Entrance Test Syllabus for Admission to

Five-Year Integrated Master's Programme (FYIMP) in Electronics

Note: The question paper shall comprise 100 multiple choice questions with four questions from each unit.

PHYSICS (Total Marks = 40)

UNIT 1: Physical World, Measurement and Kinematics (Marks: 04)

Units of measurement; systems of units; SI units, fundamental and derived units. Significant figures. Dimensions of physical quantities, dimensional analysis and its applications.
Motion in a Straight Line: Frame of reference, Motion in a straight line, Elementary concepts of differentiation and integration for describing motion, uniform and non-uniform motion, and instantaneous velocity, uniformly accelerated motion, velocity - time and position-time graphs. Relations for uniformly accelerated motion (graphical treatment).
Motion in a Plane: Scalar and vector quantities; position and displacement vectors, addition and subtraction of vectors, Unit vector; resolution of a vector in a plane, rectangular components, Scalar and Vector product of vectors. Motion in a plane, cases of uniform velocity and uniform acceleration projectile motion, uniform circular motion.

UNIT 2: Laws of Motion; Work, Energy and Power; Motion of System of Particles and Rigid Body Rotation (Marks: 04)

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. , Static and kinetic friction, laws of friction, rolling friction. Dynamics of uniform circular motion: Centripetal force, examples of circular motion (vehicle on a level circular road, vehicle on a banked road).
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: non-conservative forces, motion in a vertical circle; elastic and inelastic collisions in one and two dimensions. Rotational Motion of Centre of mass of a two-particle system, momentum conservation and Centre of mass of a rigid body; centre of mass of a uniform rod. Moment of a force, torque, angular momentum, law of conservation of angular momentum and its applications. Moment of inertia, radius of gyration, values of moments of inertia for simple geometrical objects (no derivation).

UNIT 3: Gravitation and Properties of Bulk Matter (Marks: 04)

Kepler's laws of planetary motion, universal law of gravitation. Acceleration due to gravity and its variation with altitude and depth. Gravitational potential energy and gravitational potential, escape speed, orbital velocity of a satellite.
Mechanical Properties of Solids: Elasticity, Stress-strain relationship, Hooke's law, Young's modulus, bulk modulus, shear modulus of rigidity (qualitative idea only).
Mechanical Properties of Fluids: 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, streamline and turbulent flow, critical velocity, Bernoulli's theorem and its simple applications. Surface tension.
Thermal Properties of Matter: Heat, temperature, anomalous expansion of water; specific heat capacity; Cp, Cv - calorimetry; change of state - latent heat capacity.

Heat transfer-conduction, convection and radiation, thermal conductivity, Wein's displacement Law, Stefan's law.

UNIT 4: Thermodynamics, Behavior of Perfect Gas and Kinetic Theory (Marks: 04)

Thermal equilibrium and definition of temperature, heat, work and internal energy. First law of thermodynamics, second law of thermodynamics: gaseous state of matter, change of condition of gaseous state-isothermal, adiabatic, reversible, irreversible, and cyclic processes.
Kinetic Theory: Equation of state of a perfect gas, work done in compressing a gas. Kinetic theory of gases - assumptions, concept of pressure, Expression for pressure exerted by a gas. 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 5: Oscillations and Waves (Marks: 04)

Oscillations: Displacement as a function of time, periodic functions and their applications. Simple harmonic motion (S.H.M) and its equations of motion; phase; oscillations of a loaded spring- restoring force and force constant; energy in S.H.M. Kinetic and potential energies; simple pendulum derivation of expression for its time period.
Wave motion: Transverse and longitudinal waves, speed of travelling wave, displacement relation for a progressive wave, principle of superposition of waves, reflection of waves, standing waves in strings and organ pipes, fundamental mode and harmonics, Beats.

UNIT 6: Electrostatics and Current Electricity (Marks: 04)

Electric Charges and Fields: Electric charges, Conservation of charge, Coulomb's law-force between two- point charges, forces between multiple charges; superposition principle and continuous charge distribution. 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. 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).
Electrostatic Potential and Capacitance: 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. Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarization, 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 (no derivation, formulae only).
Electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current; Ohm's law, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity, temperature dependence of resistance, Internal resistance of a cell, potential difference and emf of a cell, Kirchhoff's rules, Wheatstone bridge.

UNIT 7: Magnetic Effects of Current and Magnetism (Marks: 04)

Moving Charges and Magnetism: Biot - Savart law and its application to current carrying circular loop. Ampere's law and its applications to infinitely long straight wire. Straight solenoid (only qualitative treatment), force on a moving charge in uniform magnetic and electric fields. 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; Current loop as a magnetic dipole and its magnetic dipole moment, moving coil galvanometer- its current sensitivity and conversion to ammeter and voltmeter.
Magnetism and Matter: Bar magnet, bar magnet as an equivalent solenoid (qualitative treatment only), magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its

axis (qualitative treatment only), torque on a magnetic dipole (bar magnet) in a uniform magnetic field (qualitative treatment only), magnetic field lines. Magnetic properties of materials- Para-, dia- and ferro - magnetic substances with examples, Magnetization of materials, effect of temperature on magnetic properties.

UNIT 8: Electromagnetic Induction and Alternating Currents Electromagnetic Waves (Marks: 04)

Electromagnetic Induction: Faraday's laws, induced EMF and current; Lenz's Law, Self and mutual induction.
Alternating Current: peak and RMS value of alternating current/voltage; reactance and impedance; LCR series circuit (phasors only), resonance, power in AC circuits, power factor, wattles current. AC generator, Transformer.
Basic idea of displacement current, Electromagnetic waves, their characteristics, their transverse nature (qualitative idea only). Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays) including elementary facts about their uses.

UNIT 9: Optics (Marks: 04)

Ray Optics and Optical Instruments: Reflection of light, spherical mirrors, mirror formula, refraction of light, total internal reflection and optical fibers, refraction at spherical surfaces, lenses, thin lens formula, lens maker's formula, magnification, power of a lens, combination of thin lenses in contact, refraction of light through a prism. Optical instruments: Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.
Wave Optics Wave optics: Wave front 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, Young's double slit experiment and expression for fringe width (No derivation final expression only), coherent sources and sustained interference of light, diffraction due to a single slit, width of central maxima (qualitative treatment only).

UNIT 10: Dual Nature of Matter and Radiation; Atoms and Nuclei and Electronic Devices (Marks: 04)

Dual nature of radiation, Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation-particle nature of light. Experimental study of photoelectric effect Matter waves-wave nature of particles, de-Broglie relation.
Atoms: Rutherford's model of atom; Bohr model of hydrogen atom, Expression for radius of nth possible orbit, velocity and energy of electron in nth orbit, hydrogen line spectra (qualitative treatment only).
Nuclei: Composition and size of nucleus, nuclear force Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number; nuclear fission, nuclear fusion.
Semiconductor Electronics: Materials, Devices and Simple Circuits Energy bands in conductors, semiconductors and insulators (qualitative ideas only) Intrinsic and extrinsic semiconductors- p and n type, p-n junction Semiconductor diode - I-V characteristics in forward and reverse bias, application of junction diode -diode as a rectifier.

CHEMISTRY (Total Marks = 40)

UNIT 1: Basic Concepts of Chemistry & Atomic Structure (Marks: 04)

Laws of Chemical combination (numerical), Dalton's Atomic Theory, Concept of elements, atoms & molecules. Atomic and molecular masses, Mole concept and molar mass, percentage composition, empirical and molecular formula; chemical reactions, stoichiometry and calculation based on stoichiometry.
Structure of Atom: atomic number, isotopes and isobars. Thompson's model and its limitations, Rutherford's model and its limitations. Bohr's model & its limitations, concept of shells and sub-shells.Heisenberg's uncertainty principle, concept of orbitals, quantum numbers, shapes of s, p and d-orbitals.
Rules for filling electrons in orbitals - Aufbau's principle, Pauli's exclusion principle and Hund's rule. Electronic configuration of atoms, stability of half-filled and completely filled orbitals.

UNIT 2: Chemical Equilibrium and Chemical Kinetics (Marks: 04)

Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constant, factors affecting equilibrium: Le-Chatelier's principal equilibrium-ionization of acids and bases, strong and weak electrolytes, degree of ionization, Concept of pH. Hydrolysis of salts (elementary idea), buffer solutions. Solubility product, common ion effect (with suitable examples).
Rate of reaction (average and instantaneous rate of a reaction), factors affecting rate of reactions: (concentration, temperature, catalyst), rate law, specific rate constant and order, molecularity of a reaction, integrated rate expression of zero and first order reactions and their derivations, half-life period. Concept of collision theory (elementary idea, no mathematical derivation). Activation energy, Arrhenius equation.

UNIT 3: Solutions and Chemical Thermodynamics (Marks: 04)

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties: relative lowering of vapor pressure of a solution, Raoult's law, elevation of boiling point, depression in freezing point temperature and osmotic pressure), determination of molecular masses using colligative properties. Abnormal molecular mass, Van't Hoff factor and calculations involving it.
Concepts of system, types of systems, surrounding, work, heat; energy intensive and extensive properties, state functions. First Law of Thermodynamics, internal energy, enthalpy, heat capacity, specific heat, molar heat capacity, measurement of E and H, Hess's law of constant heat summation, enthalpy of bond dissociation, combustion; formation, atomization, sublimation, phase transition ionization and dilution. Introduction of entropy as a state function, free energy change for spontaneous and non-spontaneous process and equilibrium.

UNIT 4: Redox Reactions and Electrochemistry (Marks: 04)

Concept of oxidation and reduction, redox reactions, oxidation number, balancing of chemical equations in redox reactions, applications of redox reactions, conductance in electrolytic solutions, specific conductivity, molar conductivity, variation of conductivity with concentration, Kohlrausch's law and its applications Electrolysis and laws of electrolysis (elementary idea), 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 Gibb's energy change and emf of a cell, fuel cells, corrosion.

UNIT 5: Co-Ordination Chemistry and Periodic Properties (Marks: 04)

Co-ordination compounds: co-ordination number, color, magnetic properties and shapes, IUPAC nomenclature of mononuclear co-ordination compounds. Bonding (Werner's theory, VBT and CFT),

structural and stereoisomerisms, importance of coordination compounds in qualitative inclusion of analysis.
Significance of classification, Modern periodic law and the present form of the periodic table, periodic trends in properties of elements: atomic radii, ionic radii, inert gas radii, ionization enthalpy, electron gain enthalpy, electronegativity, valency.

UNIT 6: Chemical Bonding and Molecular Structure (Marks: 04)

Valence electrons, lonic bond, covalent bond, bond parameters, Lewis's structure, polar character of covalent bond, valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization involving s, p and d-orbitals and shapes of some simple molecules, molecular orbital theory of homonuclear molecules (Qualitative idea only), hydrogen bond.

UNIT 7: Organic Chemistry-Some Basic Principles and Techniques (Marks: 04)

General introduction to organic chemistry, methods of purification, qualitative and quantitative analysis, classification and IUPAC nomenclature of organic compounds.
Electronic displacement in a covalent bond: inductive effect, electromeric effect, resonance and hyperconjugation. Homolytic and heterolytic fission of a covalent bond, free radicals, electrophiles, nucleophiles, carbocations and carbanions. Types of organic reactions.

UNIT 8: Hydrocarbons, Haloalkanes and Haloarenes (Marks: 04)

Classification of hydrocarbons - Alkanes: Nomenclature, isomerism, conformations (ethane only), physical properties. Chemical reactions including free radical mechanism of halogenation, combustion and Pyrolysis Alkenes: Nomenclature, structure of double bond (ethene), geometrical isomerism, methods of preparation, physical properties, chemical reactions- addition of hydrogen. halogen, water, hydrogen halides (Markownikov's addition. Alkynes: Nomenclature, structure of triple bond (ethyne), physical properties, methods of preparation, chemical reactions: acidic character of alkynes, addition reaction of hydrogen, halogens, hydrogen halides and water, Aromatic hydrocarbon's introduction, IUPAC nomenclature, Benzene resonance, aromaticity, chemical properties, mechanism of electrophilic substitution-nitration, sulphonation, halogenations Friedel Craft's alkylation and acylation.
Haloalkanes: Nomenclature, nature of C-X bond, physical & chemical properties, mechanism of substitution reactions. Stability of carbocations, R-S and d-1 configurations.
Haloarenes: Nature of C-X bond, substitution reactions (directive influence of halogens for mono substituted compounds only), Stability of carbocations, R-S and D-L configurations.

UNIT 9: Alcohols, Phenols and Ethers (Marks: 04)

Alcohols: Nomenclature, methods of preparation, physical & chemical properties (of primary alcohols only), identification of primary, secondary & tertiary alcohols; mechanism of dehydration of alcohols. Uses, some important compounds - methanol and ethanol.
Phenols: Nomenclature, methods of preparation, physical & chemical properties, acidic nature of phenol, electrophilic substitution reactions, uses of phenols.
Ethers: Nomenclature, methods of preparation, physical & chemical properties and uses.

UNIT 10: Aldehydes, Ketones and Carboxylic Acids; Organic Compounds Containing Nitrogen (Marks: 04)

Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical & chemical properties & mechanism of nucleophilic addition reaction to C=O group, reactivity of alpha hydrogen in aldehydes, uses.
Carboxylic Acids: Nomenclature, acidic nature, methods of preparation, physical & chemical properties and uses.

GENERAL APTITUDE (Total Marks = 20)

Unit 1: Verbal Aptitude (Marks: 04)

Basic English grammar: tenses, articles, adjectives, prepositions, conjunctions, verb-noun agreement, and other parts of speech Basic vocabulary: words, idioms, and phrases in context Reading and comprehension Narrative sequencing.

Unit 2: Quantitative Aptitude (Marks: 04)

Numerical computation and estimation: ratios, percentages, powers, exponents and logarithms, permutations and combinations, and series, Profit and Loss, Simple Interest, Compound Interest Mensuration and geometry.

Unit 3: Data Interpretation and Graphical Analysis (Marks: 04)

Data interpretation: Elementary Statistics, Mean, Median, Mode, Measures of Dispersion, Elementary probability, Graphical Analysis: Bar Graph, Line Graph, Pie-Chart and other graphs representing data, Tabulation, 2- and 3-dimensional plots, maps, and tables.

Unit 4: Analytical Aptitude (Marks: 04)

Logic: deduction and induction, Analogy, Numerical relations and reasoning- Series Formation, Coding-Decoding, Distance and Directions, Calendar and Clock, Ranking and Arrangement, Puzzles, etc.

Unit 5: Spatial Aptitude (Marks: 04)

Transformation of shapes: translation, rotation, scaling, mirroring, assembling, and grouping Paper folding, cutting, and patterns in 2 and 3 dimensions.