

**Syllabus for FYIMP (Hons./Research) Physics/Energy Studies Entrance Exam, University of Kashmir (Kupwara Satellite Campus) 2026-27**

**Physics:**

**UNIT I**

Units and Measurements: The international system of units, Significant figures, Dimensions of physical quantities, Dimensional formulae and dimensional equations, Motion in Straight Line and Plane: Instantaneous velocity and speed, Acceleration, Scalars and vectors, Vector Algebra, Motion in a plane, Projectile motion, Uniform circular motion.

**UNIT II**

Laws of Motion: Law of inertia, Newton's laws of motion, Conservation of momentum, Equilibrium of a particle, Common forces in mechanics, Circular motion, Work energy and Power: work-energy theorem, Kinetic energy, Work done by a variable force, work-energy theorem for a variable force, concept of potential energy, conservation of mechanical energy, potential energy of a spring, Power, Collisions.

**UNIT III**

System of Particles and Rotational Motion: Centre of mass, Motion of centre of mass, Linear momentum of a system of particles, Angular velocity and its relation with linear velocity, Torque and angular momentum, Equilibrium of a rigid body, Moment of inertia, Gravitation: law of gravitation, Acceleration due to gravity of the earth, Gravitational potential energy, Escape speed, Kepler's laws, Earth satellites, Energy of an orbiting satellite.

**UNIT IV**

Properties of Solids and Fluids: Stress and strain, Hooke's law, Elastic moduli, Pressure, Streamline flow, Bernoulli's principle, Viscosity, Surface tension, Thermodynamics and Kinetic Theory: Thermal equilibrium, Zeroth law, Heat, internal energy and work, Laws of thermodynamics, Specific heat capacity, Reversible and irreversible processes, Kinetic theory of an ideal gas, Law of equipartition of energy, Mean free path.

**UNIT V**

Electric Charges and Fields: Conductors and Insulators, Properties of Electric Charge, Coulomb's Law, Forces between Multiple Charges, Electric Field, Electric Flux, Electric Dipole, Dipole in a Uniform External Field, Gauss's Law and its Applications, Electrostatic Potential and Capacitance: Electrostatic Potential due to point charge and dipole, Equipotential Surfaces, Dielectrics and Polarisation, Parallel Plate Capacitor, Effect of Dielectric on Capacitance, Energy Stored in a Capacitor.

## **UNITVI**

Current Electricity: Electric Currents in Conductors, Ohm's law and its limitations, Resistivity, Temperature Dependence of Resistivity, Electrical Energy, Power, Magnetism: Magnetic Force, Motion in a Magnetic Field, Biot-Savart Law, Solenoid, Magnetisation and Magnetic Intensity, Magnetic Properties of Materials, Faraday's Law of Induction, Lenz's Law and Conservation of Energy, Transformers, Electromagnetic Waves, Electromagnetic Spectrum.

## **UNITVII**

Ray and Wave Optics: Reflection of Light by Spherical Mirrors, Refraction, Total Internal Reflection, Refraction through a Prism, Huygens Principle, Interference of Light Waves and Young's Experiment, Diffraction, Polarisation, Dual Nature of Matter and Radiation: Electron Emission, Photoelectric Effect and Wave Theory of Light, Energy Quantum of Radiation, Photon, Wave Nature of Matter.

## **UNITVIII**

Atoms and Nuclei: Alpha-particle Scattering and Rutherford's Nuclear Model of Atom, Atomic Spectra, Bohr Model of the Hydrogen Atom, The Line Spectra of the Hydrogen Atom, Atomic Mass, Composition and Size of the Nucleus, Mass-Energy and Nuclear Binding Energy, Nuclear Force, Radioactivity, Nuclear Energy.

## **Chemistry**

### **Unit-IX:**

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), Adsorption – physisorption and chemisorption; factors affecting adsorption of gases on solids; catalysis: homogenous and heterogeneous, activity and selectivity: enzyme catalysis

Concepts of system, types of systems, surroundings, work, heat, energy, extensive and intensive properties, state functions.

First law of thermodynamics – internal energy and enthalpy, heat capacity and specific heat, measurement of  $\Delta U$  and  $\Delta H$ , Hess's law of constant heat summation, enthalpy of : bond dissociation, combustion, formation, atomization, sublimation, phase transition, ionization, solution and dilution.

### **Unit-X:**

Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions in terms of loss and gain of electron and change in oxidation numbers

Valence electrons, ionic bond, covalent bond, bond parameters, Lewis structure, polar character of covalent bond, covalent character of ionic 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,

General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals

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.

### **Unit-XI:**

Electronic displacements in a covalent bond: inductive effect, electromeric effect, resonance and hyper conjugation. Homolytic and heterolytic fission of a covalent bond: free radicals, carbocations, carbanions; electrophiles and nucleophiles, types of organic reactions.

Haloalkanes: Nomenclature, nature of C-X bond, physical and chemical properties, mechanism of substitution reactions. Optical rotation.

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.

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

### **Mathematics:**

#### **UNIT-XII**

Sets and their representations. Empty set. Finite and 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 a set, Properties of Complement sets.

Positive and negative angles. Measuring angles in radians and in degrees and conversion from one measure to another. Definition of trigonometric functions with the help of unit circle. Truth of the identity  $\sin^2 x + \cos^2 x = 1$ , for all x. Signs of trigonometric functions and sketch of their graphs. Expressing  $\sin(x + y)$  and  $\cos(x + y)$  in terms of  $\sin x$ ,  $\sin y$ ,  $\cos x$  and  $\cos y$ . General solution of trigonometric equations of the type  $\sin \theta = \sin \alpha$ ,  $\cos \theta = \cos \alpha$  and  $\tan \theta = \tan \alpha$ . Proofs and simple applications of sine and cosine formulae.

Need for complex numbers, especially  $\sqrt{-1}$ , to be motivated by inability to solve every quadratic equation. Brief description of algebraic properties of complex numbers. Argand plane and polar representation of complex numbers. Statement of Fundamental Theorem of Algebra,

solution of quadratic equations in the complex number system, Square-root of a Complex number.

### **UNIT-XIII**

Matrices: 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-commutativity 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; (Here all matrices will have real entries).

Determinant of a square matrix (upto  $3 \times 3$  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 equations by examples, solving system of linear equations in two or three variables (having unique solution) using inverse of a matrix.

### **UNIT-XIV**

Derivative introduced as rate of change both as that of distance function and geometrically, intuitive idea of limit. Definition 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.

Continuity and differentiability, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit function. Concepts of exponential, logarithmic functions. Logarithmic differentiation. Derivative of functions expressed in parametric forms. Second order derivatives. Rolle's, Lagrange's and Mean Value Theorems (without proof) and their geometric interpretations

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 (without proof). Basic properties of definite integrals and evaluation of definite integrals.

### **English:**

### **UNIT-XV**

Identification of Common errors Vocabulary—word formation, synonyms, antonyms, pairing of words. Sentence Structure and construction Prepositions Completion of sentences.