



DR. RAM MANOHAR LOHIA AVADH UNIVERSITY, AYODHYA

Structure of Syllabus for the

PROGRAM: M.Sc., SUBJECT: Biotechnology

Syllabus Developed by				
SN	Name of Expert/BoS Member	Designation	Department	College/ University
1	Prof. Samir Sharma	External Expert	Department of Biochemistry	University of Lucknow, Lucknow
2	Prof. Rajoeva Gaur	Dean, Faculty of Science	Department of Microbiology	Dr. Rammanohar Lohia Avadh University, Ayodhya
3	Prof. Farrukh Jamal	Professor	Department of Biochemistry	Dr. Rammanohar Lohia Avadh University, Ayodhya
4	Dr. Pankaj Singh	Assistant Professor	Department of Biotechnology	Dr. Rammanohar Lohia Avadh University, Ayodhya
5	Dr. Manikant Tripathi	Assistant Professor	Department of Biotechnology	Dr. Rammanohar Lohia Avadh University, Ayodhya
6.	Prof. Neelam Pathak	Professor, Head & Convener	Department of Biochemistry	Dr. Rammanohar Lohia Avadh University, Ayodhya

Course Code		Course Title	Credits	T/P	Evaluation	
A	B				CIE	ETE
A	B	C	D	E	F	G
SEMESTER I (YEAR I)						
B100701T	CORE	Macromolecules: Structure and Functions	5	T	25	75
B100702T	CORE	Microbial Physiology and Genetics	5	T	25	75
B100703T	CORE	Bioanalytical Tools and Techniques	5	T	25	75
B100704T	FIRST ELECTIVE (Select any one)	Essentials of Molecular Biology	5	T	25	75
B100705T		Enzyme and Food Technology	5	T	25	75
B100706P	SECOND ELECTIVE (Select any one)	Biotechnology Lab Course-A	5	P	50	50
B100707P		Biotechnology Lab Course-B	5	P	50	50
SEMESTER II (YEAR I)						
B100801T	CORE	Immunology	5	T	25	75

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B100802T	CORE	Genetic Engineering	5	T	25	75
B100803T	CORE	Environmental Biotechnology	5	T	25	75
B100804T	THIRD ELECTIVE (Select any one)	Fundamentals of Nutrition Science	5	T	25	75
B100805T		Cell & Molecular Biology	5	T	25	75
B100806P	FOURTH ELECTIVE (Select any one)	Biotechnology Lab Course-C	5	P	50	50
B100807P		Biotechnology Lab Course-D	5	P	50	50
SEMESTER III (YEAR II)						
B100901T	CORE	Animal Biotechnology and Cell Culture	5	T	25	75
B100902T	CORE	Plant Biotechnology and Tissue culture	5	T	25	75
B100903T	CORE	Bioprocess Engineering and Technology	5	T	25	75
B100904T	FIFTH ELECTIVE (Select any one)	Clinical Biochemistry and IPR & Biosafety	5	T	25	75
B100905T		Medical Biotechnology	5	T	25	75
B100906P	SIXTH ELECTIVE (Select any one)	Biotechnology Lab Course-E	5	P	50	50
B100907P		Biotechnology Lab Course-F	5	P	50	50
SEMESTER IV (YEAR II)						
B101001T	CORE	Applied Biotechnology	5	T	25	75
B101002T	CORE	Research Methodology	5	T	25	75
B101003P	SEVENTH ELECTIVE (Select any one)	Seminar & Interactive Course	5	P	50	50
B101004P		Review and Assignment	5	P	50	50
B101005P	RESEARCH PROJECT/ DISSERTATION	Major Research Project/ Dissertation	10	P	50	50

Subject Prerequisites:

Program Outcomes (POs)

- The program has been designed in such a way so that the students acquire strong theoretical and practical knowledge in various domains of biotechnology.
- The programme includes details of bio-molecules, proteins & enzymes, cell biology, microbial physiology, tools and techniques, metabolism, immunology, molecular biology, genetic engineering, animal biotechnology, plant biotechnology, bioprocess engineering, followed by computational analysis to make the study of living system more interesting which is the need of hour.
- The practical courses have been designed to equip the students with the laboratory skills in

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biotechnology. Students will be able to design and conduct experiments, as well as to analyze and interpret scientific data.

- The programme will offer students with the knowledge and skill base that would enable them to undertake advanced studies in biotechnology and related areas or in multidisciplinary areas that involve biotechnology and that will develop entrepreneurship skills among students.
- The students will gain domain knowledge and know-how for successful career in academia, industry and research. Promoting lifelong learning to meet the ever evolving professional demands by developing ethical, interpersonal and team skills.
- The students will get exposure of wide range of careers such as teacher, scientists, in pharmaceutical industries that combine biology, plants and medicine.

Semester wise Paper Titles with Details

Year	Semester	Paper	Paper Title	Prerequisite for Paper	Elective for Major Subjects
		Masterin Biotechnology			
First	SEM-I	Core Theory Paper – I	Macromolecules: Structure and Functions	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core Theory Paper – II	Microbial Physiology and Genetics	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core Theory Paper – III	Bioanalytical Tools and Techniques	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology
		FIRST ELECTIVE (Select any one)	Essentials of Molecular Biology	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
			Enzyme and Food Technology	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology
		SECOND ELECTIVE	Biotechnology Lab Course-A	B.Sc. (Botany, Zoology, Chemistry, Biochemistry,	M.Sc. (Microbiology, Biotechnology,

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		(Select any one)		Biotechnology, Microbiology)	Environmental Science, Chemistry, Botany, Zoology)
			Biotechnology Lab Course-B	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
	SEM-II	Core Theory Paper - IV	Immunology	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology
		Core Theory Paper - V	Genetic Engineering	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology
		Theory Paper - VI	Environmental Biotechnology	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		THIRD ELECTIVE (Select any one)	Fundamentals of Nutrition Science	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
			Molecular Cell Biology	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		FOURTH ELECTIVE (Select any one)	Biotechnology Lab Course-C	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
			Biotechnology Lab Course-D	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)



Seco nd	SEM- III	Core Theory Paper - VII	Animal Biotechnology and Cell Science	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)	
		Core Theory Paper - VIII	Plant Biotechnology and Tissue culture	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology	
		Core Theory Paper - IX	Bioprocess Engineering and Technology	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)	
		FIFTH ELECTIVE (Select any one)	Clinical Biochemistry and IPR & Biosafety	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology	
			Medical Biotechnology	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology	
		SIXTH ELECTIVE (Select any one)	Biotechnology Lab Course-E	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)	
			Biotechnology Lab Course-F	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)	
		SEM- IV	Core Theory Paper- X	Applied Bintechnology	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M. Sc (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core Theory	Research	B.Sc. (Botany, Zoology, Chemistry,	M. Sc (Microbiology,	

	Paper- XI	Methodology	Biochemistry, Biotechnology, Microbiology)	Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
	SEVENTH ELECTIVE (Select any one)	Seminar & Interactive Course		
		Review and Assignment		
	RESEARCH PROJECT/ DISSERTATIO N	Major Research Project/ Dissertation		

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Program/Class: Master in Biotechnology	Year: First	Semester: I
Subject: Biotechnology		
Course Code: B100701T	Course Title: Macromolecules: Structure and Functions	
Course Objectives: The objective is to study about the structure and biological functions of macromolecules of living systems like carbohydrates, proteins, lipids, and nucleic acids laying the foundation for other advanced courses like physiology, cell biology, molecular biology, and immunology.		
Course outcomes:		
CO.1 Learn about the Contribution of Indian scientists in biological field and Ayurveda system of disease treatment.		
CO.2 The students will learn about role of water and buffer in metabolic activity. They will also learn about the classification, structure, function and properties of carbohydrate and glycoconjugates.		
CO.3 Students will understand classification of lipids and structure, properties, deficiency diseases of vitamins.		
CO.4 Students will learn about types, structure, properties of nucleic acids, DNA sequencing and various supramolecular assemblies;		
CO.5 Students will understand the structure, hierarchy of proteins and biophysical and cellular aspects of protein folding.		
Credits: 5		Core Compulsory
Max. Marks: 25+75		Min. Passing Marks:40
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-1-0		

Unit	Topics	No. of Lectures
I	Contribution of Indian scientists to biological sciences: Jagdish Chandra Bose, Har Gobind Khorana, Ananda Mohan Chakrabarty, Birbal Sahni, Lalji Singh. Ayurveda: The Science of Life, Introduction to traditional Indian medicinal system, Indian medicinal plants and their therapeutics importance, A comparative account of traditional and modern therapy	10
II	Properties of water, pH, Henderson Hasselbalch equation, buffer, physiological buffer & its significance; Carbohydrates: Classification, structure, function and properties, Glycoconjugates: glycolipids, glycoproteins, proteoglycans, Glycosaminoglycans.	12
III	Lipids: Classification, structure, function and properties, Sterols, Lipoproteins, Vitamins (fat soluble and water soluble), structure, properties, deficiency diseases.	12
IV	Nucleic Acids: types, structure, properties, DNA sequencing, DNA polymorphism, Supramolecular assemblies: molecular assemblies like membranes, ribosomes, extracellular matrix and chromatin.	12
V	Proteins: structure of amino acids and its classification, hierarchy in structure. Primary, secondary, tertiary and quaternary structure,	14



Ramachandran map, Protein folding: Biophysical and cellular aspects. Protein-protein and protein-ligand interactions, Sequencing of proteins, Protein denaturation

Suggested Readings:

- Lehninger, Albert, Cox, Michael M. Nelson, David L. (2017) *Lehninger principles of biochemistry*/New York: W. H. Freeman.
- Voet&Voet: Biochemistry Vols 1 & 2: Wiley (2004)
- Voet, D., &Voet, J. G. (2011). Biochemistry. New York: J. Wiley & Sons
- Biochemistry – Lubertstryer Freeman International Edition.
- Biochemistry – Keshav Trehan Wiley Eastern Publications
- Murray et al: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott:
- Fundamentals of Biochemistry-J. L. Jain S. Chand and Company
- Biochemistry and Molecular Biology: Oxford University Press
- Endocrinology (2007) 6th ed.. Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.

This course can be opted as an elective by the students of following subjects: M.Sc. Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Internal Continuous Evaluation Methods:

Total Marks: 25

House Examination/ Test: 10 Marks

Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

External Evaluation: 75 Marks

Course prerequisites: To study this course, a student must have had the Botany/Zoology/Chemistry/Biochemistry/Microbiology/Biotechnology/ in B.Sc.

Suggested equivalent online courses:

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Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None



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Program/Class: Biotechnology	Master in	Year: First	Semester: II
Subject: Biotechnology			
Course Code: B100805T		Course Title: Cell & Molecular Biology	
Course Objectives: The objectives of the course are to learn and understand the fundamentals of regulation of transcription, protein synthesis, protein synthesis regulation, protein trafficking and signal transduction, biology of cancer cell biology like cellete.			
Course outcomes:			
CO.1 Students will understand the transcription in eukaryotes, co-transcriptional processing, post transcriptional processing; regulation of prokaryotic gene expression and inhibitors of transcription			
CO.2 Students will understand about processes and mechanism of translation in prokaryotes and eukaryotes; nonsense and sense codons; wobble hypothesis; proofreading activity of ribosomes and fidelity of translation.			
CO.3 Students will learn about regulation of translation, co- and post-translational modifications of proteins; protein import into nuclei, mitochondria, chloroplasts and peroxisomes.			
CO.4 Students will understand about cell cycle and cell cycle regulation, mechanism of signal transduction, surface receptor mediated transduction.			
CO.5 Students will understand about molecular biology and biochemistry of cancer, tumor suppressor genes, Antisense and ribozyme technology and their applications.			
Credits: 5		Elective	
Max. Marks: 25+75		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-1-0			

Unit	Topics	No. of Lectures
I	Transcription in eukaryotes: Synthesis of pre-mRNA: Outline of process - Initiation, elongation and termination, RNA Pol II, promoter, Enhancer elements, Subunit structure of RNA Pol II, Roles of RNA polymerase II, Transcription factors, Co-transcriptional processing: Addition of 5' cap and 3' Poly A tail in mRNA; Post transcriptional processing; Regulation of prokaryotic gene expression; Concept of operon: <i>lac</i> and <i>trp</i> operons, Significance of repressor, Attenuation; Inhibitors of transcription	12
II	Translation in prokaryotes and eukaryotes: Outline of the process - Initiation, elongation and termination; Adapter role of tRNA, Genetic code, Evidences for a triplet codon; Properties of Genetic code; Codon family and Codon pairs; Nonsense and Sense codons; Degeneracy: Significance of Isoacceptor tRNAs and Wobble hypothesis; Codon bias; Amino acyl tRNA synthetase:	14

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	Classification, Specificity, Reaction catalyzed; A, P and E sites of ribosome; Start and stop codons, Ribosome binding site; Formation of initiation complex; Transpeptidation and Translocation; Ribosome cycle; Roles of Initiation factors, Elongation factors, Release factors, Ribosome recycling. Aminoacyl tRNA synthetases, catalytic role of GTP, Peptidyl transferase site and Factor binding site of ribosomes in translation. Proofreading activity of ribosomes and Fidelity of Translation. Regulation of translation, co- and post-translational modifications of proteins; Inhibitors of translation	
III	Protein traffic in cells: Secretory and non-secretory proteins, Endocytic and Exocytic pathways, Protein sorting and signal sequences; protein translocation in ER and vesicular transport to Golgi, lysosomes and plasma membrane; protein import into nuclei, mitochondria, chloroplasts and peroxisomes.	10
IV	Cell cycle: Cell cycle and cell cycle regulation, Mechanism of signal transduction, Exocrine, Endocrine, Paracrine and Synaptic strategies of chemical signaling, surface receptor mediated transduction (DAG, Ca ²⁺ , c-40AMP, G-Proteins).	12
V	Biology of Cancer: Molecular biology and biochemistry of cancer, oncogenes, mutation, chemical carcinogenesis, viral and cellular oncogenes, tumor suppressor genes from humans, structure, function and mechanism of action of pRB and p53 tumor suppressor proteins. Antisense and Ribozyme Technology and their applications: Molecular mechanism of antisense molecules, inhibition of splicing and translation, strategies for designing ribozymes, Fundamentals of epigenetics.	12

Suggested Readings:

- Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Dennis Bray, Karen Hopkin, Keith Roberts, Peter Walter "Essential Cell Biology"
- Baltimore "Molecular Cell Biology"
- Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter "Molecular Biology of the Cell"
- Lodish H, Baltimore D, Berk A, Zipursky SL, Matsudaira P, Darnell J. (1995). Molecular cell biology.
- Cooper "Molecular Cell Biology"
- Karp & Karp "Molecular Cell Biology"

This course can be opted as an elective by the students of following subjects: M.Sc. Microbiology, Biochemistry, Environmental Science, Chemistry, Botany, Zoology

Suggested Internal Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Research Orientation/ Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

External Evaluation: 75 Marks

Course prerequisites: To study this course, a student must have had the Botany/Zoology/Chemistry/Biochemistry/Microbiology/Biotechnology in B.Sc.

Suggested equivalent online courses:

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Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

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