

Department of Biotechnology

COURSE STRUCTURE AT A GLANCE

B.Sc. Biotechnology-Semester and Choice Based Credit System
Jamia Millia Islamia, New Delhi-110025

FIRST YEAR

SEMESTER I					SEMESTER II				
N	Papers	Code	Credit	MM	N	Papers	Code	Credit	MM
1	Biochemistry & Metabolism	BBT-101	4	100	1	Mammalian Physiology	BBT-201	4	100
2	Cell Biology	BBT-102	4	100	2	Plant Anatomy & Physiology	BBT-202	4	100
3	Plant Diversity-I	BBT-103	4	100	3	Animal Diversity-I	BBT-203	4	100
4	Biotechnology & Human Welfare (CBCE)	BBT-104	4	100	4	Bioethics & Biosafety (CBCE)	BBT-204	4	100
5	Lab Course-I	BBT-105	4	100	5	Lab Course-II	BBT-205	4	100

SECOND YEAR

SEMESTER III					SEMESTER IV				
N	Papers	Code	Credit	MM	N	Papers	Code	Credit	MM
1	Genetics	BBT-301	4	100	1	Gen Microbiol.	BBT-401	4	100
2	Mol. Biology	BBT-302	4	100	2	Immunology	BBT-402	4	100
3	Chemistry-I	BBT-303	4	100	3	Chemistry-II	BBT-403	4	100
4	Plant Divi-II	BBT-304	4	100	4	Animal Divi-II	BBT-404	4	100
5	Med. Biotech (AECC)	BBT-305	4	100	5	Dev. Biology (CBCE)	BBT-405	4	100
6	Lab Course-III	BBT-306	4	100	6	Lab Course-IV	BBT-406	4	100

THIRD YEAR

SEMESTER V					SEMESTER VI				
N	Papers	Code	Credit	MM	N	Papers	Code	Credit	MM
1	Bioprocess Tech	BBT-501	4	100	1	Bioanalytical Tools	BBT-601	4	100
2	rDNA Tech. (CBCE)	BBT-502	4	100	2	Animal Biotech	BBT-602	4	100
3	Plant Biotech	BBT-503	4	100	3	Env. Biotech	BBT-603	4	100
4	Bioinformatics	BBT-504	4	100	4	Biostatistics	BBT-604	4	100
5	Essent. Maths	BBT-505	4	100	5	Enzymology (SEC)	BBT-605	4	100
6	Lab Course-V	BBT-506	4	100	6	Lab Course-VI	BBT-606	4	100

UNIT I

Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels.

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: (*S.aureus*, *C.tetani*, *C.botulinum*, *C.diphtheriae*, *M.tuberculosis*, *M. Leprae*) and gram negative bacteria: (*E.coli*, *N. gonorrhoea*, *P. aeruginosa*, *S. typhi*, *Y. pestis*, *V. cholerae*, *T. Pallidum*, *Rickettsiaceae*, *Chlamydiae*)

Resistance to antimicrobials: Biochemical mechanisms of resistance, Genetics of resistance; Laboratory safety regulations.

UNIT II

Viral disease and diagnosis- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses. Antiretrovirals.

UNIT III

Enzyme Immunoassays:

Enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting. Enzyme immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Immuno florescence.

UNIT IV

Molecular Diagnostics:

Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing of bacterial pathogens. flowcytometry and cell sorting.

SUGGESTED READINGS

1. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
2. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier. .
3. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
4. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
5. Bioinstrumentation, Webster
6. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
7. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.

UNIT - I (20 Periods)

Isolation, crystallization and purification of enzymes, test of homogeneity of enzyme preparation, methods of enzyme analysis.

Enzyme classification (rationale, overview and specific examples) Zymogens and their activation (Proteases and Prothrombin).

Enzyme substrate complex: concept of E-S complex, 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. Collision and transition state theories, Significance of activation energy and free energy.

UNIT – II (15 Periods)

Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition, determination of K_i , suicide inhibitor.

Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. Techniques for studying mechanisms of action, chemical modification of active site groups, specific examples:-chymotrypsin, Isozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase.

Enzyme regulation: Product inhibition, feed backcontrol, covalent modification.

UNIT – III (13 Periods)

Allosteric enzymes with special reference to aspartate transcarbomylase and phosphofructokinase. Qualitative description of concerted and sequential models. Negative cooperativity and half site reactivity. Enzyme - Enzyme interaction, Protein ligand binding, measurements analysis of binding isotherm, cooperativity, Hill and scatchard plots, kinetics of allosteric enzymes. Isoenzymes– multiple forms of enzymes with special reference to lactate dehydrogenase. Multienzyme complexes. Ribozymes. Multifunctional enzyme-eg Fatty Acid synthase.

UNIT – IV(12 Periods)

Enzyme Technology: Methods for large scale production of enzymes.

Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors. Application of Immobilized and soluble enzyme in health and industry. Application to fundamental studies of biochemistry. Enzyme electrodes.

Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering– selected examples, Delivery system for protein pharmaceuticals, structure function relationship in enzymes, structural motifs and enzyme evolution.

Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes. Protein folding *invitro* & *invivo*.

SUGGESTED READING

1. Biochemistry, Lubert Stryer, 6th Edition, WH 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, McGrawHill, 2009.
3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley and Sons, 1995.
4. Biochemistry by Mary K. Campbell & Shawn O. Farrell, 5th Edition, Cengage Learning, 2005.
5. Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999
6. Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 2004
7. Practical Enzymology Hans Bisswanger Wiley–VCH 2004
8. The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press 2002

Course Structure at a Glance

M.Sc. Biotechnology

(4 Semester PG Degree Course)

(Choice Based Credit System)

Department of Biotechnology

Jamia Millia Islamia, New Delhi

Semester I			
Paper Code	Paper Title	Maximum Marks	Credits
MBT 101	Molecular Biology	100	4
MBT 102	Cell Biology	100	4
MBT 103	Biochemistry and Biophysics	100	4
MBT 104	Genetics (CBCE)	100	4
MBT 105	Immunology	100	4
MBT 106	Lab Course-I	100	4

Semester II			
Paper Code	Paper Title	Maximum Marks	Credits
MBT 201	Microbiology	100	4
MBT 202	Metabolism and Enzymology	100	4
MBT 203	Animal Biotechnology	100	4
MBT 204	Genetic Engineering	100	4
MBT 205	Cellular and Molecular Physiology (CBCE)	100	4
MBT 206	Modern (-Omics) Technologies (SEC)	100	4

Semester II			
MBT 207	Lab Course-II	100	4
MBT 208	Seminar-II	25	

Semester III			
Paper Code	Paper Title	Maximum Marks	Credits
MBT 301	Bioprocess Engineering and Fermentation Technology	100	4
MBT 302	Plant Biotechnology	100	4
MBT 303	Environmental Biotechnology	100	4
MBT 304	Biostatistics and Bioinformatics	100	4
MBT 305	Medical Biotechnology and Mol. Medicine (CBCE)	100	4
MBT 306	IPR, Bioethics and Entrepreneurship (AECC)	100	4
MBT 307	Lab Course- III	100	4
MBT 308	Seminar III	25	

Semester IV			
Paper Code	Paper Title	Maximum Marks	Credits
MBT 401	Research Project	400	16
MBT 402	Seminar IV	100	4

Unit 1: Genomics

Introduction to genomics, large scale DNA sequencing methods- whole genome analysis, next generation sequencing, genome mapping, structural and functional genomics, comparative genomics, metagenomics, toxicogenomics, pharmacogenomics, different methods for characterization of animal genomes, SNP, STR, QTL, RFLP, RAPD, genome bioinformatics, genome annotation.

Unit 2: Transcriptomics and microarray technology

Transcriptome and expression profiling, DNA and RNA microarray, RNA seq, microarray databases and bioinformatics tools.

Unit 3: Proteomics

Introduction to proteomics, concept and applications, structural proteomics, functional proteomics, tools and techniques in proteomics- IEF, 2D PAGE and mass spectrometry, analytical chromatography (HPLC, UPLC, nano-HPLC) and working principle of mass-spectrometry, types and variants of mass-spectrometry (ESI, MALDI-TOF, FT-MS, Triple-Quad, MS/MS, Quadrupole), MS1 and MS2, use of mass-spectrometry in proteomic analysis, interactome and PTM analysis by mass-spectrometry, protein identification, expressional, functional and structural proteomics in health and disease, diagnostics and biomarker discovery.

Unit 4: Metabolomics

Introduction, concept and applications, metabolomics instrumentation, use of NMR and mass-spectrometers in metabolomics, metabolomics in health and disease, metabolomics in diagnostics and biomarker discovery.

Suggested Readings:

1. *Genes IX* by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
2. *Modern Biotechnology, 2nd Edition*, S.B. Primrose, Blackwell Publishing, 1987.
3. *Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition*, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010.
4. *Molecular Cloning: A Laboratory Manual (3rd Edition)* Sambrook and Russell Vol. I to III, 1989.
5. *Principles of Gene Manipulation 6th Edition*, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.
6. *Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.*
7. *Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.*
8. *Russell, P. J. (2009). iGenetics- A Molecular Approach. III Edition. Benjamin Cumming*