

# Syllabus for Entrance Exam PUCAT-2022

A common paper for M.Sc.(Physics), M.Sc.(Chemistry) M.Sc./M.A. (Mathematics), M.Sc.(Geology) will come in the entrance examination of PUCAT-2022 which contains six parts (Physics, Chemistry, Mathematics, Geology, Botany and Zoology). Each section will have 24 question. Candidate will attempt any two parts. Time: 1 Hr.

## Syllabus-Geology

Origin of Earth; Radiometric dating methods of rocks, Geological time scale; Internal structure and chemical composition of the Earth, Weathering, Landforms related to wind, rivers and glaciers. Basic concepts of plate tectonics and sea-floor spreading; Basic concept of stress and strain. Measurement of dip, strike and thickness of beds; Forms of igneous bodies; Fold and faults. Basic idea about crystal, crystal growth and crystallization; Crystal systems. Twinning and common twin laws; Physical properties, chemical composition, occurrences and uses of minerals belonging to the Silica, Feldspar, Feldspathoid, Amphibole, Pyroxene, Olivine, Mica and Garnet families. Principles of stratigraphy. Physical and structural subdivisions of the Indian subcontinent and their characters. Brief idea of Archaean and Proterozoic successions of Peninsular India. Marine and non-marine Palaeozoic, Mesozoic and Cenozoic successions of the Himalayan and Peninsular India; Gondwana super group; Deccan traps and Siwalik Group. Process of fossilization; Preliminary idea of origin of life and Precambrian fossil records; Morphology and geological history of Bivalvia, Gastropoda, Brachiopoda, Cephalopoda and Trilobita. Igneous, Sedimentary and Metamorphic rocks; Bowen's Reaction series; Magmatic differentiation and assimilation; Texture of igneous rocks; IUGS classification of igneous rocks, Phase rule; mineralogical characteristics of acidic, basic, alkaline and ultramafic igneous rocks. Origin and classification of sedimentary rocks; Diagenesis; Texture of sedimentary rocks; Sediment characteristics; Sedimentary structures. Definition, agents and types of metamorphism; Metamorphic rocks: texture, structure and classification; Process of formation of ores, Occurrence, origin and distribution of important mineral deposits of India. Conventional and non-conventional Energy resource; Concept of surface and subsurface mining. Remote sensing concepts and its applications in Geology; Groundwater and its vertical distribution types; Types of aquifers. Geological hazards namely Earthquakes, Landslides, Floods and Tsunami.

## Syllabus-Physics

### MECHANICS & WAVE PHENOMENA

Multiplication and differentiation of vectors, Gradients, Divergence and curl of a vector, Gauss and Stoke's theorems, Centre of mass, Work and energy, Conservative and non-conservative forces. Law of conservation of energy, Motion in central field, two particle central force problem and reduced mass, Compound pendulum, Linear and angular momenta, Torque and angular momentum. Moment of inertia. Calculation of M.I. of some simple objects, Flywheel. Elastic constants, Torsion of cylinder, Bending beam, Cantilevers, Viscosity, Poiseuille's formula, Stoke's law. S.H.M., Differential equation of wave motion, Lissajous figures, Damped and forced oscillations. Fourier analysis.

### OPTICS

Fermat's principle, Cardinal points, Aberrations, Eyepieces. Interference, Fresnel's biprism, Interference in thin film, Newton's rings, Michelson Interferometer. Diffractions, Simple theory of Fresnel diffraction with applications. Fraunhofer diffraction- single slit, double slit, plan diffraction grating. Resolution, Rayleigh criteria, resolving power of prism, Grating and telescope. Polarisation, Malus law, Brewster's law, Double refraction, Nicol prism, Production and detection of plane, Circular and elliptically polarised light. Optical rotation.

### THERMODYNAMICS

Kinetic theory of gases, Maxwell's distribution law, Specific heat, Mean free path, Vander-waal's equation, Critical constants, First law of thermodynamics, Isothermal and adiabatic processes, Reversible and irreversible processes, Carnot's engine and Carnot's theorem, Absolute scale of temperature, Second law of thermodynamics, Identity of perfect gas scale and absolute scale, Entropy, Clausius-Clapeyron's heat equation, Joule-Thomson effect, Maxwell's thermodynamical relations, Conductivity, Radiation, Kirchhoff's law, Stefan-Boltzmann law, Energy distribution in the spectrum of black body.

#### **ELECTRICITY AND MAGNETISM**

Gauss theorem and its applications, Electric field and electric potential, Electric polarisation of matter, Polarisation and displacement vectors, Dielectrics, Kirchhoff's laws and their applications, Biot-Savart law and its applications, Electromagnetic induction, Faraday's law, Maxwell's equations, Magnetic permeability and susceptibility, Dia, para and ferromagnetism, Measurement of susceptibility, Hysteresis loop.

#### **QUANTUM MECHANICS**

Black body radiation, Planck's theory, photoelectric effect, Compton effect, Frank-Hertz experiment, Uncertainty principle, Wave particle duality, de-Broglie theory, Schrodinger equation with application to simple potential problems.

#### **ATOMIC PHYSICS**

Bohr, Sommerfeld and vector atom model, Electron spin, Pauli exclusion principle, Normal Zeeman effect, Stern-Gerlach experiment, Various coupling schemes.

#### **SOLID STATE AND NUCLEAR PHYSICS**

Space lattice, Unit cell, Miller indices, sc, bcc and fcc lattices, CsCl and NaCl structure, Bragg's law, X-ray diffraction. Binding energy, Nuclear forces, Nuclear spin, Magnetic moment, Liquid drop and shell models, Fission and fusion, Radioactivity.

#### **RELATIVITY**

Special theory of relativity, Galilean invariance, Michelson-Morley experiment, Lorentz transformation, Relativistic addition of velocities, Mass variation with velocity, Mass energy equivalence.

#### **ELECTRONICS**

Thermionic emission, Vacuum diode, triode, tetrode and pentode, Intrinsic and extrinsic semiconductors, PN junction, Half wave and full wave rectification, Filter circuits, Zener diode, Voltage stabilization, Bipolar Junction Transistor, Transistor biasing, Transistor configurations: CE, CB and CC transistor amplifiers.

## **Syllabus-Chemistry**

**Atomic Structure and Quantum Mechanics:** de-Broglie equation, Heisenberg uncertainty principle, Schrödinger wave equation, quantum numbers, Aufbau and Pauli Exclusion principles, Hund's multiplicity rule.

**Periodic Properties:** Atomic and ionic radii, ionization energy, electron affinity and electronegativity definition, trends in periodic table and applications in predicting and explaining the chemical behaviour.

**Chemical Bonding:** Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, valence shell electron pair repulsion (VSEPR) theory. Molecular orbital theory (MOT).

**Ionic Solid:** Ionic structures, radius ratio effect and coordination number, lattice defects, semiconductors, lattice energy and Born-Haber cycle, Fajan's rule. Derivation of Bragg equation.

**s-Block Elements:** Comparative study, diagonal relationship, salient features of hydrides, solvation and complexation tendencies.

**Chemistry of Noble Gases:** Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.

**p-Block Elements:** Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacids and halides of group 13-16, hydrides of boron-diborane and higher boranes, borazine,

**d-Block Elements:** Chemistry of Elements of First, second and third Transition Series. Characteristic properties of d-block elements in respect of ionic radii, oxidation states, magnetic behavior. **Coordination Compounds:** Werner's coordination theory, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. Crystal field theory (CFT).

**Chemistry of Lanthanide and Actinides:** Electronic configuration, oxidation states, ionic radii and lanthanide contraction, complex formation, oxidation states and magnetic properties.

**Spectroscopy:** Ultra violet (U.V.) and Infrared (I.R.)

**Alkanes, alkenes and alkynes:** General synthesis and its chemical reactions.

**Alcohols:** Classification and nomenclature, Monohydric alcohols – nomenclature, methods of formation and chemical reactions. (ii) **Phenols:** Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Reimer-Tiemann reaction.

**Aldehydes and Ketones:** Synthesis of aldehydes and ketones, Aldol, Perkin and Knoevenagel condensations, Wittig reaction. Oxidation of aldehydes and ketones, Cannizzaro reaction, MPV, Clemmensen reduction. (ii) **Carboxylic Acids:** Preparation of carboxylic acids, Reactions of carboxylic acids, Hell-Volhard-Zelinsky reaction.

**Heterocyclic Compounds:** Preparation and reactions of Pyrrole, thiophene indole, quinoline and isoquinoline.

**Arenes and Aromaticity:** Aromatic and antiaromatic compounds: Huckel rule.

**Alkyl halides:** Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams.

**Stereochemistry:** Cis-trans Isomers, E-Z notation for geometric isomerism, Absolute Configuration: R-S Sequence Rules

**Gaseous States:** Deviation from ideal behavior, van der Waals equation of state, Critical Phenomena, Molecular velocities: Root mean square, average and most probable velocities,

**Solutions:** Raoult's and Henry's law, Colligative properties include lowering of vapor pressure, boiling point elevation, freezing point depression, and osmotic pressure.

**Chemical Kinetics and Catalysis:** Rate of a reaction, factors influencing the rate of a reaction, zero order, first order, second order, pseudo first order

**Thermodynamics:** I st and II nd law of thermodynamic, Carnot's cycle and its efficiency, Carnot's theorem, Joule- homson coefficient and inversion temperature. Concept of entropy: Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, Gibbs and Helmholtz free energy.

**Thermochemistry:** Hess's Law of heat summation and its applications, Heat of reaction at constant pressure and at constant volume, Enthalpy of neutralization, Bond dissociation energy and its calculation from thermochemical data, temperature dependence of enthalpy, Kirchhoff's equation.

**Chemical Equilibrium:** Equilibrium constant and free energy, law of mass action, Le Chatelier's principle.

**Electrochemistry:** Nernst equation, Relationship between cell potential and Gibbs' energy change, Cell Constant, conductance in electrolytic solutions, specific and molar conductivities and their variation with concentration: Kohlrausch's law.

## Mathematics

**Algebra:** Groups, subgroups, Abelian groups, non-abelian groups, cyclic groups, permutation groups; Normal subgroups, Lagrange's Theorem for finite groups, group homomorphism and quotient groups, Rings, Subrings, Ideal, Prime ideal; Maximal ideals; Fields, quotient field. Vector spaces, Linear dependence and Independence of vectors, basis, dimension, linear transformations, matrix representation with respect to an ordered basis, Range space and null space, rank-nullity theorem; Rank and inverse of a matrix, determinant, solutions of systems of linear equations, consistency conditions. Eigenvalues and eigenvectors. Cayley-Hamilton theorem. Symmetric, Skew

symmetric, Hermitian, Skew-Hermitian, Orthogonal and Unitary matrices.

**Real Analysis:** Sequences and series of real numbers. Convergent and divergent sequences, bounded and monotone sequences, Convergence criteria for sequences of real numbers, Cauchy sequences, absolute and conditional convergence; Tests of convergence for series of positive terms-comparison test, ratio test, root test, Leibnitz test for convergence of alternating series. Functions of one variable: limit, continuity, differentiation, Rolle's Theorem, Cauchy's Taylor's theorem. Interior points, limit points, open sets, closed sets, bounded sets, connected sets, compact sets; completeness of  $\mathbb{R}$ , Power series (of real variable) including Taylor's and Maclaurin's, domain of convergence, term-wise differentiation and integration of power series. Functions of two real variable: limit, continuity, partial derivatives, differentiability, maxima and minima. Method of Lagrange multipliers, Homogeneous functions including Euler's theorem.

**Complex Analysis:** Functions of a complex Variable, Differentiability and analyticity, Cauchy Riemann Equations, Power series as an analytic function, properties of line integrals, Goursat Theorem, Cauchy theorem, consequence of simply connectivity, index of a closed curves. Cauchy's integral formula, Morera's theorem, Liouville's theorem, Fundamental theorem of Algebra, Harmonic functions.

**Integral Calculus:** Integration as the inverse process of differentiation, definite integrals and their properties, Fundamental theorem of integral calculus. Double and triple integrals, change of order of integration. Calculating surface areas and volumes using double integrals and applications. Calculating volumes using triple integrals and applications.

**Differential Equations:** Ordinary differential equations of the first order of the form  $y'=f(x,y)$ . Bernoulli's equation, exact differential equations, integrating factor, orthogonal trajectories, Homogeneous differential equations-separable solutions, Linear differential equations of second and higher order with constant coefficients, method of variation of parameters. Cauchy-Euler equation.

**Vector Calculus:** Scalar and vector fields, gradient, divergence, curl and Laplacian. Scalar line integrals and vector line integrals, scalar surface integrals and vector surface integrals, Green's, Stokes and Gauss theorems and their applications.

### **Linear Programming:**

Convex sets, extreme points, convex hull, hyper plane & polyhedral Sets, convex function and concave functions, Concept of basis, basic feasible solutions, Formulation of Linear Programming Problem (LPP), Graphical Method of LPP, Simplex Method.

## **Botany**

### **Diversity of Viruses, Bacteria and Fungi**

History, nature and classification of Viruses, Bacteria and Fungi:

History of virology and bacteriology; prokaryotic and eukaryotic cell structure (bacteria, mycoplasma and yeast); structure, classification and nature of viruses; structure (gram positive and gram negative) and classification (based on cell structure) of bacteria; classification, thallus organization and reproduction in fungi; economic importance of fungi.

Viruses: Symptoms of virus infection in plants; transmission of plant viruses; genome organisation, replication of plant virus (tobacco mosaic virus); techniques in plant viruses - purification, serology and electron microscopy; structure and multiplication of bacteriophages; structure and multiplication of viroids.

Bacteria: Nutritional types of bacteria (based on carbon and energy sources), metabolism in different nutritional types (basics only) and nitrogen cycle; bacterial genome and plasmids; bacterial cell division, variability in bacteria - mutation, principles of genetic recombination; techniques of sterilisation, bacterial culture and staining; economic importance of bacteria.

Fungi: The characteristics and life cycles of the following: Mastigomycotina: *Albugo*, *Pythium*; Ascomycotina: *Saccharomyces*, *Aspergillus*, *Ascobolus*; Basidiomycotina: *Ustilago*, *Puccinia*, *Polyporus*, *Agaricus*; Deuteromycotina: *Fusarium*, *Cercospora*.

Diversity of Algae, Lichens and Bryophytes

General characters: Range of thallus organization, classification, ultrastructure of eukaryotic algal cell and cyanobacterial cell, economic importance of algae. Lichens classification, thallus organization, reproduction, physiology and role in environmental pollution, Ecological and economic importance of lichens

The characteristics and life cycles of the following: Cyanophyta: *Microcystis*, *Oscillatoria*, Chlorophyta: *Volvox*, *Hydrodictyon*, *Oedogonium*, *Coleochaete*, *Chara*; Bacillariophyta: *Navicula*; Xanthophyta: *Vaucheria*; Phaeophyta: *Ectocarpus*; Rhodophyta: *Polysiphonia*.

Bryophytes: General characters, classification, reproduction and affinities. Gametophytic and sporophytic organization of Bryopsida: *Pogonatum*; Anthocerotopsida: *Anthoceros*.

Gametophytic and sporophytic organization of **Hepaticopsida**: *Riccia*, *Marchantia*.

### **Diversity of Pteridophytes, Gymnosperms and elementary Palaeobotany**

Pteridophytes: General features, classification, stellar system and its evolution. Comparative study of morphology, anatomy, development, vegetative and reproductive systems of Lycopsidea: *Lycopodium*, *Selaginella*; Psilopsida: *Rhynia*.

General and comparative account of gametophytic and sporophytic system in Filicopsida: *Pteridium*, *Nephrolepis*, *Marsilea*. Heterospory and seed habit

Gymnosperms: General characters, classification. Comparative study of morphology, anatomy, development of vegetative and reproductive parts in Cycadales: *Cycas*.

Study of morphology, anatomy, development and reproductive parts in Coniferales: *Pinus*, Gnetales: *Ephedra*.

Affinities and relationship of Gymnosperms, evolutionary significance

Elementary Palaeobotany: General account, types of fossils, methods of fossilization and geological time scale.

## **Diversity of Angiosperms: Systematics, Development and Reproduction**

Systematics: Principles of classification, Binomial nomenclature; comparative study of different classification systems, viz. Linnaeus, Bentham & Hooker, Engler & Prantl, Hutchinson, and Cronquist. Herbarium techniques and important Botanical Gardens

Taxonomic study of following families and their economic importance:

Dicots; Nymphaeaceae, Nelumbonaceae, Ranunculaceae, Malvaceae, Bombacaceae, Brassicaceae, Cucurbitaceae, Rosaceae, Leguminosaceae, Myrtaceae, Rutaceae, Apiaceae, Apocynaceae, Solanaceae, Convolvulaceae, Cuscutaceae, Scrophulariaceae, Acanthaceae, Lamiaceae, Asteraceae, Rubiaceae, Euphorbiaceae, and Amaranthaceae.

Monocots: Cyperaceae, Poaceae, Arecaceae, Liliaceae.

External morphology of vegetative and floral parts, modifications – phyllodes, cladodes, and phylloclades

Meristems types, study of tissue system - epidermal, ground and vascular Anatomy of roots, stems and leaves

Cambium - its function and anomalies in root and stem; root and stem transition

Structure and development of male and female gametophytes: microsporogenesis, microgametogenesis, megasporogenesis and megagametogenesis; embryo sac types, double fertilization, development of embryo, endosperm development and its morphological nature, apomixis and polyembryony

## **Cytology, Genetics, Evolution and Ecology**

Cell structure, cell organelles, nucleus, chromosome structure, nucleosome and solenoid model, salivary gland, lampbrush and B-chromosomes Cell division – mitosis, meiosis, their significance; chromosomal aberrations

Genetics: Laws of inheritance, gene interaction, linkage, cytoplasmic inheritance, sex determination Mutation: Spontaneous, induced mutations, molecular mechanism and evolutionary significance

Ployploidy: origin, kinds and role in evolution Evidences and theories of evolution

Ecology: relation with other disciplines. Plant types: Hydrophytes - *Hydrilla*, *Eichhorina*, *Nymphaea*, *Typha*, Xerophytes – *Nerium*, *Casuarina*, *Saccharum*, *Begonia*. Plant succession – xerophytes, hydrosere; Ecosystems - concept, basic types, components and functioning

## **Plant Physiology and Biochemistry.**

Plant and water relationship: Colligative properties of water, free energy concept; water uptake, conduction, transpiration, mechanism and its regulation by environmental variables

Mineral nutrition: Macro, and micronutrients, their role, deficiency and toxicity symptoms, plant culture practices, mechanism of ion uptake and translocation

Photosynthesis and Chemosynthesis: photosynthetic pigments, O<sub>2</sub> evolution, photophosphorylation, CO<sub>2</sub> fixation in C<sub>3</sub>, C<sub>4</sub> and CAM plants

Respiration: aerobic and anaerobic respiration, respiratory pathways: glycolysis, Krebs cycle, electron transport, oxidative phosphorylation, pentose phosphate pathway, photorespiration, cyanide resistant respiration.

Lipid biosynthesis and its oxidation Nitrogen metabolism: atmospheric nitrogen fixation, nitrogen cycle, nitrogen assimilation Growth, general aspects of phytohormones and inhibitors-auxins, kinetin, gibberellins and ethylene, action and their application; photoperiodism and vernalization Germination, growth movements, parthenocarpy, abscission and senescence

Biomolecules: Classification, properties and biological role of Carbohydrates, Protein and lipids; Chemistry of nucleic acids

Enzymes: Discovery and nomenclature, characteristics of enzymes, concept of holoenzyme, apoenzyme, coenzyme and cofactors; regulation of enzyme activity, mechanism of enzyme action

### **Plant Resource utilization, Palynology and Biostatistics**

Centres of diversity of plants, origin of crop plants, Domestication and introduction of crop plants; Concepts of sustainable development; cultivation, production and uses of - wheat, rice, legumes and sugarcane

A general account of plants yielding oils, spices, beverages. An account of major fiber, medicinal and petro plants of Uttar Pradesh.

Conservation of plants resources for agriculture and forestry.

In situ conservation, sanctuaries, national parks, biosphere reserves, wetlands, mangroves. Ex-situ conservation, botanical gardens, fields, gene banks, seed banks, cryobanks

An introductory knowledge to palynology; morphology, viability and germination of pollens  
Classification of data, mean, median and mode. Standard deviation, standard error, variance, correlation,  $\chi^2$  test and experimental designs

### **Molecular Biology and Biotechnology**

Nucleic acid as genetic material, nucleotides, structure of nucleic acids, properties of genetic code, codons assignment, chain initiation codons, mechanism of protein synthesis and its regulation

Structure and properties of polysaccharides, amino acids, proteins, vitamins and hormones;  
Enzymes: active sites, specificity, mechanisms, factors, general aspects of enzyme kinetics.  
Bioenergetics: Laws of thermodynamics, concept of Gibb's free energy, high energy compounds

Replication of DNA in prokaryotes and eukaryotes, gene expression and regulation, Hormonal control and second messengers  $Ca^{++}$ , Cyclic AMP, IP<sub>3</sub> etc.

Introduction to biotechnology, recombinant DNA technology, plant tissue culture, methods of gene transfer, transgenic plants, biotechnology and healthcare, microbial and environmental biotechnology

### **Environmental Botany and Plant Pathology**

Mineral resources of planet earth, Conservation of mineral resources, soils types, properties and various problem soils

Water: the source of water, physico-chemical and biological properties of water; Sustainable management of water; energy resources in India; Forests: global forest wealth, importance of forests, deforestation.

Environmental pollution: air, water, soil, radioactive, thermal and noise pollutions, their sources, effects and control. (green house effect, ozone depletion and acid rain). CO<sub>2</sub> enrichment and climate change.

Biodiversity and Phytogeography : biotic communities and populations, their characteristics and population dynamics. Natural vegetation of India, static and dynamic plant geography, basic principles governing geographical distribution of plants, endemism Etiology of viral, bacterial, fungal and insect-pest diseases: mosaic diseases of tobacco and cucumber, yellow vein mosaic of bhindi; citrus canker, potato scab, little leaf of brinjal; damping off of seedlings, late blight of potato, red rot of sugarcane Integrated pest disease management

# **Zoology**

Invertebrates (Phylums-Protozoa, Porifera, Coelentrata, Platyminthese, Nematoda, Mollusca, Annelida, Arthropoda, Echinodermata), Hemichordata and Chordata (Urochordata, Cephalochordata, Vertebrate (Pisces, Amphibia, Reptilia, Avian and Mammalia))



# **Syllabus for M.Sc. Entrance Exam (Biological Science)** **(Biotechnology/Microbiology/Biochemistry/Environmental Sciences)**

**A common paper for M.Sc. (Biotechnology/Microbiology/Biochemistry/Environmental Sciences) will come in the entrance examination of PUCAT-2022 which contains 100 question. All questions are compulsory. Time: 2 Hr.**

## **Bio-molecules**

Carbohydrates, Nucleic acids, Proteins, Lipids, Vitamins.

## **Cell biology**

Prokaryotic and eukaryotic cell-structure, Cell Organelle, Cell wall, plasma (cell) membrane, cytoplasm, cytoskeleton, Endoplasmic reticulum (ER) Golgi apparatus, cytoplasmic vacuoles, Glyoxysomes, peroxisomes, Lysosome, mitochondria, plastids, ribosomes microtubules and micro tubular organelles, Nucleus – Chromatin, nuclear envelope and nucleoplasm, Stress physiology, Ageing of cells.

## **Metabolism**

Glycolysis, Gluconeogenesis, Pentose Phosphate pathway, Citric Acid Cycle, DNA Metabolism, RNA metabolism, Protein Metabolism, Fatty Acid catabolism, Biological oxidations-reduction Reactions, ATP synthesis-oxidative and photo-phosphorylation Electron acceptors and donors in plants and animals

## **Genetics**

Mendelian laws of inheritance, Chromosomal theory of inheritance, Linkage and crossing over, Gene mapping, Theories of mutation and evolution, Genetic disorders, DNA modifying enzymes, DNA replication and amplification.

## **Animal Sciences**

Characteristics of invertebrates and vertebrates, anatomy and physiology of different system of humans Circulatory system, Nervous system, Endocrine and exocrine system, Reproductive system, Hormone diversity and action, nerve impulse transmission, endocrinology, human diseases, Apoptosis and cancer, inherited diseases, animal cell culture

## **Plant Sciences**

Vascular and Non Vascular plants, Bryophytes, Pteridophytes, Gymnosperms, Angiosperms, Vascular system in plants, Photosynthesis, photorespiration and its implications, Photoperiodism, Vernalization, Plant hormones Transport across plant cell, Transpiration, Flowering, Sexual Reproduction in flowering Plants, Plant tissue culture, Production of transgenic plants, Economic important of plants,

## **Microbiology & Immunology**

Diversity of microbes, bacterial reproduction, Microbial growth, Antimicrobial agents, Drug resistance, Transformation, Transduction, Conjugation Structure and organization of microbial cells Innate and adaptive immunity T-cells and B-cells Antigen Structure and functions of immunoglobulin vaccine

## **Molecular Biology**

Prokaryotic and eukaryotic Replication, DNA Repair systems, Recombination, Transcription, Translation, Regulation of Gene Expression, genetic code, operon concept.

## **Recombinant DNA technology**

Principles of gene cloning, Plasmids, Bacteriophages, Cosmids Phagemids, BACs YACs Alpha complementation Restriction enzymes Ligases PCR applications of biotechnology in medicine, industry and agriculture, environmental biotechnology Biogeochemical cycle

## **Bio-Techniques**

Principles Types and Applications of chromatography, Spectrophotometry, Centrifugation, Electrophoresis

# **Syllabus for B.Sc. (Zoology, Botany, Chemistry, Environmental Science, Physics, Maths, Chemistry, Geology, Microbiology), B.Sc. (Hons.) Biotechnology, B.Sc. (Hons.) Environmental Science.**

**Question paper consists of 100 MCQs. 30 questions from physics, 30 questions from chemistry and 40 questions from Mathematics or Biology. All Parts are compulsory. Time: 2 Hr.**

## **Biology**

### **Diversity of Living Organisms**

**The Living World What is living? Biodiversity;** Need for classification; three domains of life; concept of species and taxonomical hierarchy; binomial nomenclature.

**Biological Classification Five kingdom classification;** Salient features and classification of Monera, Protista and Fungi into major groups; Lichens, Viruses and Viroids.

**Plant Kingdom** Salient features and classification of plants into major groups - Algae, Bryophyta, Pteridophyta and Gymnospermae. (salient and distinguishing features and a few examples of each category).

**Animal Kingdom** Salient features and classification of animals, non-chordates up to phyla level and chordates up to class level (salient features and distinguishing features of a few examples of each category). (No live animals or specimen should be displayed.)

### **Structural Organization in Animals and Plants**

**Morphology of Flowering Plants** Morphology of inflorescence and flower, Description of 01 family: Solanaceae or Liliaceae (to be dealt along with the relevant experiments of the Practical Syllabus).

**Structural Organization in Animals** Animal tissues.

### **Cell: Structure and Function**

**Cell-The Unit of Life** 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.

**Biomolecules** Chemical constituents of living cells: biomolecules, structure and function of proteins, carbohydrates, lipids, nucleic acids; Enzymes- types, properties, enzyme action.

### **Cell: Structure and Function**

**Cell Cycle and Cell Division** Cell cycle, mitosis, meiosis and their significance

### **Plant Physiology**

**Photosynthesis in Higher Plants** Photosynthesis as a means of autotrophic nutrition; site of photosynthesis, pigments involved in photosynthesis (elementary idea); photochemical and biosynthetic phases of photosynthesis; cyclic and non-cyclic photophosphorylation; chemiosmotic hypothesis; photorespiration; C<sub>3</sub> and C<sub>4</sub> pathways; factors affecting photosynthesis.

**Respiration in Plants** 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.

**Plant - Growth and Development** Growth regulators - auxin, gibberellin, cytokinin, ethylene, ABA.

### **Human Physiology**

**Breathing and Exchange of Gases** 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.

**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.

**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 - uremia, renal failure, renal calculi, nephritis; dialysis and artificial kidney, kidney transplant.

**Locomotion and Movement** Skeletal muscle, contractile proteins and muscle contraction.

**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.

**Chemical Coordination and Integration** 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, goiter, exophthalmic goiter, diabetes, Addison's disease.

## **Reproduction**

**Sexual Reproduction in Flowering Plants** 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 dispersal and fruit formation.

## **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 (STDs); 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).

## **Genetics and Evolution**

**Principles of Inheritance and Variation** 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; chromosome theory of inheritance; chromosomes and genes; Sex determination - in human being, birds and honey bee; linkage and crossing over; sex linked inheritance - haemophilia, colour blindness; Mendelian disorders in humans -thalassemia; chromosomal disorders in humans; Down's syndrome, Turner's and Klinefelter's syndromes.

**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, Human and rice genome projects; DNA fingerprinting.

## **Biology and Human Welfare**

**Human Health and Diseases** Pathogens; parasites causing human diseases (malaria, dengue,

chikungunya, filariasis, ascariasis, typhoid, pneumonia, common cold, amoebiasis, ring worm) and their control; Basic concepts of immunology - vaccines; cancer, HIV and AIDS; Adolescence - drug and alcohol abuse.

**Microbes in Human Welfare** Microbes in food processing, industrial production, sewage treatment, energy generation and microbes as bio-control agents and bio-fertilizers. Antibiotics; production and judicious use. Unit-IX Biotechnology and its Applications Chapter-11:

**Biotechnology - Principles and Processes** Genetic Engineering (Recombinant DNA Technology).

**Biotechnology and its Application** Application of biotechnology in health and agriculture: Human insulin and vaccine production, stem cell technology, gene therapy; genetically modified organisms - Bt crops; transgenic animals; biosafety issues, biopiracy and patents.

### **Ecology and Environment**

**Organisms and Populations** 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.

**Biodiversity and its Conservation** Biodiversity - Concept, patterns, importance; loss of biodiversity; biodiversity conservation; hotspots, endangered organisms, extinction, Red Data Book, Sacred Groves, biosphere reserves, national parks, wildlife, sanctuaries and Ramsar sites.

## **Physics**

### **Physical World and Measurement**

Physical World: Physics- scope and excitement, nature of physical laws, Physics, technology and society

Units and Measurements: Need for measurement, Units of measurement, Length, mass and time measurements, systems of units, SI units, fundamental and derived units, errors in measurement, significant figures, Dimensions of physical quantities, accuracy and precision of measuring instruments, dimensional analysis and its applications

### **Kinematics**

Motion in a Straight Line: Frame of reference, Motion in a straight line, Position-time graph, speed and velocity, uniform and non-uniform motion, average speed and instantaneous velocity, uniformly accelerated motion, Relations for uniformly accelerated motion, velocity-time and position-time graphs, Elementary concepts of differentiation and integration for describing motion

Motion in a Plane: Scalar and vector quantities, general vectors and their notations, equality of vectors, position and displacement vectors, multiplication of vectors by a real number, addition and subtraction of vectors, relative velocity, Unit vector, rectangular components, Scalar and Vector product of vectors, resolution of a vector in a plane, Motion in a plane, cases of uniform velocity and uniform acceleration, projectile motion, uniform circular motion

### **Laws of Motion**

Intuitive concept of force, Equilibrium of concurrent forces, Inertia, Newton's first, second and third law of motion, momentum, impulse, Law of conservation of linear momentum and its

applications, Centripetal force, examples of circular motion, Static and kinetic friction, laws of friction, rolling friction, lubrication, Dynamics of uniform circular motion

## **Work, Energy and Power**

Work done by a constant force and a variable force, kinetic energy, motion in a vertical circle, work-energy theorem, power, elastic and inelastic collisions in one and two dimensions, Notion of potential energy, potential energy of a spring, conservative forces, conservation of mechanical energy, non-conservative forces

## **Motion of System of Particles and Rigid Body**

Centre of mass of a two-particle system, momentum conservation and centre of mass motion, Centre of mass of rigid body, rigid body rotation and equations of rotational motion, centre of mass of uniform rod, Equilibrium of rigid bodies, Moment of force, torque, angular momentum, law of conservation of angular momentum and its applications, comparison of linear and rotational motions, Moment of inertia, values of moments of inertia for simple geometrical objects, Statement of parallel and perpendicular axes theorems and their applications, radius of gyration

## **Gravitation**

Kepler's laws of planetary motion, universal law of gravitation, Gravitational potential energy and gravitational potential, Acceleration due to gravity and its variation with altitude and depth, escape velocity, Geo-stationary satellites, orbital velocity of a satellite

## **Properties of Bulk Matter**

Mechanical Properties of Solids: Elastic behaviour, Hooke's law, Stress-strain relationship, bulk modulus, Young's modulus, shear modulus of rigidity, Poisson's ratio, elastic energy

Mechanical Properties of Fluids: Pressure due to a fluid column, Pascal's law and its applications, Viscosity, Stokes' law, terminal velocity, streamline and turbulent flow, critical velocity, effect of gravity on fluid pressure, application of surface tension ideas to drops, Bernoulli's theorem and its applications, Surface energy and surface tension, angle of contact, excess of pressure across a curved surface, bubbles and capillary rise

Thermal Properties of Matter: Heat, temperature, thermal expansion, thermal expansion of solids, liquids and gases, specific heat capacity, Wein's displacement Law, Stefan's law,  $C_p$ ,  $C_v$  - calorimetry, change of state- latent heat capacity, Heat transfer-conduction, convection and radiation, qualitative ideas of Blackbody radiation, anomalous expansion of water, thermal conductivity, Greenhouse effect

## **Thermodynamics**

Thermal equilibrium and definition of temperature, zeroth law, heat, work and internal energy, isothermal and adiabatic processes, Laws of thermodynamics, reversible and irreversible processes, Heat engine and refrigerator

## **Behaviour of Perfect Gases and Kinetic Theory of Gases**

Equation of state of a perfect gas, concept of mean free path, work done in compressing a gas, Kinetic interpretation of temperature, Kinetic theory of gases- assumptions, concept of pressure, Avogadro's number, RMS speed of gas molecules, degrees of freedom, law of equi-partition of energy and application to specific heat capacities of gases

## **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, energy in S.H.M., phase, oscillations of a loaded spring- restoring force and force constant, Kinetic and potential energies, Free, forced and damped oscillations, simple pendulum derivation of expression for its time period, resonance

Waves: Wave motion, speed of travelling wave, Transverse and longitudinal waves, displacement relation for a progressive wave, fundamental mode and harmonics, Beats, principle of superposition of waves, reflection of waves, Doppler effect, standing waves in strings and organ pipes

## **Units and Measurements**

Need for measurement: 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, 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 a plane, cases of uniform velocity and uniform acceleration- projectile motion, uniform circular 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. Equilibrium of concurrent forces, Static and kinetic friction, laws of friction, rolling friction, lubrication. 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.

## **System of Particles and Rotational Motion**

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. Moment of a force, torque, angular momentum, law of conservation of angular momentum and its applications. Equilibrium of rigid bodies, rigid body rotation and equations of rotational motion, comparison of linear and rotational motions. Moment of inertia, radius of gyration, values of moments of inertia for simple geometrical objects (no derivation).

## **Gravitation**

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 velocity, 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), Poisson's ratio; elastic energy.

## **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 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.

## **Thermal Properties of Matter**

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, qualitative ideas of Blackbody radiation, Wein's displacement Law, Stefan's law .

## **Thermodynamics**

Thermal equilibrium and definition of temperature zeroth law of thermodynamics, 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. Kinetic interpretation of temperature; rms speed of gas molecules; degrees of freedom, law of equi-partition of energy (statement only) and application to specific heat capacities of gases; concept of mean free path, Avogadro's number.

## **Oscillations**

Periodic motion - time period, frequency, displacement as a function of time, periodic functions and their application. 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.

## Waves

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.

## Chemistry

**Some Basic Concepts of Chemistry:** General Introduction: Importance and scope of Chemistry. Atomic and molecular masses, mole concept and molar mass, percentage composition, empirical and molecular formula, chemical reactions, stoichiometry and calculations based on stoichiometry.

**Structure of Atom:** Bohr's model and its limitations, concept of shells and subshells, dual nature of matter and light, de Broglie's relationship, Heisenberg uncertainty principle, concept of orbitals, quantum numbers, shapes of s, p and d orbitals, rules for filling electrons in orbitals - Aufbau principle, Pauli's exclusion principle and Hund's rule, electronic configuration of atoms, stability of half-filled and completely filled orbitals.

**Classification of Elements and Periodicity in Properties:** Modern periodic law and the present form of periodic table, periodic trends in properties of elements - atomic radii, ionic radii, inert gas radii, Ionization enthalpy, electron gain enthalpy, electronegativity, valency. Nomenclature of elements with atomic number greater than 100.

**Chemical Bonding and Molecular Structure:** 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, molecular orbital theory of homonuclear diatomic molecules(qualitative idea only), Hydrogen bond.

**Redox Reactions:** Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions - in terms of loss and gain of electrons and change in oxidation number.

**Hydrogen:** Position of hydrogen in periodic table, occurrence, isotopes, hydrides ionic, covalent and interstitial; physical and chemical properties of water, heavy water, hydrogen as a fuel.

**Organic Chemistry:** Some basic Principles and Techniques: General introduction, classification and IUPAC nomenclature of organic compounds. 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.

**States of Matter:** Gases and Liquids: Three states of matter, intermolecular interactions, types of bonding, melting and boiling points, role of gas laws in elucidating the concept of the molecule, Boyle's law, Charles law, Gay Lussac's law, Avogadro's law, ideal behaviour, empirical derivation of gas equation, Avogadro's number, ideal gas equation and deviation from ideal behaviour.

**Chemical Thermodynamics:** Concepts of System and types of systems, surroundings, work, heat, energy, extensive and intensive properties, state functions. First law of thermodynamics - internal energy and enthalpy, 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. Second law of Thermodynamics (brief introduction) Introduction of entropy as a state function, Gibb's energy change for spontaneous and non- spontaneous processes. Third law of thermodynamics (brief introduction).

**Equilibrium:** Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constant, factors affecting equilibrium - Le Chatelier's principle, ionic



equilibrium- ionization of acids and bases, strong and weak electrolytes, degree of ionization, ionization of poly basic acids, acid strength, concept of pH, buffer solution, solubility product, common ion effect (with illustrative examples).

**s -Block Elements:** Group 1 and Group 2 Elements -General introduction, electronic configuration, occurrence, anomalous properties of the first element of each group, diagonal relationship, trends in the variation of properties (such as ionization enthalpy, atomic and ionic radii), trends in chemical reactivity with oxygen, water, hydrogen and halogens, uses.

**Some p -Block Elements:** General Introduction to p -Block Elements Group 13 Elements: General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous properties of first element of the group, Boron - physical and chemical properties. Group 14 Elements: General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behaviour of first elements. Carbon - catenation, allotropic forms, physical and chemical properties.

**Hydrocarbons:** Classification of Hydrocarbons Aliphatic Hydrocarbons: Alkanes - Nomenclature, isomerism, conformation (ethane only), physical properties, chemical reactions. Alkenes - Nomenclature, structure of double bond (Ethene), geometrical isomerism, physical properties, methods of preparation, chemical reactions:- addition of Hydrogen, Halogen, water, hydrogen halides (Markovnikov's addition and peroxide effect), Ozonolysis, Oxidation, mechanism of electrophilic 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 Hydrocarbons:** Introduction, IUPAC nomenclature, benzene: resonance, aromaticity, chemical properties: mechanism of electrophilic substitution. Nitration, sulphonation, halogenation, Friedel Craft's alkylation and acylation, directive influence of functional group in monosubstituted benzene. Carcinogenicity and toxicity.

**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.

**Solutions:** Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, Raoult's law, colligative properties - relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties.

**p Block Elements:** Group -15 Elements: General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; Nitrogen preparation properties and uses; compounds of Nitrogen: preparation and properties of Ammonia and Nitric Acid. 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; compounds of Sulphur: preparation properties and uses of Sulphur-dioxide, Sulphuric Acid: 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.

**Haloalkanes and Haloarenes: Haloalkanes:** Nomenclature, nature of C-X bond, physical and chemical properties, optical rotation mechanism of substitution reactions. Haloarenes: Nature of C-

X bond, substitution reactions (Directive influence of halogen in monosubstituted compounds only). **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. **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.

**Biomolecules: Carbohydrates** - Classification (aldoses and ketoses), monosaccharides (glucose and fructose), D-L configuration **Proteins** -Elementary idea of - amino acids, peptide bond, polypeptides, proteins, structure of proteins - primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins. **Nucleic Acids:** DNA and RNA

## Mathematics

**Sets:** Empty set, Finite and Infinite sets, Equal sets, Subsets, Power set, Universal set, Venn diagrams. Union and Intersection of sets. Difference of sets. Complement of a set. Properties of Complement. Ordered pairs. Cartesian product of sets. Number of elements in the Cartesian product of two finite sets.

**Relations & Functions:** Definition of relation, domain, co-domain and range of a relation. Types of relations: reflexive, symmetric, transitive and equivalence relations. Function as a special type of relation. Domain, co-domain and range of a function. Types of functions. Sum, difference, product and quotients of functions.

**Trigonometric Functions:** Measuring angles in radians and in degrees and conversion from one measure to another. Definition of trigonometric functions with the help of unit circle. Domain and range of trigonometric functions and their graphs. Trigonometric identities. General solution of trigonometric equations. Definition and elementary properties of inverse trigonometric functions.

**Algebra:** Principle of mathematical induction and simple applications. Permutations and Combinations with simple applications. Binomial theorem. Pascal's triangle, General and middle term in binomial expansion, simple applications.

**Complex Numbers and Quadratic Equations--** Algebraic properties of complex numbers. Argand plane and polar representation of complex numbers. Statement of Fundamental Theorem of Algebra. Solutions of quadratic equations (with real coefficients) in the complex number system. Square root of a complex number.

**Matrices--** Concept, notation, order, equality, types of matrices. Operations on matrices. Concept of elementary row and column operations. Invertible matrices (Here all matrices will have real entries).

**Determinants--** Determinant of a square matrix and properties of determinants. 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.

**Linear Inequalities--** Solutions of linear inequalities in one variable as well as in two variables.

**Sequence and Series--** Definitions of sequence and series. Arithmetic Progression (A. P.). Arithmetic Mean (A.M.). Geometric Progression (G.P.). Geometric Mean (G.M.). Simple applications regarding A.P. and G.P.

### Coordinate Geometry:

**Straight Lines--** Various forms of equations of a line, slope of a line and angle between two lines. Distance of a point from a line.

**Conic Sections--** Circle, ellipse, parabola, hyperbola, a point, a straight line and a pair of intersecting lines as a degenerated case of a conic section. Standard equations and simple properties of circle, parabola, ellipse and hyperbola.

**Introduction to Three-dimensional Geometry--** Coordinate axes and coordinate planes in three

dimensions. Coordinates of a point. Distance between two points and section formula.

### **Calculus:**

**Limit, Continuity and Derivative--** Concept of limit of a function, Definitions of Continuity and differentiability of a function. Algebra of limits of functions, continuous functions and derivatives of functions. Chain rule. Rolle's and Lagrange's Mean Value Theorems (without proof) and their geometric interpretation. Applications of limits, continuity and derivatives.

**Integrals--** Integration as inverse process of differentiation. Integration of a variety of functions. Definite integrals as a limit of a sum, Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals.

**Applications of the Integrals--** Applications in finding the area under simple curves, especially lines, circles/ parabolas/ellipses (in standard form only), Area between any of the two above said curves (the region should be clearly identifiable).

**Differential Equations--** Definition, order and degree, general and particular solutions of a differential equation. Formation of differential equation whose general solution is given. Solution of differential equations by method of separation of variables, solutions of homogeneous differential equations of first order and first degree

### **Vectors and Three-Dimensional Geometry:**

**Vectors and Scalars--** Definition of a vector and also of a scalar. Direction cosines and direction ratios of a vector. Types of vectors, position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Properties and applications of scalar (dot) product of vectors, vector (cross) product of vectors, and scalar triple product of vectors.

**Three-dimensional Geometry--** Direction cosines and direction ratios of a line joining two points. Cartesian equation and vector equation of a line, coplanar and skew lines, shortest distance between two lines. Cartesian and vector equation of a plane. Angle between (i) two lines, (ii) two planes, (iii) a line and a plane. Distance of a point from a plane.

**Linear Programming:** Introduction, related terminology such as constraints, objective function, optimization, different types of linear programming (L.P.) problems, mathematical formulation of L.P. problems, graphical method of solution for problems in two variables, feasible and infeasible regions (bounded or unbounded), feasible and infeasible solutions, optimal feasible solutions (up to three non-trivial constraints).

### **Statistics and Probability:**

**Statistics--** Measures of Dispersion: Range, Mean deviation, variance and standard deviation of ungrouped/grouped data. Analysis of frequency distributions with equal means but different variances. **Probability--** Random experiments; outcomes, sample spaces (set representation). Events; occurrence of events, 'not', 'and' and 'or' events, exhaustive events, mutually exclusive events, Axiomatic (set theoretic) probability, connections with other theories of earlier classes. Probability of an event, probability of 'not', 'and' and 'or' events. Conditional probability, multiplication theorem on probability, independent events, total probability, Bayes' theorem, Random variable and its probability distribution, mean and variance of random variable. Binomial probability distribution.

## **MBA\_Syllabus\_2022**

**A common paper for MBA, MBA(Business Economics), MBA(Finance & Control), MBA(e-Commerce), MBA(Agri-Business), MBA (HRD) will come in the entrance examination of PUCAT-2022. Question paper consists of 100 MCQs. All questions are compulsory. Time: 2 Hr.**

### **Section A**

English Language Grammar Vocabulary Uncommon words Sentence completion Synonyms Antonyms Relationship between words & phrases Comprehension of passages

### **Section B**

Numerical Aptitude Numerical calculation Arithmetic Simple algebra Geometry and trigonometry Interpretation of graphs Charts and tables.

### **Section C**

Thinking and Decision Making Creative thinking unfamiliar relationships Verbal reasoning finding patterns trends Assessment of figures & diagrams

### **Section D**

General Awareness Knowledge of current affairs other issues related to trade, industry, economy, sports, culture and science

## Syllabus - D. Pharm Entrance PUCAT-2022

Syllabus for D. Pharm entrance exam in PUCAT-2022 comprises Physics, Chemistry, and Biology/Mathematics of Intermediate level. Question paper consists of 100 MCQs (35 questions of Physics, 35 Questions of Chemistry and 30 Questions of Biology & 30 Questions of Mathematics). All questions of Physics and Chemistry are compulsory and candidates should solve either of Biology or Mathematics questions. Time: 2 Hr.

- 1. Physics:-** Units and measurements, motion in a straight line, motion in a plane, laws of motion, work, energy and power, system of particles and rotational motion, gravitation, mechanical properties of solids, thermal properties of fluids, thermodynamics, kinetic theory, oscillations, waves, electric charges and fields, electrostatic potential and capacitance, current electricity, moving charges and magnetism, magnetism and matter, electromagnetic induction, alternating current, electromagnetic waves, ray optics, dual nature of radiation, atoms, nuclei, semiconductor electronics: materials, devices and simple circuits.
- 2. Chemistry :-** Basic concepts of chemistry, structure of atoms, classification of elements and periodicity in properties, chemical bonding and molecular structure, states of matter, thermodynamics, equilibrium, redox reactions, s-block elements, p-block elements, d and f- block elements, hydrocarbons, environmental chemistry, the solid state, solutions, electrochemistry, chemical kinetics, surface chemistry, general principles and processes of isolation of elements, coordination compounds, haloalkanes, alcohols, phenols and ethers, aldehydes, ketones, and carboxylic acids, amines, biomolecules, polymers, chemistry in everyday life.
- 3. Biology:-** The living world, biological classification, plant kingdom, animal kingdom, morphology of flowering plants, anatomy of flowering plants, structural organisation in animals, Cell, biomolecules, cell cycle and cell division, transport in plants, mineral nutrition, photosynthesis, respiration, plant growth and development, digestion and absorption, breathing and exchange of gases, body fluids and circulation, excretory products and their elimination, locomotion and movement, neural control and coordination, chemical coordination and integration, reproduction in organism, sexual reproduction in flowering plants, principles of inheritance and variation, molecular basis of inheritance, evolution, human health and diseases, microbes in human welfare, biotechnology and its application, organisms and populations, ecosystems, biodiversity and conservation, environmental issues.
- 4. Mathematics:-** Relations and functions, inverse trigonometric functions, matrices, determinants, continuity and differentiability, application of derivatives, integrals, application of integrals, differential equation, vector algebra, three dimensional geometry, linear programming, probability, sets, complex numbers and quadratic equations, linear inequalities, permutations and combinations, binomial theorem, sequence and series, conic sections, limits and derivatives, statistics, mathematical reasoning.

## Syllabus - BCA Entrance PUCAT-2022

**Syllabus for BCA entrance exam in PUCAT-2022 comprises of Arithmetic Aptitude, Logical reasoning, Computer Awareness, English language and General Knowledge & Current Affairs. Question paper consists of 100 MCQs and divided into five section. Each section has equal number of questions. All questions are Compulsory. Time:2 Hr.**

- 1. Arithmetic Aptitude-** Percentage , Profit and Loss, Calendar problem, Simplification, Average, Problem on Trains, Time and work, Probability, Simple & compound Interest, Problems on Ages, Clock, Volume and Surface Area, Ratio.
- 2. Reasoning-** Odd man out, Analogy, Letter and Symbol Series, Letter and Symbol Series, Blood Relation, Logical Problems, Statement and Conclusion, Artificial Language, Data Sufficiency
- 3. Computer Awareness** – Introduction, Generation of computers, Operating system, History of Computer, Input/output devices, Hardware & Software, Computer networks, Data Processing, Computer Memory.
- 4. General English-** One Word Substitution, Synonyms, Antonyms, Grammar, Idioms and Phrases, Ordering of Words, Ordering of Sentences, Sentence Completion, Punctuation, Article.
- 5. General Knowledge & Current Affairs-** Knowledge of Current Affairs and other issues related to Trade, Industry, Economy, Govt. Program, , National /International days, Sports, Culture and Science, Awards and Honours, Famous Personalities, World Rankings, Annul Reports of International Organizations/Institutions, Geography, History, Awards and Honours, Inventions.

# Syllabus for Master of Computer Applications

**Syllabus for MCA entrance exam in PUCAT-2022 consists of 100 MCQs. All questions are Compulsory. Time: 2 Hr.**

## **Thinking and Decision Making:**

- Creative thinking, unfamiliar relationships, verbal reasoning, finding patterns trends and Assessment of figures & diagrams.
- Geometrical designs & Identification
- Selection of related letters / words / numbers / figures
- Identification of odd thing / item out from a group
- Completion of numerical series based on the pattern / logic
- Fill in the blanks of the series based on the numerical pattern and logic of the series
- Syllogisms (logic based questions), Identification of logic & selection of correct answers based on the logic

## **Mathematics:**

- Set Theory: Concept of sets – Union, Intersection, Cardinality, Elementary counting; permutations and combinations. • Probability and Statistics: Basic concepts of probability theory, Averages, Dependent and independent events, frequency distributions, measures of central tendencies and dispersions.
- Algebra: Fundamental operations in algebra, expansions, factorization, simultaneous linear /quadratic equations, indices, logarithms, arithmetic, geometric and harmonic progressions, determinants and matrices.
- Coordinate Geometry: Rectangular Cartesian coordinates, distance formulae, equation of a line, and intersection of lines, pair of straight lines, equations of a circle, parabola, ellipse and hyperbola. Calculus: Limit of functions, continuous function, differentiation of function, tangents and normal, simple examples of maxima and minima. Integration of functions by parts, by substitution and by partial fraction, definite integrals, applications of definite integrals to areas.
- Vectors: Position vector, addition and subtraction of vectors, scalar and vector products and their applications to simple geometrical problems and mechanics.
- Trigonometry: Simple identities, trigonometric equations, properties of triangles, solution of triangles, heights and distances, general solutions of trigonometric equations.

## **Computer Awareness:**

- Computer Basics: Organization of a computer, Central Processing Unit (CPU), structure of instructions in CPU, input/output devices, computer memory, and back-up devices.
- Data Representation: Representation of characters, integers and fractions, binary and hexadecimal representations, binary arithmetic: addition, subtraction, multiplication, division, simple arithmetic and two's complement arithmetic, floating point representation of numbers, Boolean algebra, truth tables, Venn diagrams.

## **Syllabus – B.Com (Hons.) Entrance Exam PUCAT-2022**

**Syllabus for B.Com (Hons) entrance exam in PUCAT-2022 comprises of Basic Mathematics, Business Organization, Business Management, Accountancy, Financial Statement Analysis, Financial Markets, Economics, Money and Banking, Business Environment, General English Computer Basics Current Economic Affairs and Reasoning. Question paper consists of 100 MCQs. All questions are Compulsory. Time: 2 Hr.**

## **Syllabus – B.A. LLB (Hons.) Entrance Exam PUCAT-2022**

**Syllabus for B.A. LLB (Hons.) entrance exam in PUCAT-2022 consists of 100 MCQs. All questions are Compulsory. Time: 2 Hr.**

### **A.Language Comprehension**

**(i) Hindi-10 questions,**

**10 marks**

**(ii) English-20 questions**

**20 marks**

**B.(i) Reasoning, Mental Ability-20 questions**

**20 marks**

**And (ii) Legal Aptitude-20 questions 20 marks**

**C. General Awareness and Current Affairs-30 questions**

**30 marks**

**Total-100 (Multiple Choice Questions) 100 marks**