

M.Sc. BIOCHEM. PART 1 & 2

GUJARAT UNIVERSITY

BIOCHEMISTRY SYLLABUS

M.SC. PART - I

To be implemented from 15th June, 2005

| Paper | Titles | Marks |
|---------------------|---|-------|
| <u>M.Sc. Part-I</u> | | |
| I. | Instrumentation and Biostatistics | 75 |
| II. | Cell Biology and Physiology | 75 |
| III. | Bioenergetics and Intermediary metabolism | 75 |
| IV | Plant Biochemistry | 75 |
| | Practicals | 150 |

Work load

3 periods of 60 min per paper X 4 papers

= 12 hours/week

Laboratory practicals 4hrs X 3 practicals

= 12 hours/week

Seminars

= 2 hours/week

Library

= 2 hours/week

Total

= 28 hours/week

M.SC. PART – I BIOCHEMISTRY

PAPER – I

INSTRUMENTATION AND BIostatISTICS

UNIT – I

Electrochemistry: Types of electrodes, standard electrode potential and its determination, its relationship with EMF, electron transfer measures, pH metry, pH metric titrations, Potentiometry, potentiometric titrations, conductometric titrations.

Radioisotope techniques: Nature of radioactivity, properties of α , β and γ -rays, measurement of radioactivity, use of radioisotopes in research. In vivo and in vitro labelling techniques, double labelling, quenching, internal standard, channel ratio, external standard ratio, emulsion counting, radioactive decay, autoradiography.

UNIT - II

Viscosity: Its measurement, viscosity of macromolecules, molecular weights of biomolecules, sedimentation of macromolecules, centrifugation techniques and their applications, differential centrifugation, density gradient and ultracentrifugation techniques, Subcellular fractionation.

Electrophoretic techniques: Moving boundary and zonal electrophoresis, paper and gel electrophoresis, isoelectric focusing.

UNIT - III

Chromatography: Paper, TLC, HP-TLC, adsorption, partition, ion-exchange, reverse phase, gel filtration, affinity, gas chromatography, HPLC.

Microscopy: Light, electron (scanning and transmission), phase contrast, fluorescence microscopy, freeze-fracture techniques, specific staining of organelles or marker enzymes.

UNIT - IV

Spectroscopy: Basic concepts and applications of X-ray diffraction, NMR, ESR, UV, IR, fluorescence, Raman, mass spectroscopy in structure determination of organic and biomolecules, Flame photometry, Atomic absorption, Atomic Emission, Plasma Emission

UNIT - V

Biostatistics

Sampling techniques

Statistical evaluation of results, probability theory, random variables and distribution functions

Point and interval estimation, Correlation, Regression analysis

Analysis of variance and covariance

Distribution of student-t, chi-square, F test

Non-parametric statistics

Use of packaged statistical computer programmes for statistical analysis

Paper – III

BIOENERGETICS AND INTERMEDIARY METABOLISM

UNIT - I

Bioenergetics: Energy transformation, Laws of thermodynamics, Biological oxidations, oxygenases, hydroxylases, dehydrogenases and energy transducing membranes, Gibbs energy, free energy changes and redox potentials, phosphate potential, ion electrochemical potentials, proton electrochemical potential, membrane potentials, photons energy interconversions. Chemotaxis and chemoreceptors, chemiosmotic theory, ion transport across energy transducing membranes. Influx and efflux mechanisms, proton circuit and electrochemical gradient, the transport and distribution of actions, anions and ionophores, Uniport, antiport and symport mechanisms, shuttle systems

UNIT - II

The mitochondrial respiratory chain, order and organization of carriers, proton gradient, iron sulfur proteins, cytochromes and their characterization, The Q cycle and stoichiometry of proton extrusion and uptake; P/O and H/P ratios, Reversed electron transfer, respiratory controls and oxidative phosphorylation, uncouplers and inhibitors and energy transfer. Fractionation and reconstitution of respiratory chain complexes

ATP -synthetase complex, Microsomal electron transport, partial reduction of oxygen, Free radicals in biological systems: Oxygen as a free radical in the autooxidation of fats. Antioxidants (Free radical inhibitors in the cell such as vitamin A, vitamin E, vitamin C, Se etc.) superoxides.

UNIT - III

Carbohydrates:

Glycolysis, citric acid cycle: its function in energy generation and biosynthesis of energy rich bonds, pentose phosphate pathway and its regulation. Alternate pathways of carbohydrate metabolism

Gluconeogenesis, interconversions of sugars

Biosynthesis of glycogen, starch and oligosaccharides

Regulation of blood glucose homeostasis

Hormonal regulation of carbohydrate metabolism

UNIT - IV

Lipids

Fatty acid biosynthesis, Acetyl CoA carboxylase, fatty acid synthase, desaturases and elongase. Fatty acid oxidation: α , β and ω oxidation and lipoxidation. Lipid biosynthesis: Biosynthesis of triacylglycerols, phosphoglycerides and sphingolipids, Biosynthetic pathways for terpenes, steroids and prostaglandins. Ketone bodies: Formation and utilization. Metabolism of circulating lipids: chylomicrons, LDL, HDL and VLDL. Free fatty acids, Lipid levels in pathological conditions

UNIT - V

Amino acids

Biosynthesis and degradation of amino acids and their regulation

Specific aspects of amino acid metabolism

Urea cycle and its regulation

Paper – IV

PLANT BIOCHEMISTRY

UNIT - I

Structures and function of plant cell (including cell wall, plasmodesmata, meristematic cells, vacuoles, secretory system and root quiescent zone), isolation of cell organelles, absorption, adsorption and transport of water and ions in plants. Evapotranspiration

UNIT - II

Photosynthesis –structure of organelle involved in photosynthesis in plants and bacteria. Proton gradient and electron transport in chloroplast of plants and in the purple bacteria- differences from mitochondria, Light receptors – chlorophyll, light harvesting complexes, bacteriorhodopsin, rhodopsin as ion pump.

Photosystem I and II, their location, mechanism of quantum capture and energy transfer between photosystems- ferredoxin, plastocyanin, plastoquinone, carotenoids
The Hill reaction, photophosphorylation and reduction of CO₂

C₃, C₄ and CAM metabolism, light and dark reaction, light activation of enzymes, regulation of photosynthesis. Photorespiration

UNIT - III

Biological nitrogen fixation and ammonia assimilation
Nitrate and sulphate reduction and their incorporation into amino acids
Translocation of inorganic and organic substances

Special features of secondary plant metabolism, formation of phenolic acids, tannins, lignins, lignans, pigments, terpenes, terpenoids, plant phenolics, alkaloids and surface waxes, their biosynthesis and functions, cell wall components.

UNIT - IV

Plant hormones- Growth regulating substances, biosynthesis, translocation and their mode of action, Physiological effects of auxin, gibberellic, abscisic acid, cytokinins and ethylene in the regulation of seed dormancy, germination, growth and development and embryogenesis

UNIT - V

Biochemistry of seed development and fruit ripening and flowering senescence

Tissue culture: General aspects, application and uses; production of secondary metabolites; micropopagation, protoplast fusion and transgenics.