

Syllabus for Life Sciences & Physical Sciences groups are given below:

LIFE SCIENCES

UNIT-I

Morphology and anatomy of land plants, Cell cycle, cell division, senescence, life cycle of an angiosperm, pollination, fertilization, embryogenesis, seed formation, seed storage proteins, seed dormancy and germination. Concept of cellular totipotency, organogenesis and somatic embryogenesis, Principles of Mendelian inheritance, linkage, recombination and genetic mapping; extrachromosomal inheritance; gene mutation, chromosome aberrations (numerical and structural), transposons. Introduction to Plant Breeding. Pteridophytes and Bryophytes, Taxonomy and Plant Geography

UNIT-II

Diversity, distribution, systematics and phylogeny of animals, Origin of life, history of life on earth, evolutionary theories, natural selection, adaptation, speciation. Principles of inheritance, molecular basis of heredity, the genetic material, transmission of genetic material, Structure of cell, cellular organelles and their structure and function, cell cycle, cell division, Comparative physiology of different systems, Parasitic organisms and host-parasite relationship, Immune response, cellular and humoral immunity, evolution of the immune system: Embryonic development, cellular differentiation, organogenesis. metamorphosis, genetic basis of development. The ecosystem, habitats, species diversity, zoogeography and Animal behavior.

UNIT-III

Structure of atoms, molecules and chemical bonds, Isomerism, hydrogen bond and hydrophobic interaction in biomolecules; Chemistry of biomolecules-carbohydrates, amino acids, proteins, lipids and nucleic acids, Enzymes and their kinetics, factors affecting enzyme activity, Competitive and non-competitive inhibitions. Coenzymes and cofactors, Metabolism of carbohydrates, fatty acids and proteins. eukaryotic genome organization (chromatin structure), Genetic code, replication, transcription and translation. Regulation of gene expression, Plant pigments, Secondary metabolites, Vitamins, Hormones and metabolic regulation.

UNIT-IV

Spontaneous generation theory-Germ theory-Discovery of antibiotics-Types of microscopes-Principles and equipment of different kinds of sterilisation-staining Techniques-Nutritional types of bacteria-Growth curve-Factors influencing bacterial growth-Fermentation and other Metabolic pathways: Principle and Application-Classification of Bacteria-Gene transfer methods in microorganisms Antigen and antibody reaction. Role of microbes in carbon and nitrogen cycles-Influence of Rhizosphere on soil microorganism. Microbes in Industry and health

UNIT-V

Plant physiology and its significance in agriculture; physical properties and chemical constitution of protoplasm; plant cell water relation-imbibition, surface tension, diffusion, osmosis; absorption and translocation of water and nutrients; transpiration, guttation, mineral deficiencies and their symptoms; physiological disorders, correction, hydroponics, foliar nutrition aerobic and anaerobic respiration; Photorespiration Factors affecting respiration and Photorespiration. Photosynthesis- modern concept and the factors affecting photosynthesis, nitrogen fixation growth development and differentiation; growth hormones, growth retardants, growth inhibitors and their use in agriculture; tropism in plants photoperiodism and vernalization; seed dormancy, germination; fruit ripening process and its control.

UNIT-VI

Concepts and scope of biotechnology, Tissue culture and its applications, Micropropagation, Meristem culture and production of virus free plants. Anther and microspore culture. Embryo and ovary culture. Protoplast isolation, fusion, and somatic hybridization, cybrids, somaclones, synthetic seeds, In vitro germ conservation, Cryopreservation, Organellar DNA, satellite and repetitive DNA, DNA repair, Recombinant

DNA technology, Cloning vector, Restriction enzymes, Gene cloning. Methods of gene transfer in plants, Achievements and recent developments of genetic engineering in agriculture.

UNIT-VII

Ecology and its relevance to life, natural resources-their management and conservation, Climatic elements as factors of crop growth, Impact of change in environment on cropping patterns, Change in environment due to agricultural environmental pollution and associated hazards to crops and animals, Human liquid and solid waste disposal, Pollution prevention and remediation, Concepts and dynamics of ecosystem component, Food chain and energy flow, Productivity and biogeochemical cycle, Types of ecosystem, Population ecology and biological control, Community structure and organization, Sustainable development, Economic importance of microbes, plants and animals.

UNIT VIII

Electronic configuration of elements, periodic classification of elements, atomic number, atomic and ionic radii, ionization potential, electron affinity and electro negativity, electronic theory of valency, sigma and pi-bonds, hybridization and directional nature of covalent bonds, metallic bonds, VSEPR theory, V.B. and MO theory, ionic solids and weak interactions, Lewis and Bronsted theories of acids and bases, hard soft acid and bases (HSAB), oxidation states and oxidation number, common oxidizing and reducing agents, Ionic equations. Natural and artificial radioactivity, radioactive decay, nuclear fission and fusion. Chemistry of the common elements and their compounds. Principles of extraction isolation (and metallurgy) of important elements. Chemistry of transitional elements, lanthanides and actinides. Structures of hydrogen peroxide, diborane, aluminium chloride and the important oxyacids of nitrogen, phosphorus, chlorine and sulphur. Interhalogen compounds.

Outlines of the manufactures of: sodium carbonate, sodium hydroxide, ammonia, nitric acid, sulphuric acid, cement, glass, ceramics and artificial fertilizers.

Inert gases: Isolation and Chemistry, structure of inert gas compounds.

Werner's theory of coordination compounds, V.B. and M.O. theory of bonding in metal complexes, electronic spectrum, magnetic and spectral properties of metal complexes. Organo metallic compounds. Bioinorganic chemistry, biological role of alkaline earth metal ions, metalloporphyrins.

Analytical chemistry: Principles and methods of chemical analysis, principles involved in separation techniques, chromatography.

UNIT IX

Modern concepts of covalent bonding, bond lengths, energy and bond angles, electron displacements, inductive, electromeric, mesomeric and hyper conjugative effects, resonance and its applications to organic chemistry, tautomerism, effects of structure on chemical reactions, dissociation constants.

Mechanism of organic reactions: Types of reagents and organic reactions, reaction intermediates, product analysis, isotope effects, kinetic and stereo chemical studies.

Stereochemistry: Optical and geometrical isomerism, chirality, enantiomers, stereogenic centers, diastereomers, resolution and racemization, relative and absolute configuration, sequence rules, E&Z and R&S nomenclature, concept of conformation and conformational analysis of ethane, butane and cyclohexane and sugars.

Chemistry and reactions of derivative of aliphatic and aromatic compounds including: Alkanes, alkynes and alkenes. arenes and aromaticity, benzene and polynuclear hydrocarbons, alkyl and aryl halides, S_N1 , S_N2 and S_Ni reactions, nuclear and side chain reactions, aromatic substitutions reactions, elimination reactions. Aliphatic and aromatic alcohols and phenols, ethers and epoxides, aliphatic and aromatic aldehydes and ketones, aliphatic and aromatic carboxylic acids and their derivatives, aliphatic and aromatic amines and amides, synthetic applications of diazonium salts. Amino-acids.

Reactions and applications of organometallic compounds, Acetoacetic and malonic esters, Organic synthesis via enolates.

Heterocyclic compounds, pyridine, quinoline, thiophene, furan and pyrrole.

Important organic name reactions and rearrangements of synthetic importance.

Carbohydrates, classification and general reactions, glucose, fructose and amino acids and proteins, terpenoids and alkaloids. Polymers, dyes and pigment.

Theory and application of spectral techniques, UV, IR and NMR in structure elucidation of simple organic molecules.

UNIT X

Elementary quantum mechanics

Gaseous states: Kinetic theory of gases and gas laws, Maxwell's law of distribution of velocities, Van der Waal's equation, Law of corresponding states, Liquefaction of gases, Ratio of C_p/C_v .

Thermodynamics: The first law of thermodynamics, Isothermal and adiabatic expansion, Enthalpy, heat capacities, Thermo chemistry –heats of reaction, formation, solution and combustion, Calculation of bond energies, Kirchhoff equation, Criteria for spontaneous changes, second law of thermodynamics entropy. Free energy, criteria of thermodynamic equilibrium.

Solutions: osmotic pressure lowering of vapour pressure, depression of freezing point, elevation of boiling point, determination of molecular weights, association and dissociation of solutes.

Chemical equilibrium, law of mass action and its applications to homogeneous and heterogeneous equilibrium, Le Chatelier's principle, Influence of temperature on chemical equilibrium.

Electrochemistry: Faraday's laws of electrolysis, conductivity of an electrolyte: equivalent conductivity and its variation with dilution, solubility of sparingly soluble salts, electrolytic dissociation, Ostwald's dilution law, anomaly of strong electrolytes, solubility product, strength of acids and bases: hydrolysis of salts, hydrogen ion concentration buffer action, theory of indicators.

Electrochemical cells: Reversible cells, standard hydrogen and calomel electrodes and redox-potentials, concentration cells, determination of pH transport number and ionic product of water, Potentiometer titration, chemical kinetics: Molecularity and order of a reaction, First order and second order reactions, Determination of order of a reaction, temperature coefficients and energy of activation, Collision theory of reaction rates, Activated complex theory.

Phase rule: Explanation of the terms involved, Applications to one and two component system, reduced phase rule, distribution law.

Colloids: General nature of colloidal solutions and their classification, general methods of preparation and properties of colloids, coagulation, protective action, gold number, adsorption phenomenon and adsorption isotherms.

Catalysis: Homogeneous and heterogeneous catalysis, catalytic promoters and poisons.

Photochemistry: Law of photochemistry. Simple numerical problems.

PHYSICAL SCIENCES

UNIT I

Gradient, Divergence and Curl of Vector fields, Gauss's, Stoke's and Green's theorems.

Newton's laws, Galilean invariance, Non-relativistic motion of charged particles in electric and magnetic field, conservation of linear, angular momenta and energy, Collisions, Centre of mass frame. Inverse square law force, Kepler's laws. Harmonic oscillator. Damped harmonic oscillator, Quality factor. Coulomb's law, field due to a charge distribution, Gauss's theorem and its applications, Line integral of electrical field, electric potential, Force on a surface charge, Energy associated with electric field. Current density, charging and discharging of a condenser through a resistance. Force on a moving charge, Fields due to a Helmholtz coil, Solenoid and a current loop, magnetic flux, Faraday's law in differential form, Self and mutual inductance, RL and RC circuits. Dielectrics, Moments of a charge distribution, Torque and force on a dipole in and electric field, Induced dipole moment, Polarisability, Qualitative idea about dia, para and Ferro magnetism, Magnetic susceptibility, Langevin's theory of paramagnetism, Hysteresis phenomenon, AC circuits.

UNIT II

Rutherford's atomic model, Bohr's model and spectra of hydrogen atom fine structure, Sommerfeld model, spatial quantization and electron spin. Normal Zeeman effect. X-ray spectra, Moseley's law, Luminescence, Principle and working of different kinds of Lasers, Raman effect. Laws of thermodynamics, Entropy, C_p and C_v of a gas. Macroscopic and microscopic systems, Internal and external energy states of a molecule, Reversible and irreversible processes, production of low temperatures. Maxwell's thermodynamic relationships, Triple point, applications of Maxwell's thermodynamical relations. Introduction to cryogenics and refrigeration. Black body radiation and different radiation laws. Einstein's theory of specific heat and its limitations, Lattice

vibrations, phonons-Debye's theory of specific heat of solids, specific heat of diatomic gases and its variation with temperature.

Black body spectrum, photoelectric effect and Compton effect. De Broglie's waves, Group and phase velocities, Uncertainty principle. Schrödinger's equation, Operators, Expectation values. Applications of Schrödinger's equation and its various applications. Michelson Morley experiment, Postulates of special relativity, Lorentz transformations, Relativistic kinematics

UNIT III

Fermat's Principle, Cardinal points, telescopic combinations, Interference and diffraction of light, Rayleigh criterion, resolving power of telescope and microscope, Grating, Resolving power of a grating, Polarization and different kinds of polarized light, Double refraction, optical activity
Electromagnetic theory.

Kirchoffs Laws, Thevenins & Nortons Theorems, Filters, VTVM, CRO. Semiconductor Devices, diodes and transistors, FET, MOSFETS, UJT, Thermistors, Rectifiers, Power supply. Different types transistor based amplifiers and oscillators, Multivibrators, Logic gates and Boolean Algebra.

UNIT IV

Crystal structure, Unit cell, Bravais lattices, Miller indices, X-ray diffraction, Bragg's law. Lattice vibrations: Free electron theory of metals, Distinction between conductors, semiconductors and insulators, Intrinsic and Extrinsic semiconductors.

Probability, Ensemble and average properties, Equilibrium and fluctuations, constraints, Equilibrium between two systems in thermal contact, the β parameter, Entropy and probability Boltzmann entropy relation, Statistical interpretation of second law of thermodynamics.

Maxwellian Distribution of Speeds in an ideal gas.

Bose-Einstein and Fermi-Dirac Statistics, Free electrons in a metal, photons in black body chamber, Fermi level and Fermi energy.

Structure of nucleus; Liquid drop model and semi empirical mass formula, nuclear reactions, nuclear fission and fusion, elementary particles. Artificial nuclear transmutation, Particle accelerators & detectors, α , β , γ . decay.

UNIT V

Real analysis: continuity and discontinuity, Riemann Integral and its applications. Algebra of integral function, convergence and divergence. Different methods in Hydrodynamics in the equation of continuity in different systems. Equation of motion and Bernoulli's equation with different cases. Motion in 2D and its applications. Differential and Integral calculus: successive differentiation, Different form of theorems, Tangents and normal, Maxima and Minima with different cases. Various types of integral form, Beta and gamma functions.

Linear Algebra: Group, ring field, Integral domain and vector space with examples and theorems. Differential equations and Laplace transformation, vector analysis and Analytical Geometry, mechanics and complex analysis.

UNIT VI

General Statistics, Probability Distributions, Test of Significance, Analysis of Variance, Sampling Theory, Design of Experiment, Time series Analysis, Index Numbers, Statistical Quality Control, Vital statistics, Statistical organizations in India.

UNIT VII

Introduction to computers, fundamentals, peripherals of PCs, software and Hardware. Evolution. Operating system. Structural computer Languages: programming in C, UNIX, WINDOWS
Operating Systems. Number systems and computer architecture.

Computational methods for Numerical Analysis: Algebraic and Transcendental equations, systems of simultaneous equations. Interpolation and Differentiation, solution of ordinary differential equations with initial value and boundary value problems.

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acids and bases: hydrolysis of salts, hydrogen ion concentration buffer action, theory of indicators.

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Photochemistry: Law of photochemistry. Simple numerical problems.

Note: Questions from similar topics can also be included.