गोंय विद्यापीठ
ताळगांव पठार,
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Goa University
Taleigao Plateau,Goa - 403 206
Tel : +91-8669609048
Email : registrar@unigoa.ac.in
Website : www.unigoa.ac.in

(Accredited by NAAC with Grade A+)

GU/Acad –PG/BoS - GU-ART /2025-26/580 Date: 26.11.2025

CIRCULAR

The syllabus for the Goa University–Admission Ranking Test (GU-ART) of **Master of Science in Biochemistry** and **B.Ed. in Biochemistry** Programmes, approved by the Academic Council in its meeting held on 7th November 2025 is attached.

The Dean/Vice-Dean (Academic) of the School of Chemical Sciences and the Principals of all the affiliated Colleges are requested to take note of the above and bring the contents of this Circular to the notice of all concerned, including students aspiring to pursue the Master's and B.Ed. Programmes.

ASHWIN VYAS LAWANDE
Digitally signed by ASHWIN VYAS LAWANDE
Date: 2025.11.26 14:53:23 +05'30'

(Ashwin V. Lawande)
Deputy Registrar – Academic

To,
1. The Dean, School of Chemical Sciences, Goa University.
2. The Vice-Dean (Academic), School of Chemical Sciences, Goa University.
3. Principals of all the affiliated Colleges.

Copy to:
1. Controller of Examinations, Goa University.
2. Assistant Registrar (Admissions), Goa University.
3. Assistant Registrar Examinations (UG/PG), Goa University.
4. Director, Directorate of Internal Quality Assurance, Goa University for uploading the Syllabus on the University website.

GOA UNIVERSITY

SYLLABUS FOR GOA UNIVERSITY-ADMISSIONS RANKING TEST (GU-ART) FOR MASTER'S & B.Ed. IN BIOCHEMISTRY PROGRAMMES

Effective from AY: 2026-27

Modules	Content
Module 1:	**Cell Biology**
	Cell theory and cell as the basic unit of life; Structure of prokaryotic and eukaryotic cells; Plant cell and animal cell; Prokaryotic cell components (cell envelope; cell membrane, cell wall, Glycocalyx, slime, capsule, flagella, fimbriae, pili); Structure and functions of eukaryotic cell organelles (endomembrane system, endoplasmic reticulum, Golgi bodies, lysosomes, vacuoles; mitochondria, ribosomes, plastids, Plasmodesmata, cytoskeleton, cilia, flagella, centrioles, nucleus, peroxisomes, endosome and microbodies). Cell Cycle and Cell Division: Cell cycle, mitosis, meiosis and their significance
Module 2:	**Diversity of living organisms and classification**
	Biodiversity; Need for classification; taxonomy and systematics; concept of species and taxonomical hierarchy; Systems of classification: Binomial nomenclature, Classification schemes such as (Linnaeus, Haeckel, Whittaker and Woese); Animal and plant diversity and ecosytems/ habitats associated animal and plant diversity; Microbial diversity and classification: General characteristics (Occurrence, mode of nutrition, morphology, reproduction) of different groups of microorganisms: viruses, viroids, prions, Prokarya (Archaea, Eubacteria), Eukarya (Algae, fungi, protozoa).
Module 3:	**Biomolecules**
	Chemical constituents of living cells **Carbohydrates**: Classification (monosaccharides- aldoses and ketoses e.g. glucose and fructose; D-L configuration oligosaccharides e.g. sucrose, lactose, maltose; polysaccharides e.g. starch, cellulose, glycogen; Glycoconjugates); Importance of carbohydrates;

Approved by: Academic Council on 7th November 2025

	Proteins: Classification, structure & physico-chemical properties of amino acids (amphoteric molecules, ionisation, zwitterions, pka values, isoelectric point), elementary idea of amino acids, peptide bond, polypeptides, proteins; structure of proteins - primary, secondary, tertiary structure and quaternary structures. **Enzymes**: Classification of Enzymes; Holoenzyme, Zymogens, Iso-enzymes, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, Specificity of enzyme action, Factors affecting rate of enzyme-catalyzed reactions; Concept of Michaelis-Menten equation, Significance of Km; Reversible and Irreversible inhibition: Competitive, Non-competitive and mixed inhibition. Feedback inhibition. **Lipids**: Classification of Lipid; Building blocks of lipids: fatty acids (Physiologically important saturated and unsaturated fatty acids), glycerol, ceramide; Storage lipids: triacylglycerol and waxes; Structural lipids in membranes: glycerophospholipids, galactolipids, sphingolipids and sterols. **Nucleic Acids**: Bases, Nucleosides, Nucleotides, Nucleotides as Energy carriers; Structure of nucleotides; Watson & Crick's model of DNA, forms of DNA; structure of RNA, types of RNA. **Vitamins**: Classification, properties, occurrence and functions and deficiency symptoms of vitamins (Fat-soluble viz. A, D, E, K and Water-soluble vitamins e.g. B Complex, Vitamin C)
Module 4:	**Biochemical Processes, Metabolism, Bioenergetics** **Carbohydrate metabolism:** Glycogenolysis; Glycolysis: sequence of reactions, products, energetics, fate of pyruvate in aerobic and anaerobic conditions. Kreb's cycle: cellular location, sequence of reactions, products, energetics, amphibolic nature. Substrate level phosphorylation, Oxidative Phosphorylation: Electron transport chain: electron carriers, redox potentials, basic chemistry (Free energy, free energy change, exergonic and endergonic reactions), sequence and location of electron carriers in the mitochondrial membrane. ATP: Structure, ATP as high energy compound, Structure of ATPase (FoF1- ATPase). Mechanism of ATP synthesis, hydrolysis of ATP & other high energy phosphate compounds. HMP Shunt: Cellular location, sequence of reactions, oxidative and non-oxidative phases of pathway and multifunctional nature; Gluconeogenesis, Glyoxylate pathway. Glycogenesis. **Protein metabolism:** Transamination, Decarboxylation, Deamination: Oxidative (NAD, FAD, FMN-linked oxidases) & Non-oxidative – Asp, Cys, Ser; Urea Cycle (Cellular location, sequence of reactions, formation and transport of ammonia).

	Lipid metabolism: Beta–oxidation of even carbon saturated fatty acids and unsaturated fatty acids, fatty acyl synthetase complex; Alpha and Omega oxidation of fatty acids, ketogenesis- Ketogenic and Antiketogenic substances, Regulation of ketogenesis. **Metabolism of nucleotides:** Degradation of purine and pyrimidine nucleotides. Recycling and biosynthesis of purines and pyrimidines.
Module 5:	**Animal and plant physiology** **Animal physiology:** **Circulatory system**: General pattern of circulation; Hemodynamics-volume, viscosity and stasis; Structure of heart; Origin of heartbeat, Conduction of heartbeat; Cardiac cycle, cardiac output, stroke volume. Regulation of heart function; Blood pressure- systolic, diastolic, mean arterial & pulse pressure, factors controlling blood pressure; Composition of blood, blood groups, coagulation of blood; composition of lymph and its function. **Respiratory system in humans:** Mechanism of respiration, Pulmonary ventilation; Transport of O2 and CO2 in blood; Dissociation curves and the factors influencing it. **Muscle physiology:** Types of muscles, microscopic and electron microscopic structure of striated, smooth and cardiac muscles. The sarco-tubular system. **Digestion and Absorption:** Alimentary canal and digestive glands, Mechanical and chemical digestion of food; role of digestive enzymes and gastrointestinal hormones; Peristalsis, digestion, absorption and assimilation of proteins, carbohydrates and fats. **Excretory Products and Their Elimination:** Modes of excretion: ammonotelism, ureotelism, uricotelism; human excretory system: Organization of urinary system, Gross structure of kidney, Role of kidney in acid base balance, urine formation, osmoregulation. **Reproductive system:** Ovary (Structure, functions, Folliculogenesis and ovulation, hormonal control of ovarian function; Menstrual cycle and its hormonal control); Testis (Structure and Functions, seminiferous tubules and interstitial tissue of Leydig; Hormonal control of testicular function) **Plant physiology:** **Photosynthesis**: Structure of photosynthetic apparatus; photosynthetic pigments (chlorophyll a, chlorophyll b, carotenoids, phaeophytins and phycobillins); Light reaction: Photosystems and harvesting of light; electron transport pathways (cyclic and non-cyclic); mechanism of ATP synthesis; photophosphorylation); Dark reaction: C3, C4 and CAM pathways of carbon fixation; Mechanism of photorespiration;

	Respiration- Glycolysis, TCA cycle, oxidative phosphorylation, Pentose Phosphate Pathway; anaerobic respiration.
Module 6:	**Genetics and evolution**
	Heredity and variation: Overview of Mendelian genetics- Mendel's experimental design, monohybrid, di-hybrid and tri-hybrid crosses, Mendel's Laws of Inheritance, Law of segregation & Principle of independent assortment, test cross, back cross, Chromosomal theory of inheritance. **Chromosome and genomic organization:** Eukaryotic nuclear genome nucleotide sequence composition (unique & repetitive DNA, satellite DNA); Genetic organization of prokaryotic genome; Concept of euchromatin and heterochromatin; Packaging of DNA molecule into chromosomes, chromosome morphology, chromosome banding pattern, karyotype; concept of cistron, exons, introns. **Evolution:** Origin of life; biological evolution; Darwin's contribution, modern synthetic theory of evolution; mechanism of evolution - variation (mutation and recombination) and natural selection with examples, types of natural selection and speciation.
Module 7:	**Molecular biology**
	Central dogma: DNA replication, transcription, translation; genetic code; DNA damage and repair; Regulation of gene expression in prokaryotes (lac operon) and eukaryotes; Gene transfer mechanisms: Transformation: (Griffith's experiment-Avery MacLeod and McCarty's experiment).
Module 8:	**Environmental pollution and impact**
	Environmental pollution: air, water and soil, chemical reactions in atmosphere, smog, major atmospheric pollutants, acid rain, ozone and its reactions, effects of depletion of ozone layer, greenhouse effect and global warming, pollution due to industrial wastes, deforestation; reen chemistry as an alternative tool for reducing pollution, strategies for control of environmental pollution.
Module 9	**Concepts of Chemistry**
	General Introduction: Importance and scope of chemistry. Nature of matter, laws of chemical combination, Dalton's atomic theory: concept of elements, atoms and molecules. 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. **Classification of Elements and Periodicity in Properties:** Modern periodic law and the present form of periodic table, periodic trends in properties of elements, 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. **States of Matter:** Gases, Liquids and Solids; Three states of matter, intermolecular interactions, types of bonding, melting and boiling points, role of gas laws in elucidating the concept of the molecule. Liquid State: vapour pressure, viscosity and surface tension Solid state: Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids
	Chemical Thermodynamics: Concepts of System and types of systems, surroundings, work, heat, energy, extensive and intensive properties, state functions. Laws of thermodynamics. **Equilibrium**: Equilibrium in physical and chemical processes, 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, Henderson Equation, hydrolysis of salts, buffer solution, solubility product, common ion effect. **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, applications of redox reactions. **Electrochemistry:** Redox reactions, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and law of electrolysis (elementary idea), dry cell-electrolytic cells and Galvanic cells, lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs energy change and EMF of a cell, fuel cells, corrosion. **Chemical Kinetics:** Rate of a reaction (Average and instantaneous), factors affecting rate of reaction: concentration, temperature, catalyst; order and molecularity of a reaction, rate law and specific rate constant, integrated rate equations and half-life (only for zero and first order reactions), concept of collision theory (elementary idea, no mathematical treatment). Activation energy, Arrhenious equation.

	Hydrogen: Position of hydrogen in periodic table, occurrence, isotopes, preparation, properties and uses of hydrogen, hydrides-ionic covalent and interstitial; physical and chemical properties of water, heavy water, hydrogen peroxide -preparation, reactions and structure and use; hydrogen as a fuel. **Hydrocarbons**: Types (alkanes, alkenes, alkynes, aromatic), IUPAC nomenclature, Isomerism, physical and chemical properties. **Haloalkanes and Haloarenes**: Nomenclature, nature of C-X bond, physical and chemical properties, mechanism of substitution reactions, optical rotation. Uses and environmental effects of - dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT. **Alcohols, Phenols and Ethers**: Nomenclature, physical and chemical properties **Aldehydes, Ketones and Carboxylic Acids**: Nomenclature, nature of carbonyl group, physical and chemical properties **Amines:** Nomenclature, classification, structure, physical and chemical properties **Polymers:** Classification - natural and synthetic, methods of polymerization (addition and condensation), copolymerization, polythene, nylon polyesters, bakelite, rubber. Biodegradable and non-biodegradable polymers.
	Analysis based on pH: pH of solutions, solution of known and varied concentrations of acids, bases and salts using pH paper or universal indicator; Comparison of the pH of solutions of strong and weak acids of same concentration. **Solutions:** Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties - relative lowering of vapour pressure, Raoult's law, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass, Van't Hoff factor.
	Surface Chemistry: Adsorption - physisorption and chemisorption, factors affecting adsorption of gases on solids, catalysis, homogenous and heterogenous activity and selectivity; enzyme catalysis colloidal state distinction between true solutions, colloids and suspension; lyophilic, lyophobic multi-molecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation, emulsion - types of emulsions.

	Chromatography: Separation of pigments by paper chromatography and determination of Rf values; Separation of constituents present in an inorganic mixture containing cations**.**
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