DR. RAM MANOHAR LOHIA AVADH UNIVERSITY, AYODHYA

Structure of Syllabus for the

Program:M.Sc. Subject: Biochemistry

Syllabus Developed by				
SNo	Name of Expert/BoS Member	Designation	Department	College/ University
1	Prof. R.K. Mishra	External Expert	Department of Biochemistry	University of Lucknow, Lucknow
2	Prof. Farrukh Jamal	Professor	Department of Biochemistry	Dr. Rammanohar Lohia Avadh University, Ayodhya
3	Dr. Vandana Ranjan	Associate Professor	Department of Biochemistry	Dr. Rammanohar Lohia Avadh University, Ayodhya
4	Dr. Sangram Singh	Associate Professor	Department of Biochemistry	Dr. Rammanohar Lohia Avadh University, Ayodhya
5	Dr. Neelam Yadav	Assistant Professor	Department of Biochemistry	Dr. Rammanohar Lohia Avadh University, Ayodhya
6	Dr. Shivi Srivastava	Assistant Professor	Department of Biochemistry	Dr. Rammanohar Lohia Avadh University, Ayodhya
7	Dr. Pradeep Kumar Singh	Assistant Prof.	Department of Biochemistry	Dr. Rammanohar Lohia Avadh University, Ayodhya
8	Prof. Neelam Pathak	Professor,Head&Convenor	Department of Biochemistry	Dr. Rammanohar Lohia Avadh University, Ayodhya

Course Code		Course Title	Credits	T/P	Evaluation	
					CIE	ETE
A	B	C	D	E	F	G
SEMESTER I (YEAR I)						
B110701T	CORE	Biomolecules: Structure & Function	5	T	25	75
B110702T	CORE	Bioanalytical techniques	5	T	25	75
B110703T	CORE	Essentials of Metabolism	5	T	25	75
B110704T	FIRST ELECTIVE (Select any one)	Essentials of Molecular Biology	5	T	25	75
B110705T		Pharmaceutical Biochemistry	5	T	25	75
B110706P	SECOND ELECTIVE (Select any one)	Biochemistry Laboratory Course -A	5	P	50	50
B110707P		Biochemistry Laboratory Course -B	5	P	50	50
SEMESTER II (YEAR I)						
B110801T	CORE	Gene Expression & Regulation	5	T	25	75

B110802T	CORE	Cell Biology & Signaling pathways	5	T	25	75
B110803T	CORE	Protein Biochemistry & Enzymology	5	T	25	75
B110804T	THIRD ELECTIVE (Select any one)	Fundamentals of Nutrition Science	5	T	25	75
B110805T		Fundamentals of Environmental Sciences	5	T	25	75
B110806P	FOURTH ELECTIVE (Select any one)	Biochemistry Laboratory Course -C	5	P	50	50
B110807P		Biochemistry Laboratory Course -D	5	P	50	50
SEMESTER III (YEAR II)						
B110901T	CORE	Essentials of Microbiology	5	T	25	75
B110902T	CORE	Immunology	5	T	25	75
B110903T	CORE	Genetic Engineering	5	T	25	75
B110904T	FIFTH ELECTIVE (Select any one)	Clinical Biochemistry and IPR & Biosafety	5	T	25	75
B110905T		Bioinformatics and Biostatistics	5	T	25	75
B110906P	SIXTH ELECTIVE (Select any one)	Biochemistry Laboratory Course -E	5	P	50	50
B110907P		Biochemistry Laboratory Course -F	5	P	50	50
SEMESTER IV (YEAR II)						
B111001T	CORE	Applied Biotechnology	5	T	25	75
B111002T	CORE	Research Methodology	5	T	25	75
B111003P	SEVENTH ELECTIVE (Select any one)	Seminar & Interactive Course	5	P	50	50
B111004P		Review and Assignment	5	P	50	50
B111005P	RESEARCH PROJECT/ DISSERTATION	Major Research Project/ Dissertation	10	P	50	50

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 biochemistry. • The programme includes details of biomolecules, metabolism, tools and techniques molecular biology, clinical biochemistry, proteins &enzymes, immunology, cell biology, genetic engineering, clinical biochemistry, IPR and bioethics followed by applied biotechnology to make the study of living system more comprehensive with in depth knowledge yet interesting, which is the need of hour. • The practical courses have been designed to equip the students with the laboratory skills in biochemistry. Students will able to design and conduct experiments, as well as to analyze and interpret scientific data in useful form. • The program will offer students with the knowledge and skill base that would enable them to undertake advanced studies in biochemistry and related areas or in multidisciplinary areas that involve biochemistry. • The students will get exposureof wide range of careers that combine biology, animal science, plant science and medicine. • The students will gain domain knowledge and know-how for successful career in academia,industry and research. • Moreover, students will learn values for lifelong learning to meet the ever evolvingprofessionaldemands by developing ethical, inter personal and team skills.

Semester wise Paper Titles with Details					
Year	Semester	Paper	Paper Title	Prerequisite for Paper	Elective for Major Subjects
Master in Biochemistry					
First	SEM-I	Core Theory Paper - I	Biomolecules: Structure & Function	B.Sc (Botany, Zoology, Chemistry, Biochemistry Biotechnology, Microbiology)	M.Sc.(Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core Theory Paper –II	Bioanalytical techniques	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc.(Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core Theory Paper - III	Essentials of Metabolism	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)
			Pharmaceutical Biochemistry	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		SECOND ELECTIVE (Select any one)	Biochemistry Laboratory Course -A	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
			Biochemistry Laboratory 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	Gene Expression & Regulation	B.Sc. (Botany, Zoology, Chemistry,	M.Sc. (Microbiology, Biotechnology,

				Biochemistry, Biotechnology, Microbiology)	Environmental Science, Chemistry, Botany, Zoology)
		Core Theory Paper –V	Cell Biology & Signaling pathways	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core Theory Paper – VI	Protein Biochemistry& Enzymology	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)
			Fundamentals of Environmental Sciences	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		FOURTH ELECTIVE (Select any one)	Biochemistry Laboratory Course -C	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
			Biochemistry Laboratory Course -D	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc. (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
Second	SEM-III	Core Theory Paper VII	Essentials of Microbiology	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core Theory Paper - VIII	Immunology	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology,	M.Sc (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)

				Microbiology)	
		Core Theory Paper - IX	Genetic Engineering	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)
			Bioinformatics and Biostatistics	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M.Sc (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		SIXTH ELECTIVE (Select any one)	Biochemistry Laboratory Course -E	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M. Sc (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
			Biochemistry Laboratory Course -F	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M. Sc (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core Theory Paper- X	Applied Biotechnology	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M. Sc (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core Theory Paper- XI	Research Methodology	B.Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M. Sc (Microbiology, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		SEVENTH ELECTIVE (Select any one)	Seminar & Interactive Course		
			Review and Assignment		
		RESEARCH PROJECT/ DISSERTATION	Major Research Project/ Dissertation		

Program/Class: Master in Biochemistry	Year: First	Semester: 1
Subject: Biochemistry		
Course Code: B1107021	Course Title: Biomolecules: Structure & Functions	

Course Objectives:

The objective is to study about the structure and biological functions of macromoleculesof 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:

After completion of this course, a student will be able to:
CO1: Learn about the chemical structures of significant/major carbohydrate, and their structural and metabolic role in cellular system.
CO2:Learn about structure and functions of major lipid subclasses,circulating lipids etc. Theywill also learn about primary, secondary, tertiary, quaternarystructure of proteins.
CO3:Understand about the structure and function ofnucleosides and nucleotides, Physical & biochemical properties of DNA, Classification structure and function of different types of RNA, DNA topology and DNA supercoiling
CO4:Developunderstanding of otheraccessory molecules like vitamins, plant and animal hormones.

Credits:4	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	**Carbohydrates:** Classification and properties of simple carbohydrates: monosaccharide, oligosaccharide and polysaccharides; Reducing and Non-Reducing Sugar, Enantiomers, Structural Polysaccharides: Cellulose, Chitin, Storage Polysaccharides: Starch and Glycogen, Glycoproteins and Glycolipids. Biological Importance of carbohydrates.	12
III	**Proteins:** Amino acids: Chemical structure and general properties; Protein classification - globular, fibrous & membrane proteins. Biological Importance of amino acids and proteins. **Lipids:** Fatty acids: General formula, nomenclature and chemical properties; Lipid classification: simple, complex; General structure and functions of major lipid subclasses - acyl glycerols, phosphoglycerides, sphingolipids, waxes, terpenes, steroids and prostaglandins & free fatty acids; Circulating lipids - chylomicrons, LDL, HDL and VLDL.	14

IV	**Vitamins and Hormones**: Vitamins – internal & external sources, structure, properties, and functions including biochemical reactions, symptoms of hyper & hypo-vitaminosis. Hormones – Source organs, Structure, classification, properties & functions of animal & plant hormones.	12
V	**Nucleic Acids**: Structure of purines, pyrimidines, nucleosides and nucleotides; Physical & biochemical properties of DNA; Types of DNA: A, B and Z DNA & Triplet DNA, their structure and significance; Chargaff's Rule, DNA denaturation and Tm value, Types of repetitive nucleic acid sequences, Satellite DNA, DNA topology: Supercoiling, Linking number, Twist and Writhe; Classification structure and function of different types of RNA: mRNA, tRNA, rRNA, hnRNA; snRNA, snoRNA, miRNA, gRNA, Primary, secondary, and tertiary structures of RNA.	12

Suggested Readings:

1. Lehninger,Albert,Cox,MichaelM.Nelson,DavidL.(2017)*Leningerprinciplesofbiochemistry*/NewYork:W .H.Freeman.
2. Voet,D.,&Voet,J.G.(2011).Biochemistry.NewYork:J.Wiley&Sons
3. Biochemistry – Lubertstryer Freeman InternationalEdition.
4. Biochemistry – Keshav Trehan Wiley EasternPublications
5. Fundamentals of Bochemistry-J.L.JainS.ChandandCompany
6. Voet&Voet: Biochemistry Vols 1 & 2: Wiley (2004)
7. Murray et al: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott:
8. Biochemistry and Molecular Biology: Oxford University Press
9. Taiz, L., Zeiger, E.,. Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
10. Hopkins, W.G., Huner, N.P.,. Introduction to Plant Physiology. John Wiley & Sons,
11. .Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raft, H. and Strang, K.T. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.
12. Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.

Suggestive digital platforms web links

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

Suggested Continuous Internal 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 theBotany/Zoology/Chemistry/Biochemistry/Microbiology/Biotechnology in B.Sc.

Suggested equivalent online courses:

.....

Further Suggestions: None

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