of electrolytes, various concepts of acids and bases and their ionization, acid - baseequilibria {including multistage ionization) and ionization constants, ionization of water, pH-scale, common ion effect, hydrolysis of salt and pH of their solutions, solubility of sparingly soluble salts and solubility products buffer solutions.

8. Redox Reactions and Electrochemistry:- Electronic concept of oxidation and reduction' redoy reactions, oxidation number, rules for assigning oxidation number balancing of redox reactions. Eectrolytic and metallic conduction, conductance in electrolytic solutions, specific and mojar conductivities and their variation with concentration: Kohlrausch's law and its applications, Electrochemical cells - Electrolytic and Galvanic cells, different types of electrodes' electrode potentials including standard electrode potential, half-cell and cell reactions, emf of a Galvanic cell and its measurement; Nernst equation and its applications; Relationship between cell potential and Gibbs'energy change, Dry cell and lead accumulator; Fuel cells'

9. Chemical Kinetics : Rate of a chemical reactions, factors affecting the rate of reactions: concentration, temperature, pressure and catalyst; elementary and complex reactions, order and molecularity of reactions, rate law, constant and its units, differential and integral forms of zero and first order reactions, their characteristics and half-lives, effect of temperature on rate of reactions - Arrhenius theory, activation energy and its calculation, collision theory of bimolecular gaseous reactions(no derivation).

10. Surface Chemistry:- Adsorption - Physisorption and chemisorptions and their characteristics, factors affecting adsorption of gases on solids - Freundlich and Langmuir adsorption isotherms, adsorption from solutions, colloidal state - distinction among true solutions, collides and suspensions

11. Solid states-: General Characteristics of solid state, Amorphous and Crystalline Solids, Classification of Crystalline Solids, Crystal Lattices and Unit Cell, Close-Packed Structures, Packing Efficiency, Calculations involving Unit Cell Dimensions, imperfections in Solids, Electrical Properties, Magnetic Properties.

12. concepts of catalysis: Homogenous and heterogeneous catalysis,

13. Solutions:- Types of Solutions, expressing concentration of solutions, Solubility, Vapor pressure of liquid solutions, ldeal and Non-ideal solutions, Colligative Properties and Determination of Molar Mass, Abnormal Molar Masses.

lnorganic Chemistry

1. Chemical periodicity:. Modern periodic law and present form of the periodic table, s, p, d and f block elements, periodic trends in properties of elements atomic and lonic radii, ionization enthalpy, electron gain enthalpy, valence, oxidation states and chemical reactivity.

2. General principles & process of isolation of metals:- Modes of occurrence of elements in nature, minerals, ores; Steps involved in the extraction of metals - concentration, reduction (chemical and electrolnic methods) and refining with special references to the extraction of Ar, cu, zn and Fe; Thermodynamic and electrochemical principles involved in the extraction of metals.

3. Hydrogen:- position of hydrogen in periodic table, isotopes, preparation, properties and uses oF hydrogen; physical and chemical properties 0f water and heavy water, structure preparation, reactions and uses of hydrogen peroxide,Hydrogen as a fuel.

4. S-Block elements:- Group-l and 2 elements introduction, electronic configuration and general trends in physical and chemical properties of elements, anomalous properties of the first element of each group, diagonal relationships. preparation and properties of some important compounds - sodium carbonate and sodium hydroxide; industrial uses of lime, limestone Plaster of Paris and cement; Biological significance of Na, K, Mg and Ca.

5. P-Block elements- Group 13 to Group 18 element, Electronic configuration general trends in physical and chemical properties of elements across the periods and down the group; unique behavior of the first element in each group. Preparation, properties and uses of boron and aluminum; properties of boric acid, diboron, boron trifluride, aluminum chloride and alums, allotropes of carbon, catenation; Structure & properties of silicates and zeolites. Properties and uses of nitrogen phyphorus, Allotrophic forms, structure and uses of ammonia, nitric acid, and p-C13, pC15: Structures of oxides of physphoruspreperation, properties and structure and uses of Ozone. Allotropic forms of sulphure, sulphuric acid and structures of oxo acids of sulphur.

6. D and F block elements :position in periodic table, electronic configurations of d-block elements, general properties of the transition elements of D-Block. some important compounds of transition elements, the lanthanoids, the actinoids, some application of d3 and f-Block elements. Preparation, properties and uses of K2cr207 and KMno4.

7. Coordination compounds &organometalic compounds: Introduction to coordination compounds. Werner's theory: liquids, coordination number, dentistry, IUPAC nomenclature of mononuclear co-ordination compounds, isomerism; Bonding - valence bond approach and basic idea of crystal field theory colour and magnetic properties importance of coordination compounds in qualitative analysis extraction of matels and in biological system. Organ metallic compound synthesis bonding and structure and reactivity organ metallic in homogenous catalysis .

8 . Environmental Chemistry:-Environmental pollution-Atmospheric' water and soil' Atmospheric pollution - Troposoheric and Stratospheric Trposphericpollutents - Gaseous pollutants , oxides of carbon, nitrogen and sulphur, hydrocarbons: thoir sources harmful effects and prevention ; Green house effect and Global warring; Acid rain; particulate

pollutants. Smoke, dust, smog , fumes, mist; their sources, harmful effects and prevention. Stratospheric pollution formation and breakdown of ozone' depletion of ozone layer - its mechanism and effects.water Pollution ' Major pollutants

9. Nuclear chemistry: Nuclear reaction, fission and fusion' radio-analytical techniques and activation analysis.

10. Analytical chemistry: Sepration techniques' Spectroscopic electro and thermo-analytical methods.

11. Bioinorganic Chemistry - Photosystems Porphyrinesmetalloenzymes oxygen transport, electron transfer reactions, nitrogen fixation physical characterization of inorganic compounds by IR' Raman' NMR,EPR, uossbauer, UV, NQR, MS, electron spectroscopy.

III. Mathematics

Elementary set theory, Sets:

Sets and their representations. Empty set, Finite & infinite sets, Equal sets. subsets. subsets of the set of real numbers especially intervals (with notations). Power set. Universal set' venn diagrams.Union and intersection of sets Difference of sets' Complement of set, Properties of complement sets.

Finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, Supremum, infilrnum.

Sequence and series: Sequence and Series, Arithmetic Progression (A.P), Arithmetic Mean (A.M), Geometric Progression (G.P), general term of a G.P, sum of n terms of a G-P .Arithmetic and Geometric series, infinite G.P. and its sum. Geometric mean (G.M), relation between A'M and G'M' Sum to n term of the special series. convergence,. sequences and series of functions, uniform convergence.

Binomial Theorem:

History, statement and proof of the binomial theorem for positive integral indices' Pascal's triangle, general and middle term in binomial expansion, simple applications' Bolzano Weierstrass theorem, HelneBorel theorem.

Continuity and Differentiability:

Continuity, uniform continuity.Continuity and Differentiability' derivative of composite functions, chain rule, derivative of inverse trigonometric functions' derivative of implicit function.

Concepts of exponential and logarithmic functions.Derivatives of logex differentiation. Derivative of functions expressed in parametric forms.

Second order derivatives. Rolle's and lagrange's Mean value theorems their Geometric interpretations.

Applications of Derivatives: Applications of derivatives: rate of charge, increasing/decreasing functions, tangents and normal, approximation, maxima and min ma. Simple problems (that illustrate basic principles and understanding of the subject as well as real life situations).

Limits and Derivatives:

Derivative introduced as rate of change both as that of distance function and geometrically, intuitive idea of limit. , limsup, liminf .Definitionn of derivative, relate it to slope of tangent of the curve, derivative of sum. difference, product and quotient of functions. Derivatives of polynomial and trigonometric functions. Mean value theorem.

Integrals : Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts.Definite integrals as a limit of a sum. Fundamental Theorem of Calculus, Basic properties of definite integrals and evaluation of definite integrals.

Applications of the Integrals

Applicators in finding the area under simple curves, especially lines, areas of circle, parabolas, ellipses, area between the two above said curves. Riemann sums and Riemann Integrals improper integrals.

Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems. Metric spaces, compactness, connectedness, Nor med linear Spaces. Spaces of continuous functions as examples.

Linear Algebra:

Vector spaces: Vectors and scalars, magnitude and direction of a vector. Direction cosines/ratios of vectors. Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point, negative of vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio Scalar {dot) product of vectors, projection of a vector on a line. Vector (cross) product of vectors scalar triple vector.

Linear inequalities:

Linear equations: Algebraic solutions of linear inequalities in one variable and their representation on the number line. Graphical solution of linear inequalities in two variables. Solution of system of linear inequalities in two variables - Graphically

Matrices & Determinant

Concept, notation, order, equality, types of matrices, zero matrix, transpose of a matrix, symmetric and skew symmetric matrices, Addition, multiplication and scalar multiplication of matrices, simple properties of addition, multiplication and scalar multiplication. Non commutative of multiplication of matrices and existence of non-zero matrices whose product is the Zero matrix (restrict to square matrices of order 2), Concept of elementary row and column operations. Invertible matrices and proof of the uniqueness of inverse, if it exists

Determinant of a square matrix (up to 3, n 3 matrices), properties of determinants, minors, cofactors and applications of determinants in finding the area of a triangle.

Adjoint and inverse of a square matrix. Consistency, inconsistency and number of solutions of system of linear equation by examples, solving system of linear equations in two or three variables using inverse of a matrix. Rank and determinant of matrices, linear equations. Eigen values and Eigen vectors, Cayley-Hamilton theorem.

Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, Orthonormal basis. Quadratic forms.reduction and classification of quadratic forms.

Straight Lines.

Brief recall of 2 D from earlier classes Shifting of origin. Slope of a line and angle between two lines Various forms of equations of a line: parallel to axes, point-slope form, slop intercept form, two-point form, intercept form and normal form, General equation of a line. Equation of family of lines passing through the point of intersection of two lines.Distance of a point from a line.

Conic Sections: Sections o, a cone; circles, ellipse, parabola, hyperbola ,a point / a straight line and a pair of intersecting lines as a degenerated case of a conic section. Standard equations and simple properties of parabola, ellipse and hyperbola.Standard equations of a circle.

Introduction to Three-dimensional Geometry:

Coordinate axes and coordinate planes rn three dimensions. Coordinates of a point. Distance between two points and section formula.

Three-dimensional Geometry:

Direction cosines/ratios of a line joining two points.Cartesian and vendor equation of a line, coplanar and skew lines, shortest distance between two lines.Cartesian and vector equation of a prane.Angie between (i) two lines, (ii) two planes, (iii) a line and a plane. Distance of a point from a plan

Complex Numbers and quadratic Equations:

Algebra of complex numbers, the complex plane, polynomials' power series' transcendental functions such as exponential, trigonometric and hyperbolic functions.

Trigonometric Functions:

Positive and negative angles.Measuring angles in radians and in degrees and conversion from one mea sure to another. Definition of trigonometric functions with the help of unit circle Truth of the identity sin2x + cos2x = 1, for all x. Signs of trigonometric functions and sketch of their graphs. Expressing sin(x*y) and cos(x*y) in terms of sinx, siny, cosx&cosy'

Analytic functions, Cauchy-Riemann equations.Contour integral, Cauchy's theorem' Cauchy's integral formula, Liouvilie's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorm. Taylor series, Laurcet series, calculus of residues Conformal mappings Mobius tramsformation.

Algebra:

Permutations & Combinations:

Fundamental principle of counting, Factorial n(n!) Permutations and combinations, derivation of formulae and their connections, simple applications.Pigeon-hole principle, inclusion exclusion principle.

Groups, subgroups , normal subgroups, quotient groups, homomorphisms, cyclic Groups, permutation groups, CaYley's theorem, class equations, Sylow theorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain.

Polynomial ring and irreducibility criteria.Fields, finite fields, field extensions, Galois Theory. Dense sets, subspace and product topology, separation axioms, connectedness and compactness

Ordinary Differential Equations (ODEs)

Differential Equations:

Definition, order and degree, General and particular solutions of a differential equation' Formation of differential equation whose General solution is given'

Existence and uniqueness of solutions of initial value problems for first order ordinary differential equation, singular solutions of first order ODEs, system of first order ODEs'

General theory of homogenous and non homogeneous linear ODES, variation of parameter, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs):

Lagrange and Charpit methods for solving first order PDEs, cauchy problem for first order PDES. classification of second order PDEs, General solution of higher order: PDEswith constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis:

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

Calculus and Variations:

Variation of functional, Euter-Lagrange equation, Necessary and sufficient conditions for extrema.Variational methods for boundary value problems in ordinary and partial differential equations.

Linear integral Equations:

Linear integral equation at the first and second kind of Fredholm and Volterra type, Solutions with separable kernels, Characteristic numbers and eigen functions, resolvent kernel.

Classical Mechanics:

Generalized coordinates, Lagrange's equation Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

Descriptive statistics, exploratory data analysis

Mathematical Reasoning:

Mathematically acceptable statements. Connecting words/phrases-consolidating the understanding of "if and only if (necessary and sufficient) condition", " implies", "and/of, "implied by", "and", "or", there exists" and their use through variety of examples related to real life and Mathematics , Validating the statements involving the connecting words-difference between contradiction, converse and contra positive.

Statistics:

Measure of dispersion: mean deviation, variance and standard deviation of ungrouped/grouped data. Analysis of frequency distributions with equal means but different variances.

Probability:

Random experiments: outcomes, sample spaces{ set representation). Events: Occurrence of events, '.not', 'and' & 'nor' events, exhaustive events, mutually exclusive events. Axiomatic (set theoretic) probability, connections with the theories of earlier classes.

Probability of an event, probability of 'not', 'and' & 'nor events. Multiplication theorem on probability. Conditional probability, independent events, total probability, Baye's theorem, Random variable and its probability distribution, mean and variance of haphazard variable. Repeated independent (Bernoulli) trials and Binomial distribution. Sample space, discrete probability, independent events, Baye's theorem. Random variables and distribution functions {univariate and multivariate}; expectation and moments.independent random variables, marginal and conditional distributions. Characteristic functions. probability inequalities (Tchebyshef, Markov, .Jensen). Modes of convergence, weak and strong laws of large number Central Limit theorems.

Markov chains with finite and countable state space, classification of states, limiting behavior of n-step transition probabilities, stationary distribution, Poisson and birth-and-death processes .

Standard discrete and continuous univariate distributions.sampling distributions, standard errors and asymptotic distributions, distribution of order statistics and range.

Methods of estimation, properties of estimators, confidence intervals. Tests of hypotheses: most powerful and uniformly most powerful tests, likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit.Large sample tests. Simple non-parametric tests for one and two sample problems, rank correlation end test for independence. Elementary Bayesian inference.

Gauss-Markov models, estimability of parameters, best linear unbiased estimators, confidence intervals, tests for linear hypotheses. Analysis of variance and covariance. Fixed, random and mixed effects models. Simple and multiple linear regression. Elementary regression diagnostics.Logistics regression.

Multivariate normal distribution, Wishart distribution and their properties.Distribution of quadratic.forms. Inference for parameters, partial and multiple correlation coefficients and related tests Data reduction techniques: Principle component analysis, Discriminate analysis, Cluster analysis, Canonical correlation.

Simple random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods.

Completely randomized designs, randomized block designs and Latin-square designs.

Connectedness and orthogonality of block designs, BIBD. 2K factorial experiments: confounding and construction.

Linear Programming Problem: introduction, definition of related terminology such as constraints, objectives function, optimization, different types of linear programming problems, mathematical formulation of L P problems, graphical method of solution for problems in two variables, feasible and infeasible regions, feasible and infeasible solutions, optimal feasible solutions (up to three non trivial constrains).

Simplex methods, duality.Elementary queuing and inventory models. Steady-state solutions of Mar(ovranqueurrg models: M/M/1, M/M/I with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1.

IV Botany

1. Non-chordata and Chordata:

(a) Classification and relationship of various phyla up to subclasses: Acoelomate and Coelomate, Protostomes and Deuterostomes, Bilateria and Radiata; Status of Protista, Parazoa, Onychophora and Hemichordata; Symmetry.

(b) Protozoa: Locomotion, nutrition, reproduction, sex; General features and life history of Paramaecium, Monocystis, Plasmodium and Leishmania.

(c) Porifera: Skeleton, canal system and reproduction.

(d) Cnidaria: Polymorphism, defensive structures and their mechanism; coral reefs and their formation; metagenesis; general features and life history of Obelia and Aurelia.

(e) Platyhelminthes: Parasitic adaptation; general features and life history of Fasciola and Taenia and their pathogenic symptoms.

(f) Nemathelminthes: General features, life history, parasitic adaptation of Ascaris and Wuchereria. (g) Annelida: Coelom and metamerism; modes of life in polychaetes; general features and life history of Nereis, earthworm and leach.

(h) Arthropoda: Larval forms and parasitism in Crustacea; vision and respiration in arthropods (Prawn, cockroach and scorpion); modification of mouth parts in insects (cockroach, mosquito, housefly, honey bee and butterfly); metamorphosis in insect and its hormonal regulation, social behaviour of Apis and termites.

(i) Mollusca: Feeding, respiration, locomotion, general features and life history of Lamellidens, Pila and Sepia, torsion and detorsion in gastropods.

(j) Echinodermata: Feeding, respiration, locomotion, larval forms, general features and life history of Asterias.

(k) Protochordata: Origin of chordates; general features and life history of Branchiostoma and Herdmania.

(l) Pisces: Respiration, locomotion and migration.

(m) Amphibia: Origin of tetrapods, parental care, paedomorphosis.

(n) Reptilia; Origin of reptiles, skull types, status of Sphenodon and crocodiles.

(o) Aves: Origin of birds, flight adaptation, migration.

(p) Mammalia: Origin of mammals, dentition, general features of egg laying mammals, pouched-mammals, aquatic mammals and primates, endocrine glands (pituitary, thyroid, parathyroid, adrenal, pancreas, gonads) and their interrelationships.

(q) Comparative functional anatomy of various systems of vertebrates (integument and its derivatives, endoskeleton, locomotory organs, digestive system, respiratory system, circulatory system including heart and aortic arches, urino-genital system, brain and sense organs (eye and ear).

3. Ethology:

(a) Behaviour: Sensory filtering, reponsiveness, sign stimuli, learning and memory, instinct, habituation, conditioning, imprinting.

(b) Role of hormones in drive; role of pheromones in alarm spreading; crypsis, predator detection, predator tactics, social hierarchies in primates, social organization in insects.

(c) Orientation, navigation, homing, biological rhythms, biological clock, tidal, seasonal and circadian rhythms.

(d) Methods of studying animal behaviour including sexual conflict, selfishness, kinship and altruism.

4. Economic Zoology:

(a) Apiculture, sericulture, lac culture, carp culture, pearl culture, prawn culture, vermiculture.

(b) Major infectious and communicable diseases (malaria, filaria, tuberculosis, cholera and AIDS) their vectors, pathogens and prevention.

(c) Cattle and livestock diseases, their pathogen (helminthes) and vectors (ticks, mites, Tabanus, Stomoxys).

(d) Pests of sugar cane (Pyrillaperpusiella) oil seed (Achaea janata) and rice (Sitophilusoryzae).

(e) Transgenic animals.

(f) Medical biotechnology, human genetic disease and genetic counselling, gene therapy.

(g) Forensic biotechnology

5. Biostatistics:

Designing of experiments; null hypothesis; correlation, regression, distribution and measure of central tendency, chi square, student-test, F-test (one-way & two-way F-test).

6. Instrumentation Methods:

(a) Spectrophotometer, phase contrast and fluorescence microscopy, radioactive tracer, ultra centrifuge, gel electrophoresis, PCR, ELISA, FISH and chromosome painting.

(b) Electron microscopy (TEM, SEM).

7 Cell Biology:

(a) Structure and function of cell and its organelles (nucleus, plasma membrane, mitochondria, Golgi bodies, endoplasmic reticulum, ribosomes, and lysosomes), cell division (mitosis and meiosis), mitotic spindle and mitotic apparatus, chromosome movements, chromosome type polytene and lambrush, organization of chromatin, heterochromatin, Cell cycle regulation.

(b) Nucleic acid topology, DNA motif, DNA replication, transcription, RNA processing, translation, protein foldings and transport.

8. Genetics:

(a) Modern concept of gene, split gene, genetic regulation, genetic code.

(b) Sex chromosomes and their evolution, sex determination in Drosophila and man.

(c) Mendel's laws of inheritance, recombination, linkage, multiple alleles, genetics of blood groups, pedigree analysis, hereditary diseases in man.

(d) Mutations and mutagenesis.

(e) Recombinant DNA technology; plasmid, cosmid, artificial chromosomes as vectors, transgenic, DNA cloning and whole animal cloning (principles and methods).

(f) Gene regulation and expression in prokaryotes and eukaryotes.

(g) Signal molecules, cell death, defects in signaling pathway and consequences.

(h) RFLP, RAPD and AFLP and application of RFLP in DNA finger printing, ribozyme technologies, human genome project, genomics and protomics.

9. Evolution:

(a) Theories of origin of life.

(b) Theories of evolution; Natural selection, role of mutations in evolution, evolutionary patterns, molecular drive, mimicry, variation, isolation and speciation.

(c) Evolution of horse, elephant and man using fossil data.

(d) Hardy-Weinberg Law. (e) Continental drift and distribution of animals.

10. Systematics:

Zoological nomenclature, international code, cladistics, molecular taxonomy and biodiversity.

11. Biochemistry:

(a) Structure and role of carbohydrates, fats, fatty acids and cholesterol, proteins and amino-acids, nucleic acids. Bioenergetics.

(b) Glycolysis and Kreb cycle, oxidation and reduction, oxidative phosphorylation, energy conservation and release, ATP cycle, cyclic AMP – its structure and role.

(c) Hormone classification (steroid and peptide hormones), biosynthesis and functions.

(d) Enzymes: types and mechanisms of action.

(e) Vitamins and co-enzymes

(f) Immunoglobulin and immunity.

12. Physiology (with special reference to mammals):

(a) Composition and constituents of blood; blood groups and Rh factor in man, factors and mechanism of coagulation, iron metabolism, acid-base balance, thermo-regulation, anticoagulants.

(b) Haemoglobin: Composition, types and role in transport of oxygen and carbon dioxide.

(c) Digestion and absorption: Role of salivary glands, liver, pancreas and intestinal glands.

(d) Excretion: nephron and regulation of urine formation; osmo-regulation and excretory product (e) Muscles: Types, mechanism of contraction of skeletal muscles, effects of exercise on muscles.

(f) Neuron: nerve impulse – its conduction and synaptic transmission, neurotransmitters.

(g) Vision, hearing and olfaction in man.

(h) Physiology of reproduction, puberty and menopause in human.

13. Developmental Biology:

(a) Gametogenesis; spermatogenesis, composition of semen, in vitro and in vivo capacitation of mammalian sperm, Oogenesis, totipotency; fertilization, morphogenesis and morphogen, blastogenesis, establishment of body axes formation, fate map,

gestulation in frog and chick; genes in development in chick, homeotic genes, development of eye and heart, placenta in mammals.

(b) Cell lineage, cell-to cell interaction, Genetic and induced teratogenesis, role of thyroxine in control of metamorphosis in amphibia, paedogenesis and neoteny, cell death, aging.

(c) Developmental genes in man, in vitro fertilization and embryo transfer, cloning.

(d) Stem cells: Sources, types and their use in human welfare.

(e) Biogenetic law.

V. Botany

1. Microbiology and Plant Pathology:

Viruses, bacteria, and plasmids-structure and reproduction.General account of infection, Phytoimmunology. Applications of microbiology in agriculture, industry, medicine and pollution control in air, soil and water. Important plant diseases caused by viruses, bacteria, mycoplasma, fungi and nematodes. Mode of infection and dissemination.Molecular basis of infection and disease resistance/defence.Physiology of parasitism and control measures.Fungal toxins.

2. Cryptogams:

Algae, Fungi, Bryophytes, Pteridophytes-structure and reproduction from evolutionary viewpoint.Distribution of Cryptogams in India and their economic potential.

3. Phanerogams:

Gymnosperms: Concept of Progymonosperms. Classification and distribution of Gymnosperms. Salient features of Cycadales, Coniferrals and Gnetales, their structures and reproduction. General account of Cycadofilicales, Bennettitales and Cordaitales.

Angiosperms: Systematics, anatomy, embryology, palynology and phylogeny. Comparative account of various systems of Angiosperm Classiification. Study of angiospermic families–Magnoliaceae, Ranunculaceae, Brassicaceae (Cruci-ferae), Rosaceae, Leguminosae, Euphorbiaceae, Malvaceaie, Dipterocar-paceae, Apiaceae (Umbelliferae), Asclepiadaceae, Verbenaceae, Solana-ceae, Rubiaceae, Cucurbitaceae, Asteraceae (Composite), Poaceae (Gramineae), Arecaceae (Palmae), Liliaceae, Musaceae, Orchidaceae. Stomata and their types.Anomalous secondary growth, Anatomy of C 3 and C4 plants.Development of male and female gametophytes, pollination, fertilization.Endosperm–its development and function.Patterns of embryo development.Polyembryony, apoxmix, Applications of palynology.

4. Plant Utility and Exploitation:

Origin of cultivated plants, Vavilov'scentres of origin.Plants as sources for food, fodder, fibres, spices, beverages, drugs, narcotics, insecticides, timber, gums, resins and dyes.Latex, cellulose Starch and their products.Perfumery.Importance of Ethnobotany in Indian context.Energy plantation.Botanical Gardens and Herbaria.

5. Morphogenesis:
Totipotency, polarity, symmetry and differentiation. Cell, tissue, organ and protoplast culture. Somatic hybrids and Cybrids.

6. Cell Biology:
Techniques of Cell Biology.Prokaryotic and eukaryotic cells -structural and ultrastructuraldetails.Structure and function of extracellular matrix or ECM (cell wall) and membranes-cell adhesion, membrane transport and vesicular transport.Structure and function of cell organelles (chloroplasts, mitochondria, ER, ribosomes, endosomes, lysosomes, peroxisomes, hydrogenosome). Nucleus, nucleolus, nuclear pore complex. Chromatin and nucleosome.Cell signalling and cell receptors. Signal transduction (G-1 proteins, etc.). Mitosis and meisdosis; molecular basis of cell cycle.Numerical and structural variations in chromosomes and their significance.Study of polytene, lampbrush and Bchromosomes– structure, behaviour and significance.

7. Genetics, Molecular Biology and Evolution:
Development of genetics, and gene versus allele concepts (Pseudoalleles).Quantitative genetics and multiple factors.Linkage and crossing over–methods of gene mapping including molecular maps (idea of mapping function).Sex chromosomes and sexlinked inheritance, sex determination and molecular basis of sex differentiation.Mutation (biochemical and molecular basis).Cytoplasmic inheritance and cytoplasmic genes (including genetics of male sterility).Prions and prion hypothesis.
Structure and synthesis of nucleic acids and protines.Genetic code and regulation of gene expression.Multigene families.Organic evolution-evidences, mechanism and theories.Role of RNA in origin and evolution.

8. Plant Breeding, Biotechnology and Biostatistics:
Methods of plant breeding -- introduction, selection and hybridization (pedigree, backcross, mass selection, bulk method). Male sterility and heterosis breeding.Use of apomixis in plant breeding.Micropropagation and genetic engineering–methods of transfer of genes and transgenic crops; development and use of molecular markers in plant breeding.Standard deviation and coefficient of variation (CV).Tests of significance (Z-test, t-test and chi-square Tests).Probability and distributions (normal, binomial and Poisson distributions).Correlation and regression.

9. Physiology and Biochemistry:
Water relations, Mineral nutrition and ion transport, mineral deficiencies. Photosynthesis– photochemical reactions, photophosphorylation and carbon pathways

including C pathway (photorespiration), C, C and CAM pathways.Respiraion (anaerobic and aerobic, including fermentation-electron transport chain and oxidative phosphorylation.Chemiosmotic theory and ATP synthesis.Nitrogen fixation and nitrogen metabolism.Enzymes, coenzymes, energy transfer and energy conservation.Importance of secondary metabolites. Pigments as photoreceptors (plastidialpigments andphytochrome). Photoperiodism and flowering, vernalization, senescence.Growth substances-their chemical nature, role and applications in agri-horticulture, growth indices, growth movements. Stress physiology (heat, water, salinity, metal). Fruit and seed physiology.Dormancy, storage and germination of seed. Fruit ripening -- its molecular basis and manipulation.

10. Ecology and Plant Geography:

Ecological factors.Concepts and dynamics of community.Plant succession.Concepts of biosphere.Ecosystems and their conservation.Pollution and its control (including phytoremediation).

11. Forest types of India:

Afforestation, deforestation and social forestry.Endangered plants, endemism and Red Data Books.Biodiversity.Convention of Biological Diversity, Sovereign Rights and Intellectual Property Rights.Biogeochemical cycles.Global warming.

Botany

1. Diversity in Living World

- Biology- its meaning of relevance to mankind.
- Taxonomy- concept of species and taxonomical hierarchy.
- Systematic - introduction of plants systematic, its aims, objectives and importance, classifications , brief history , introduction, various systems of classification of living organism. Brief introduction to nomenclature and binomial system of nomenclature.
- Salient features and classification of kingdom Monera- General structure , occurrence, reproduction and economic importance.
- Kingdom protista- general structure, occurrence, reproduction and economic importance.
- Kingdom Fungi- general structure, occurrence, reproduction and economic importance, diseases of economically important crop plant, rusts , smuts, downy and powdery mildew damping off.
- Kingdom plantae- silent feature and classification of plants into major groups Algae- general account, structure , life cycle and economic importance of liverworts and mosses.
- Pteridophytes- general account, structure, classification, life cycle and economic importance.
- Gymnosperms- general account, structure, classification, life cycle and economic importance.
- Angiosperms- classification upto class, general account, structure, classification, life cycle and economic importance.

  Viruses- General structure , types and reproduction of virues.

  Lichens- general account, structure, and life history.

2. Structural organization in plants

- Tissue: tissue system in Plants
- Morphology: faction and modification of root , stem and leaf.
- Anatomy of roots , stem and leaf, primary and secondary growth in dicot stem.
- Inflorescence- types of Inflorescence, flower (including position and arrangement of different whorls) placentation , fruit , type of fruit, seed.
- Diagnostics features, economic, importance and distribution pattern of Angiospermic families:
    A) Family Brassicaceae
    B) Family Fabaceae
    C) Family Solnaceae
    D) Family Liliaceae
    E) Family Poaceae

3. Plant Physiolpogy

- Transport in Plants- movement of water(including diffusion , osmosis, plasmolysis and water relation of cell and nutrients, long distant of water-absorption , apoplast, symplast, transpiration pull, root pressure and guttation , transpiration opening and closing of stomata, uptake and translocation of mineral nutrients-transport of food , phloem transport, mass flow hypothesis.
- Mineral nutrients- Essential minerals , macro and micro nutrients and their role, deficiency symptoms, mineral toxicity, elementary idea of hydroponics as a method to study mineral nutrients.
- Nitrogen metabolism- biological nitrogen fixation, nitrogen cycle.
- Photosynthesis- photosynthesis as means of auto tropic nutrients ,pigments involved in photosynthesis ,absorption and action spectra, photochemical and biosynthetic phases of photosynthesis, phtophosphorylation : cycle and non cycle of photophosphorylation, chemiosmotic hypothesis, photorespiration, factors affecting photosynthesis.
- Respiration- Aerobic respiration: Glycoiysis: Kerb's cycle Electron transport chain and oxidative phosphoryation Anaerobic respiration , respiratory substance and respiration quotient.
- Plant growth and Develpoment: Phases of plant growth and plant rate , condition of growth , Diffentiation and dedifferentiation , dedifferentiation growth regulators- role of Auxins, gibberedlin, cytokinen, ethylene, abscissic acid phototropism, role of phytochrome and hormones in photoperiodism , Dormancy, method of breaking seed dormancy , verbalization.
- Plants Movements- tropic movement , phototropism, gravitropism and their mechanism Nastic movement.
-

4. Reproduction

Reproduction in Organisms: Reproduction , a characteristics features of all organism for continuation of species : Modes of reproduction- Asexual and sexual: asexual reproduction; Modes -binary fission , spectulation, budding gemmule, fragmentation: vegetative propagation in plants.

Sexual reproduction in flowering plant: flower structure, development, of male and female gametophytes: Pollination- types , agencies and examples: out breeding devices: Pollen-Pistil interaction: Double fertilization , Post fertilization events-Development of endosperm and embryo , Development of seed and formation of fruit : special modes apomixes, parthenocarpypolyembryony: Significance of seed and fruit formation.

5. Cell biology, genetics and evolution

Structures and function of bio molecules: Carbohydrates , lipids proteins and nucleic acid.
Enzymes- type , properties, functions and enzymes action Cell-physic- chemical nature of plasma membrance , cell wall.
Ultra structure of cell organelles with brief

- Endoplasmicreticulum, golgibodies, lysosome, vacuoles, mitochondria, ribosomes, platids, cilla, flagella, centrioles nucleolus.
- Cell division: cell cycle , mitosis, meiosis and their significance.

Heredity and variation :Mendelian inheritance: deviations from Mendelism - incomplete dominance, co-dominance , multiple alleles, Pleiotropy, Elementary idea of polygenic inheritance , Chromosome theory of inheritance : Chromosomes and genes.
Molecular basic of inheritance: search for genetic material and DNA a genetic material: structure of DNA and RNA, DNA packaging : DNA Replication: Central Dogma : transcription , genetic code, translation : Gene expression and regulation.
Evolution : Origin of Life: Biological evolution and evidence for biological evolution from Paleontology, comparative anatomy , embryology and molecular evidence); lamarcka theory of evolution Darwin's contribution . modern synthesis theory of evolution : Mechanism of evolution Variation and Natural Selection with examples, types of natural selection: Gene flow and generic drift: hardy- Weinberg's principle: Adaptive Radiation : Human Evolution.

6. Biology and Human Welfare
Improvement in food production : plant breeding , tissue culture , single cell protine, Biofortification: Apiculture and Animal husbandry.

7. Biotechnology and its applications

- Principles and process of Biotechnology: Genetic Engineering
- Application of Biotechnology in health and agriculture :Human insulin and vaccine production, gene therapy: Genetically modified organisms- Bt crops, Transgenic animals :Biosafety issues- Biopiracy and patents.

8. Ecology and environment

- Organisms and environment : Habitat and niche: Population and ecological adaptations: Population interactions- mutualism, competition , predation , parasitism: Population attributes-growth, birth rate and death rate, age distribution.

-Ecosystem: Pattern, components , productivity and decomposition: energy flow :Pyramid of number, biomass , energy, nutrients cycling: Ecological succession: ecological Services- Carbon fixation, pollination , oxygen release, biogeochemical cycle.

-Biodiversity and its conservation : Concept of diversity: Patterns of biodiversity: importance of biodiversity, loss of biodiversity, biodiversity conservation: Hotspots: endangered organisms, extinction. Red data Book, Biosphere Reserves, National Parks and sanctuaries.

-Environment issues: Air pollution and its control: water pollution and its control: Agrochemical and its effects: solids waste management, radioactive waste

management: Greenhouse effect and global warning: Ozone depletion: Deforestation: any three case studies as success stories addressing environmental issues.

Note:-a) The distribution of marks/question in each section is indicative. It may vary slightly.

b) The syllabus is broadly classified as above but may vary to some extent.