ORDINANCES
for
M.Sc. Biochemistry course programme

Name of the course: M.Sc. Biochemistry

Duration of the course:
The Course shall be of 2 years duration under semester system and shall be completed in 4 (four) semesters.

Admission to the course:
Admission to the M.Sc. Biochemistry course programme shall be done through Merit/ Entrance Examination conducted by the University. All matters relating to admission to this course shall be dealt with by the Admission committee/Coordinator or any other such authority which may be authorized by the Vice-Chancellor in accordance with the University rules. Admission to the programme cannot be claimed as a matter of right. The admission committee shall have power to refuge/reject/cancel any admission if it possesses sufficient reasons to do so.

Eligibility for admission:
Minimum essential qualification of the candidate for entry to the course shall be B.Sc. in any discipline of Life Sciences with Chemistry/Biochemistry/Biotechnology/Microbiology studied for at least two years/four semesters during graduation with 50 % marks (45 % for SC/ST) from a recognized University. The candidate who is appearing in the qualifying examination can also apply but his/her eligibility for the admission will be purely provisional subject to the condition that he/she has to produced a passing certificate scoring at least the minimum percentage of marks as prescribed for the qualifying examination on the day and the specified time of counseling.

Maximum intake capacity: 25 (Twenty Five)

Reservation Policy:
The reservation rules of for admission shall be as per Government Orders/University policy implemented from time to time.

Fees Structure: As decided by the University from time to time.

Assignment of Advisor:
All students admitted to the course would be assigned a teacher-Advisor who would help the student in selecting the seminar and project topics and completion of the project.

Assessment:
30% of the marks allotted for each theory paper shall be assessed internally by the concerned teacher/s in the Department. Rest 70% marks shall be assessed by external examiners. Sessional marks shall be distributed as follows:
20 Marks: Two class tests of 10 marks each after the completion of 40% and 80% syllabus, respectively, with the provision of a makeup test.
10 Marks: Will be awarded on the basis of attendance and the performance in the class.

Project work:
Each student shall do one project work individually, which carries 500 marks. The Advisor of each student will guide the student in selecting the topic and completion of the project to be done in IVth semester.

aluation of project work:
he project will be evaluated by the Project Evaluation Committee (**PEC**) with Head as the Chairman, the Advisor of the student and an outside expert. All the faculty members of the department will be invited during the presentation. The presentation will open to all the students of the department.

Evaluation of Seminar & Interactive Course:
All the faculty members of the department present in the seminar will evaluate the presentation skill, content etc. and average of the marks will be taken as final marks of the student.

Pass marks:
Minimum pass marks for each of the theory and practical paper will be 40%. The minimum aggregate pass marks will be 50%. Back paper will be allowed in one theory course only in each semester. The student has to pass the course in the mid semester time or as per the examination schedule fixed by the University before he/she enters in the next semester.

Attendance: As per University rules

Others: Issues/points not covered above shall be governed by the existing University rules and regulations. The University may modify/amend any of the above clause with the approval of appropriate bodies/authorities.

Department of Biochemistry
Masters Programme (Four Semester/Two Years)

Semester I Max. Marks: 600

Paper	Title	Sessional Exams	End of Semester Exams	Total Marks
MBC101	Introductory Biological Chemistry	30	70	100
MBC102	Tools and Techniques	30	70	100
MBC103	Bioenergetics	30	70	100
MBC104	Biosynthetic Pathways	30	70	100
MBC105	Laboratory Course-I			200

Semester II Max. Marks: 600

Paper	Title	Sessional Exams	End of Semester Exams	Total Marks
MBC206	Biomembranes & Transport	30	70	100
MBC207	Molecular Biology	30	70	100
MBC208	Physiology and Clinical Biochemistry	30	70	100
MBC209	Protein Chemistry & Enzymology	30	70	100
MBC210	Laboratory Course-II			150
MBC211	Seminar and Interactive Course-1			50

Semester III Max. Marks: 600

Paper	Title	Sessional Exams	End of Semester Exams	Total Marks
MBC312	Immunology	30	70	100
MBC313	Cell Biology & Microbiology	30	70	100
MBC314	Biotechnology	30	70	100
MBC315	Environmental Biochemistry & Toxicology	30	70	100
MBC316	Laboratory Course-III			200

Semester IV Max. Marks: 600

Paper	Title	Sessional Exams	Total Marks
MBC419	Project Work/Dissertation	-	500
MBC420	Seminar and Interactive Course-2	-	100

Total Marks: 2400

M. Sc. Biochemistry Programme

MBC-101: Introductory Biological Chemistry **M.M. 100 (70+30)**

Unit-I

Carbohydrates: Classification and properties of simple carbohydrates, monosaccharide's, disaccharides and polysaccharides, reducing and non reducing sugar, enantiomers, Structural polysaccharides: cellulose, Storage polysaccharides: starch and glycogen, glycoproteins and glycolipids, biological importance of carbohydrates.

Unit-II

Enzymes: Classification and nomenclature of enzymes, active site, factors affecting enzymatic catalysis, prosthetic groups and cofactors, structure and properties of important coenzymes, abzymes and ribozymes, biological importance of enzymes.

Unit-III

Lipids: Classification,structure,chemistry and biological significance of lipids,steroids, prostaglandins and eicosanoids, chylomicrons, LDL, HDL and VLDL.

Unit-IV

Proteins: General properties and configuration of amino acids, peptide bond formation and its characteristics, different types of protein structures, protein denaturation, biological importance of amino acids and proteins.

Unit-V

Nucleic Acids: Structure and properties of purines and pyrimidines, nucleosides and nucleotides, structure of DNA (A, B, & Z) and RNA, DNA as genetic carrier, physico-chemical properties nucleic acids, Chargaff's rule, DNA denaturation, Genetic code.

MBC-102: Tools and Techniques in Biochemistry **M.M. 100 (70+30)**

Unit I

Spectroscopy– Concepts of spectroscopy, Visible and UV spectroscopy, Beer-Lambert's law, Principles and applications of colorimetry, Principles and biological applications of NMR, ESR, Raman, Mass, atomic absorption and atomic emission spectroscopy and X-ray crystallography.

Unit II

Chromatography & Microscopy – Principles of partition chromatography, paper, thin layer, ion exchange and affinity chromatography, gel permeation chromatography, HPLC and FPLC.

Transmission and scanning, freeze fracture techniques, specific staining of biological materials.

Unit III

Centrifugation & Radioactive techniques – Principles of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications, subcellular fractionation. Introduction to radiations and their uses in biology, safety measures, principles and applications of liquid scintillation counting (LSC), Gamma counting and autoradiography.

Unit IV

Electrophoretic techniques & Viscosity– Principles of electrophoretic separation. Continuous, zonal and capillary electrophoresis, different types of electrophoresis including paper, cellulose, acetate/nitrate and gel. Electroporation, pulse field gel electrophoresis. **Viscosity–** Viscosity of macromolecules, relationship with conformational changes.

Unit V

Biostatistics, Computers and Bioinformatics-Statistical analysis of biochemical data: standard deviation, variance, mean, median, mode. Basics of common application software packages for Word processing (MS Word), spreadsheets (MS Excel) and presentation (MS Powerpoint). Introduction to internet, Medline and Pubmed for accessing biological information. **Introduction to Bioinformatics-** Accessing and retrieving sequence information from genome sequence databases, use of genomic data. Overview of comparative and functional genomics, Introduction to protein modeling and proteomics.

MBC-103: Bioenergetics **M.M. 100 (70+30)**

Unit – I

Metabolism, living organism participate in the cycling of carbon and oxygen, nitrogen cycle, metabolism consists of catabolic pathways and anabolic pathways. Energy relationships between catabolic and anabolic pathways.

Unit-II

Principle of bioenergetics, bioenergetics and thermodynamics –biological energy transformation obey the Laws of Thermodynamics, first law of thermodynamics, second law of thermodynamics; Gibbs free energy, enthalpy, entropy and their relationships; the change in free energy determines the direction and spontaneity of a chemical reaction. Free energy change and directly related to equilibrium constant; generation of concentration gradients and in understanding enzymes. Unfavorable chemical reactions can be driven by coupling to an energetically favorable reaction.

Unit – III

Energy cycle and specialized role of ATP as universal currency in biological system; free energy change for ATP hydrolysis is large and negative; ATP hydrolysis drives metabolism by shifting the equilibrium of coupled reactions. Other phosphorylated compounds and thioesters – have large free energies of hydrolysis- but not suitable as currency of energy. ATP provide energy by group transfer; ATP donate phosphoryl, pyrophosphoryl and adenylyl groups. ATP drives many cellular process; trans-phosphorylation, Inorganic phosphate as a potential phosphoryl donor.

Unit – IV

Flow of electrons can do biological work; oxidation- reductions as half reactions; oxidation-reduction involves dehydrogenation; reduction potential; standard reduction potentials and free energy change; certain coenzymes and proteins serve as universal electron carriers; NADH and NADPH with dehydrogennases serve as soluble electron carriers; Flavin nucleotides tightly bounds with flavorprotein also serve as electron carriers, coenzyme Q as lipid soluble electron carrier.

Unit – V

Chemiosmotic theory of Peter Mitchell and its justifications. Electron transport chain; proton motive force. Oxidative phosphorylation and ATP synthesis uncouplers,

MBC-104: Biosynthetic Pathways **M.M. 100 (70+30)**

Unit I

Biosynthesis of disaccharides, starch, glycogen, cellulose and mucopolysaccharides gluconeogenesis, interconversion of sugars.

Unit II

Biosynthesis of Fatty acids, triglycerides, cholesterol and its regulation.

Unit III

Biosynthesis and regulation of: porphyrins,Purines and Pyrimidines, and Amino acids , Urea cycle,

Unit IV

Biochemistry of Nitrogen Fixation, Physiology of nodule formation, oxygen sensitivity of nitrogenase complex and protection methods, Regulation system of ammonia synthesis and its utilization, ammonium and nitrate transport and assimilation system, component of Diazotrophic symbiosis, nif gene, nod gene.

Unit V

Energy transduction in chloroplast: Structure of organelles involved in plant and bacterial photosynthesis, Light receptors and Light Harvesting complexes, Hill reaction and its components, , ETC and its differences from electron transport mechanism of Mitochondria, chemiosmotic theory of cyclic and non cyclic photophosphorylation,Carbon reduction Pathways in plants(C3,C4 and CAM), Photorespiration, Bioluminescence. . Chemiosmotic theory of transpiration.

MBC-105 Laboratory Course –I **M.M. 200**

1. Qualitative and Quantitative Analysis of –

a) Carbohydrates
b) Amino acids and proteins
c) Free and bound phosphate
d) Vitamin C

2. Fats: Acid number, saponification, and iodine values.

3. Fractionation of egg proteins and its quantification.

4. Isolation of casein from milk and its quantification.

5. Isolation and estimation of serum cholesterol.

6. Qualitative and quantitative analysis of: (i) Saliva (α-amylase); (ii) Urine (urea, uric acid, glucose, proteins)

7. Experiments on blood: (a) Identification and count of blood corpuscles; (b) Estimation of haemoglobin

8. Determination of Serum creatinine and uric acid.

10. Determination of Serum enzyme assays: alkaline phosphates, SGOT, SGPT.

MBC-206: Biomembranes and Transport **M.M. 100 (70+30)**

Unit I

Membrane lipids. Physical properties of lipids and their interaction with water to form membranes. Concept of fluidity and factors causing variations in fluidity. Appropriateness of varied lipid geometry for different membrane structures. Micelles, liposomes, planar bilayers and dark membranes. Lipid rafts. Membrane asymmetry.

Unit II

Biological membranes. Modification of lipid fluidity by membrane proteins. Arrangement of proteins within lipid bilayers. Hydropathy plots and prediction of membrane spanning domains. Organization of chloroplast and mitochondrial membrane systems.

Unit III

Techniques to study biomembranes. FRAP, FRET, Use of spin labeling and polarity dependent fluorescence probes to determine membrane state changes. Detergents. Solubilization, purification and reconstitution of membrane protein systems.

Unit IV

Membrane transport. Channels, transporters and pumps. Active and passive transport. Pand F- type pumps and ABC transporters. Ion channels and electrical properties of membranes. Voltage, ligand and mechanically gated channels. Use of patch clamping to study ion channel activity.

Unit V

Intracellular vesicular trafficking. Import of proteins into E.R. and processing in the E.R. and Golgi. Mechanism of vesicle formation and fusion. Import of relevant nuclear coded proteins into chloroplasts and mitochondria.

MBC-207: Molecular Biology **M.M. 100 (70+30)**

Unit I- Organization of genetic materials: in prok. – genome type and size, nucleoid, structural maintenance proteins(SMP), Euk.- nucleosome, histones, chromatin, remodeling, , DNA binding proteins and motifs, concept of gene, fine structure of gene(intron, exon, replicon, recon, muton, cistron, genome organization, gene density, satellite dna, mechanical strength, reassociation kinetics- COT value : associated repeats Central Dogma

Unit II- DNA replication: experimental evidences, Replicon, ARS(Autonomously replicating sequences), ORE(origin replication element), DUE(dna unwinding element), Replisome, DNA Polymerases in prok. & euk., replication fork, Clamp loader complex, Helicase, topoisomerase: DNA gyrase, DNA Ligase, Direction of replication, okazaki fragments , Primers for replication, reaction mechanism of polymerization, End replication problem,Telomerase, fidelity of replication, replication of RNA viruses. Inhibitors

UNIT III- Transcription: RNA polymerases in prok. & euk. and associated factors, Direction of transcription, Promoters and its recognition, initiation , elongation and termination, regulation of transcription by inducers and repressors, Cis & Trans acting elements, concept of operon (lac operon, trp operon)Catabolic activator, Post transcriptional processing, (hn RNA,RNA splicing:modes & spliceosome, maturation of mRNA & t-RNA,). Transcriptional bursting, RNA editing, HomeoBox domain & HD proteins. Inhibitors

UNIT IV- Translation: sites , properties of genetic code, wobble hypothesis, involvement of ribosome and ribosomal proteins, amino acyl t-RNA ,Shine dalgarno sequence, initiation, elongation and termination, role of various factors and GTP , recycling of ribosomes, ORF(open reading frame), tRNA str., Ribosome subunits, Regulation(by Pbodies, exosomes, miRNA, Riboswitches), ribosome recycling, post translational processing, protein secretion and targeting.

UNIT V- Mutation: mutagenic agents, molecular basis of mutation , genetic repair mechanism, Cancer: types, molecular basis, prevention and cure. Genetic mapping by-conjugation and transduction.

MBC-208: Physiology and Clinical Biochemistry **M.M. 100 (70+30)**

Unit-I

Body fluids: Blood – function, composition, blood groups, Rh factor, plasma proteins, blood coagulation, clot formation and coagulation. Urine and its composition, alterations under pathological conditions, role of kidney in acid-base and electrolyte balance.

Unit-II

Physiological roles of hormones, mechanism of action of hormones and prostaglandins. Physiological roles of vitamins: Structure, function and their deficiency diseases.

Unit-III

Biochemistry of respiration, Muscle contraction, cell motility, role of calmodulin. **Detoxification of Xenobiotic**

Unit-IV

Nerve impulse transmission: nerve and synapse structure, excitation – its conduction and synaptic transmission by neural systems, neurotransmitters, venoms and nerve poisons.

Unit-V

Clinical and biochemical aspects of atherosclerosis, jaundice, diabetes, hepatitis, glomerular nephritis, gall stones, Addison's disease, Conn's syndrome, Cushing's syndrome, hypo & hyperthyroidism, Parkinson's disease and Alzheimer's disease.

MBC-209: Protein Chemistry & Enzymology **M.M. 100 (70+30)**

Unit I

The native state of proteins; denaturation and inactivation of proteins; characteristics and importance of different levels of protein structure; protein evolution; assembly of fibrous proteins; the concept and importance of domain structures in proteins.

Unit II

Measurement of stability of the native state; the role of short-, medium-, and long-range interactions in protein folding; mechanism of protein folding; the thermodynamics and kinetics of protein folding; determinants of protein folding with special reference to the roles of molecular chaperones, signal peptides and the environment in protein folding; the problem of inclusion body formation and recovery of active proteins.

Unit III

The living state and role of enzymes in its sustenance; chemical catalysis: general-acid-base, covalent and intramolecular catalysis; detection of intermediates in enzymatic reactions; features and mechanism of action of lysozyme, chymotrypsin and carboxypeptidase A.

Unit IV

Steady state and equilibrium hypotheses of enzyme kinetics, Michaelis-Menten and Briggs-Haldane equations, significance of Michaelis-Menten parameters i.e. $V_{max,}$ K_m, k_{cat} and k_{cat}/K_m ; mechanism and features of different types of enzyme inhibition; breakdown of the Michaelis-Menten equation; mechanism and kinetics of multisubstrate reactions.

Unit V

Enzyme induction, repression and covalent modification; feed back inhibition; importance of isozymes and zymogen in enzyme regulation; allosteric enzymes and their regulation; Hills coefficient and the determination of enzyme-ligand binding/dissociation constant.
Measurement of stability of the native state; the role of short-, medium -, and long-range interactions in protein folding; mechanism of protein folding; determinants of protein folding with special reference to the roles of molecular chaperones, signal peptides and the environment in protein folding.

MBC-210: Laboratory Course-II **M.M. 150**

1. Titration of a weak acid using a pH meter, preparation of buffers
2. Verification of Beer-Lambert's law and determination of absorption coefficients
3. Paper chromatography – Separation of amino acids and carbohydrates in a mixture
4. Thin layer chromatography of fatty acids
5. Column chromatography – Separation of a mixture of proteins and salt using Sephadex column
6. Electrophoresis
7. Isolation and estimation of RNA and DNA from yeast, liver, and plants
8. Gel Electrophoresis of serum proteins
9. SDS-PAGE of proteins
10. Assay of enzyme activity
11. Isolation and purification of urease
12. Time course of enzymatic reaction
13. Influence of substrate concentration on the rate of enzymatic reaction
14. Effect of pH and temperature on the rate of enzyme reaction
15. Inhibition of enzyme activity.

MBCS-211: Seminar and Interactive Course **M.M. 50**

MBC-312: Immunology **M.M. 100 (70+30)**

Unit-I

Introduction of cells and organs of immunity; basic concept of innate and acquired immunity, host specialization, granulocytes (neutrophils, eosinophils,basophils) and their functions. Antigens, immunogens and heptane, structure and classification of antibody, isotypes, allotypes, idiotypes.

Unit-II

Comparison of receptors on T and B lymphocytes, CD markers. Concept of Histocompitability: Major histocompitability complex (MHC), MHC restriction for CD4 and CD8 subset of T cells. Role of MHC complex and transplantation, Generation of diversity in immune response: clonal selection theory, the gene encoding antigen specific receptors on T and B lymphocytes immunoglobulin genes, Activation of T and B cells by antigen, antigen processing and presentation.

Unit-III

The complement system; biological role of complement system, components of classical and alternative pathways, mechanism of NK cell mediated cytotoxicity, Inflammation, its physiological basis and relevance. General properties of cytokines and interferons and their applications.

Unit-IV

Allergey and hypersensitivity, autoimmunity, autoimmune diseases, Vaccines: preparation and delivery system, immunoadjuvants, Raising of antisera and monoclonal antibodies.

Unit-V

Measurement of antigen and antibody interactions: direct binding assay, agglutination and precipitation reactions in gels; immunoelectrophoresis, immunoprecipitation, RIA & ELISA, biotin-avidin based immunoassay, immunofluorescence assay (IFA); immunohistochemistry, immunoblotting.

MBC-313: Cell Biology and Microbiology **M.M. 100 (70+30)**

Unit-I

Cell theory, Cell size, shape and functions. Structural differences of prokaryotic and eukaryotic cells. Cytoskeleton–microtubules and microfilaments. Cell movement and chemotaxis.

Unit-II

The ultra structure and general functions of: Nucleus-Nucleoid, SMC proteins, nucleosome, chromatin. Mitochondria, Endoplasmic reticulum (rough and smooth), Golgi apparatus, Lysosomes & ribosomes, peroxisomes, microsomes.

Unit-III

Morphology and Structure of bacteria, gram positive and gram negative organisms, gram positive and gram negative staining. Nutritional requirements and growth characteristics of bacteria, media for growing bacteria. Bacterial toxins.

Unit-IV

Cell cycle and Cell death, General structure, properties and classification of viruses. Virions, prions, lytic cycle, lysogeny, plasmid.

Unit-V

Types of toxins: Exotoxins, endotoxins, enterotoxins, their structure and mode of action. Antimicrobial agents, sulfa drugs, Penicillins and Cephalosporins, antibiotics, resistance to antibiotics.

MBC-314: Biotechnology **M.M. 100 (70+30)**

Unit I

Restriction and Modification: DNA methylation, restriction endonucleases, Class I, II and III, nomenclature, general properties, mode of action; Vectors and Cloning Strategies: plasmids, plasmid based vectors, lambda based vectors, cosmids, phagemids, YAC, expression vectors, chemical synthesis of DNA, DNA libraries.

Unit II

Molecular Techniques: Nucleic acid sequencing, blotting, polymerase chain reactions, gene transfer techniques, in vitro mutagenesis, HRT, HART, DNA footprinting.

Unit III

Production of recombinant pharmaceuticals: therapeutic proteins, hormones, vaccines, amino acids, vitamins and interferon.

Unit IV

Animal transgenesis and its applications: Expression of transgenes, embryonic stem cell technology, gene knock-outs; uses of some transgenic animals.

Unit V

Transgenic plants and their applications: Genetic engineering of plants, Ti plasmid derived vector system, reporter genes and its applications; improving agronomic traits: Insect resistance, herbicide resistance, virus-resistance, fungal resistance, drought resistance.
Enzyme technology: Enzymes Immobilization and its applications, enzyme/protein engineering.

MBC-315: Environmental Biochemistry & Toxicology **M.M. 100 (70+30)**

Unit-I

Air pollution: particulate matter; compounds of carbon and sulfur, their interactions and effects on atmosphere; green house effects; other types of pollution: Sounds, thermal and radioactive pollution, harmful effects of ultra-violet rays, Ozone layer depletion, Ozone hole, Chlorofluorocarbons and their substitutes

Unit -II

Water pollution: Types of water bodies and their general characteristics, chief pollutant in domestic, industrial and agricultural wastes, effects of pollutants on flora and fauna

Unit-III

Nature of agricultural and industrial wastes and bye products and their treatment and recycling.

Unit-IV

Principle of Biochemical toxicology: Properties of xenobiotics, type of chemicals alteration, molecular mechanism of toxicity development, dose response relationship, risk assessment of chemicals; Acute, short term and chronic toxicity studies, metabolic disposition. Carcinogenicity and mutagenicity studies

Unit V

Microbial degradation of pesticides, Lignin, detergents, dyes, petrol and petroleum products, Use of microorganism in pollution control, ways and means for abatement of environmental pollution

MBC-316: Laboratory Course-III **M.M. 200**

1. Preparation of culture media.
2. Preparation of broth and slants.
3. Sterilization of culture media by autoclave method.
4. Isolation and propagation of bacteria.
5. Staining of bacteria – Simple staining, differential staining, staining of spores and capsules.
6. Determination of growth curve of bacteria.
7. Biochemical tests and motility for the identification of bacteria.
8. Precipitin reaction by double immunodiffusion and radial immunodiffusion (Ouchterlony).
9. Detection of antibodies or antigen by ELISA.
10. Detection of antigens by immunoblotting techniques.
11. Experiments on restriction digestion, ligation and cloning.
12. Experiments on western blotting.
13. Experiments on plasmid isolation.

MBCS-417: Seminar and Interactive Course **M.M. 100**

MBC-418: Project work **M.M. 500**