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	Prof. Neelam Pathak	Professor, Head&Convenor	Department of Biochemistry	Dr. Rammanohar Lohia Avadh University, Ayodhya
8	Prof. C.K. Mishra	Dean Faculty of Science		Dr. Rammanohar Lohia Avadh University, Ayodh

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 evolving professionaldemands 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: I
Subject: Biochemistry		
Course Code: B110701T	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:Develop understanding of otheraccessory molecules like vitamins, plant and animal hormones.		
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	**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
II	**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.	12
III	**Proteins:** Amino acids: Chemical structure and general properties; Protein classification - globular, fibrous & membrane proteins, with associated size, shape, sequence of proteins; Primary, secondary, tertiary and quaternary structure of proteins, Protein native structure & denaturation, Biological Importance of amino acids and proteins.	12
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	12

	hormones.	
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)*Lehningerprinciplesofbiochemistry*/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., Raff, 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:

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Further Suggestions: None

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

Neelam Pathak

Program/Class: Master in Biochemistry	Year: First	Semester: I
Subject: Biochemistry		
Course Code: B110702T	Course Title: Bioanalytical Techniques	

Course Objectives:

COURSE OBJECTIVES:
Bioanalytical techniques are used to understand the theoretical principles involved in bioinstrumentation which may further utilized for the determination of nutrients, major ions and trace elements, biological samples together with the analytical techniques. This will enable the students to implement the use of these techniques in biological research and in discovering new products/compounds.

Course outcomes:

After completion of this course, a student will be able to:
CO1:Acquaint with basic instrumentation, principle and procedure of various sophisticated instruments.
CO2:Get the theoretical knowledge of various instruments and their practical applications.
CO3 Learn about Centrifugation & Electrophoresis.
CO4:Implement the use of instruments like chromatography, UV-VIS spectroscopy, NMR, CD, ORD in biological research
CO5: Understand the basics of handling of data, measures of central tendency like mean, median and mode, Measures of dispersion like mean deviation and standard deviation and Coefficient of variation.
CO6: To apprise students about bioinformatics tools.

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	**Spectroscopy-** Concepts of spectroscopy, Visible and UV spectroscopy,Beer-Lambert's Law, Principles and applications of NMR,ESR,Raman,Mass,atomic absorption and atomic emission spectroscopy and X-ray crystallography	12
II	**Chromatography and Microscopy-** Principles of partition chromatography, Paper, Thin layer, Ion exchange and affinity chromatography, Gel permeation Chromatography, HPLC & FPLC. Transmission and scanning EM: Freeze fracture techniques, Specific staining of biological materials.	12
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 application, subcellular fractionation.	12
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.	12

V	**Radioactive Techniques-** Introduction to radiations and their uses in biology, Safety measures, Principles and Applications of Liquid scintillation counting (LSC), Gamma counting and Autoradiography.	12

Suggested Readings:

1. Boyer, R.F., Biochemistry Laboratory: Modern Theory and Techniques, 6th ed., Boston, Mass: Prentice Hall, 2012,
2. Plummer D. T., An Introduction to Practical Biochemistry 3rd ed., Tata McGraw Hill Education Pvt. Ltd. 2006.
3. Wilson K. and Walker J., Principles and Techniques of Biochemistry and Molecular Biology, 7th ed., Cambridge University Press, 2010

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 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 theBotany/Zoology/Chemistry/Biochemistry/Microbiology/Biotechnology/Chemistry 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

Neelam Pathak

Program/Class: Master in Biochemistry	Year: First	Semester: I
Subject: Biochemistry		
Course Code: B110703T	Course Title: Essentials of Metabolism	
Course Objectives:		
The objectives of the course are to learn and understand the fundamentals of cellular metabolismof carbohydrates, lipids, aminoacids, and nucleic acids and their association with variousmetabolic diseases.		
Course outcomes:		
After completion of this course, a student will be able to: CO1:Learn Carbohydrate catabolism, and its association with cellular energy production, and carbohydrate anabolism in plants and animal cells. CO2:Understand Lipid biosynthesis, Degradation of fatty acids and cholesterol, ketone bodies, acidosis,and ketosis. CO3:Understand about the Biosynthesis of purines and pyrimidine nucleotides, degradation of nucleotides, salvage pathways,biosynthesis, and biodegradation of amino acids. Inborn errors of metabolism. CO4: Understand detailed mechanism of nitrogen metabolism and photosynthesis .		
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	**Principle of bioenergetics:** Laws of Thermodynamics, Energy cycle and specialized role of ATP as universal currency of energy, **Energy transduction:** energytransducing membranes from organelles in animals, plants and bacteria, Phosphorylation – Oxidative and Photophosphorylation, Chemiosmotic theory of phosphorylation. Photosynthetic light receptors and light harvesting complexes, Hill reaction, its components and products, Redox potential and electron flow through electron transport chain complexes in bacteria, chloroplast & mitochondria, Uphill and downhill flow of electrons, difference between cyclic and non-cyclic phosphorylation, regulation of ETC, Inhibitors of ETC, uncouplers, Bioluminescence,	12
II	**Carbohydrate metabolism:** Catabolic pathways – Glycolysis and Non- glycolytic pathways, Hexose monophosphate shunt and its modes, Tricarboxylic acid cycle. Anaplerotic reactions sequences in metabolism, fate and role of metabolic byproducts -NADH, $FADH_2$, Glycogenolysis, Krebs- Kornberg pathway Glyoxylate pathway. Glucose catabolism in cancerous tissue, aerobic and anaerobic catabolism of glucose in terms of respiration, Biosynthesis/Anabolic pathways with Regulation –Gluconeogenesis, Biosynthesis of disaccharides – sucrose, lactose, Biosynthesis of polysaccharides - glycogen synthesis, Starch synthesis, Cellulose synthesis, Glucosaminoglycans synthesis and their biological roles.	12
III	**Lipid Metabolism: Biosynthesis** – synthesis of saturated and unsaturated fatty acids, biosynthesis of triacylglycerols glycerophospholipids and membrane phospholipids, sphingolipids, cholesterol.	12

	Degradation of fatty acids: Carnitine transporters, α, β, ω oxidation; Ketone bodies, acidosis, ketosis, Cholesterol degradation and production bile acids and bile salts.	
IV	**Metabolism of Nitrogenous compounds:** Biosynthesis of amino acids and Urea cycle, associated metabolic disorders, Kreb-Urea bicycle, Biosynthesis of Nucleotides - salvage and de-novo synthesis of purines and pyrimidines, Catabolism of amino acids and nucleosides, and nucleic acids, Inborn errors of metabolism related to amino acids and nucleosides.	**12**
V	**Biochemistry of Nitrogen fixation:** Diazotrophy and its components,Nitrogen fixing organism, symbiotic and non-symbiotic modes, Physiology of nodule formation, Nitrogenase complex and its oxygen sensitivity with protection methods, Ammonia assimilation and regulation system, Ammonia and nitrate transport, nif gene, nod gene. **Photosynthesis:** Carbon fixation/reduction pathways - Calvin cycle, C3, C4 and CAM pathway, photorespiration and C2 pathway	**12**

Suggested readings

1. Lehninger,Albert,Cox,MichaelM.Nelson,DavidL.(2017)*Lehningerprinciplesofbiochemistry*/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,

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/Chemistry 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

Neelam Pathak

Program/Class: Master in Biochemistry	Year: First	Semester: I
Subject: Biochemistry		
Course Code: B110704T	Course Title: Essentials of Molecular Biology	

Course Objectives:

The objective of the course is learning and understanding the fundamentals of molecular biology likenucleic acid as genetic material, replication, gene organization and its regulation etc.

Course outcomes:

After completion of this course, a student will be able to:

CO1:Learn about nucleic acid as genetic information carriers, Possible modes of replication, and roles of helicase, primase, gyrase, topoisomerase, DNA Polymerase, DNA ligase, and Regulation of replication

CO2:Understand the detailed mechanism and regulation of Eukaryotic DNA replication, along with Mitochondrial and Chloroplastic DNA Replication

CO3:Learn about mechanism and regulation of transcription in prokaryotes along with Reverse transcription.

CO4: DevelopUnderstanding about the classes of DNA sequences, Genome-wide and Tandem repeats, Retroelements, Transposable elements, Centromeres, Telomeres, Satellite DNA, Minisatellites, Microsatellites; Applications of satellite DNA and Split genes

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	**Organization of Genetic materials in prokaryotes and Eukaryotes:** Genetic material, Genome type, Size, Genome Organization - Structural Maintenance of Chromosomes (SMC) Protein, Eukaryotic Nucleosomes, Histones, Chromatin, Concept of Gene, mono-cistronic and poly-cistronic genes, Gene Structure with various functional units - replicon, muton, recon, C-value and C-value paradox; Unique sequences and Cot value, reassociation kinetics, Split genes: Exons and Introns, DNA transposon.	12
II	**Replication:** Modes of replication: Details of Meselson and Stahl experiment; Prokaryotic DNA replication: Origin and Initiation, elongation and termination; Roles, properties and mechanism of action of DnaA, Helicase, Primase, DNA gyrase, Topoisomerases, DNA Polymerases, DNA ligase, Leading and lagging strands; Okazaki fragments; RNA primers; Regulation of replication; Fidelity of replication; Viral replication, σ or Rolling circle replication in ϕX174.	12
III	Eukaryotic DNA replication: Initiation, elongation and termination; Multiple replicons/initiation sites; Autonomously replicating sequence; Mechanism and significance of Origin recognition complex, Mini-chromosome maintenance proteins, DNA dependent DNA polymerases α, δ, ε, Nucleases, DNA ligase and Telomeres in eukaryotic nuclear DNA replication; Regulation of eukaryotic DNA replication; Mitochondrial and Chloroplast DNA replication,	12
IV	Transcription in prokaryotes: Initiation, elongation and termination; Prokaryotic promoter; weak and strong promoters, DNA dependent RNA polymerase: Physical properties, Templet strand, non-template strand, coding strand, Subunits, σ factor, its types and function; Recognition of promoter; Transcription bubble, Direction of	12

	Transcription; Abortive initiations; Promoter clearance; Elongation factor Gre and its role, Rho dependent and Rho independent termination of transcription; Sigma cycle; RNA - dependent DNA polymerase and Reverse transcription.	
V	**DNA damage and DNA Repair:** Types of DNA damages,Types ofDNARepair systems, Photoreactivation, BER,NER, Mismatch Correction, Homologous recombination and NHEJ method, SOS Repair,	**12**

Suggested Readings:

1. Lehninger,Albert,Cox,MichaelM.Nelson,DavidL.(2017)*Lehninger principles of biochemistry*/NewYork:W.H.Freeman.
2. Lewin "Genes"
3. Freifelder, DM "Molecular Biology"
4. Brown, TA "Genomes"
5. Watson, JD "Molecular Biology of the cell"
6. Twyman, R.M.Advanced Molecular Biology"
7. Brown, TA"Gene cloning: An introduction"
8. Old & Primrose "Principles of Gene Manipulation"
9. Primrose, SB "Molecular Biotechnology"
10. Jose B. Cibelli, Robert P. Lanza, Keith Campbell, Michasel D. West "Principles of Cloning"
11. Voet&Voet "Biochemistry"
12. LubertStryer "Biochemistry"

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 Internal Continuous Evaluation Methods:75

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/Chemistry 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

Neelam Pathak

Program/Class: Master in Biochemistry	Year: First	Semester: I
Subject: Biochemistry		
Course Code: B110705T	Course Title: Pharmaceutical Biochemistry	

Course Objectives:

The course is designed to make the students understand the concept and basic steps of pharmaceutical biochemistry which emphasizes on the production of monoclonal antibodies and its applications, different formulations of proteins and peptides, pulmonary drug delivery systems for example aerosols along with polymers for controlled drug delivery and nucleic acid drug delivery systems etc.

Course outcomes:

After completion of the course, a student will be able to:

CO1: Understand about monoclonal antibodies and its applications along with regulatory requirements

CO2: Understand about formulation of proteins and peptides, adult-phase drug delivery systems

CO3 :Understand about injectable lipid emulsions, liposomes, polymeric systems for oral protein and peptide delivery.

CO4: Understand about the pulmonary drug delivery systems for biomacromolecules; Lipid based pulmonary delivery, Arosols etc.

CO5: Understand about different polymers used for controlled drug delivery.

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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	Monoclonal antibodies: applications, generation, recombinant antibodies, production methods, Pharmaceutical, regulatory and commercial aspects.	12
II	Formulation of proteins and peptides: making small protein particles, precipitation of proteins, quality control issues, multi-phase drug delivery system; Preparation of collagen, gelatin particles, albumin microparticles	12
III	Proteins and phospholipids: structural properties of phospholipids, injectable lipid emulsions, liposomes, cochleal phospholipids structures; Polymeric systems for oral protein and peptide delivery.	12
IV	Pulmonary drug delivery systems for biomacromolecules; Lipid based pulmonary delivery; Solid colloidal particles; Polycyanoacrylates; Poly (ether-anhydrides); Diketopiperazine derivatives; Poly ethylene glycol conjugates; Factors affecting pulmonary dosing. Aerosols, propellents, containers types, preparation and evaluation, intra nasal route delivery systems: Types, preparation and evaluation.	12
V	Polymers used for controlled drug delivery: Hydrophobic polymers poly(esters), poly(cyanoacrylate), poly (ortho esters), poly (phosphazenes), Hydrophobic polymers poly (alkyl methacrylates), poly (methacrylates), poly (acrylates)], alginates, chitosan, polyethylene glycol. Gene therapy: the current viral and non-viral vectors. Nucleic Acid Based Delivery System: Gene therapy, introduction of ex-vivo and in-vivo gene therapy. Potential target diseases for gene therapy. Gene expression systems (viral & nonviral gene transfer).	12

Neelam Pathak

	Liposomal gene delivery systems. Biodistribution and pharmacokinetics. Knowledge of therapeutic antisense molecules and aptamers as drugs of future.	

Suggested Readings:

1. Groves MJ 'Pharmaceutical Biotechnology', Taylor and Francis Group.
2. Crommelin DJA, Robert D, Sindelar 'Pharmaceutical Biotechnology'.
3. Kayser O, Muller R 'Pharmaceutical Biotechnology'.
4. Banga AK 'Therapeutic peptides and proteins'.
5. Molecular Cell Biology- by Lodish H., Berk A., Matsudiaira P., Kaiser C.A., Krieger M. and Scott M.P., W. H. Freeman and Company, New York.
6. Vyas S.P. and Kohli D.V., Pharmaceutical Biochemistry, 1st Edition, CBS Publishers & Distributors, New Delhi
7. Principles and Techniques of Biochemistry and Molecular Biology by Wilson K. and Walker J. , Cambridge University Press

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 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 theBotany/Zoology/Chemistry/Biochemistry/Microbiology/Biotechnology/Chemistry 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

Neelam Pathak

Program/Class: Master in Biochemistry	Year: First	Semester: I
Subject: Biochemistry		
Course Code: B110706P	Course Title: Biochemistry Lab. A	

Course Objectives:

The lab is designed to train the students in basic and some advanced techniques of Biochemistry like isolation, purification, and estimation of biomolecules. It also deals with microbial techniques of isolation, purification and maintenance of microbial cultures.

Course outcomes:

After completion of this course, a student will be able to:
CO1: Get practical knowledge ofQualitative and Quantitative Analysis ofbiological molecules.
CO2:Learn isolation of egg proteins and milk protein.
CO3:Performexperiments on blood.
CO4: Acquaint with determination of clinically important enzymes

Credits:5	Elective
Max. Marks: 25+75	Min. Passing Marks:40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-5

Unit	Topics	No. of Lectures
I	1. Qualitative and Quantitative Analysis of- a. Carbohydrates b. Amino acids and Proteins 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 (a) Saliva (alpha-amylase) (b) Urine (urea,uric acid, glucose, proteins) 7.Determination of serum enzyme assays: Alkaline phosphatase, SGOT, SGPT.	60

Suggested Readings:

Keith Wilson, John Walker, John Walker, John M. Walker "Principles and Techniques of Practical Biochemistry"
Chirikjian "Biotechnology Theory & Techniques"
Joseph Sambrook, David W. Russel, Joe Sambrook "Molecular Cloning: A Laboratory Manual"
William M, O'Leary Robert, Dony Wu "Practical Handbook of Microbiology"
Principles of Biochemistry- Albert L. Lehninger CBS Publishers &Distributors
Texbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.
An Introduction to Practical Biochemistry, David T. Plummer (2006) Tata McGraw Hill Education, 3rd edition
"
Sadasivam "Biochemical Methods"

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 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
Course prerequisites: To study this course, a student must have had theBotany/Zoology/Chemistry/Biochemistry/Microbiology/Biotechnology/Chemistry in B.Sc.
Suggested equivalent online courses: .....
Further Suggestions: None

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

Program/Class: Master in Biochemistry	Year: First	Semester: I
Subject: Biochemistry		
Course Code: B110707P	Course Title: Biochemistry Lab. B	

Course Objectives:

The lab is designed to train the students in basic and some advanced techniques of Biochemistrylike isolation, purification, and estimation of biomolecules. It also deals with microbialtechniques of isolation, purification and maintenance of microbial cultures.

Course outcomes:

After completion of this course, a student will be able to:
CO1: Get practical knowledge ofQualitative and Quantitative Analysis ofbiological molecules.
CO2:Learn isolation of egg proteins and milk protein.
CO3:Performexperiments on blood.
CO4: Acquaint with determination of clinically important enzymes

Credits:5	Elective
Max. Marks: 25+75	Min. Passing Marks:40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-5

Unit	Topics	No. of Lectures
I	1. Qualitative and Quantitative Analysis of- a. Free and Bound Phosphate b. Vitamin C 2. Fats : Acid number,saponification,and iodine values. 3. Fractionation of egg proteins and its quantification. 4. Isolation and estimation of serum cholesterol. 5. Qualitative and quantitative analysis of (a) Saliva (alpha-amylase) (b) Urine (urea,uric acid, glucose, proteins) 6. Experiments on blood :(a)Identification and Count of Blood corpuscles; (b)Estimation of haemoglobin 7.Determination of Serum creatinine and uric acid.	60

Suggested Readings:

Keith Wilson, John Walker, John Walker, John M. Walker "Principles and Techniques of Practical Biochemistry"
Chirikjian "Biotechnology Theory & Techniques"
Joseph Sambrook, David W. Russel, Joe Sambrook "Molecular Cloning: A Laboratory Manual"
William M, O'Leary Robert, Dony Wu "Practical Handbook of Microbiology"
Principles of Biochemistry- Albert L. Lehninger CBS Publishers &Distributors
Texbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.
An Introduction to Practical Biochemistry, David T. Plummer (2006) Tata McGraw Hill Education, 3rd edition
"
Sadasivam "Biochemical Methods"

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 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 theBotany/Zoology/Chemistry/Biochemistry/Microbiology/Biotechnology/Chemistry in B.Sc.
Suggested equivalent online courses: .....
Further Suggestions: None

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

Neelam Pathak

Program/Class: Master in Biochemistry	Year: First	Semester: II
Subject: Biochemistry		
Course Code: B110801T	Course Title: Gene Expression & Regulation	
Course Objectives:		
The objective of this course is to understand the fundamentals of gene expression and regulation in prokaryotes and eukaryotes which comprise of the knowledge of transcription and itsregulation, post-transcriptional regulation, translation, post-translational regulation etc.		
Course outcomes:		
After completion of the course, a student will be able to: **CO1 Learn and understand the basics of transcription ineukaryotes** **CO2 Learn and understand Post - transcriptional / Co-transcriptional processing ofRNA** **CO3 Understand the fundamentals of translation in prokaryotes and eukaryotes.** **CO4 Understand regulation of gene expression; Concept of operon, Significance of repressor, Attenuation; Inhibitors of transcription and translation.**		
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	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, Nucleosome modifiers, Mediator complexes, Chromatin remodelers, Elongation factors in transcription; Synthesis & processing of pre-rRNA and pre-tRNA: Outline of process, RNA Pol I and III, promoters sequences, DNA-binding motifs: Helix-turn-Helix, Zinc Finger, Leucine-Zipper, Homeodomain.	12
II	**Co-transcriptional processing**: Addition of 5` cap and 3' Poly A tail in mRNA; **Post transcriptional processing**: RNA splicing – Type 1 and Type 2 Intron splicing, Spliceosome mediated splicing and maturation of precursors of rRNA, mRNA, tRNA): Role of different ribonucleases in splicing, Covalent modifications, RNA editing, Alternative splicing, Histone mRNA processing	12
III	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: 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.	12
IV	Regulation of prokaryotic gene expression; Concept of operon: Lac, Trp and Ara operons, Significance of repressor, Attenuation; Inhibitors of	12

	transcription and translation	
V	**Regulation of gene expression by chemical modification:** concept of epigenome,Types of modification – histone acetylation, phosphorylation, methylation, ribosylation, ubiquitinylation, sumoylation and their role in regulation, Determination of DNA methylation patterns, DNA methylation and expression, CpG islands.	12

Suggested Readings:

1. Lehninger,Albert,Cox,MichaelM.Nelson,DavidL.(2017)*Lehninger principles of biochemistry*/NewYork:W.H.Freeman.
2. Lewin "Genes"
3. Freifelder, DM "Molecular Biology"
4. Brown, TA "Genomes"
5. Watson, JD "Molecular Biology of the cell"
6. Twyman, R.M.Advanced Molecular Biology"
7. Brown, TA"Gene cloning: An introduction"
8. Old & Primrose "Principles of Gene Manipulation"
9. Primrose, SB "Molecular Biotechnology"
10. Jose B. Cibelli, Robert P. Lanza, Keith Campbell, Michasel D. West "Principles of Cloning"
11. Voet&Voet "Biochemistry"
12. LubertStryer "Biochemistry"

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/Chemistry 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

Program/Class: : Master in Biochemistry	Year: First	Semester: II
Subject: Biochemistry		
Course Code: B110802T	Course Title: Cell Biology and Signaling Pathways	

Course Objectives:

The objectives of the course are to learn and understand the fundamentals of cell biology like cell organelles, cytoskeleton, cellular transport, cell-extracellular matrix interaction, cell division, and protein trafficking and signal transduction etc.

Course outcomes:

After completion of this course, a student will be able to:
CO1:Learn about structural organization of prokaryotic andeukaryotic cells, ultra structure and functions of cell organelles.
CO2:Understand about cell division: mitosis and meiosis; Cell cycle:check points, role of cyclin and cyclin dependent kinases in cell cycleregulation,
CO3: Acquire knowledge about Basics of signal transduction
CO4:Understand about protein trafficking in cells,Protein sorting, vesicular Transport and protein targeting.

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	**Ultrastructure and Organization of prokaryotic & eukaryotic cell**: Structural organization and function of subcellular organelles, Cytoskeleton (Microtubules, Microfilaments, actins etc.); Structure and functions of cell membrane, physiochemical and electrical properties of membrane, Transport across cell membrane: Diffusion, Facilitated diffusion, Active transport and its types. Techniques to study biomembranes - FRAP, FRET.	12
II	**Cell division and cell cycle**: Mitosis and Meiosis; Cell cycle: Check points, role of cyclin and cyclin dependent kinases in its regulation, Programmed cell death, aging and senescence.	12
III	**Cell communication and signaling**: Cell - cell and cell – extracellular matrix interactions: Plasmodesmata, Gap junction, Tight junction, Adherens, Cohesin, Elastin, Collagen, Fibronectins, Laminins, Integrins; Basics of signal transduction: Types of cell signaling, Stages in signaling, role of calcium, cAMP, G-protein, inositol phosphates, phospholipases and protein kinases in signal transduction, General principle of cell - signaling system	12
IV	**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.	12
V	**Applied Cell Biology**: Basic techniques in mammalian cell culture; Cell &tissue culture media; Serum free media; maintenance of the culture and cell lines; Stem cell and their applications.	12

Suggested Readings:

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Dennis Bray, Karen Hopkin, Keith Roberts, Peter Walter "Essential Cell Biology"

2. Baltimore "Molecular Cell Biology"
3. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter "Molecular Biology of the Cell"
4. Lodish H, Baltimore D, Berk A, Zipursky SL, Matsudaira P, Darnell J. (1995). Molecular cell biology.
5. Cooper ""Molecular Cell Biology"
6. Karp & Karp "Molecular Cell Biology"

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 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 Evluation:75 Marks

Course prerequisites: To study this course, a student must have had theBotany/Zoology/Chemistry/Biochemistry/Microbiology/Biotechnology/Chemistry 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

Program/Class: Master in Biochemistry	Year: First	Semester: II
Subject: Biochemistry		
Course Code: B110803T	Course Title: Protein Biochemistry & Enzymology	
Course Objectives:		
The objective of this course is to understand the importance of enzymes, their classification, and properties, to understand the mechanism of enzyme action, their kinetics and types of enzyme inhibitions, and to know about the advantages of immobilization of enzymes, methods of immobilization.		
Course outcomes:		
After completion of this course, a student will be able to: CO1:Acquire the knowledge of characteristics and importance of different levels of protein structure. CO2: Learn about protein folding CO3:Acquire the knowledge of enzymes their properties and classification, Mechanism of action, Michaelis-Menten initial rate equation, methods for the determination of Km and Vmax. CO4: Learn different immobilization techniques and Industrial and clinical scope of enzymes.		
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	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 structure in proteins.	12
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 the protein folding; the problem of inclusion body formation and recovery of active proteins, Intein, Intein Splicing	12
III	The living state and role of enzymes in its substance;chemicalcatalysis;general acid-base ,covalent and intramolecular catalysis;detection of intermediates in enzymatic reactions;features and mechanism of action of lysozyme,chymotrypsin and carboxypeptidase A.	12
IV	Steady state and equilibrium hypotheses of enzyme kinetics,Michaelis-Menten and Briggs-Haldane equations,significance of Michaelis-Menten parameters i.e.,Vmax,Km,Kcat and Kcat/Km;Mechanism and features of different types of enzyme inhibition;Breakdown of the Michaelis-Menten equation;Mechanism and kinetics of multisubstrate reactions.	12
V	Enzyme induction,repression and covalent modification;feed backinhibition;importance of isozymes and zymogen in enzyme regulation;allosteric enzymes and their regulations;Hills coefficient and the determination of enzyme-ligand binding/dissociation constant.EnzymeImmobilization:Immobilization; kinetics of	12

	immobilized systems	

Suggested Readings:

1. Lehninger, AL "Principles of Biochemistry".
2. LubertStryer "Biochemistry".
3. Voet&Voet "Biochemistry".
4. Alan Fersht "Enzyme Structure and Mechanism".
5. David S. Sigman, Paul S. Sigman "The Enzymes: Mechanisms of Catalysis".
6. Trevor Palmer and Philip Bonner 2008 Enzymes Biochemistry,Biotechnology, Clinical Chemistry, 2 ndedn EWP
7. Gerhartz W 2003 Enzymes in Industry Production and Applications, Wiley VCH
8. Wilson, K and Walker, J .(eds 2000 Principles and Techniques of
9. Practical Biochemistry, 5 thedn Cambridge University PressPalmer "Enzymes"
10. Dixon & Webb "Enzymes
11. Shuler "Bioprocess Engineering"

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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 ContinuousInternal 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/Chemistry 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

Program/Class: Master in Biochemistry	Year: First	Semester: II
Subject: Biochemistry		
Course Code: B110804T	Course Title: Fundamentals of Nutrition Science	

Course Objectives:

The objective of this course is to learn and understand the basic concepts of nutritional biochemistry which comprises nutritional values of foods, dietary requirements of carbohydrates, lipids and proteins, nutritional significance of minerals. Moreover, this course is also designed to understand the factors responsible for malnutrition and measures to overcome malnutrition in infants and adults.

Course outcomes:

After completion of this course, a student will be able to:

CO1:Learn and understand the basic concepts of nutrition, andnutritional values of foods, and BMR and measurement ofenergy requirements.

CO2:Learn and understand the dietary requirement ofcarbohydrates, lipids and proteins and their biological significance.

CO3:Understand the nutritional requirement andsignificance of dietary minerals and Vitamins.

CO4: Understand the condition of malnutrition, its prevention, andrecommended dietary allowances.

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	Basic concepts – Function of nutrients. Measurement of the fuel values of foods. Direct and indirect calorimetry. Basal metabolic rate: factors affecting BMR, measurement and calculation of BMR. Measurement of energy requirements.	12
II	Elements of nutrition – Dietary requirement of carbohydrates, lipids and proteins. Biological value of proteins. Concept of protein quality. Protein sparing action of carbohydrates and fats. Essential amino acids, essential fatty acids and their physiological functions.	12
III	Minerals – Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper. Vitamins – Dietary sources, biochemical functions, requirements and deficiency diseases associated with vitamin B complex, C and A, D, E & K vitamins.	12
IV	Malnutrition – Prevention of malnutrition, improvement of diets. Recommended dietary allowances, nutritive value of common foods. Protein-calorie malnutrition. Requirement of proteins and calories under different physiological states- infancy, childhood, adolescence, pregnancy, lactation and ageing.	12
V	Obesity: Definition, Genetic and environmental factors leading to obesity. Starvation: Techniques for the study of starvation. Protein metabolism in prolonged fasting.	12

Suggested Readings:

1. Tom Brody: Nutritional Biochemistry (Second Edition), Academic Press.
2. DAVID A. BENDER: Nutritional Biochemistry of the Vitamins, SECOND EDITION, University College London, Cambridge University Press.

3. Harper's Illustrated Biochemistry, 29th edition, Mc Graw Hill Education, Lange.
4. Denise R. Ferrier, Richard A. Harvey, Biochemistry (Lippincott Illustrated Reviews Series), 6th edition. Wolters Kluwer/ Lipincott, Williams and Wilkins.

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 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 theBotany/Zoology/Chemistry/Biochemistry/Microbiology/Biotechnology/Chemistry 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

Neelam Pathak

Program/Class: Master in Biochemistry	Year: First	Semester: II
Subject: Biochemistry		
Course Code: B110805T	Course Title: Fundamentals of Environmental Sciences	
Course Objectives:		
The objectives of the course are to develop the ability to solve the problems related to theenvironment, to make them aware of various eco-friendly techniques and modern techniques tosolve various environment-related problems.		
Course outcomes:		
After completion of this course, a student will be able to: CO1:Understand pollution and its impact on environment and health. CO2: Able to devise and suggest means for tackling the problem of pollution and abatement. CO3 :Understand the generation of various toxicants and suggest means to safeguard health from its effect. CO4:Get familiarized with Xenobiotic toxicity, Bioaccumulation, bioremediation andtoxicogenomics		
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	Air pollution, Sound,thermal,and radioactive pollution, harmful effects of UV-Rays,Ozone layer depletion,Ozone hole, Acid Rain, CFCs,and their substitutes. Global warming and its effect on flora and fauna. 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.	12
II	Nature of agriculture and industrial wastes and by-products and their treatment and recycling 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.	12
III	Principle of Biochemical toxicology; Properties of Xenobiotics, Type of chemical alteration, molecular mechanism of toxicology development, dose response relationship, risk assessment of chemicals; acute, short term and chronic toxicity studies, metabolic disposition, Carcinogenicity and mutagenicity studies.	12
IV	Recycling of organic waste: Major sources of recyclable materials including agricultural waste. Key technology in recycling of crop residues, human and animal wastes. Composting and vermicomposting; Production and application. Role of microbes in composting and biogas production. Municipal solid waste treatment and management.	12
V	Xenobiotic toxicity/ genotoxicity, Mode of action of pesticides, fungicides and insecticides; Mutation detection by Ames test, microsomal assay. Bioaccumulation and bioremediation, Biosensors, DNA probes and their environmental applications, Toxicogenomics.	12

Suggested Readings:

1. Environmental biotechnology (Industrial pollution Management).Jogdand S.N., Himalaya pub.

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house.

2. Waste water treatment – Rao M.N. and A.K.Datta
3. Industrial pollution Control, Vol. 1, E. Joe, Middle Brooks.
4. The treatment of industrial wastes, 2nd Ed. Edmund D. Besselievere and Max Schwartz.
5. Water and water pollution hand book, Vol. 1, Leonard L., Ciaccio
6. EcEldowney S, Hardman DJ, Waite DJ, Waite S. (1993). Pollution: Ecology and Biotreatment Longman Scientific Technical.
7. Grant WD, Long PL. (1981) Environmental Microbiology. Blackie Glasgow and London.
8. Paul EA, Clark FF Soil Microbiology and Biochemistry, Academic Press, San Diego.
9. Rogers JE and Writman WB (1991) Microbial production and consumption and green house gases: Methane: Nitrogen oxides and Halomethanes. ASM, Washington DC.

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 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/Chemistry 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

Program/Class:Master in Biochemistry	**Year: First**	**Semester: II**
Subject: Biochemistry		
Course Code: B110807P	**Course Title:** Biochemistry Lab. C	

Course Objectives:

The lab is designed to train the students in basic techniques of Analytical Biochemistry like chromatography, electrophoresis, determination of isoelectric point of protein, andprotein separation.

Course outcomes:

After completion of the course, a student will be able to:
CO1:Get practical knowledge of Preparation of buffers and measurement of pH,
CO2: Learn various chromatography techniques.
CO3: Know to perform electrophoresis.
CO4: Acquire the skill perform enzyme assay.

Credits:5	**Elective**
Max. Marks: 25+75	**Min. Passing Marks:40**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-5

Unit	Topics	No. of Lectures
I	1. Titration of 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. Column Chromatography-Separation of mixture of proteins and salt using Sephadex column. 5. Gel electrophoresis of serum proteins. 6. SDS-PAGE of proteins. 7. Assay of enzyme activity. 8. Time course of enzymatic reaction. 9. Influence of substrate concentration of the rate of enzymatic reaction.	60

Suggested Readings:

1. Keith Wilson, John Walker, John Walker, John M. Walker "Principles and Techniques of Practical Biochemistry"
2. Chirikjian "Biotechnology Theory & Techniques"
3. Joseph Sambrook, David W. Russel, Joe Sambrook "Molecular Cloning: A Laboratory Manual"
4. William M, O'Leary Robert, Dony Wu "Practical Handbook of Microbiology"
5. Principles of Biochemistry- Albert L. Lehninger CBS Publishers &Distributors
6. Texbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.
7. An Introduction to Practical Biochemistry, David T. Plummer (2006) Tata McGraw Hill Education, 3rd edition
8. Sadasivam "Biochemical Methods

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 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/Chemistry 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

Nalem Pallek

Program/Class:Master in Biochemistry	Year: First	Semester: II
Subject: Biochemistry		
Course Code: B110806P	Course Title: Biochemistry Lab. D	
Course Objectives:		
The lab is designed to train the students in basic techniques of Analytical Biochemistry like chromatography, electrophoresis, determination of isoelectric point of protein, andprotein separation.		
Course outcomes:		
After completion of the course, a student will be able to: CO1:Get practical knowledge of Preparation of buffers and measurement of pH, CO2: Learn various chromatography techniques. CO3: Know to perform electrophoresis. CO4: Acquire the skill to perform enzyme assay.		
Credits:5	Elective	
Max. Marks: 25+75	Min. Passing Marks:40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-5		

Unit	Topics	No. of Lectures
I	1. Preparation of buffers. 2. Beer-Lambert's law 3. Paper Chromatography-Separation of amino acids 4. Thin Layer chromatography of fatty acids. 5. Gel electrophoresis of proteins. 6. SDS-PAGE of proteins. 7. Assay of enzyme activity. 8. Isolation and purification of urease. 9. Time course of enzymatic reaction. 10. Influence of substrate concentration of the rate of enzymatic reaction.	60

Suggested Readings:

9. Keith Wilson, John Walker, John Walker, John M. Walker "Principles and Techniques of Practical Biochemistry"
10. Chirikjian "Biotechnology Theory & Techniques"
11. Joseph Sambrook, David W. Russel, Joe Sambrook "Molecular Cloning: A Laboratory Manual"
12. William M, O'Leary Robert, Dony Wu "Practical Handbook of Microbiology"
13. Principles of Biochemistry- Albert L. Lehninger CBS Publishers &Distributors
14. Texbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.
15. An Introduction to Practical Biochemistry, David T. Plummer (2006) Tata McGraw Hill Education, 3rd edition
16. Sadasivam "Biochemical Methods

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 Evaluation Methods:

Total Marks: 25

Program/Class: Master in Biochemistry	Year: Second	Semester: III
Subject: Biochemistry		
Course Code: B110901T	Course Title: Essentials of Microbiology	

Course Objectives:

The objective of the course is learning and understanding the fundamentals of Microbiology like important characteristics and biology of bacteria, fungi, mycoplasma, viruses etc. Moreover, this course is designed to learn basic knowledge of fermentation process.

Course outcomes:

After completion of the course, a student will be able to:

CO1 Understand the basics of microbiology like Characterization andclassification of microorganisms, cultivation, nutrition, physiologyand growth of microbial cells, Genetic recombination in bacteria.

CO2 Learn and understand the basics of mycology, virology and production of mutants and their characterization.

CO3 Understand about Bacterial toxins, and mode of action ofbacterial protein toxins. Host Microbe Interactions.

CO4 Learn about basics of Industrial Fermentation.

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: 3-1-0

Unit	Topics	No. of Lectures
I	Prokaryotes: Bacteria: Morphology and structure of bacterial cell; Staining procedures; Criteria used in classification; Bacterial taxonomy; Phenetic and phylogenetic classification; Numerical taxonomy; General characteristics of major groups of bacteria. Bacterial Growth and Nutrition: General nutritional requirements; Culture media; Types of bacterial cultures; Measurement of bacterial growth; Control of microorganism by physical and chemical methods.Gene transfer in bacteria: Conjugation, Transformation and Transduction. Archaebacteria: Archaea as a separate lineage; Differences from eubacteria.	12
II	Eukaryotic Microorganisms:Structure of fungus: yeast and mold. Fundamentals of control of microbial growth, control by physical and chemical agents. Production of mutants by chemical and physical agents and their characterizations	12
III	Viruses:General characteristics of virions; Classification; ; Isolation, cultivation and assay methods; One-step growth curve of bacteriophages; Lysogeny and lytic cycle; Satellite and defective viruses; Viral interference; Common viral infections. Virusoids,Viroids, Diseases caused in plants. Prions: Characteristics; Prion diseases; Hypotheses regarding nature and pathogenesis of prions.	12
IV	Microorganisms and Diseases General concepts: Normal human microbiota; Opportunistic microorganisms; Koch's postulates; River's postulates; Classification of diseases; Modes of transmission of diseases; Stages in progress of a disease.	12
V	Bacterial toxins - Exotoxins, endotoxins, enterotoxins their structure	12

	and mode of action, Antimicrobial agents, supha drugs, Penicillins and Cephalosporins, antibiotics, resistance to antibiotics. Media for Industrial Fermentation: Substrates for bioconversion processes, preparation, sterilization, design. Large scale production and commercial applications of enzymes: proteases and amylases.	

Suggested Readings:

1. Pelczar MJ Jr.; Chan ECS and Kreig NR.; Microbiology; 5th Edition; Tata McGraw Hill; 1993.
2. Maloy SR; Cronan JE Jr.; and Freifelder D; Microbial Genetics; Jones Bartlett Publishers; Sudbury; Massachusetts; 2006.
3. Crueger and A Crueger; (English Ed.; TDW Brock); Biotechnology: A textbook of
4. Industrial Microbiology; Sinaeur Associates; 1990.
5. G Reed; Prescott and Dunn's; Industrial Microbiology; 4th Edition; CBS Publishers; 1987.M.T. Madigan and J.M. Martinko; Biology of Microorganisms; 11th Edition; Pearson Prentice Hall; USA; 2006

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 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/Chemistry 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

Neelam Pathak

Program/Class:Master in Biochemistry	Year: Second	Semester: III
Subject: Biochemistry		
Course Code: B110902T	Course Title: Immunology	

Course Objectives:

The objective of the course is to apprise the students about components associated with immunesystem and molecular mechanism of their working. The course also deals with implications ofderegulation of basic regulatory networks that lead to immune system related disorders. The studentswill be able to describe the roles of the immune system in both maintaining health and contributing todisease.

Course outcomes:

After completion of the course, a student will be able to:

CO1 Learn the fundamental principles of immune response including molecular, biochemical and cellular basis of immune homeostasis.

CO2 Aid in understanding various aspects of immunological response and how its triggered and regulated.

CO3 Understand the rationale behind various assays used in immunodiagnosis of diseases and will be able to transfer knowledge of immunology in clinical perspective.

CO4 Develop understanding of principles of Graft rejection, Auto immunity and Antibody based therapy.

CO5 Develop the capacity for problem-solving about immune responsiveness, knowledge of pathogenesis of diseases and designing of immunology based interventions for effective treatment.

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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	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,isotype,allotype,idiotypes.	12
II	Comparison of receptors on T&B lymphocytes,CDMarkers,Concept of Histocompatibility:Major Histocompatibility Complex (MHC),MHC restriction for CD4 & 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&B lymphocytes immunoglobin genes, Activation of T&B lymphocytes immunoglobin genes,Activation of T&B cells by antigen,Antigen processing and presentation	12
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	12

Neelam Pathak

IV	Allergy and hypersensitivity,autoimmunity,autoimmunediseases,Vaccines:preparation and delivery system, immune adjuvants,Raising of antisera and monoclonal antibodies	12
V	Measurement of antigen and antibody interaction:direct binding assay,agglutination and precipitation reaction in gels;immunoelectrophoresis,immunoprecipitation,RIA&ELISA,Biotin-avidin based immunoassay, immunofluorescence assay (IFA);immunohistochemistry,immunoblotting.	12

Suggested Readings:

2. Kuby Immunology (2007) 6th ed., Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H Freeman and Company (New York)
3. William, E. Paul (1989) Fundamental Immunology, 2nd Edition Raven Press, New York.
4. William, R. Clark (1991) the Experimental Foundations of Modern Immunology (4th Edition) John Wiley and Sons, New York.
5. Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
6. Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
7. Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell)

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 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/Chemistry 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

Neelam Pathak

Program/Class:Master in Biochemistry	Year: Second	Semester: III
Subject: Biochemistry		
Course Code: B110903T	Course Title: Genetic Engineering	
Course Objectives:		
The course is designed to make the students understand the concept and basic steps in gene cloning, to acquaint them with various vectors and enzymes used in recombinant DNAtechnology, transformation and screening techniques.		
Course outcomes:After completion of the course, a student will be able to: CO1:Developunderstandingabout enzymes used in rDNA technology and basics of cloning. CO2:Learn about features of various types of vectors like plasmid vectors, phage vectors, hybrid vectors, artificial chromosomes. CO3:Introduced with cDNA synthesis and chemical DNA synthesis. CO4: Learn about screening and selection of recombinants.		
.		
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	**Enzymes used in rDNA Technology: Outline of cloning procedure,** Host controlled restriction and modification: Restriction endonucleases and cognate methylases, Class I, II & III restriction enzymes, Variants of Type II Restriction enzyme, Restriction digestion, Star activity, Restriction mapping, Formation of chimeric DNA, Homopolymer tailing, Synthetic Linkers, Adaptors and DNA ligase; Filling in and Trimming back; Significance of T4 DNA polymerase &Klenow Fragment, Alkaline phosphatase, Reverse transcriptase in cloning.Overview of the methods for introduction of DNA into living cells: Chemical transformation, microprojectile bombardment, electroporation and microinjection.	12
II	**DNA synthesis**: Purification of mRNAs; mRNA abundance; Synthesis of cDNA: Various methods for first and second strand DNA synthesis; cDNA and Genomic library construction; Chemical synthesis of oligonucleotides by Phosphoramidite and Photolithographic methods; Preparation of probe DNA by radioactive and non-radioactive labeling methods: Nick translation, End filling, Random primer methods.	12
III	**Plasmids**: Plasmid classification on basis of phenotypic traits: Relaxed and stringent control of copy number; Plasmid incompatibility; Plasmid host range, Mobilizable plasmids and Triparental mating; Plasmid as cloning vector (recombinant plasmids): Properties of ideal plasmid cloning vectors, pBR322, pUC& pGEM3Z series, Transcriptional and translational fusion vectors; Fusion proteins; Selectable markers; Reporter genes	12
IV	**Phage as a cloning vector**: Advantage of using phage lambda vector, Genome map of phage lambda, In vitro packaging, Insertional and replacement vectors: Cosmid vectors; M13 phage and its role in single stranded DNA production, M13 series of vectors; Phagemids; Yeast as cloning vector: Basic principles of development of yeast vectors,	12

Neelam Palliker

	2µplasmid, YEP, YRP YCP, YIP; Artificial chromosomes: YACs, BACs and PACs	
1V	**Screening and selection of recombinants**: Functional (genetic) complementation (Blue-white screening, Red-white screening), Nutritional complementation, Gain of function, Colony hybridization, Plaque hybridization, Southern blotting and hybridization, Dot blot, Zoo blot, Plus-Minus screening, Northern blotting, Immunological screening, Western blotting, South-Western blotting, North-Western blotting, HART, HAT	**12**

Suggested Readings:

1. Smita Rastogi and Neelam Pathak (2009), Genetic Engineering, Oxford University Press.
2. Gene Cloning and DNA Analysis (2010) 6th ed., Brown, T.A., Wiley-Blackwell publishing (Oxford, Principles of Gene Manipulation and Genomics (2006) 7th ed., Primrose, S.B., and Twyman, R. M., Blackwell publishing (Oxford, UK)
3. Old & Primrose
4. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) 4th ed., Glick B.R., Pasternak, J.J. and Patten, C.L., ASM Press (Washington DC),
5. Molecular Cloning: A laboratory manual (2014),4nd ed., Michael R Green and J. SambrookCold spring Harbor laboratory press (3vol.), ISBN: 978-1-936113-42-2

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 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/Chemistry 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

Neelam Pathak

Program/Class: Master in Biochemistry	Year: Second	Semester: III
Subject: Biochemistry		
Course Code: B110904T	Course Title: Clinical Biochemistry, IPR& Biosafety	
Course Objectives:		
The main objective of this course is to learn and understand the fundamentals of physiology and its association with clinical biochemistry. Moreover, they will also learn about IPR and Biosafety.		
Course outcomes:		
After completion of the course, a student will be able to: CO1:Learn the basics composition of body fluids. CO2:Understand the fundamentals of digestive system. CO3:Understand the fundamentals of Respiratory system and Neural & chemical regulation of respiration. CO4:Aid in understanding of the basics aboutclinical and biochemical aspects of atherosclerosis, jaundice, diabetes, hepatitis, glomerular nephritis, gall stones, Addison's disease CO5:Understand about IPR and Biosafety.		
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	Body fluids: Blood-functions, 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. Biochemistry of respiration, Muscle contraction, cell motility, role of calmodulin	12
II	Nerve impulse transmission: excitation-its conduction and synaptic transmission by neural systems, neurotransmitters, venoms and nerve poisons.	12
III	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.	12
IV	IPR: Introduction to intellectual property rights; Intellectual property laws; significance of IPR. Forms of IPR like patent, design copyright and trademark. Requirement of a patentable novelty; Issues related to IPR protection of software and database; IPR protection of life forms. Obtaining patent; Invention step and prior art and state of art procedure; Detailed information on patenting biological products and biodiversity. trade related aspects of Intellectual Property Rights and Budapest treaty	12
V	Biosafety: Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety guidelines - Government of India; Definition of GMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication. Bioethics: Introduction, necessity and limitation; Ethical conflicts in	12

	Biotechnology; Different paradigms of bioethics.	

Suggested Readings:

1. Text-book of Biochemistry with clinical correlations by Thomas M. Devlin, 2nd Edition, J. Wiley and Sons (1986).
2. Physiological chemistry by Harper.
3. Textbook of Medical Physiology by Guyton. A.C., H. Sanders Philadelphia. 1988.
4. Physiological basis of Medical practice, West J.B., Best and Taylor.
5. Introduction to Physiology by Davidson H and Segal M.B. Academic Press

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:

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Further Suggestions: None

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

Neelam Pathak

Program/Class: Master in Biochemistry	Year: Second	Semester: III
Subject: Biochemistry		
Course Code: B110905T	Course Title: Bioinformatics and Biostatistics	

Course Objectives:

The objective of this course is understanding of developments and applications in the field of Bioinformatics The course generally focuses on genomics, proteomics and computational biology studies and their relevance in biological research. Moreover, this course will also be helpful in the learning and understanding the application of various biostatistical tools and methods in research.

Course outcomes:

After completion of the course, a student will be able to learn:
CO1:Computer basics like Operating systems, Programming in Visual Basic, Data Access, Internet and Nucleic acid Sequence and protein Data Banks.
CO2: Database Similarity Searches like BLAST, FASTA etc., Multiple sequence alignments, Primer Designing, Homology.
CO3: Basics of handling of data, measures of central tendency like mean, median and mode, Measures of dispersion like mean.
CO4:Tests of significance like Null hypothesis and alternative hypothesis, t –test, F-test, Chi-square test, Correlation and Regression analysis

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	Computer basics; Operating systems; Software, DOS; Programming in Visual Basic: Introduction to application development using Visual Basic; Standard Controls; Data Access Using Data Control; Internet; LAN; WAN; Web servers; Introduction to Nucleic acid Sequence and protein Data Banks: SWISSPROT; Signal peptide data bank: Genbank.	12
II	Database Similarity Searches: BLAST, FASTA, PSI-BLAST, algorithms; Multiple sequence alignments - CLUSTAL, PRAS. Primer Designing; Homology Modeling; Phylogenetic analysis & Drug Designing; Determination of Secondary & Tertiary of proteins.	12
III	Handling of data: tabulation and diagrammatic representation of data – bar diagram and pie diagram. Measures of central tendency: mean, median and mode. Measures of dispersion: range, quartile deviation, mean deviation and standard deviation. Coefficient of variation.	12
IV	Tests of significance: Null hypothesis and alternative hypothesis, Z-test, Student's distribution, Paired t – test, F-test for equality of population variances. Contingency table, Chi-square test for goodness of fit and independence of attributes	12
V	Correlation analysis: Positive and negative correlation, Karl person's coefficient of correlation, Spearsman's rank coefficient of correlation. Regression analysis: regression lines X on Y and Y on X.	12

Suggested Readings:

1. O'Reilly "Developing Bioinformatics computer skills"
2. J.F. Griffiths "An intro to generic Analysis"

Neelam Pathak

3. Lawrence hunter "Artificial Intelligence & molecular biology"
4. Andreas D. Baxevanis "Bioinformatics: A practical Guide to the analysis of genes and proteins"
5. Stephen A., Ph.D. Krawetz David D., Ph.D. Womble "Introduction to Bioinformatics: A Theoretical and Practical Approach"

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:

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Further Suggestions: None

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

Neelam Pathak

Program/Class: Master in Biochemistry	Year: Second	Semester: III
Subject: Biochemistry		
Course Code: B110906P	Course Title: Biochemistry Lab. E	
Course Objectives:		
The lab is designed to train the students in basic and some advanced techniques of microbiology and immunology. It also deals with molecular biology techniques of isolation and purification of bacterial plasmid and chromosomal DNA and their application in cloning.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: Practically learn about preparation of culture media, broth and slants, staining of bacteria and determination of growth curve. CO2:Practically learn and understand the antigen-antibody interaction by Double Immunodiffusion method, Ouchterlony's Method, Immunoelectrophoresis, Western Blotting and ELISA. CO2: Practically learn to isolate plasmid DNA and genomic DNA from E. coli and will learn to perform Agarose gel electrophoresis of DNA CO3 :The course will aid to learn Restriction digestion of DNA and its application in cloning and to perform PCR		
Credits:5	Elective	
Max. Marks: 25+75	Min. Passing Marks:40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-5		

Unit	Topics	No. of Lectures
I	1. Preparation of Culture media. 2. Sterilization of culture media by autoclave method. 3. Isolation and propagation of bacteria. 4. Staining of bacteria-Simple staining, differential staining, staining of spores and capsules. 5. Determination of growth curve of bacteria. 6. Precipitin reaction by double immunodiffusion and radial immunodiffusion (Ouchterlony) 7. Detection of antibodies or antigen by ELISA. 8. Experiments on western blotting. 9. Experiments on plasmid isolation. 10. Isolation of genomic DNA from bacteria, plant and animal. 11. Amplification of DNA by PCR	60

Suggested Readings:

1. Molecular Cloning: A laboratory manual (2014),4nd ed., Michael R Green and J. SambrookCold spring Harbor laboratory press (3vol.),
2. Wilson, K and Walker, J ..(eds 2000 Principles and Techniques of Practical Biochemistry, 5 thedn Cambridge University Press
3. M.T. Madigan, J.M. Martinko& D.A. Stahl, Brock Biology of Microorganisms, 13th Ed., Pearson Education International. (2010)
4. J.G. Cappuccino, and N. Sherman, Microbiology: A Laboratory manual, 10th Ed. Benajamin/ Cummings (2013)

Suggestive digital platforms web links

Nalam Lalhak

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/Chemistry in B.Sc.
Suggested equivalent online courses: ……
Further Suggestions: None

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

Program/Class: Master in Biochemistry	Year: Second	Semester: III
Subject: Biochemistry		
Course Code: B110907P	Course Title: Biochemistry Lab. F	

Course Objectives:

The lab is designed to train the students in basic and some advanced techniques of microbiology and immunology. It also deals with molecular biology techniques of isolation and purification of bacterial plasmid and chromosomal DNA and their application in cloning.

Course outcomes:

After completion of this course, a student will be able to:
CO1: Practically learn about preparation of culture media, broth and slants, staining of bacteria and determination of growth curve.
CO2:Practically learn and understand the antigen-antibody interaction by Double Immunodiffusion method, Ouchterlony's Method, Immunoelectrophoresis, Western Blotting and ELISA.
CO2: Practically learn to isolate plasmid DNA and genomic DNA from E. coli and will learn to perform Agarose gel electrophoresis of DNA
CO3 :The course will aid to learn Restriction digestion of DNA and its application in cloning and to perform PCR

Credits:5	Elective
Max. Marks: 25+75	Min. Passing Marks:40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-10

Unit	Topics	No. of Lectures
I	1. Preparation of Culture media. 2. Preparation of broth and slants. 3. Isolation and propagation of bacteria. 4. Staining of bacteria-Simple staining, differential staining, staining of spores and capsules. 5. Ouchterlony-Precipitin reaction by double immunodiffusion and radial immunodiffusion 6. Detection of antigens by immunoblotting techniques. 7. Experiments on plasmid isolation. 8. Isolation of genomic DNA from bacteria, plant and animal 9. Experiments on restriction digestion, ligation and cloning. 10. Experiments on western blotting. 11. PCRAmplification of DNA	60

Suggested Readings:

5. Molecular Cloning: A laboratory manual (2014),4nd ed., Michael R Green and J. SambrookCold spring Harbor laboratory press (3vol.),
6. Wilson, K and Walker, J ..(eds 2000 Principles and Techniques of Practical Biochemistry, 5 thedn Cambridge University Press
7. M.T. Madigan, J.M. Martinko& D.A. Stahl, Brock Biology of Microorganisms, 13th Ed., Pearson Education International. (2010)
8. J.G. Cappuccino, and N. Sherman, Microbiology: A Laboratory manual, 10th Ed. Benajamin/ Cummings (2013)

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/Chemistry in B.Sc.
Suggested equivalent online courses: ……
Further Suggestions: None

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

Neelam Pathak

Program/Class: Master in Biochemistry	Year: Second	Semester: IV
Subject: Biochemistry		
Course Code: B111001T	Course Title: Applied Biotechnology	
Course Objectives:		
The course is designed to make the students understand the modern techniques such as PCR technology, Real-Time PCR, Sequencing, DNA fingerprinting etc.		
Course outcomes:		
After completion of the course, a student will be able to: CO1:Understand principle and application of PCR, Rapid DNA and RNA sequencing techniques, High throughput Sequencing, and Microarray. CO2:Learn about the principle& applications of Blotting and hybridization. CO3:Introducedwith DNA fingerprinting and Molecular Markers CO4: Learn about application of recombinant microorganism, plant biotechnology & animal biotechnology. CO5: Develop understanding of basics in protein engineering and bionanotechnology.		
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	**Principle & applications of PCR**; RACE, DD-RTPCR, Degenerate PCR TA cloning, Realtime PCR, Scorpion PCR, Site Directed Mutagenesis: oligonucleotide directed, PCR based Mutagenesis, Error prone PCR. Antisense RNA technique, Sense co-suppression in plants and animals, RNAi, in gene silencing, ribozymes, Microarray techniques for DNA, Proteins and Antibodies	12
II	Rapid DNA and RNA sequencing techniques: Sanger method, Maxam and Gilbert procedure, automated DNA sequencing, pyrosequencing; High throughput Sequencing Genomics:shot gun cloning, Clone contig cloning, Fundamentals of Whole-Genome Sequencing., Sequencing of Phage, Viral and Bacterial Genomes, Human Genome sequencing, and comparative genomics. Molecular Markers: RFLP, RAPD, AFLP, SCAR, STS, Yeast two-hybrid system,DNase I foot printing, Genome editing, CRISPER/cas 9.	12
III	**Application of recombinant microorganism:** Production of recombinant pharmaceuticals, therapeutic proteins, Production of Restriction Enzyme,Production of Antibiotics,Metabolic Engineering,Production of Biopolymer,Combating Human Diseases,Biopesticides, Bioremediation.	12
IV	**Plant Biotechnology**:Ti plasmid, Binary and Cointegrate vectors derived from Ti plasmid of Agrobacterium, plant virus vectors, Transgenic plants and their applications, Improving agronomic traits, Herbicide tolerant, Insect resistance, disease resistance, viral resistance, abiotic stress resistance,Genetic Manipulation of FlowerPigmentation,Delaying of Postharvest Softening and Discoloration of Fruits,Plants as Bioreactors,Production of	12

	Biopolymers,Production of Edible Vaccines. **Animal transgenesis and its application:** Expression of transgenes, Reproductive and Therapeutic cloning, gene knock outs, Applications of transgenic animals,Transgenic Animals as Basic Research Models,Gain-of-function, Loss-of-function, Gene Knock-out, Modeling Human Diseasetransgenic Animals as Bioreactors,Xenotransplantation.	
V	Protein Engineering: Concept of designing of new protein molecule, Application of protein engineering.Basics of nanobiotechnology.	**12**

Suggested Readings:

1. Brown TA "Gene cloning: An introduction"
2. Old & Primrose "Principles of Gene Manipulation"
3. Jose B. Cibelli Robert P. Lanza Keith Cambell, Michasel D. West "Principles of Cloning"
4. H. S. Chawla "Plant Biotechnology: A Practical Approach"
5. Adrian Slater, Nigel W. Scott, Mark R. Fowler "Plant Biotechnology: The Genetic Manipulation of Plants"
6. Molecular Cloning
7. Brown TA "Gene cloning: An Introduction"
8. Old & Primrose "Principles of Gene Manipulation"
9. Genetic Engineering Rastogi and Pathak

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 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 theBotany/Zoology/Chemistry/Biochemistry/Microbiology/Biotechnology/Chemistry 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

Neelam Pathak

Subject: Biochemistry	
Course Code: B111002T	Course Title: **Research Methodology in Biochemistry**
Course Objectives:	
To equip the students with knowledge offraming and analyzing research related issues.	
Course outcomes:	
After completion of this course, a student will be able to learn: CO1: Various aspects of research design. CO2: Analysis of research findings through statistical means. CO3: Presenting research findings and publishing them. CO4: Computer applications in research.	
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	Research Methodology: definition, purpose, Process of Research; Objectives and Dimensions of Research, Design Tools of Research: Library, Field, Laboratory; Methods of research: Qualitative and Quantitative. Systematic review of literature, Features of good research study. Research Ethics (Issues relating to referencing and documentation, copyrights, plagiarism etc), Impact Factor, H-Index, Citation Index, references/ bibliography	12
II	Biostatistics: Data Collection, presentation, data processing, classification and tabulation. Measures of Central tendency and Dispersion. Quantitative Techniques: Levels of significance	12
III	Scientific proposal and paper writing: An Insight into Research proposal: Definition and basic concepts, defining the problem, creating a hypothesis, objectives, work plan, significance and techniques of research, , expected outcome, finding research materials - literature survey, compiling records. Definition and kinds of scientific documents - research paper, review paper, book reviews Thesis: chapter format, pagination, identification, using quotations, footnotes, abbreviations, presentation of tables and figures, referencing, documentation, use and format of appendices, indexing.	12
IV	Basics of Computers- classification, computer system components (CPU, Input/output devices, internal memory i.e. RAM, ROM & Cache and external memory i.e. secondary storage devices). Computers networks and introduction of internet. MS-Office .	12
V	Computer applications in Biology -tools: Introduction to spreadsheet applications, features, Using formulas and functions, Data storing, Features for Statistical data analysis, Generating charts / graph and other features, Presentation of Power Point Presentation, Customizing presentation, Use of Computers in Quantitative analysis. Tools for digital image processing.	12

Suggested Readings:

1. Marder M P (2011) Research Methods for Science, Cambridge University Press

2. Research Methodology: Methods And Techniques By Dr C R Kothari
3. **Rosner B (2010) Fundamentals of Biostatistics, 7th Edition, Brooks/Cole Cengage Learning Publication**
4. **Dunleavy P (2003) Authoring a PhD: How to Plan, Draft, Write and Finish a Doctoral Thesis or Dissertation. Palgrave Macmillan**
5. Computer Fundamentals: Concepts, Systems and Applications By PK Sinha. BPB Publications.
6. Computer Fundamentals and Programming in C By JB Dixit. University Science Press. 7. Computer fundamentals and programming in C By Amiya Kumar Rath, Alok Kumar

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

Course prerequisites: To study this course, a student must have had theBotany/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

Neelam Pathak

Program/Class: Master in Biochemistry	Year: Second	Semester: IV
Subject: Biochemistry		
Course Code: B111003P	Course Title: Seminar & Interactive Course	
Course Objectives:		
The students will be able to summarise the existing data related to a specific topic in the form of a presentation.		
Course outcomes:		
After completion of the course, a student will be able to: CO 1 Summarize the literatureavailable on any specific topic. CO 2 Deliver power point presentations on an assigned topic.		
Credits:5	Elective	
Max. Marks: 100	Min. Passing Marks:40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-10		
Internal Evaluation:50		
External Evaluation:50		

Program/Class: Master in Biochemistry	Year: Second	Semester: IV
Subject: Biochemistry		
Course Code: B111004P	Course Title: Review & Assignment	
Course Objectives:		
The students will be able to compile the existing data related to a specific topic in the form of a review.		
Course outcomes:		
After completion of the course, a student will be able to: CO 1 Summarize the recent research work. CO 2 Acquaint with writing of bibliography.		
Credits:5	Elective	
Max. Marks: 100	Min. Passing Marks:40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-10		
Internal Evaluation:50		
External Evaluation:50		

Program/Class: Master in Biochemistry	Year: Second	Semester: IV
Subject: Biochemistry		
Course Code: B111005P	Course Title: Project Work/Dissertation	
Course Objectives:		
The objective of this course is to apprise the student of various techniques used in modern-day research in life sciences specifically in biochemistry.		

Neelam Pathak

Course outcomes:	
After completion of the course, a student will be able to: CO 1:Prepare synopsis of a defined research problem. CO 2:Perform the bench work. CO 3: Prepare the research report and its oral presentations. CO4:Get exposure of vigorous laboratory training which will help students to boost their research carrier.	
Credits:10	**Core Compulsory**
Max. Marks: 100	**Min. Passing Marks:40**
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-20	
Internal Evaluation:50	
External Evaluation:50	