

## M.Sc. BIOTECHNOLOGY

	Duration	No. of question	Max. Marks
Part A Biology Section	2 hrs.	100	100
Part B Chemistry Section	2 hrs.	100	100

**Note :** The students will have an option to answer questions from either part A or part B. Candidate will have to secure a qualifying minimum 30% marks in order to be eligible for admission.

### Part A : Biology Section

**Cell and Molecular Biology :** Modern concept of a typical cell, prokaryotic and eukaryotic cell. Cell: Structure, organelles and their functions; cell cycle and cell division. Organization of genetic material, Transcription and Translation in Prokaryotes & Eukaryotes, Replication of DNA. Regulation of Gene Expression, Genetic Code. Transport across cell membrane and signal transduction.

**Biochemistry :** Biomolecules: Carbohydrates, Proteins, Lipids, their structure, function and metabolism. Enzymes, Mechalis-Menten kinetics, Allosteric enzymes, isolation and purification of enzymes, Coenzymes, Vitamins and Hormones.

**Instrumental methods of analysis :** Spectroscopy, Microscopy, Column Chromatography, Electrophoresis, Use of tracers, Auto radiography, Centrifugation.

**Microbiology :** Basic microbiological techniques, Bacteria, Viruses, Fungi and Mycoplasma. Microbiology of food, air, water & soil. Industrial Microbiology: Fermentation, Bioreactors & its types. Biofertilizers, Biopesticides, Biosensors, Bioremediation. Waste water treatments.

**Genetics :** Mendelian Genetics, Gene Interactions, Multiple alleles, Linkage & Crossing over, Cytoplasmic inheritance, sex linked inheritance, sex determination. Genetic disorders, Mutations and its various types, Transposons.

**Genetic Engineering :** Principles of Genetic Engineering, Gene cloning, Enzymes used in gene cloning, Vectors, Genomic & cDNA library (Construction & screening), identification of recombinant clones, PCR, Molecular markers, Methods of Gene transfer, Gene sequencing, Transgenic animals & plants, Human Genome Project. Biosafety Guidelines, Intellectual Property Rights (IPR) issues and patents. Edible Vaccines.

**Biostatistics & Bioinformatics :** Measures of central tendency & dispersion, Probability.

Introduction to Bioinformatics, Biological databases, Sequence homology, Uses of BLAST & FASTA.

**Ecology & Evolution :** Ecosystems, Environment, Plant communities, Biogeochemical cycles, Population Ecology, Environmental pollution; its types & control measures. Biodiversity and

conservation of natural resources. Various theories of evolution, role of variation, adaptation, speciation and isolation in the process of evolution.

**Immunology** : Innate & Acquired immunity, Active & Passive immunity, Types of Antigens & Antibodies, Lymphocyte homing, Antigen-Antibody Reactions, Monoclonal Antibodies, Hybridoma Technology, Immunodiffusion, ELISA, Hypersensitivity, Autoimmune diseases, Immunological disorders.

**Plant Physiology & Metabolism** : Plant-water relations, Mineral nutrition, Translocation of organic substances, Photosynthesis, Respiration, Growth and Development: Photoperiodism, Dormancy, Vernalization, Senescence, Nitrogen & Fat Metabolism.

**Plant Biotechnology** : Plant tissue culture techniques, Micropropagation, Somatic embryogenesis, Protoplast isolation and culture, Somatic hybridization, Cryopreservation, Artificial seeds, Somaclonal variations.

**Animal Physiology & Metabolism** : Physiology of digestion, respiration, excretion, circulation, muscle contraction, nerve impulse, endocrine glands & reproduction in animals.

**Animal Biotechnology** : Artificial insemination, *in vitro* fertilization & embryo transfer, Animal cell products, Animal cell lines.

## **Part B : Chemistry Section**

**Structure and Bonding** : Atomic orbitals, electronic configuration of atoms and the periodic properties of elements; ionic radii, ionization potential, electron affinity, electronegativity; concept of hybridization. Molecular orbitals and electronic configuration of homonuclear and heteronuclear diatomic molecules. Shapes of polyatomic molecules; VSEPR theory. Bond lengths, bond angles, bond order and bond energies. Types of Chemical Bond (weak and strong) intermolecular forces, structure of simple, ionic and covalent solids, lattice energy.

**Acids and Bases** : Bronsted and Lewis acids and bases, pH and pKa, acid-based concept in non-aqueous media; HSAB concept. Buffer solution.

**Redox Reactions** : Oxidation numbers. Redox potential. Electrochemical series. Redox indicators.

**Energetics and Dynamics of Chemical Reactions** : Law of conservation of energy. Energy and enthalpy of reactions. Entropy, free-energy, relationship between free energy change and equilibrium. Rates of chemical reactions (first and second – order reactions). Arrhenius equation and concept of transition state. Mechanism, including SN1 and SN2 reactions, electron transfer reactions, catalysis, Colligative properties of solutions.

**Aspects of s.p.d.f. Block Elements** : General characteristics of each block. Chemical principles involved in extraction and purification of Iron, Copper, Lead, Zinc and Aluminium. Coordination chemistry: structural aspects, isomerism, octahedral and tetrahedral crystal – field

splitting of orbitals. CFSE, magnetism and colour of transition metal ions. Ferrocene and metal carbonyls. Rare gas compounds, non-stoichiometric oxides. Radio activity and transmutation of elements. Isotopes and their applications.

### **IUPAC Nomenclature of Simple Organic and Inorganic Compounds.**

**Concept of Chirality** : Recognition of symmetry elements and chiral structures; R-S nomenclature, diastereoisomerism in acyclic and cyclic system; E-Z isomerism. Conformational analysis of simple cyclic (chair and boat cyclo hexanes) and acyclic systems. Inter-conversion of Fischer, Newman and Sawhorse projections.

**Common Organic Reactions and Mechanisms** : Reactive intermediates. Formation and stability of carbonium ions, carbanions, carbenes, nitrenes, radical and arynes. Nucleophilic, electrophilic, radical substitution, addition and elimination reactions. Familiar named reactions: Aldol, Perkin, Stobbe, Dieckmann condensations; Hofmann, Schmidt, Lossen, Curtius, Beckmann and Fries rearrangements; Reimer – Tiemann, Reformatsky and Grignard reaction. Diels – Alder reactions; Claisen rearrangements; Friedel - Crafts reactions; Witting reactions; and Robinson annulation. Routine functional group transformations and interconversions of simple functionalities. Hydroboration, Oppenaur oxidations; Clemmensen, Wolf-Kishner, Meerwein-Ponndorf-Verly and Birch reductions.

**Elementary principles and applications of electronic, vibrational, NMR technique to simple structural problems.**

**Data Analysis** : Types of errors, propagation of errors, accuracy and precision, least-squares analysis, average standard deviation.

### **Sample Questions**

#### **Section A : Biology**

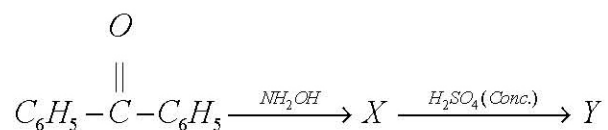
- Q1. Enzymes with same function and different molecular structure are called –  
(a) Zymases      (b) Isomerases      (c) Isoenzymes      (d) Coenzymes
- Q2. The double-helix DNA model is based on –  
(a) A-DNA      (b) B-DNA      (c) C-DNA      (d) Z-DNA
- Q3. Bacterial cell wall is made up of –  
(a) Peptidoglycan      (b) Cellulose      (c) Chitin      (d) Lignin
- Q4. pBR 322 is a –  
(a) plasmid vector      (b) bacteriophage vector  
(c) single stranded vector      (d) phasmid vector

- Q5. Monoclonal antibodies were developed by –
- (a) Komberg (b) Kohler & Milstein  
(c) Baltimore (d) Cohen
- Q6. Glyoxylate cycle is present in –
- (a) Germinating seeds (b) Flower  
(c) Pancreas (d) None of the above
- Q7. The relationship between mean, median & mode in an asymmetric distribution is given by the formula –
- (a) Mode = 3 Median – 2 Mean (b) 3 Mode = Median – 2 Mean  
(c) 2 Mode = Median – Mean (d) Mode = Median – 3 Mean
- Q8. Minimata disease is caused due to toxicity of –
- (a) Aluminium (b) Mercury  
(c) Calcium (d) Cadmium
- Q9. Fusion of protoplasts is done by –
- (a) Polyethylene glycol (b) Glycolic acid  
(c) Glycerol (d) Ascorbic acid
- Q10. Cyanide kills an animal by inhibiting cytochrome oxidase. It does not bind with active site. This is an example of –
- (a) Competitive inhibition (b) Non-competitive inhibition  
(c) Allosteric modulation (d) Feed back inhibition

### Section B : Chemistry

- Q1. Which negative radical of the following compounds does not exist in an aqueous solution independently?
- (a) NaCl (b)  $\text{NaNH}_2$  (c)  $\text{K}_2\text{SO}_4$  (d)  $\text{CaCl}_2$
- Q2. Which of the following statements is correct for Glycine?
- (a) It behaves as a base when titrated with HCl  
(b) It behaves as an acid when titrated with NaOH  
(c) It forms the Zwitterions  $\text{NH}_3^+\text{CH}_2\text{COO}^-$   
(d) All of these

- Q3. Which of the following mixture is known as the 'Fenton reagent' ?
- (a)  $\text{TiCl}_4$  and  $\text{Al}(\text{C}_2\text{H}_5)_3$  (b)  $\text{FeSO}_4$  and  $\text{H}_2\text{O}_2$   
 (c)  $\text{FeCl}_3$  and  $\text{H}_2\text{O}_2$  (d)  $\text{CH}_3\text{COONH}_4$  and  $\text{H}_2\text{O}_2$
- Q4. Which of the following bonds are polar -
- (a) O-S (b)  $\text{C} \equiv \text{N}$  (c) Cl-Cl (d) I-Cl
- Q5. Predict which compound in each of the following groups should have the higher melting & boiling points -
- (a)  $\text{C}_2\text{H}_6$  &  $\text{CH}_4$  (b) CO & NO (c)  $\text{F}_2$  &  $\text{Br}_2$  (d)  $\text{CHCl}_3$  &  $\text{CCl}_4$
- Q6. If in an equilibrium reaction
- $$\text{A} + \text{B} \rightleftharpoons \text{C} + \text{D}$$
- the activation energy for the forward reaction is 25 K Cal/ mole, which of the following statements is correct for this reaction?
- (a) It is an endothermic process (b) It is an exothermic process  
 (c) It is a reaction for which  $\Delta H = 0$  (d) It is a sublimation process.
- Q7. In the reaction of p- Chlorotoluene with  $\text{KNH}_2$  in liquid  $\text{NH}_3$ , the major product is:-
- (a) o - Toluidine (b) p - Toluidine  
 (c) m - Toluidine (d) p - Chlorobenzylamine
- Q8. Identify 'Y' in the following sequence of reactions : -



- (a)  $\text{C}_6\text{H}_5\text{CONH} \text{C}_6\text{H}_5$  (b)  $\text{C}_6\text{H}_5\text{CONH} \text{C}_6\text{H}_5$  ( $\alpha$ -OH)  
 (c)  $\text{C}_6\text{H}_5\text{CONH} \text{C}_6\text{H}_5$  (p-OH) (d)  $\text{C}_6\text{H}_5\text{NH}_2$
- Q9. Which of the following would increase the acidity of benzoic acid.
- (a) p-OH (b) o-OH (c) p- $\text{NH}_2$  (d) p- $\text{OCH}_3$
- Q10. Chlorobenzene reacts with Magnesium in ether to give X. This reacts with ethanol to give Y. Y is
- (a) Ethyl phenyl ether (b) Ethyl benzene  
 (c) Benzene (d) Phenol