

**Annexure - I**  
**Syllabus AICET-15**  
**PHYSICS**

**Unit I: Physical World and Measurement**

Measurement:- Physics - scope and excitement; nature of physical laws; physics, technology and society. Need for measurement: Units of measurement; systems of units; SI units, fundamental and derived units. Length, mass and time measurements; accuracy and precision of measuring instruments; errors in measurement; significant figures. Order of magnitude. accuracy and errors in measurement Dimensions of physical quantities, dimensional analysis and its applications.

**Unit II: kinematics**

**Scalars & Vectors :-** Scalar and vector quantities; Position and displacement vectors, general vectors and their notations; equality of vectors, multiplication of vectors by a real number; addition and subtraction of vectors.

Unit vector; Resolution of a vector in a plane - rectangular components. Scalar and Vector product of vectors.

**Motion in straight lines :-** Frame of reference, Motion in a straight line: Position-time graph, speed and velocity. Elementary concepts of differentiation and integration for describing motion Uniform and nonuniform motion, average speed and instantaneous velocity. Uniformly accelerated motion, velocity time and position-time graphs. relations for uniformly accelerated motion (graphical treatment). Motion in a plane. Cases of uniform velocity and uniform acceleration.

Projectile motion. Equation of projectile path, time of flight, horizontal range, maximum height of projectile. Relative velocity.

**Unit III: Laws of Motion**

Laws of Motion :- Intuitive concept of force. Inertia, Newton's first law of motion; momentum and Newton's second law of motion; impulse; Newton's third law of motion. Law of conservation of linear momentum and its applications.

Force :- Types of forces. General idea of gravitation, electromagnetic and nuclear forces. Moment of a force, torque, angular momentum, laws of conservation of angular momentum and its applications. Equilibrium of concurrent forces Centre of mass of a two-particle system, momentum conservation and centre of mass motion. Centre of mass of a rigid body; centre of mass of a uniform rod.

Concurrent Co-planar forces :- Definition of resultant & equilibrate - statement of law of parallelogram of forces - derivation of expression for magnitude & direction of two concurrent coplanar forces - law of triangle of forces & its converse - Lami's theorem - problems.

**Uniform circular motion:-**

angular displacement, angular velocity and angular acceleration, relation between angular velocity and linear velocity. Dynamics of uniform circular motion: radial acceleration, Centripetal force, examples of circular motion (vehicle on a level circular road, vehicle on banked road).

Vertical circular motion due to earth's gravitation, equation for

velocity and energy at different positions of vertical circular motion. Kinematical equation for circular motion in analogy with linear motion.

**Unit IV: Work, Energy and Power**

Work done by a constant force and a variable force; kinetic energy, work-energy theorem, power. Notion of potential energy, potential energy of a spring, conservative forces: conservation of mechanical energy (kinetic and potential energies); non-conservative forces: motion in a vertical circle; elastic and inelastic collisions in one and two dimensions coefficient of restitution - problems.

**Unit V: Motion of System of Particles and Rigid Body**

Motion of rigid body:- Equilibrium of rigid bodies, rigid body rotation and equations of rotational motion, comparison of linear and rotational motions. Moment of inertia, radius of gyration. Kinetic energy of rotating body rolling motion, physical significance of moment of inertia, Values of moments of inertia, for simple geometrical objects (no derivation). Statement of parallel and perpendicular axes theorems and their applications. Angular momentum and its conservation.

**Unit VI: Gravitation**

Statement and explanation of law of gravitation, definition of G, derivation of relation between  $g$  &  $G$ . Kepler's laws of planetary motion. The universal law of gravitation. Acceleration due to gravity and its variation with altitude, latitude, depth. Gravitational potential energy and gravitational potential. Escape velocity. Orbital velocity of a satellite. Geo-stationary satellites launching of satellite, expression for period of orbiting satellite.

Brief explanation of inertial mass and gravitational mass, weightlessness condition in orbit.

**Unit VII: Properties of Bulk Matter**

**Elasticity :-** Elastic behaviour, Stress-strain relationship, Hooke's law, Young's modulus, bulk modulus, shear modulus of rigidity, Relation between elastic constants, Poisson's ratio; elastic energy. Determination of  $Y$ , behavior of metal wire under increasing load, applications of elastic behaviour of material.

**Friction in solid :-** Static and kinetic friction, laws of friction, rolling friction, lubrication.

**Frictions in liquid :-** Pressure due to a fluid column; Pascal's law and its applications (hydraulic lift and hydraulic brakes). Effect of gravity on fluid pressure.

Viscosity, Stokes' law, terminal velocity, Reynold's number, streamline and turbulent flow, critical velocity. Bernoulli's theorem and its applications.

**Surface tension :-** Surface energy and surface tension, angle of contact, excess of pressure across a curved surface, application of surface tension ideas to drops, bubbles and capillary rise. Effect of impurity, temperature and detergent on surface tension. capillary action in wick of lamp.

## Unit VIII Heat

**Gas Laws** Statement and explanation of Boyle's Law and Charles's Law, Definition of pressure and volume coefficient of gas, absolute zero, Kelvin scale of temperature, perfect gas equation, explanation of isothermal and adiabatic changes, Van-der-Waal's equation of state for real gases.

**Mode of Heat Transfer** :-Heat, temperature, Thermal expansion; thermal expansion of solids, liquids and gases, anomalous expansion of water; specific heat capacity;  $C_p$ ,  $C_v$  - calorimetry; change of state - latent heat capacity.

Heat transfer-conduction, convection and radiation, thermal conductivity.

**Radiation** :-Newton's law of cooling, Definition of Radiant energy, emissivity and absorptivity, perfect black body, statement and explanation of Kirchhoff's law, Qualitative ideas of Blackbody radiation, Wein's displacement Law, Stefan's law, Plank's law, qualitative explanation of solar constant and surface temperature of sun, principles and working of total radiation pyrometer, Green house effect.

## Unit IX: Thermodynamics

Thermal equilibrium and definition of temperature (zeroth law of thermodynamics). Heat, work and internal energy. First law of thermodynamics. Isothermal and adiabatic processes.

Second law of thermodynamics: reversible and irreversible processes. Heat engine and refrigerator.

## Unit X: Behaviour of Perfect Gases and Kinetic Theory of Gases

Equation of state of a perfect gas, work done in compressing a gas. Kinetic theory of gases - assumptions, concept of pressure. Kinetic interpretation of temperature; rms speed of gas molecules; degrees of freedom, law of equipartition of energy (statement only) and application to specific heat capacities of gases; concept of mean free path, Avogadro's number.

## Unit XI: Oscillations and Waves

**Oscillations**:- Periodic motion - time period, frequency, displacement as a function of time. Periodic functions. Simple harmonic motion (S.H.M) and its equation; phase; oscillations of a spring-restoring force and force constant; energy in S.H.M. Kinetic and potential energies; simple pendulum- derivation of expression for its time period.

**Sound Wave** :- Properties of sound, speed of sound in gas, Newton's formula for speed of sound, Laplace formula, effect of pressure, temperature, humidity and wind on speed of sound.

Definition of sound intensity, explanation of loudness and its unit, distinguish between noise and musical note, comparison of Doppler effect in sound and light.

**Wave Motion** :-Wave motion. Transverse and longitudinal waves, speed of wave motion relation between speed, velocity and frequency of a progressive wave. Definition of progressive wave & its characteristics, Derivation of equation of a progressive wave & its different forms, definition of wave intensity, mention expression for wave intensity & its unit, Principle of superposition of waves, reflection of waves, Beats, Doppler effect.

**Standing wave** :-standing waves in strings and organ pipes, fundamental mode and harmonics, effect. Free, forced and damped oscillations (qualitative ideas only), resonance.

## Unit XII: Electrostatics

**Electric Charges** :- Electric Charges; Conservation of charge, Coulomb's law-force between two point charges, forces between multiple charges; superposition principle and continuous charge distribution.

**Electrostatic field** :-Electric field, electric field due to a point charge, electric field lines, electric dipole, electric field due to a dipole, torque on a dipole in uniform electric field. Mechanical force on unit area of the charge conductor, energy density of the medium. Electric flux, statement of Gauss's theorem and its applications to find field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell (field inside and outside). Charged cylinder. Electric potential, potential difference, electric potential due to a point charge, a dipole and system of charges; equipotential surfaces, electrical potential energy of a system of two point charges and of electric dipole in an electrostatic field.

**Capacitors** :-Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarisation, capacitors and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor. Van de Graaff generator.

## Unit XIII: Current Electricity

**Electric Current** :-Electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current; Ohm's law, electrical resistance, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity. Carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance.

Internal resistance of a cell, potential difference and emf of a cell, combination of cells in series and in parallel. Elementary idea of secondary cells. concept of super conductivity - explanation of critical temperature, critical field & high temperature superconductors - mention of uses of super conductors - thermistors & mention of their uses. Definition of emf & internal resistance of a cell - ohm's law applied to a circuit - problems.

**Kirchhoff's laws**:- Kirchhoff's laws and simple applications. Wheatstone bridge, metre bridge. Potentiometer - principle and its applications to measure potential difference and for comparing emf of two cells; measurement of internal resistance of a cell.

## Unit XIV: Magnetic Effects of Current and Magnetism

**Concept of magnetic field** :-Concept of magnetic field, Oersted's experiment. Biot - Savart law and its application to current carrying circular loop at the centre Magnetic induction at a point along the axis of a coil carrying current, Magnetic induction at a point on the axis of a solenoid, basic concept of terrestrial magnetism, statement & explanation of tangent law, construction & theory of tangent galvanometer, Fleming's left hand rule.

**Ampere's law:-** Ampere's law and its applications to infinitely long straight wire. Straight and toroidal solenoids, Force on a moving charge in uniform magnetic and electric fields. Cyclotron.

Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current-carrying conductors-definition of ampere. Torque experienced by a current loop in uniform magnetic field; moving coil galvanometer-its current sensitivity and conversion to ammeter and voltmeter.

**Magnetism :-**Origin of magnetism due to moving charges, equivalence between magnetic dipole and circular coil carrying current, definition of magnetic dipole moment, and its unit, torque acting on a magnet in uniform magnetic field, Current loop as a magnetic dipole and its magnetic dipole moment. Magnetic dipole moment of a revolving electron. Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis. Torque on a magnetic dipole (bar magnet) in a uniform magnetic field; bar magnet as an equivalent solenoid, magnetic field lines; Earth's magnetic field and magnetic elements.

**Types of magnetic material :-**Para-, dia- and ferro - magnetic substances, with examples. Ferromagnetism on the basis of domain theory, curie temperature Electromagnets and factors affecting their strengths. Permanent magnets.

### **Unit XV: Electromagnetic Induction and Alternating Currents**

Electromagnetic induction; Faraday's laws, induced emf and current; Lenz's Law, Eddy currents. Alternating currents, peak and rms value of alternating current/voltage, Expression for energy stored in the coil, derivation for sinusoidal emf, reactance and impedance; LC oscillations (qualitative treatment only), LCR series circuit, Expression for impedance & current in LCR series circuit by phasor diagram method, explanation of resonance, derivation for resonant frequency, brief account of sharpness of resonance & Q- factor, power in AC circuits with resistance, inductance and capacitance, power factor & wattless current. Qualitative description of choke, basic ideas of magnetic hysteresis AC generator and construction & working of transformer, power losses in transformer, Principle & working of moving iron meter, explanation of transmission of electric power, advantages of AC & DC.

### **Unit XVI: Electromagnetic waves**

Need for displacement current, Electromagnetic waves and their characteristics (qualitative ideas only). Transverse nature of electromagnetic waves. Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays) including elementary facts about their uses. Space communication, types of propagation of electromagnetic waves in atmosphere.

### **Unit XVII: Optics**

Refraction at plane surface:- Refraction through a glass slab, expression for lateral shift and normal shift, total internal reflection and its applications, optical fibres, its application in communication.

**Refraction through prism :-** Refraction and dispersion of light through a prism. Prism formula, Deviation through thin prism, angular dispersion, and dispersive power, conditions for dispersion without deviation.

**Refraction at spherical surface :-**Reflection of light, spherical mirrors, mirror formula. Refraction of light, refraction at spherical surfaces, lenses, thin lens formula, lens maker's formula. Magnification, power of a lens, combination of thin lenses in contact, combination of a lens and a mirror. Scattering of light - blue colour of sky and reddish appearance of the sun at sunrise and sunset. Elementary idea of Raman effect.

**Optical instruments :** Human eye, image formation and accommodation, correction of eye defects (myopia, hypermetropia) using lenses. Microscopes and astronomical telescopes (reflecting and refracting), compound microscope and their magnifying powers, reflecting telescope.

**Wave optics:** Brief explanation of Newton's corpuscular theory, Huygen's wave of theory and Maxwell electromagnetic theory, Wave front, wave normal and Huygen's principle, reflection and refraction of plane wave at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygen's principle.

**Interference :-**Theory of Interference, conditions for constructive and destructive interference, Young's double slit experiment and expression for fringe width, coherent sources and sustained interference of light.

**Diffraction :-**Distinguish between Fresnel and Fraunhofer diffraction, diffraction due to a single slit, width of central maximum, Rayleigh's criteria. Resolving power of microscopes and astronomical telescope.

**Polarisation :-** Polarisation, plane polarised light, explanation of plane of polarization and plane of vibration, Brewster's law, uses of plane polarised light and Polaroids.

**Speed of Light :-** Michelson's rotating mirror experiment to determine light importance of speed of light.

### **Unit XVIII: Dual Nature of Matter and Radiation**

Introduction of Atomic physics Types of electron emission, description and theory of Dunnington's method of finding,  $e/m$  of an electron, explanation of types of spectra, emission and absorption spectra, brief account of Fraunhofer lines, explanation of electromagnetic spectra with emphasis on frequency.

**Photoelectric effect :-**Dual nature of radiation. Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation-particle nature of light, photoelectric cell and its application.

**deBroglie's hypothesis :-**Matter waves-wave nature of particles, de Broglie relation. Davisson-Germer experiment (experimental details should be omitted; only conclusion should be explained). Wave length of electron, principle of electron microscope, scanning of electron microscope, transmission electron microscope and atomic force microscope.

## Unit XIX: Atoms & Nuclei

**Bohr's atom model :-** Alpha-particle scattering experiment; Rutherford's model of atom Bohr atomic model for hydrogen atom, Bohr's Postulates- expression for radius velocity, energy, wave number, spectral series of hydrogen, energy level diagram, explanation of ionization & excitation of energy, limitation of Bohr's theory, explanation of Sommerfeld & vector atom models.

**Lasers :-** Interaction between energy levels & electromagnetic radiation, laser action, population inversion, optical pumping, properties of lasers, construction & working of Ruby laser, application of laser, brief account of photonics.

**Nuclear Physics:-** Characteristics of nucleus, Composition and size of nucleus, atomic masses, isotopes, isobars; isotones, qualitative explanation of liquid drop and nuclear magnetic resonance and its application in medical diagnostics as MRI nuclear forces and their characteristics, Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number; Nuclear fission with equation, Nuclear chain reaction, critical mass, controlled & uncontrolled chain reactions, types of nuclear reactor, mention their principles, disposal of nuclear waste nuclear fusion. stellar energy (carbon & proton cycle)

**Radioactivity :-** Laws of radioactivity, decay law, explanation of decay constant, half life period, mean life, relation between half &

mean life, unit of activity, Becquerel & Curie – artificial transmutation, artificial radioactivity, radio isotopes & mention their uses, brief account of Biological effects of radiation & safety measures.

**Elementary Particles :-** basic concepts of decay, neutrino hypothesis, beta leptons & hadrons, Qualitative explanation of it, Quarks.

## Unit XX: Electronic Devices

Energy bands in solids (Qualitative ideas only) conductor, insulator and semiconductor; semiconductor diode – I-V characteristics in forward and reverse bias, diode as a rectifier; I-V characteristics of LED, photodiode, solar cell, and Zener diode; Zener diode as a voltage regulator. Junction transistor, transistor action, characteristics of a transistor, transistor as an amplifier (common emitter configuration) and oscillator. Logic gates (OR, AND, NOT, NAND and NOR). Transistor as a switch.

## Unit XXI: Communication Systems

Elements of a communication system (block diagram only); bandwidth of signals (speech, TV and digital data); bandwidth of transmission medium. Propagation of electromagnetic waves in the atmosphere, sky and space wave propagation. Need for modulation. Production and detection of an amplitude-modulated wave.

# CHEMISTRY

## Unit I: Solid State

Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea). Unit cell in two dimensional and three dimensional lattices, calculation of density of unit cell, packing in solids, packing efficiency, voids, number of atoms per unit cell in a cubic unit cell, point defects.

Electrical and magnetic properties-Band theory of metals, conductors, semiconductors and insulators and n & p type semiconductors, diamagnetism, paramagnetism, ferromagnetism.

## Unit II: Solutions (Solution and colligative properties)

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions.

Colligative properties - relative lowering of vapour pressure, Raoult's law, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass, van't Hoff factor.

## Unit III: Electrochemistry

Redox reactions, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and law of electrolysis (elementary idea), Types of cell - Dry cell - electrolytic cells and Galvanic cells, lead accumulator. EMF of a cell, standard electrode potential, Nernst equation and its

application to chemical cells, Relation between Gibbs energy change and emf of a cell, fuel cells, corrosion.

## Unit IV: Chemical Kinetics

Rate of a reaction (Average and instantaneous), factors affecting rate of reaction: concentration, temperature, catalyst; order and molecularity of a reaction, rate law and specific rate constant, integrated rate equations and half life (only for zero and first order reactions), concept of collision theory (elementary idea, no mathematical treatment). Activation energy, Arrhenius equation.

## Unit V: Surface Chemistry

Types of Adsorption - physisorption and chemisorption, Factors affecting adsorption of gases on solids. catalysis, homogenous and heterogenous activity and selectivity; enzyme catalysis colloidal state distinction between true solutions, colloids and suspension; lyophilic, lyophobic multimolecular and macromolecular colloids; Properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation, emulsion - types of emulsions.

## Unit VI: General Principles and Processes of Isolation of Elements

Principles and methods of extraction - concentration, oxidation, reduction - electrolytic method and refining; occurrence and principles of extraction of aluminium, copper, zinc and iron.

## Unit VII: p-Block Elements

**Group -15 Elements:** General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; Nitrogen-Preparation properties & uses ; compounds of nitrogen, preparation and properties of ammonia and nitric acid, oxides of nitrogen (Structure only) ; Phosphorus - allotropic forms, compounds of phosphorus: preparation and properties of phosphine, halides  $PCl_3$  ,  $PCl_5$  and oxoacids (elementary idea only).

**Group 16 Elements:** General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties,

**Dioxygen:** Preparation, Properties and uses, classification of oxides, Ozone, Sulphur -allotropic forms;

**Sulphur:** Preparation properties and uses of sulphur-dioxide, sulphuric acid: industrial process of manufacture, properties and uses; Oxoacids of sulphur (Structures only).

**Group 17 Elements:** General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens, Preparation, properties and uses of chlorine and hydrochloric acid, interhalogen compounds, oxoacids of halogens (structures only).

**Group 18 Elements:** General introduction, electronic configuration, occurrence, trends in physical and chemical properties, uses.

## Unit VIII: d and f Block Elements

d Block Elements General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals - metallic character, ionization enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation, preparation and properties of  $K_2Cr_2O_7$  and  $KMnO_4$ .

f Block Elements Lanthanoids - Electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction and its consequences.

Actinoids - Electronic configuration, oxidation states and comparison with lanthanoids.

## Unit IX: Coordination Compounds

Coordination compounds - Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. Bonding, Werner's theory, VBT, and CFT; structure and stereoisomerism, importance of coordination compounds (in qualitative inclusion, extraction of metals and biological system).

## Unit X : Haloalkanes and Haloarenes.

(Halogen derivatives of alkanes and arenes)

**Haloalkanes:** Nomenclature, nature of C -X bond, physical and chemical properties, mechanism of substitution reactions, optical rotation, stability of carbocations R-S and d-I configurations.

**Haloarenes:** Nature of C -X bond, substitution reactions (Directive influence of halogen in monosubstituted compounds only), stability of carbocations R-S and d-I configurations.

Uses and environmental effects of - dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.

## Unit XI: Alcohols, Phenols and Ethers

**Alcohols:** Nomenclature, methods of preparation, physical and chemical properties( of primary alcohols only), identification of primary, secondary and tertiary alcohols, mechanism of dehydration, uses with special reference to methanol and ethanol.

**Phenols:** Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophilic substitution reactions, uses of phenols.

**Ethers:** Nomenclature, methods of preparation, physical and chemical properties, uses.

## Unit XII: Aldehydes, Ketones and Carboxylic Acids

**Aldehydes and Ketones:** Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties, mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes: uses.

**Carboxylic Acids:** Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

## Unit XIII: Organic compounds containing Nitrogen

**Amines:** Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

**Cyanides and Isocyanides** - will be mentioned at relevant places in text.

**Diazonium salts:** Preparation, chemical reactions and importance in synthetic organic chemistry.

## Unit XIV: Biomolecules

Carbohydrates - Classification (aldoses and ketoses), monosaccharides (glucose and fructose),

D-L configuration oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); Importance of carbohydrates.

Proteins - Elementary idea of  $\alpha$ -amino acids, peptide bond, polypeptides, proteins, structure of proteins - primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins; enzymes.

Hormones and Lipids- Elementary idea excluding structure.

Vitamins - Classification and functions.

**Nucleic Acids:** DNA and RNA.

## Unit XV: Polymers

Classification - natural and synthetic, methods of polymerization (addition and condensation), copolymerization, some important polymers: natural and synthetic like polythene, nylon polyesters, bakelite, rubber. Biodegradable and non-biodegradable polymers.

## Unit XVI: Chemistry in Everyday life

Chemicals in medicines - analgesics, tranquilizers antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines.

Chemicals in food - preservations, artificial sweetening agents, elementary idea of antioxidants.

Cleansing agents - soaps and detergents, cleansing action.

## Unit XVII: Metallurgy-2

Physic-chemical concepts involved in the following metallurgical operations - desilverisation of lead by parke's process-distribution law.Reduction of metal oxides-ellingham diagrams-relative tendency to undergo oxidation in case of

elements Fe, Ag, Hg, Al, C, Cr, and Mg. Blast furnace-metallurgy of iron-reactions involved and their role, Role of each ingredient and energetics.

## Unit XVIII: Industrially important compounds

Manufactures of caustic soda by nelson's cell method, ammonia by Haber's process, sulphuric acid by contact process, potassium dichromate from chromite, uses chemical properties of sulphuric acid and potassium dichromate.

# BIOLOGY

## Unit I: Diversity of Living Organism

**Introduction to Biology :-** Definition of Biology and its main branches, Botany and Zoology, scope of Biology, branches of Biology (definition). Classical branches – morphology, cytology, histology, anatomy, physiology, developmental Biology, biosystematics, genetics, ecology, organic evolution and palaeontology.

Inter disciplinary branches – biophysics, biochemistry, and biostatistics. Applied branches and career prospects – agriculture, entomology, silviculture, pathology, apiculture, microbiology, and bioinformatics. Role of Biology in myths and disbeliefs.

### Biosystematics

What is life? biodiversity; need for classification;

Three domains of life, concept of species:- three domains of life; taxonomy & systematics; concept of species and taxonomical hierarchy; binomial nomenclature; tools for study of taxonomy-museums, zoological parks, herbaria, botanical gardens.

Five kingdom classification; salient features and classification of Monera, Protista and Fungi (mycota) into major groups: Lichens.

**Viruses and Viroid, prions:-** Chemical nature with one example of disease each-creutzfeldt- Jacob disease (CZD) and potato spindle tuber disease (PSTD)

**Kingdom-Plantae:-** Salient features and classification of plants into major groups - Algae, Bryophyta (metaphyta), Pteridophyta, Gymnospermae and Angiospermae (three to five salient and distinguishing features and at least two examples of each category); Angiosperms - classification up to class, characteristic features and examples.

**Kingdom-Animalia :-** Salient features and classification of animals non chordates up to phyla level and chordates up to classes level (three to five salient features and at least two examples).

## Unit II: Structural Organisation in Animals and Plants

**Morphology of Plants :-** Morphology and modifications; tissues; anatomy and functions of different parts of flowering plants: root, stem, leaf, inflorescence; cymose and racemose, flower (homochlamydeous, heterochlamydeous) fruit and seed (to be dealt along with the relevant practical of the Practical Syllabus).

### Study of Animal tissues :-

Animal tissues (epithelial, connective, nervous, muscular) Study of Animal Type Example Cockroach:- morphology, anatomy and functions of different systems (digestive, circulatory, respiratory, nervous and reproductive) of an insect (cockroach). (a brief account only)

### Unit III: Cell Biology

**Organisation of cell :-** Cell theory and cell as the basic unit of life; structure of prokaryotic and eukaryotic cells; Plant cell and animal cell; Cell envelope, cell membrane, cell wall; Cell organelles – structure and function; endomembrane system, endoplasmic reticulum, Golgi bodies, lysosomes, vacuoles; mitochondria, ribosomes, plastids, microbodies; cytoskeleton, cilia, flagella, centrioles (ultrastructure and function); nucleus, nuclear membrane, chromatin, nucleolus.

**Biochemistry of cell :-** Chemical constituents of living cells: biomolecules, structure and function of proteins, carbohydrates, lipids, nucleic acids, enzymes, types, properties, enzyme action.

**Cell Reproduction :** cell cycle, mitosis, meiosis and their significance.

### Unit IV: Plant Physiology

**Plant water relation & mineral nutrition :-** Transport in plants; movement of water, gases and nutrients; cell to cell transport, Diffusion, facilitated diffusion, active transport; plant-water relations, Imbibition, water potential, osmosis, plasmolysis; long distance transport 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; diffusion of gases. Mineral nutrition: Essential minerals, macro and micronutrients and their role; deficiency symptoms; mineral toxicity; elementary idea of hydroponics as a method to study mineral nutrition; nitrogen metabolism, nitrogen cycle, biological nitrogen fixation.

### Photosynthesis:-

Bioenergetics- introduction, light as the source of energy and ATP as energy currency. photosynthesis as a means of autotrophic nutrition; site of photosynthesis-chloroplast pigments involved in photosynthesis (elementary idea); photochemical and biosynthetic phases of photosynthesis; cyclic and non cyclic photophosphorylation; chemiosmotic hypothesis; photorespiration; C3 and C4 pathways; factors affecting photosynthesis.

**Respiration:-** exchange of gases; cellular respiration - glycolysis, fermentation (anaerobic), TCA cycle and electron transport system (aerobic); energy relations - number of ATP molecules generated; amphibolic pathways; respiratory quotient, Pasteur effect.

**Plant growth and development:-** seed germination; phases of plant growth and plant growth rate; conditions of growth; differentiation, dedifferentiation and redifferentiation; sequence of developmental processes in a plant cell; growth regulators - auxin, gibberellin, cytokinin, ethylene, ABA; seed dormancy; vernalisation; photoperiodism.

## **Unit V: Human Physiology**

### **Human Nutrition :-**

**Digestion and absorption:** alimentary canal and digestive glands, role of digestive enzymes and gastrointestinal hormones; Peristalsis, digestion, absorption and assimilation of proteins, carbohydrates and fats; calorific values of proteins, carbohydrates and fats; egestion; nutritional and digestive disorders - PEM, indigestion, constipation, vomiting, jaundice, diarrhoea.

**Human Respiration :-** Breathing and Respiration: Respiratory organs in animals (recall only); Respiratory system in humans; mechanism of breathing and its regulation in humans - exchange of gases, transport of gases and regulation of respiration, respiratory volume; disorders related to respiration - asthma, emphysema, occupational respiratory disorders.

**Circulation:-**Body fluids and circulation: composition of blood, blood groups, coagulation of blood; composition of lymph and its function; human circulatory system - Structure of human heart and blood vessels; cardiac cycle, cardiac output, ECG; double circulation; regulation of cardiac activity; disorders of circulatory system - hypertension, coronary artery disease, angina pectoris, heart failure.

**Excretion & Osmoregulation :-**Excretory products and their elimination: modes of excretion - ammonotelism, ureotelism, uricotelism; human excretory system - structure and function; urine formation, osmoregulation; regulation of kidney function - renin - angiotensin, atrial natriuretic factor, ADH and diabetes insipidus; role of other organs in excretion; disorders - uraemia, renal failure, renal calculi, nephritis; dialysis and artificial kidney.

**Human skeleton & Locomotion :-**Locomotion and movement: types of movement - ciliary, flagellar, muscular; skeletal muscle - contractile proteins and muscle contraction; skeletal system and its functions; joints; disorders of muscular and skeletal system - myasthenia gravis, tetany, muscular dystrophy, arthritis, osteoporosis, gout.

**Control & Co-ordination :-**Neural control and coordination: neuron and nerves; Nervous system in humans – central nervous system; peripheral nervous system and visceral nervous system; generation and conduction of nerve impulse; reflex action; sensory perception; sense organs; elementary structure and function of eye and ear. A brief study of epilepsy, Parkinson's disease, Alzheimer's disease and Huntington's

**Chemical coordination and regulation:** endocrine glands and hormones; human endocrine system - hypothalamus, pituitary, pineal, thyroid, parathyroid, adrenal, pancreas, gonads; mechanism of hormone action (elementary Idea); role of hormones as messengers and regulators, hypo - and hyperactivity and related disorders; dwarfism, acromegaly, cretinism, goit, exophthalmic goiter, diabetes, Addison's disease.

## **Unit VI: continuity of life**

**Reproduction in plants :-** Reproduction in organisms: reproduction, a characteristic feature of all organisms for continuation of species; asexual reproduction modes of reproduction - asexual and sexual reproduction; modes - binary fission, sporulation, 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; outbreeding devices; pollen-pistil interaction; double fertilization; post fertilization events - development of endosperm and embryo, development of seed and formation of fruit; special modes - apomixis, parthenocarpy, polyembryony; Significance of seed and fruit formation.

Early development of frog - structure of egg, cleavage, blastulation, gastrulation, derivatives of primary germ layers.

**Human Reproduction:-** male and female reproductive systems; microscopic anatomy of testis and ovary; gametogenesis - spermatogenesis and oogenesis; menstrual cycle; fertilisation embryo development upto blastocyst formation, implantation; pregnancy and placenta formation (elementary idea); parturition (elementary idea); lactation (elementary idea). Reproductive health: need for reproductive health and prevention of sexually transmitted diseases (STD); birth control – need and methods, contraception and medical termination of pregnancy (MTP); amniocentesis; infertility and assisted reproductive technologies – IVF, ZIFT, GIFT (elementary idea for general awareness).

## **Unit VII Genetics and Evolution**

**Genetic basis of inheritance:-** Heredity and variation: Mendelian inheritance; deviations from Mendelism – incomplete dominance, co-dominance, multiple alleles and inheritance of blood groups, pleiotropy; elementary idea of polygenic inheritance.

**Chromosomal basis of inheritance:-** chromosome theory of inheritance; chromosomes and genes; Sex determination - in humans, birds and honey bee; linkage and crossing over; sex linked inheritance - haemophilia, colour blindness; Mendelian disorder in humans - thalassemia; chromosomal disorders in humans; Down's syndrome, Turner's and Klinefelter's syndromes, Turner's syndrome, Cri-du-Chat syndrome. gene disorders - sickle cell anemia, haemophilia.

**Gene – Its nature, expression & regulation:-** Molecular basis of inheritance: search for genetic material and DNA as genetic material; Structure of DNA and RNA; DNA packaging; DNA replication; Central dogma; transcription, genetic code, translation; gene expression and regulation - Lac Operon;

Genome and human genome project; DNA fingerprinting.

### Unit VIII Evolution

Origin of life; biological evolution and evidences for biological evolution (paleontology, comparative anatomy, embryology and molecular evidence); Darwin's contribution, modern synthetic theory of evolution; mechanism of evolution - variation (mutation and recombination) and natural selection with examples, types of natural selection; Gene flow and genetic drift; Hardy - Weinberg's principle; adaptive radiation; human evolution.

### Unit IX. Biology and Human Welfare

Man in health and diseases-concept of Homeostasis-the central dogma in physiology – definition meaning of internal environment. Factors to be kept constant to achieve homeostasis, Example to illustrate homeostasis.

**Human Health and diseases:-** pathogens; parasites causing human diseases (malaria, filariasis, ascariasis, typhoid, pneumonia, common cold, amoebiasis, ring worm); Basic concepts of immunology - vaccines; cancer, HIV and AIDs; Adolescence, drug and alcohol abuse. Improvement in food production : Plant breeding, tissue culture, single cell protein, Biofortification, Apiculture and Animal husbandry.

**Microbes in human welfare:** In household food processing, industrial production, sewage treatment, energy generation and as biocontrol agents and biofertilizers.

**Animal Husbandry:-** Management of farms and farm animals (dairy, poultry, animal breeding, bee keeping, fisheries, sericulture, lac culture.

**Vermiculture** Definition and procedure, vermicomposed – degradation of organic waste and role of earthworm in soil fertility.

### Unit X Biotechnology and Its Applications

**Process & Application:-** Principles and process of biotechnology: genetic engineering (recombinant DNA technology).transposons, plasmids, bacteriophages, production of restriction fragments, preparing and cloning DNA library, gene amplification.

**Application of biotechnology:-** in health and agriculture: human insulin and vaccine production, gene therapy; genetically modified organisms - Bt crops; transgenic animals; biosafety issuesbiopiracy and patents.

**Enhancement in food production:-** Plant breeding, tissue culture, concept of cellular totipotency, requirement of tissue culture, callus culture, suspension culture, single cell protein, biofortification.

### Unit XI Ecology and Environment

**Habitat and niche:-** 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.

**Ecosystems:-** patterns & energy flow, components; productivity and decomposition; energy flow; pyramids of number, biomass, energy; nutrient cycles (carbon and phosphorous); ecological succession; ecological services - carbon fixation, pollination, oxygen release.

**Biodiversity and its conservation:-** concept of biodiversity; patterns of biodiversity; importance of biodiversity; loss of biodiversity; biodiversity conservation; hotspots, endangered organisms, extinction, Red Data Book, biosphere reserves, national parks and sanctuaries. Benefits of biodiversity-economic-traditional crop varieties, animals of food value, medicinal plants harvested from wild habitats. Ecological/social for controlling soil-water regimes and hydrology, for efficient organic residue management and soil fertility management, ethical cultural,spiritual and religious belief system centered around the concept of sacred species, sacred groves and sacred landscapes.

Biodiversity depletion-anthropocentric causes-urbanization, expansion of agriculture, deforestation, pollution, acidification of soil and water, Mining activities, desertification and loss of soil fertility. Intellectual property rights- patenting life forms.

**Environmental issues:-** Air pollution and its control; water pollution and its control; agrochemicals and their effects; solid waste management; radioactive waste management; greenhouse effect and global warming; ozone depletion; deforestation; any three case studies as success stories addressing environmental issues.

**Economic Botany:-** Introduction, oil yielding plants, groundnut and sunflower, cereals and millets, rice and jowar, pulses, pigeon pea, and Bengal gram, medicinal plants – Adathoda vasica, Ephedra gerardiana, dryopteris, santalum album, gymnema sylvestre, Ocimum sanctum, Phyllanthus emblica, Spices – pepper, cloves and cardamom.

**Elements of Plant Pathology:-** Symptoms, etiology, type and nature of pathogens and methods of control with reference to the following diseases :- banana bunchy top, tikka disease of groundnut, crown gall (of any common dicot plant)