Entrance Test Syllabus
for
B.Sc. (Hons. / Hons. with Research) Computer Science (Artificial Intelligence and Data Science)

Scheme of Entrance Test

(i) Maximum Marks: 90

   Time: 90 Minutes

(ii) There will be 90 Questions consisting of three parts as under:

       Part-I : Mathematics **50 Questions** 50 Marks (1 to 50)

       Part-II : Chemistry **20 Questions** 20 Marks (51-70)

       Part-III: Physics **20 Questions** 20 Marks (71-90)

(iii) Only multiple-choice questions with one correct answer will be asked in the Entrance Test.

(iv) There will be no negative marking.

Part-I: Mathematics

Set Theory: Sets, relations and functions, Binary operation. **Complex Number:** Complex number, algebra of complex number, real and imaginary parts of complex number, modulus and argument of complex number, square root of a complex number, polar form of a complex number. **Quadratic Equations:** Solution of quadratic equation, relation between roots and coefficients, formation of quadratic equation. **Sequences and Series:** Arithmetic and geometric progressions. **Permutations and Combinations:** Derivation of formulae and their connections, simple applications. **Mathematical Induction and Binomial Theorem:** Mathematical Induction, Statement and proof of Binomial theorem for positive index. General and particular term of Binomial Theorem for any index. **Exponential and Logarithmic Series:** The infinite series for e, Infinite series for log (1+x) and log (1+x)/(1-x), calculation of the logarithm of a number using suitable logarithmic series. **Trigonometry:** Measurement of angles, trigonometric functions, trigonometric ratios of compound angles, transformation formulae, trigonometric ratios of multiple and submultiple angles, trigonometric equations. Inverse trigonometric functions: Definition, range, domain and principal value branches. **Matrices and Determinants:** Matrix as a rectangular arrangement of numbers, type of matrices. Determinant, minors and cofactors of determinant, expansion of a determinant, properties and elementary transformation of determinants, adjoint and inverse of a matrix and its properties, Cramer's rule. **Co-ordinate Geometry:** Distance formula, section formula, area of triangle, condition of co-linearity, centroid, incentre, locus, parallel and perpendicular lines, formation of equation of straight lines in different forms, intersection of two lines, condition for general second degree equation to represent two straight lines. **Conic Sections:** Standard equations and properties of circles, ellipse, parabola and hyperbola. **Vectors and Three Dimensional Geometry:** Vector, magnitude and direction of a vector, position vector of a point, components of a vector, vector in two and three dimensions, algebra and application of vectors. Distance between two points, condition of the intersection of two lines, shortest distance between two lines, distance of a point from the plane.

Equation of a sphere in the standard form, Equation of sphere with the position vectors as the extremities of a diameter. **Differential Calculus:** Concept of limits, continuity and differentiability. Derivative of function, theorems relating to the derivatives of the sum, difference, product and quotient of functions, derivative of a function (chain rule), derivative of trigonometric functions, inverse trigonometric functions, logarithmic and exponential functions. Increasing and decreasing functions, maxima and minima (absolute, local), Rolle's theorem, mean value theorem. **Integral Calculus:** Integration as the inverse of differentiation, properties of integrals, fundamental integrals involving algebraic, trigonometric and exponential functions, integration by substitution, integration by parts. Definite Integral: Fundamental theorem of calculus, evaluation of definite integrals, transformation of definite integrals by substitution, properties of definite integrals, evaluation of some definite integrals using properties, evaluation of area bounded by a curve. **Differential Equations:** Order and degree, formation of a differential equation, general and particular solution of a differential equation, solution of differential equation by the method of variables separable, homogeneous equations and their solution, solution of the linear equation of first order with constant coefficients. **Statistics:** Bar graph, Pie Chart, Mean, Median, Mode, Standard deviation, Mean deviation from mean and median. Correlation and Regression: Definition and calculation of the correlation coefficient, positive and negative correlation, perfect correlation. Calculation of the regression coefficient and the two lines of regression by the method of least squares, its relation with the coefficient of correlation. **Probability:** Random experiments, sample spaces, events, axiomatic approach to probability, probability of "not", "and" & "or" events, addition theorems on probability, conditional probability, multiplication theorems on probability, independent events, independent experiments, calculation of probabilities of events associated with independent experiments, total probability, Baye's theorem, random variable, distribution of a random variable.

Part-II Chemistry

Atomic Structure: Dual nature of matter and radiation, de Broglie equation, uncertainty principle, orbitals and quantum numbers, shapes of s, p and d orbitals, electronic configuration, atoms, molecules, molecular orbital method. **Periodic Properties of Elements:** Modern periodic table, periodic trends in properties of elements. **Chemical Bonds and Molecules:** Chemical bonds (ionic, covalent, coordinate), hybridization, shapes of molecules (VSEPR theory), valence bond theory and molecular orbital theory, hydrogen bond, resonance, metallic bond. **Solid State:** Structure of simple ionic compounds, close packed structures, ionic radii, properties of solids, amorphous and crystalline solids. **Chemical Thermodynamics:** Energy changes during a chemical reaction, First law, Second law and Third Law of Thermodynamics, enthalpy, entropy and chemical equilibrium. **Chemical Equilibrium:** Law of mass action, effect of concentration, pressure and temperature, Le Chatelier principle, ionization of electrolytes, weak and strong electrolytes, various concepts of acids and bases, ionization of water, pH, solubility product. **Chemical Kinetics:** Rate of chemical reaction, rate expression, unit of rate constant and specific rate constant, order of reaction, concentration and temperature dependence of rate constant, fast reactions, mechanism of reactions, photochemical reactions.

Solutions: Types of solutions, Raoult's law, colligative properties of dilute solutions. **Electrochemistry:** Electrolysis, electrolytic conductance, voltaic/galvanic cell, electrode potential and electromotive force, Gibb's free energy and cell potential, primary cells. **Surface and Catalysis:** Colloids, emulsion, micelles, homogeneous and heterogeneous catalysis. **Nuclear Chemistry:** Nature of radiation from radioactive substances, nuclear structure and nuclear properties, nuclear reactions, nuclear fission and fusion, isotopes and their uses, radio carbon dating. **Chemistry of Representative Elements:** The chemistry of s and p-block elements, electronic configuration, general characteristics, properties and oxidation states of the following: Group 1 Elements Alkali metals**;** Group 2 Elements Alkaline earth metals**;** Group 13 Elements Boron family**;** Group 14 Elements Carbon family**;** Group 15 Elements Nitrogen family**;** Group 16 Elements Oxygen family; Group 17 Elements Halogen family; Hydrogen**;** Group 18 Elements Noble gases. **Transition Metals Including Lanthanides:** Electronic configuration, oxidation states of transition metals, general properties of first, second and third row transition elements, Preparation and uses of potassium dichromate, potassium permanganate, Inner transition elements : oxidation states, lanthanide contraction. **Coordinate Chemistry and Organo-Metallics:** Coordination compounds and their applications, bonding and stability in coordination compounds. **Chemistry of Carbon Compounds: a) hydro carbons-** i) A brief study of Alkanes, Alkenes, Alkynes and their hybridization, isomerism and characteristic examples. ii) Arenes Delocalization of electrons in benzenes and resonance energy, ortho, para and meta isomers. iii) Systematic nomenclature (compounds having carbon atoms up to six). iv) Properties and reactions of hydrocarbons : Change in physical properties with chain length, chemical properties, combustion and controlled oxidation, free radicals, halogenations, aromatization and cracking of alkanes. Properties of alkenes and alkynes, Markownikoff's rule. Reactions of benzene. v) Sources and synthesis of hydrocarbons: Refining of petroleum, reforming, octane number, pyrolysis of coal. **b) Characterization of Organic Compounds**- Detection of elements, calculation of empirical and molecular formulae from weight percentage data of elements and molecular weight. **c) Alkyl and Aryl halides**- Nomenclature, isomerism, optical isomerism, racemic mixture, general methods of preparation and properties of alkyl and aryl halides, chloroform, carbon tetrachloride, DDT, benzene hexachloride. **d) Compounds with functional groups containing oxygen and nitrogen**- Nomenclature, isomerism, general methods of preparation and properties of ethers, aldehydes, ketones, carboxylic acids and their derivatives (acyl halides, acid anhydrides, amides and esters); cyanides and isocyanides, nitro compounds and amines and their methods of preparation and uses. **Polymers:** Classification of polymers, Natural and synthetic polymers, Preparation and uses of Teflon, PVC, Polystyrene, Nylon-66, Terylene. **Biomolecules:** Monosaccharides, Disaccharides, Polyaccharides Amino acids and Peptides-structure and classification, Proteins and Enzymes-structure of proteins, Nucleic Acids - DNA and RNA, Protein synthesis and replication. Lipids-structure, membranes and their functions. **Chemistry of Biological Processes**: Carbohydrates and their metabolism, Haemoglobin, blood and respiration, Immune System, Vitamins and hormones.

Part-III Physics

Physical World & Measurement: Unit for measurement and derived units, dimensions, order of magnitude, accuracy and errors in measurement. **Description of Motion in One Dimension:** Objects in motion, motion in one dimension. Motion in a straight line, uniform motion. General relation between position and velocity, application to uniformly accelerated motion. **Description of Motion in Two and Three Dimensions:** Vectors and scalars, vector addition and multiplication by a real number, zero vector and its properties. Motion in two dimensions, uniform velocity and uniform acceleration, uniform circular motion, motion of objects in three-dimensional space. **Laws of Motion:** Force and inertia. First, second and third laws of motion, rocket propulsion, equilibrium of concurrent forces. Laws of friction, rolling friction, lubrication, inertial and non-inertial frames. **Work, Energy and Power:** Work done by a constant and a variable force, kinetic energy, power, Elastic collisions, Different forms of energy, mass-energy equivalence, conservation of energy. **Rotational Motion:** Newton's law of motion, torque, angular momentum, conservation of angular momentum, examples of circular motion, comparison of linear and rotational motions, properties of moment of inertia, parallel axis theorem, examples of two dimensional rigid body motion. **Gravitation:** Acceleration due to gravity, one dimensional and two dimensional motion under gravity, universal law of gravitation, variations in the acceleration due to gravity of the earth, geo-stationary satellites, gravitational potential, escape velocity. **Molecules:** Atomic hypothesis, Brownian motion, Avogadro's number and Avogadro's hypothesis. Inter-atomic and inter-molecular forces. States of matter. **Properties of Matter:** (A) **Solids**: Crystalline and glassy solids, Hooke's Law, Young's modulus, bulk modulus, (B) **Fluids**: Surface energy and surface tension, capillary rise, viscosity, streamline flow, Reynold's number. Bernoulli's theorem. (C) **Gases** : Boyle's law, Charle's law and absolute temperature. Kinetic theory of gases. Pressure, kinetic energy and temperature, gas laws. **Heat and Thermodynamics:** Mechanical equivalent of heat, specific heat, first law of thermodynamics, pressure-temperature phase diagram, heat engines, second law of thermodynamics. Conduction, convection and radiation. **Oscillations:** Simple harmonic motion (S.H.M.), uniform circular motion. Kinetic energy and potential energy in S.H.M., simple pendulum, forced oscillations, resonance and damped oscillations.

Waves: Wave motion, speed of wave motion, principles of superposition, reflection of waves, harmonic waves, standing waves and normal modes, beats, Doppler effect, musical scale, acoustics of buildings. **Electrostatics:** Coulomb's law, dielectric constant, electric field due to a point charge, dipole, dipole field and dipole's behaviour in an electric field, flux, conductors and insulators, presence of free charges and bound charges inside a conductor, Capacitance, energy of capacitor, Van de Graff generator. **Current Electricity:** Electric current, resistance and resistivity, colour code for carbon resistances, Ohm's law, Kirchoff's law, resistance in series and parallel circuits, Wheatstone's bridge, measurement of voltages and currents, concept of e.m.f., terminal voltage and internal resistance of a cell. **Thermal and Chemical Effects of Currents:** Electric power, Heating effects of current, chemical effects and law of electrolysis, cells (primary and secondary), thermoelectricity, thermocouple.

Magnetic Effects of Currents: Oersted's observation, Biot-Savart law, magnetic field due to a straight wire, circular loop and solenoid, force on a moving charge in a magnetic field (Lorentz force), cyclotron, forces and torques on current in a magnetic field, force between two currents, Moving coil galvanometer. **Magnetism:** Bar magnet (comparison with a solenoid), line of force, torque on a bar magnet in a magnetic field, Earth's magnetic field, tangent galvanometer, vibration magnetometer, para, dia and ferromagnetism. **Electromagnetic Induction and Alternating Currents:** Faraday's law, Lenz's law, induction and inductance, alternating currents, impedance and reactance, power in a.c. circuits with L, C & R; series and parallel resonant circuits, electrical machines and devices, transformer, a.c. generator, choke and starter. **Electromagnetic Waves:** Electromagnetic oscillation, history of e.m. waves, electromagnetic spectrum with their applications and uses. **Ray Optics and Optical Instruments:** Sources of light, Photometry, ray optics as a limiting case of wave optics, reflection, total internal reflection, curved mirrors, lenses, dispersion by a prism, spectrometer and spectra, absorption and emission, scattering, rainbow, telescope, microscope. **Wave Optics:** Wave front and Huygen's principle, interference - Young's double slit experiment. Diffraction due to a single slit, diffraction grating, polarization of transverse waves, application related to these phenomena. **Electrons and Photons:** Electrical conduction of gases, electron, photon, Einstein's photoelectric equation, photocells. **Atoms, Molecules and Nuclei:** Rutherford model of atom, Bhor model, energy quantization, hydrogen spectrum, composition of nucleus, atomic masses, isotopes, size of nucleus, radioactivity, mass-energy relation, fission, fusion, nuclear holocaust. **Solids and Semi-Conductor Devices:** Conductors, insulators and semi-conductors, p-n junction diodes, solar cells, junction transistor, diode as rectifier, transistor as amplifier and oscillator, logic gates. **Universe:** The constituents of the universe, planets, stars, brightness, magnitude scale, luminosity, surface temperature, stellar spectra, energy source of stars.