

**DEPARTMENT OF MOLECULAR BIOLOGY
&
BIOTECHNOLOGY**



**COURSE STRUCTURE
for
B.Sc.MAJOR
in
MOLECULAR BIOLOGY & BIOTECHNOLOGY**

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**COURSE STRUCTURE FOR B.SC. MAJOR
IN
MOLECULAR BIOLOGY AND BIOTECHNOLOGY**

SEMESTER I							
Course Code	Course Title	Nature of Course	Credit of Course	Class hour/ week	Evaluation		Total
					IA	Sem End	
MBBT – M-T-1	BIOCHEMISTRY & METABOLISM	Major	4	4	15	40	55
MBBT – M-P-1			2	4		20	20
MBBT – MI-T-1	BIOLOGICAL CHEMISTRY To be OPTED by the students from OTHER department	Minor	3	3	10	30	40
MBBT – MI-P-1			1	2		10	10
MBBT– MU- T-1	To be developed and offered by respective colleges. To be OPTED by the students from OTHER department	Multidisciplinary	3	3	10	35	45
AECC	XXX	Ability Enhancement	X	X	X	X	X
MBBT – SEC- T-1	ENZYMOLGY	Skill Enhancement	2	2	10	25	35
MBBT – SEC- P-1			1	2		10	10
VA-T-1	ENVIRONMENTAL EDUCATION (Content from general pool)	Value added	4	4	10	40	50
	XXX	Internship	X	X	X	X	X
05	Total		20	24	55	210	265

XXX – Component is not part of course structure of current semester

SEMESTER II							
Course Code	Course Title	Nature of Course	Credit of Course	Class hour/week	Evaluation		Total
					IA	Sem End	
MBBT – M-T-2	CELL BIOLOGY	Major	4	4	15	40	55
MBBT – M-P-2			2	4		20	20
MBBT – MI-T-1	BIOLOGICAL CHEMISTRY To be OPTED by the students from OTHER department	Minor	3	3	10	30	40
MBBT – MI-P-1			1	2		10	10
MBBT – MU- T-1	To be developed and offered by respective colleges. To be OPTED by the students from OTHER department	Multidisciplinary	3	3	10	35	45
AECC	COMMUNICATIVE ENGLISH (Content from general pool)	Ability Enhancement	4	4	10	40	50
MBBT – SEC- T-2	MICROBIAL DIAGNOSIS IN HEALTH CLINICS	Skill Enhancement	2	2	10	25	35
MBBT – SEC- P-2			1	2		10	10
VA	XXX	Value added	X	X	X	X	X
	Additional for Certificate	Internship	4				
05	Total		20 + 4	24	55	210	265

XXX – Component is not part of course structure of current semester

DEPARTMENT OF MOLECULAR BIOLOGY & BIOTECHNOLOGY

Proposed Syllabus for

B.Sc. MAJOR IN MOLECULAR BIOLOGY & BIOTECHNOLOGY

Semester I

Title of the Paper: BIOCHEMISTRY AND METABOLISM

Code: MBBT – M-T-1

Course Category: MAJOR (Theo)

Theory – 4 Credits

Total: 60 hrs (4hrs/week)

UNIT I (10 periods)
Water, buffer, and acid-base chemistry: Physical and chemical properties of water, Weak interactions in aqueous systems, Basis of acidity and basicity, Ionization of water, weak acids and weak bases, Equilibrium constant, Dissociation constant and the pH scale, Ionic product of water, Buffers – systems that resist pH changes, Henderson-Hasselbalch equation, significance of pH in biological systems, Measurement of pH – indicators, pH meter. Chromatography: Principles and Applications in protein purification.
UNIT II (20 periods)
Structure, classification and properties of Amino acids, Peptide bond, Conformation of peptide bonds, Backbone torsion angles, Ramachandran plot, Forces stabilizing protein structure, Different Level of structural organization of proteins: alpha helix, beta sheet, reverse turns, helix propensity scale, collagen helix and coiled coil, Motifs and domains, Fibrous and globular proteins, Structural features of membrane proteins, hydrophobicity scale. Strategies of protein purification. Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides (glycogen, starch, cellulose).
UNIT III (10 periods)
Lipids: Structure and functions –Classification, nomenclature, and properties of fatty acids, essential fatty acids. Triglycerides, Membrane lipids: Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Archaeobacterial ether lipids, Prostaglandins, Cholesterol. Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, purines & pyrimidines, Nucleosides & Nucleotides, Anti and syn conformations of nucleotides, sugar pucker in DNA and RNA, Double helical model of DNA structure and forces responsible for A, B, C& Z – DNA, DNA-RNA hybrid. Melting temperature, Supercoiling of DNA, Topoisomers.
UNIT IV (20 periods)
Carbohydrates Metabolism (Reactions and regulations): Glycolysis, Fate of pyruvate under aerobic and anaerobic conditions, TCA cycle, Gluconeogenesis, Glycogenolysis, glycogen synthesis, Pentose phosphate pathway. Fatty acid metabolism (Reactions and regulations): Synthesis and β -oxidation of fatty acids.

Title of the Paper: BIOCHEMISTRY AND METABOLISM

Code: MBBT – M-P-1

Course Category: MAJOR (Pract)

Practical – 2 Credits

Total: 60 hrs (4hrs/week)

1. Examination of physical properties of biomolecules – colour, odour, texture.
2. Preparation of normal, molar, and gm% solutions.
3. Qualitative tests for Carbohydrates, proteins, and lipids.
4. Operation of pH meter.
5. Preparation of buffers.
6. Separation of Amino acids and plant pigments by Paper chromatography.
7. Separation of Amino acids and plant pigments by Thin Layer chromatography.

SUGGESTED READING

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
2. Segel, I. H., (2004) Biochemical calculations, 2nd Edition, John Wiley and Sons.
3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
4. Upadhyay, A., Upadhyay, K., Nath, N., (2006) Biophysical Chemistry – principles and techniques. Himalaya Publishing House.
5. Plummer, D. T., (2005) An Introduction to Practical Biochemistry, Tata McGraw-Hill publishing Co. Ltd.

Title of the Paper: ENZYMOLOGY
Code: MBBT – SEC- T-1
Course Category: SEC (Theo)
Theory – 2 Credits

Total: 30 hrs (2hrs/week)

UNIT I (15 periods)

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity and enzyme Unit, Enzyme substrate complex: concept of E-S complex, lock and key and induced fit hypothesis, binding sites, active site, specificity, Kinetics of enzyme activity, Michaelis-Menten equation and its derivation, Different plots for the determination of K_m and V_{max} and their physiological significance, factors affecting initial rate, E, S, temp. & pH, Significance of activation energy and free energy.

Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition: types of inhibition, Lineweaver-Burk plots, suicide inhibitor. Zymogens and their activation (Proteases and Prothrombin).

Biocatalysts from extreme thermophilic and hyper-thermophilic archaea and bacteria. Mechanism of enzyme action: General mechanistic principle, Enzyme regulation: Product inhibition, feed-back control, covalent modification.

Role of: NAD^+ , $NADP^+$, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxalphosphate, lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions

UNIT II (15 periods)

Allosteric enzymes with special reference to phosphofructokinase, kinetics of allosteric enzymes. Isoenzymes– multiple forms of enzymes. Ribozymes. Multifunctional enzyme – examples.

Isolation, crystallization and purification of enzymes, test of homogeneity of enzyme preparation, Methods for large scale production of enzymes.

Immobilized enzyme and their comparison with soluble enzymes, Application of Immobilized and soluble enzyme in health and industry.

Methods for protein sequencing. Brief overview of the methods for analysis of secondary and tertiary structures of enzymes.

Title of the Paper: ENZYMOLOGY
Code: MBBT – SEC- P-1
Course Category: SEC (Pract)
Theory – 1 Credit

Total: 30 hrs (2hrs/week)

Principles and concepts may be demonstrated through hands-on exposure or virtual labs

1. Demonstration of the digestion of starch by amylase.
2. Investigation of the effect of temperature on enzyme activity.
3. Demonstration of the action of lipase.
4. Demonstration of Enzyme/Cell Immobilization.
5. Demonstration of Isolation and purification of enzymes.
6. Demonstration of Protein sequencing techniques.

SUGGESTED READING

1. Biochemistry, Lubert Stryer, 6th Edition, W H Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGraw-Hill, 2009.
3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley and Sons, 1995.
4. Molecules of Life. John Kuriyan, Boyana Konforti, David Wemmer. Garland Science. 2013
5. Student Companion to Accompany Biochemistry. Richard I Gumpert, Frank H Deis, Nancy Counts Gerber, Roger Koeppe II. 5th Edition. W. H. Freeman. 2002
6. Biochemistry by Mary K. Campbell & Shawn O. Farrell, 5th Edition, Cengage Learning, 2005.
7. Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999
8. Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 2004
9. Practical Enzymology Hans Bisswanger Wiley-VCH 2004
10. The Organic Chemistry of Enzyme-catalyzed Reactions, Richard B. Silverman Academic Press 2002

Semester II

Title of the Paper: CELL BIOLOGY

Code: MBBT – M-T-2

Course Category: MAJOR (Theo)

Theory – 4 Credits

Total: 60 hrs (4hrs/week)

UNIT I (10 periods)
Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation, visualisation of cells Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport
UNIT II (15 periods)
Membrane Vacuolar system, cytoskeleton, and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion. Lysosomes: Vacuoles and micro bodies: Structure and functions
UNIT III (20 periods)
Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis Chloroplasts: Structure and function, genomes, biogenesis Nucleus: Structure and function, chromosomes, and their structure Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function
UNIT IV (15 periods)
Cell Signaling: Principles of cell signaling, Signaling through G protein coupled receptor and enzyme coupled receptors, Signaling routes in regulation of gene expression Cell Cycle: Overview of the cell cycle, Cell cycle control system, Control of cell division and cell growth Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics, and molecular basis of cancer

Title of the Paper: CELL BIOLOGY
Code: MBBT – M-P-2
Course Category: MAJOR (Pract)
Practical – 2 Credits

Total: 60 hrs (4hrs/week)

1. Study the effect of temperature and organic solvents on semi permeable membrane.
2. Demonstration of dialysis.
3. Study of plasmolysis and de-plasmolysis.
4. Cell fractionation and determination of enzyme activity in organelles using sprouted seed or Yeast cell.
5. Study of structure of any Prokaryotic and Eukaryotic cell.
6. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, oesophagus, stomach, pancreas, intestine, kidney, ovary, testes.
7. Cell division in onion root tip/ insect gonads.
8. Preparation of Nuclear, Mitochondrial & cytoplasmic fractions.

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons, Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Title of the Paper: MICROBIAL DIAGNOSIS IN HEALTH CLINICS

Code: MBBT – SEC- T-2

Course Category: SEC (Theo)

Theory – 2 Credits

Total: 30 hrs (2hrs/week)

UNIT I (15 periods)Importance of Diagnosis of Diseases

Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.How to collect clinical samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage. Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa-stained thin blood film for malaria; Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.
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UNIT II (15 periods)Methods of Diseases Diagnosis
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Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acidbased methods - PCR, Nucleic acid probes; Kits for Rapid Detection of Pathogens- typhoid, Dengue and HIV, Swine flu. Testing for Antibiotic Sensitivity in Bacteria- Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method

Title of the Paper: MICROBIAL DIAGNOSIS IN HEALTH CLINICS

Code: MBBT – SEC- P-2

Course Category: SEC (Pract)

Theory – 1 Credit

Total: 30 hrs (2hrs/week)

Principles and concepts may be demonstrated through hands-on exposure or virtual labs

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| <ol style="list-style-type: none">1. Preparation and use of culture media for culturing various pathogenic microorganisms2. Determination of minimal inhibitory concentration (MIC) of an antibiotic3. Serological Methods - Agglutination, ELISA |
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SUGGESTED READING

1. Ananthanarayan R and Paniker CKJ (2009) Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology 2nd edition, Elsevier India Pvt Ltd
4. Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13th edition, Mosby
5. Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and McCartney Practical Medical Microbiology, 14th edition, Elsevier.

Semester I and II MINOR

Title of the Paper: BIOLOGICAL CHEMISTRY

Code: MBBT – MI-T-1

Course Category: MINOR (Theo)

Theory - 3 Credits

Total: 45 hrs (3hrs/week)

UNIT I (10 periods): Carbohydrates and Lipids
1.1. Carbohydrates-Importance and classification 1.2. Structure, configuration, and biochemical importance of Monosaccharides (Glucose and Fructose) Oxidation, Reduction, Osazone formation, Aldose & Ketose, Glycosides (Streptomycin, Cardiac glycosides and Ouabain) 1.3. Structure, configuration, and biochemical importance of Disaccharides and glycosidic bond, Mutarotation, Haworth projection (Sucrose, Trehalose, Lactose, Maltose, Isomaltose, Cellobiose) 1.4. Structure, and biochemical importance Polysaccharides (Starch, Glycogen, Cellulose) 1.5. Lipids, Fatty acids-importance, properties and classification, Simple lipids-TAG, Complex lipids, Derived lipids, sterols, Fatty acids: Saturated and Unsaturated fatty acids with examples.
UNIT II (15 periods): Proteins and Enzymes
2.1 Classification, structure, and physical and chemical properties of amino acids & proteins 2.2 Enzymes-classification and nomenclature. Michaelis-Menten Equation-Factors influencing the enzyme reactions and Enzyme inhibition (Competitive and Non-competitive), role of co-enzymes. 2.4 Hormones, mode of action (Thyroid gland) 2.5 Vitamins- classification, sources, functions, and applications 2.6 Paper chromatography and Thin Layer Chromatography: Principles and Applications.
UNIT III (15 periods): Bioenergetics of biomolecules
3.1 Glycolysis 3.2 Gluconeogenesis and its significance 3.3 TCA Cycle, electron transport, Oxidative phosphorylation 3.4 Biosynthesis of Fatty acids -palmitoyl-CoA, Cholesterol, β -oxidation of fatty acid. 3.5 Transamination and Oxidative deamination reactions of amino acids. Amino acid catabolism (Phenyl ketonuria, albinism)
UNIT IV (5 periods): Intermediary Metabolism
4.1 Urea cycle 4.2 Biosynthesis and regulation of purine and pyrimidine nucleotides, de novo and salvage pathways

Title of the Paper: BIOLOGICAL CHEMISTRY

Code: MBBT – MI-P-1

Course Category: MINOR (Pract)

Practical- 1 Credit

Total: 30 hrs (2hrs/week)

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| <ol style="list-style-type: none">1. Preparation of normal, molar, and gm% solutions.2. Preparation of buffers.3. Qualitative tests of sugars, amino acids, and lipids.4. Separation of amino acids by paper chromatography and TLC. |
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SUGGESTED READING

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry.VI Edition. W.H Freeman and Co.
2. Segel, I. H., (2004) Biochemical calculations, 2nd Edition, John Wiley and Sons.
3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
4. Upadhyay, A., Upadhyay, K., Nath, N., (2006) Biophysical Chemistry – principles and techniques. Himalaya Publishing House.
5. Plummer, D. T., (2005) An Introduction to Practical Biochemistry, Tata McGraw-Hill publishing Co. Ltd.