2. M.Sc. BIOTECHNOLOGY

		Duration	No. of questions	Max. Marks
Part A	Biology Section	2 hrs.	100	100
Part B	Chemistry Section		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 - II : Personality Inventory Test **Duration : 30 minutes**

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. Ferocene 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, cabanions, 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 — 100 Questions

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 stramded vector (d) phasmid vector

Q5. Monoclonal antibodies were developed by –

(a) Kornberg (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 — 100 Questions

Q1. Which negative radical of the following compounds does not exist in an aqueous solution independently?

(a) NaCl (b) $NaNH_2$ (c) K_2SO_4 (d) $CaCl_2$

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 $NH_3^+CH_2COO^-$

(d) All of these

Q3. Which of the following mixture is known as the 'Fenton reagent' ?

(a) $TiCl_4$ and $Al(C_2H_5)_3$ (b) $FeSO_4$ and H_2O_2

(c) $FeCl_3$ and H_2O_2 (d) CH_3COONH_4 and H_2O_2

Q4. Which of the following bonds are polar –

(a) O-S (b) C ≡ 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) C_2H_6 & CH_4 (b) CO & NO (c) F_2 & Br_2 (d) $CHCl_3$ & CCl_4

Q6. If in an equilibrium reaction

$A + B \rightleftharpoons C + D$

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 KNH_2 in liquid 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 : -

$$C_6H_5-\overset{\overset{O}{\|}}{C}-C_6H_5 \xrightarrow{NH_2OH} X \xrightarrow{H_2SO_4(Conc.)} Y$$

(a) $C_6H_5CONH\ C_6H_5$ (b) $C_6H_5CONH\ C_6H_5$ (o-OH)

(c) $C_6H_5CONH\ C_6H_5$ (p-OH) (d) $C_6H_5NH_2$

Q9. Which of the following would increase the acidity of benzoic acid.

(a) p-OH (b) o-OH (c) p-NH_2 (d) p-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