

M. Sc. BIOCHEMISTRY

Syllabus

UNIVERSITY DEPARTMENT

Program Code: BCHA

2020 – 2021 onwards



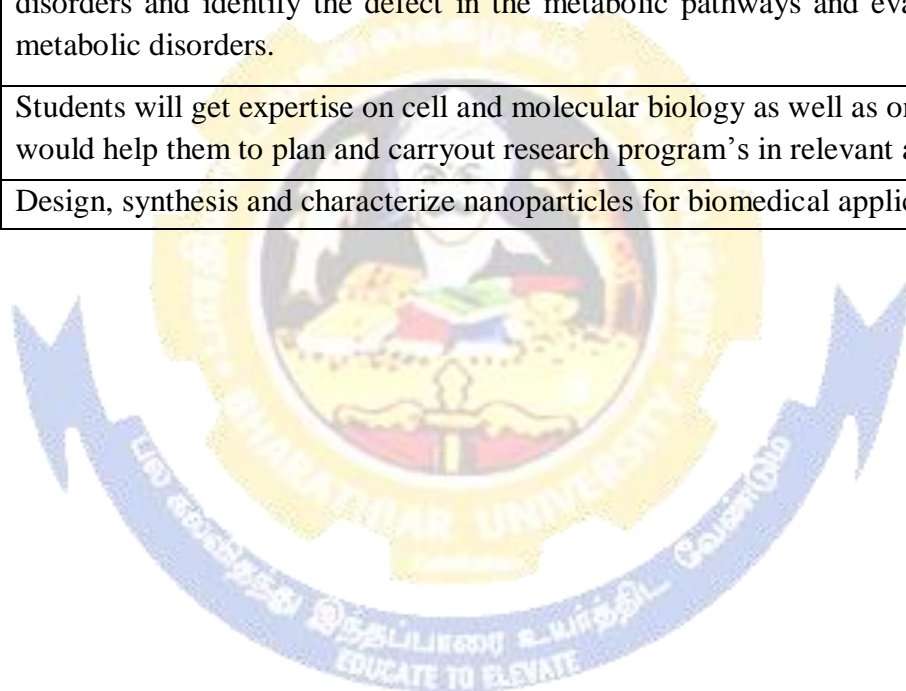
BHARATHIAR UNIVERSITY

(A State University, Accredited with “A” Grade by NAAC,
Ranked 13th among Indian Universities by MHRD-NIRF,
World Ranking : Times - 801-1000, Shanghai - 901-1000, URAP - 982)

Coimbatore - 641 046, Tamil Nadu, India

Program Educational Objectives (PEOs)	
Upon completion of M. Sc. Biochemistry program, the graduates are expected to attain.	
PEO1	The skills to communicate the concepts and results of their laboratory experiments through effective writing and/or oral communication using discipline standards for reporting and citation.
PEO2	Students will have critical thinking and scientific inquiry in the performance, design, interpretation and documentation of laboratory experiments to the level suitable to succeed at an entry level position in biochemical industries.
PEO3	The summer training, industrial visit & project work help the students to know the practical aspects about the subject.
PEO4	Theory and Knowledge: Upon completion of the biochemistry sequence, students are able to recognize and demonstrate the structure, chemical properties, and reactions of the biomolecules and their biopolymers to predict chemical properties and reactivity
PEO5	Instrumentation: Upon completion of the degree, students are able to understand the theoretical concepts of analytics and instruments that are commonly used in most biochemistry fields, which will help them to excel in relevant fields.
PEO6	The course aims to develop the students in understanding the areas that are widely used as well as on advanced scientific methods This is achieved via lectures, classes, seminars and a problem-based learning exercise.
PEO7	Student would suggest, evaluate and interpret biochemical investigation in a given clinical situation and apply knowledge to solve clinical problems
PEO8	Ability to participate in and report the team work-based investigations of problem-based assignments
PEO9	Build on their knowledge to understand highly advanced and specialized courses in future.
PEO10	Ability to contribute their knowledge and experiences gained during the course to professional and/or communal activities in developing the society.

Program Specific Outcomes (PSOs)	
After the successful completion of Biochemistry program, the students are expected to	
PSO1	Students would be to recognize demonstrate and understand of structure, chemical properties and reactions of the biomolecules and their biopolymer structure to predict chemical properties and reactivity.
PSO2	To obtain the knowledge about the qualitative and quantitative analysis of different molecules using different types of microscopes, chromatographic techniques, spectroscopic techniques, radio isotopes and electrophoresis.
PSO3	Expect to diagnose the pathogenic microbes in the laboratory by applying the knowledge of microbial culture techniques.
PSO4	By applying the knowledge of metabolism, the students will be able to detect various disorders and identify the defect in the metabolic pathways and evaluate solutions for metabolic disorders.
PSO5	Students will get expertise on cell and molecular biology as well as on cell signaling that would help them to plan and carryout research program's in relevant aspects.
PSO6	Design, synthesis and characterize nanoparticles for biomedical applications.



Program Outcomes (POs)	
On successful completion of the M. Sc. Physics program	
PO1	Ability to apply and acquire the knowledge of biochemistry
PO2	Ability to function competently in a laboratory setting, design and conduct experiments and simulations, operating and calibrating technical equipment as well as critical analyzing
PO3	Identify problems in specific area
PO4	To function effectively as an individual and in a multidisciplinary team with the capacity to be a leader
PO5	Apply ethical principles and professional ethics in the field of Biochemistry
PO6	Discriminate knowledge effectively with the general society
PO7	Borden the knowledge of Biochemistry by providing an understanding on global environmental and societal contents
PO8	Ability to engage in life-long learning
PO9	Ability to increase the knowledge of contemporary issues in allied fields
PO10	Participate and become successful in competitive examination

BHARATHIAR UNIVERSITY: COIMBATORE 641 046

M. Sc. Biochemistry Curriculum (University Department)

(For the students admitted during the academic year 2020 – 21 onwards)

Course Code	Title of the Course	Credit	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
13A	Biomolecules and Bioenergetics	4	65	-	25	75	100
13B	Cell and Molecular Biology	4	65	-	25	75	100
13C	Analytical Biochemistry	4	65	-	25	75	100
13D	Genetics and Developmental Biology	4	65		25	75	100
13P	Biochemistry, Cell biology and Microbiology	4	-	50	40	60	100
1EA	Microbiology	4	62	-	25	75	100
1EB	Nutrition						
GS108	Supportive I	2	32	-	12	38	50
Total		26	-	-	177	473	650
SECOND SEMESTER							
23A	Enzymology	4	65	-	25	75	100
23B	Intermediary metabolism	4	65	-	25	75	100
23C	Human Physiology	4	65	-	25	75	100
23D	Immunology	4	65	-	25	75	100
23P	Enzymology and Immunology Lab	4	-	50	40	60	100
2EB	Molecular Physiology	4	62	-	25	75	100
2EC	Nano science and Technology						
GS102	Supportive II	2	32	-	12	38	50
	Summer Training*						
Total		26			177	473	650
THIRD SEMESTER							
33A	Clinical Biochemistry	4	65	-	25	75	100
33B	Recombinant DNA Technology	4	65	-	25	75	100
33C	Pharmacology and Toxicology	4	65	-	25	75	100
33D	Biostatistics and Research Methodology	4	65	-	25	75	100
33P	Clinical Biochemistry & Molecular Biology Lab	4	-	50	40	60	100
3EC	Plant Biochemistry and Environmental	4	65	-	25	75	100

	Biotechnology						
3ED	Biology of Cancer and Stem cell	4	62	-	25	75	100
GS109	Supportive III	2	32	-	12	38	50
	Summer Training	2	-	-	50		50
	Industrial Visit***						
	Online Course for a period of 4 weeks duration **	2	-	-	50	-	50
Total		30			277	473	750
FOURTH SEMESTER							
	Professional certification course	2	-	-	50	-	50
	Project work****	8	-	-	50	150	200
	Value added Course#						
	Job oriented Course##						
Total		10	-	-	100	150	250
Grand Total		92			731	1569	2300

***Summer Training:** All the students have to undergo summer training for period of minimum 30 days. Final reports have to be submitted which will be evaluated.

****All the students should be required to complete online courses offered by SWAYAM, MOOCs or NPTEL by the end of 3rd semester. Online courses have an extra credit (other than 90 credits) - 2 week program carries 1 credit; 4 week program carries 2 credit**

*****Industrial Visit:** Students have to undertake an industrial /institutional visit and have to submit report for evaluation.

******Project Work:** The report is the bonafied work carried out by the candidate under the guidance of a faculty authenticated and countersigned by the HOD. This project work must be presented and defended by the candidate in the department attended by all faculties and reviewed by external examiner.

CO-SCHOLASTIC COURSES							
ONLINE COURSES							
	Swayam, MOOC Course etc.,	2	-	-	-	-	-
VALUE ADDED COURSES							
	Value Added Course - I	2	30	-	50	-	50
	Value Added Course - II	2	30	-	50	-	50
CERTIFICATE COURSES							
	Certificate Course - I	4	30-40	-	100	-	100
	Certificate Course - II	4	30-40	-	100	-	100
The scholastic courses are only counted for the final grading and ranking. However, for the award of the degree, the completion of co-scholastic courses is also mandatory.							



First Semester

Course code	13A	BIOMOLECULES AND BIOENERGETICS	L	T	P	C
Core/Elective/Supportive	Core – 13A		3	1	-	4
Pre-requisite	Basic Knowledge in Biology		Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
1. This course emphasizes on various bio-molecules and its significance.						
2. To enable the students to learn the basic functions, structures and biological importance of lifeless chemical compounds.						
3. On successful completion of the course the students should have understood the significance of the complex bio-molecules, polysaccharides, lipids, proteins, nucleic acids, vitamins and minerals.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Helps to understand about the polysaccharides and its types.			K1 & K2		
2	Gives a clear understanding about the lipids and its role.			K1 & K2		
3	A Clear Knowledge regarding amino acids and protein characterization.			K2 & K3		
4	Provides the structure and properties of Nucleic acids.			K2 & K3		
5	Gives an idea about energy level and its synthesis.			K1, K2 & K3		
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Water and Carbohydrates				15 Hours	
Water - Unique properties, weak interactions in aqueous systems, ionization of water, buffers. Classification, chemical properties of carbohydrates, Chemistry and biological roles of homo and heteropolysaccharides. Structural elucidation of polysaccharides; Oligosaccharides – lectin interaction in biochemical processes. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides).						
Unit:2	Lipids				15 Hours	
Classification of Lipids, Biological significance of lipids, Fatty acids and their physiochemical properties. Structure and properties of Prostaglandins. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Lipids as signals, cofactors and pigments.						
Unit:3	Amino Acids and Proteins				11 Hours	
Amino acids–classification, structure and physiochemical properties, chemical synthesis of peptides – solid phase peptide synthesis. Proteins – classification, purification, and criteria of homogeneity. Structural organization, sequence determination and characterization of proteins. Conformation of proteins – Ramachandran plots. Denaturation of proteins. Apoprotein and Prosthetic group- Porphyrins – Structure and properties of porphyrins – heme, Chlorophyll and Cytochromes.						

Unit:4	Nucleic Acids	11 Hours
Nucleotides- structure and properties, physicochemical properties of nucleic acids, cleavage of nucleic acids by enzymatic methods, non – enzymatic transformation of nucleotides and nucleic acids, methylation, Sequencing, chemical synthesis of DNA. Three-dimensional structure of DNA. Different forms of DNA – circular DNA and Supercoiling. Types of RNA mRNA, tRNA, rRNA, Sn RNA, Si RNA, Hn RNA. Structure of t-RNA. Nucleotides as source of energy, component of coenzymes, second messengers. Porphyrins – Structure and properties of porphyrins – heme, Chlorophyll and Cytochromes.		
Unit:5	Thermodynamics	11 Hours
Principles of thermodynamics, free energy, enthalpy and entropy, Freeenergy changes in biological transformations in living systems. Redox potential, phosphate group transfer potential and ATP, High-energy compounds, oxidation and reduction reactions. Mitochondrial electron transport system – organization of components and importance. Substrate level phosphorylation, oxidative phosphorylation, Respiratory control, Mechanism and theories of oxidative phosphorylation. Respiratory chain inhibitors and uncouplers of oxidative phosphorylation.		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	65 Hours
Text Book(s)		
1	D. L. Nelson and M. M. Cox, <i>Lehninger Principles of Biochemistry</i> (7th Edition), W.H. Freeman, 2017	
2	D. Voet and J. G. Voet, <i>Biochemistry</i> , (4th Edition), Wiley & Sons, 2011.	
Reference Books		
1	J. M. Berg, J. L. Tymoczko and L. Stryer, <i>Biochemistry</i> (9th Edition), W.H. Freeman, 2019.	
2	P. W. Kuchel, G. B. Ralston et al., <i>Schaum's outline of theory and problems of biochemistry</i> (3 rd Edition) McGraw-Hill, 2009	
3	W. B. Wood, J. H. Wilson, R. M. Benbow, and L. E. Hood., <i>Biochemistry: A problems approach</i> , (2nd Edition), Benjamin/Cummins Publishing Company, 1981.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Biochemistry of Biomolecules https://onlinecourses.swayam2.ac.in/cec20_bt12/preview	
2	Biomolecules: Structure, Function in Health and Disease http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/353	
3	Introduction to Carbohydrates https://aklectures.com/lecture/carbohydrates/introduction-to-carbohydrates	
4	Introduction to Nucleic Acids https://www.youtube.com/watch?v=1Wc4jTH2v_w&list=PL9jo2wQj1WCNG9mFuNBmJ1m7x1skBNKw-	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	S	S	M	S	M	S
CO3	M	S	S	M	M	S	M	S	S	S
CO3	M	S	S	M	M	M	S	M	M	S
CO4	S	S	S	M	M	M	S	M	M	S
CO5	S	L	M	M	M	M	S	M	M	S

*S-Strong; M-Medium; L-Low



Course code	13B	CELL AND MOLECULAR BIOLOGY	L	T	P	C
Core/Elective/Supportive	Core - II		3	1	-	4
Pre-requisite	Awareness on structure and function of cell organelles and cell division		Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To study the structure and function of cells and to know about extracellular Matrix and cell communication. Understanding the function of intracellular organelles and cell cycle mechanism. Also, thorough understanding the replication process as well as DNA damage and repair mechanisms. Upon completion of the course, students might also be thorough about transcription mechanism and its regulations as well as on translation and post translational modification of proteins. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	The course material will provide clear understanding of structure and functions of cells.				K1 & K2	
2	Students will advance their knowledge in cell cycle events and regulation of cell cycle at molecular level.				K1 & K2	
3	The course will provide detailed understanding of replication process.				K1 & K2	
4	Students will learn their mechanism of transcription and its regulation in detail.				K1 & K2	
5	Course material provides detailed understanding of translation process, including proofreading and post translational modification of proteins.				K1, K3 & K4	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Structure and Function of Cells				15 Hours	
Structure and function of cells–prokaryotes and eukaryotes, difference, Structure and organization of membrane – structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active & passive transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Extracellular matrix, cell-cell communication.						
Unit:2	Cell Components, Cell Division & Cell Death				15 Hours	
Plasma membrane, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility and cell division: amitosis mitosis; meiosis and genetic recombination; regulation of cell cycle; factors and genes regulating cell cycle. Mechanisms of cell death: apoptosis; necrosis and autophagy.						

Unit:3	DNA Replication	11 Hours
Chromosome-structure and function, Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extra chromosomal replicons, and DNA damage and repair mechanisms.		
Unit:4	Transcription	11 Hours
RNA polymerases, Regulatory sequences in protein-coding genes, Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, regulation of transcription factor activity, capping, elongation and termination, Processing of Pre- mRNA, splicing, polyadenylation; RNA transport, Cytoplasmic mechanisms of Post- transcriptional control, Processing of rRNA and tRNA. Gene regulation –lac and trp operon.		
Unit:5	Translation	11 Hours
Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post- translational modification of proteins.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		65 Hours
Text Book(s)		
1	Cell Biology – 2013 by Gerald Karp; Publisher: Wiley; Seventh edition.	
2	Advances in Cell Biology: Volume 2, 2013 by David M. Prescott; Publisher: Springer; Softcover reprint of the original 1st ed. 1971 edition.	
3	Lehninger Principles of Biochemistry: International Edition – 2017 by David L. Nelson and Michael Cox; Publisher: WH Freeman; 7th ed. 2017 edition.	
Reference Books		
1	Molecular Cell Biology– 2016 by Arnold Berk, Chris A. Kaiser, Harvey Lodish, Angelika Amon, Hidde Ploegh, Anthony Bretscher, Monty Krieger and Kelsey C. Martin; Publisher: WH Freeman; 8 edition.	
2	Molecular Biology of the Cell – 2014 by Bruce Alberts, Alexander D. Johnson, Julian Lewis, David Morgan, Martin Raff, and Keith Roberts; Publisher: W. W. Norton & Company; 6 edition.	
3	Molecular Biology of the Gene – 2017 by James D. Watson, A. Baker Tania, P. Bell Stephen, Gann Alexander, Levine Michael and Losick Richard; Publisher: Pearson Education; Seventh edition.	
4	Biochemistry – 2015 by Jeremy M. Berg, Lubert Stryer, John L. Tymoczko and Gregory J. Gatto; Publisher: WH Freeman; 8th ed. edition.	
5	Lewin's GENES XII – 2017 by Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick; Publisher: Jones and Bartlett Publishers, Inc; 12th Revised edition edition.	
6	The Cell: A Molecular Approach -2013 by Geoffrey M. Cooper, and Robert E. Hausman;	

	Publisher: Sinauer Associates Inc; 6 edition
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://bio.libretexts.org/Bookshelves/Cell and Molecular Biology/Book%3A Cells - Molecules and Mechanisms (Wong)
2	https://nptel.ac.in/courses/102/106/102106025/#
3	https://www.easybiologyclass.com/molecular-biology-online-tutorials-lecture-notes-study-materials/
4	https://www.mooc-list.com/tags/molecularbiology?title=MOLECULAR+PHYSIOLOGY
Course Designed By: Dr. S. Selvakumar	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	M	M	S	L	M	S	M	S
CO3	S	S	M	L	L	L	M	S	S	S
CO3	S	S	M	L	S	M	L	L	M	M
CO4	S	L	M	L	L	L	M	S	M	M
CO5	S	M	M	M	L	M	M	S	M	S

*S-Strong; M-Medium; L-Low

Course code	13C	ANALYTICAL BIOCHEMISTRY		L	T	P	C
Core/Elective/Supportive	Core - III			3	1	-	4
Pre-requisite	Prior knowledge on modern methods and technologies used in biochemical analysis			Syllabus Version		20 - 21	
Course Objectives:							
The main objectives of this course are to:							
1. The main objective of the course is qualitative and quantitative analysis of different molecules taking place in a biochemical reaction.							
2. It includes the development of different tools and methods for identification, analysis and examination of physical properties of different biochemical compositions to provide better chemical information.							
3. It helps the biochemistry students in understanding the basic science in a variety of applications.							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	To obtain the knowledge about the microscope handling and the basic difference between the ordinary microscope and electron microscope.					K2	
2	To learn the chromatographic techniques for the separation of the individual compound from the mixture of compound.					K3 & K5	
3	To study the interaction between matter and electromagnetic radiation and visible light dispersed according to its wavelength, by a prism.					K4 & K5	
4	To understand the characterization of surfaces using radioisotopes generally involves observing the manner in which the radioactive species interact with the surface					K1, K2 & K3	
5	To obtain knowledge about the separation and analysis of macromolecules and their fragments, based on their size and charge.					K2 & K3	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit:1	Microscopy, Centrifugation and Electrochemical Techniques					15 Hours	
Light microscope, Fluorescence microscope, Phase contrast microscope, Electron microscope, Confocal microscopy. Centrifugation: Small bench top centrifuges, large capacity refrigerated centrifuges, High speed refrigerated centrifuges, preparative and analytical ultra-centrifuge. Electrochemical techniques: Principles of electrochemical techniques, redox reactions, the pH electrode, ion sensitive and gas-sensitive electrodes, The clark oxygen electrode, Biosensors.							
Unit:2	Chromatography					15 Hours	

Principles of chromatography, size exclusion, Ion-exchange and affinity chromatography. High performance Thin Layer chromatography (HPTLC), Gas liquid chromatography (GLC), Thin layer chromatography (TLC), Paper chromatography, GC-MS, LC-MS, MALDI-TOF, ICPMS and Surface Plasma Resonance methods.		
Unit:3	Spectroscopic Techniques	11 Hours
Spectroscopic techniques: Properties of electromagnetic radiation, interaction with matter. Gamma ray spectroscopy, X-ray spectroscopy, UV and Visible spectroscopy, Infrared and Raman spectroscopy, Electron spin resonance spectroscopy, Nuclear magnetic resonance spectroscopy, Circular dichroism spectroscopy, Atomic absorption spectroscopy. Lasers, Spectro fluorimetry, turbidometry and nephelometry.		
Unit:4	Radio Isotope Techniques	11 Hours
Radio isotope techniques: The nature of radioactivity, detection and measurement of radioactivity: detection based on gas ionization- Geiger Muller counter- principles and applications. Detection based on excitation- Liquid Scintillation counter-principle and applications. Supply, storage and purity of radio-labelled compounds, specific activity, inherent advantages and restrictions of radiotracer experiments, safety aspects, applications of radio isotopes in biological sciences. Flowcytometry, ELISA.		
Unit:5	Electrophoresis	11 Hours
Electrophoresis: General principles, Electrophoresis of proteins: SDS-PAGE, Native gels, Gradient gel, Isoelectric focusing, 2-D gel electrophoresis (2-D PAGE), cellulose acetate electrophoresis, continuous flow electrophoresis; Detection, estimation and recovery of proteins. immunoblotting. Electrophoresis of nucleic acids: agarose gel electrophoresis of DNA, Pulse field gel electrophoresis, electrophoresis of RNA, Capillary electrophoresis. DNA sequencing - Next generation sequencing (NGS).		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	65 Hours
Text Book(s)		
1	Instrumental methods of chemical analysis – P.K. Sharma	
2	Biophysical chemistry – Upadhyay., Upadhyay and Nath	
3	Allen, J.P. (2008) Biophysical Chemistry, 1st Edition, Markono Print Media Limited, Singapore	
4	Wilson, K. and Walker, J. (2012) Practical Biochemistry – Principles and techniques of Biochemistry and Molecular Biology, 7th Edition, Cambridge University Press, India	
Reference Books		
1	A Biologist's guide to principle and techniques of practical biochemistry – Brigan L. Williams.	

2	Experimental methods in Biophysical chemistry- Nicolau, C.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://epgp.inflibnet.ac.in/
2	http://epgp.inflibnet.ac.in/Home/ViewSubject?catid=944
Course Designed By: Dr. K. M. Saradhadevi	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	M	L	S	M	M
CO3	S	S	S	S	S	M	L	S	M	S
CO3	S	S	M	S	S	M	L	M	M	S
CO4	S	M	M	S	S	M	L	M	M	S
CO5	S	S	S	S	S	M	L	S	M	S

S-Strong; M-Medium; L-Low



Course code	13D	GENETICS AND DEVELOPMENT BIOLOGY		L	T	P	C
Core/Elective/Supportive	Core - IV			3	1	-	4
Pre-requisite				Syllabus Version		20 - 21	
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> 1. The main objective of this course is to introduce about concepts in Genetics and Developmental Biology. This course emphasizes to learn about principles involved in mendelian genetics and Non-mendelian inheritance and techniques used to diagnose genetic diseases and mutation concepts. 2. The course aims to give exposure to learn the basic concepts involved in developmental biology such as Potency, commitment, specification, induction, competence, determination and differentiations and morphogenetic gradients 3. This course also provides knowledge about Cell division in cleavage, Rudimental organs, Gametogenesis and Fertilization approaches. 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	To learn Mendelian genetics, history, Monohybrid, Dihybrid and Trihybrid cross, Mendelian ratio of segregation, interaction of genes, alleles, Extrachromosomal inheritance, Extensions of mendelian principles					K1, K2 & K4	
2	To understand the types, causes and detection, mutant types and techniques involved in Prenatal diagnosis of genetic diseases, DNA/RNA probes in the diagnosis of infectious diseases (Chagas disease, AIDS, HPV, Lymph disease) and diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia, Cancer)					K2 & K3	
3	To learn the concept of determination and differentiation; morphogenetic gradients; cell fate and cell lineages and imprinting.					K1, K2 & K4	
4	To understand the process of cell division in cleavage, patterns in embryonic cleavage after fertilization. To know about the development of primary organs and Rudimental organs					K1, K2	
5	To learn the process involved in spermatogenesis, gametogenesis and fertilization					K1 & K2	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit:1	Mendelian Inheritance and Its Extensions					15 Hours	
Principles of Mendelian inheritance; Mendel's experiments-mono hybrid, dihybrid trihybrid and multi hybrid crosses. Concept of gene: Allele, multiple alleles, pseudo allele, complementation tests. Extensions of mendelian principles: Codominance, Incomplete dominance, Gene interactions, Pleiotropy, Genomic imprinting, Penetrance and expressivity, Phenocopy, Linkage and crossing over. Sex linkage, Sex limited and sex influenced characters. Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.							

Unit:2	Mutations & Genetic Diseases	15 Hours
Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Prenatal diagnosis of genetic diseases- amniocentesis, karyotyping. DNA probes in diagnosis of genetic diseases: Cystic fibrosis, Sickle cell anemia, Leukaemia, Burkets lymphoma.		
Unit:3	Basic Concepts of Development	11 Hours
Potency, commitment, specification, induction, competence, determination and differentiation; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.		
Unit:4	Cell Differentiation	11 Hours
Cell division in cleavage–Chemical changes–Patterns of embryonic cleavage – Morula and Blastula – Role of egg cortex – Morphogenetic gradients – Fate map – Gastrulation – Primary organ, Rudimental organs, Organizer – Morphogenetic movements. Anterior and posterior axis differentiation in drosophila		
Unit:5	Gametogenesis	11 Hours
Gametogenesis–Origin of germ cells–Significance of gametogenesis. Oogenesis – Types of eggs–growth, development and maturation of oocyte, Egg envelopes, Polarity and symmetry, Spermatogenesis–Sperm Structure, Types of sperm, Fertilization – Approach of spermatozoon–Reaction of egg, essence of activation – Changes in egg cytoplasm caused by fertilization		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	65 Hours
Text Book(s)		
1	Principles of Genetics 5th Edition by Gardner, M. J. Simmons 2006, D. P. Snustad John Wiley & Sons.	
2	Developmental biology, Gilbert, Scott F, Singer, Susan Sunderland, Mass Sinauer Associates, c2000. 6th ed. United States	
3	Genetics, 3rd edition, 2002, Strickberger, Prentice Hall of India.	
4	Wilson, K. and Walker, J. (2012) Practical Biochemistry – Principles and techniques of Biochemistry and Molecular Biology, 7th Edition, Cambridge University Press, India	
5	Animal Regeneration, Diwan A.P., Dhakad N.K., 1996, Anmol Publications Ltd.	
6	Developmental Biology, Browder L.W., Erickson C.A., And Jeffery W.R, 1991 Saunder college Publishing House, Philadelphia.	
Reference Books		
1	Genes VII, Benjamin Lewin, 2000, Oxford University Press.	

2	Genetics, 3rd edition, 2002, Strick berger, Prentice Hall of India.
3	Genetics, Gupta PK., 1996, Rastogi Publications, Meerut, India.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/121/106/121106008/
2	https://nptel.ac.in/courses/102/104/102104052/
3	https://www.toppr.com/guides/biology/human-reproduction/gametogenesis-in-humans/
4	https://www.ndsu.edu/pubweb/~mcclean/plsc431/mutation/mutation4.htm
Course Designed By: Dr. M. Rajesh	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	L	S	S	S	S	M	S
CO3	S	S	S	L	S	S	S	M	S	S
CO3	M	M	S	M	S	S	M	S	S	S
CO4	S	S	S	M	S	S	S	S	S	S
CO5	M	S	S	M	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	13P	BIO-CHEMISTRY, CELL BIOLOGY & MICROBIOLOGY	L	T	P	C
Core/Elective/Supportive		Core Practical - I	-	-	4	4
Pre-requisite		Understand the practical knowledge in Biochemistry, cell biology and microbiology	Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. The course enables the students to learn the basic biochemical tests 2. Give basic knowledge about the cell biology techniques 3. Learn the microbial culture techniques 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Helps to understand the basic biochemical techniques				K1 & K2	
2	Gives a clear understanding about the estimation and separation of biomolecules				K1 & K2	
3	Perform the basic cell biology techniques and evaluate the biological samples				K3 & K5	
4	Apply basic microbiological culture techniques and to analyze the microbes present in the biological samples				K3 & K4	
5	Apply bacterial Isolation and Identification techniques and evaluate the bacterial sample				K3 & K5	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Bio-chemistry						
1.	Estimation of Glucose by GOD/POD end point.					
2.	Estimation of Total Cholesterol by ZAK's method.					
3.	Separation of amino acids using paper chromatography.					
4.	Separation of amino acids and plant pigments using thin layer chromatography (TLC).					
5.	Separation of two proteins using column chromatography.					
6.	Estimation of proteins using Bradford and Lowry's methods.					
7.	Estimation of DNA using DPA.					
8.	Estimation of RNA using Orcinol reagent.					
9.	Separation of protein by Gel filtration, HPLC, flow cytometry					
10.	Estimation of Methionine					
Cell biology						
1.	Subcellular fractionation of organelles from liver cells and identification by the use of marker enzymes.					

2.	Squash preparation of onion root tip and anther lobes.
3.	Cell counting methods – use of hemocytometer – calibration of the ocular micrometer and measurement of average cell size and chromosome length.
4.	Determination of apoptosis by staining method.
Microbiology	
1.	Preparation of culture media- Nutrient Broth, Nutrient Agar, Blood Agar, Macconkey Agar, Potato Dextrose Agar.
2.	Isolation of bacteria from soil and air.
3.	Staining techniques – simple, differential and special staining, streaking method.
4.	Plotting of bacterial growth curve.
5.	Identification of unknown bacteria by biochemical tests, IMVIC test.
6.	Motility of bacteria by hanging drop method.
7.	Assay of antibiotics by disc diffusion method
8.	MIC assay
9.	Bacteriological examination of water / Industrial effluents.
Reference Books	
1.	Rao, B. S., & Deshpande, V. (2006). <i>Experimental biochemistry: a student companion</i> . Anshan.
2.	Experiments and Techniques in Biochemistry: by Sheel Sharma, Galgotia publications. 2007.
3.	Vasanthakumari.R, (2009) Practical Microbiology, BI Publishers Pvt Ltd, India.
4.	Watson, J.D., Baker, T. A., Bell, S.P., Gan, A., Levine, M. and Losick, R. (2009) Molecular Biology of the Gene, 5th Edition, Pearson Education Inc.
Course Designed By: Dr. S. Suja and Dr. R. Kavitha	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

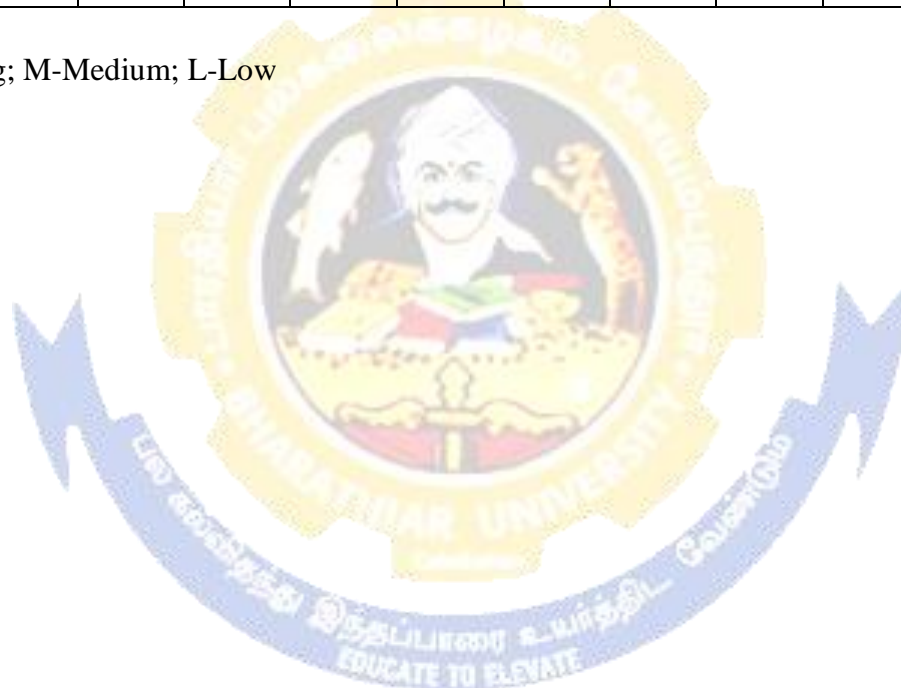
Course code	1EA	MICROBIOLOGY	L	T	P	C
Core/Elective/Supportive		Elective - I	3	1	-	4
Pre-requisite		Basic knowledge in cell and molecular biology	Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. Provide knowledge about microbial culture techniques. 2. Learn the concepts of different energy sources. 3. Understand the basic concepts of food fermentation and its industrial applications. 4. Understand the concepts for diagnosing infectious diseases and assessment of antimicrobial activity in textiles. 5. Provide knowledge about industrial application of microbes 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Students will be able to apply culture techniques for isolation of microbes from various sources and preserve the isolates.					K3
2	Students will gain knowledge about different energy sources such as inorganic compounds, organic compounds and visible radiation for organisms.					K2
3	Students will learn about fermentation in food industry.					K2
4	Students will learn about isolation and identification of microbes from textiles					K3
5	Students will know the concepts of production, harvest, recovery and uses of industrially beneficial microbial products.					K3
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Culture Techniques					15 Hours
Isolation of microbes from various sources, serial dilution techniques, pure culture techniques, anaerobic culture methods – chemical and physical methods. Culture preservation techniques. Microbial nutrition-Nutritional requirements. Culture media- types of media, composition of media-carbon sources, nitrogen sources, vitamin and growth factors, mineral, inducers, precursors and inhibitors. Sterilization methods.						
Unit:2	Bioenergy					15 Hours
Energy from inorganic compounds - ET in chemolithotrophs, production of reducing power in chemolithotrophs; Energy from visible radiation – photosynthesis in eukaryotes, blue- green algae, bacteria. Phosphate solubilizing bacteria. Bioenergy: Renewable and non-renewable energy sources - Green technology - Biofuels, biogas, bioethanol.						
Unit:3	Microbiology of Food					10 Hours
Microbiology of Fermented Foods – yoghurt, cheese, bread, sauerkraut. Mushroom farming – Use of enzymes in food industry. Food borne diseases- Bacterial and Non- Bacterial. Microbial quality and safety – Determining microorganisms in food culture, Microscopy and sampling						

methods – Chemical and immunological methods.		
Unit:4	Clinical Microbiology	10 Hours
Infectious Diseases – Diagnosis – Process of sample collection, transport and examinations of the specimens (Bacteria, Fungi and Virus). Antibioqram. Bacteriology: Morphology, cultural characteristics, pathogenicity and laboratory diagnosis of Gram positive organisms - <i>Staphylococcus aureus</i> , Mycoplasma; Gram negative organisms: E. coli. Hospital acquired infections: Antimicrobial agents for textiles, International standards for the assessment of antimicrobial activity of textiles.		
Unit:5	Industrial Microbiology	10 Hours
Microbial products in pharmaceutical and agriculture industry: Production, harvest, recovery and uses Enzymes, Antibiotics (Penicillins, Tetracycline), vitamins (B2, B12), Aminoacids (lysine, glutamic acid, Organic solvents (acetone, ethanol); Organic acids (acetic acid, citric acid). Formulation of Biofertilizer (<i>Rhizobium</i>) and Biopesticides (<i>Bacillus thuringiensis</i>).		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
Total Lecture hours		62 Hours
Text Book(s)		
1	Pescott, Harley and Klein's Microbiology 7th edition Joanne M. Wwiley, Linda M. Sherwood, Christopher j.Woolverton Mcgraw Hill Education 2017 ISBN -10: 981315 1269.	
2	Gerard J. Tortora, Berdell R. Funke, Christine L. Case. (2013) Microbiology: An Introduction, 11 th edition, Pearson Education, Inc. Company Ltd, New Delhi.	
3	Pelczar, M.J., Chan, E.C. and Krieg, N.R. (2006) Microbiology, 5th Edition, Tata McGraw Hill Publishing Company Ltd, New Delhi.	
Reference Books		
1	Kathleen Park Talaro. (2008) Foundations in Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi.	
2	Joanne M. Willey, Linda Sherwood, Christopher J. Woolverton. (2017) Prescott's Microbiology, 10 th edition, Tata McGraw Hill Publishing Company Ltd, New Delhi.	
3	Casida., J.R. (2006) Industrial Microbiology, 4th Edition, Wiley Eastern Ltd, New Delhi.	
4	Gupta, P.K (2006) Biotechnology and Genomics, 1st Edition, Rastogi Publications, Meerut.	
5	Yuan Gao and Robin Cranston. Recent Advances in Antimicrobial Treatments of Textiles, Textile Research Journal, 2008 78: 60. SAGE publications.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Bioenergy - an overview ScienceDirect Topics www.sciencedirect.com > earth-and-planetary-sciences > b..	

2	Sciencedirect.com/topics/agricultural-and-biological-sciences/industrial-microbiology
3	Hospital-Acquired Infections: Practice Essentials, Background ... emedicine.medscape.com > article > 967022-overview
Course Designed By: Dr. R. Kavitha	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low



Course code	1EB	NUTRITION	L	T	P	C
Core/Elective/Supportive		Elective - I	3	1	-	4
Pre-requisite			Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. The main objective of this course is to introduce about Dietary requirements and energy content in foods needed for human body 2. The course aims to give exposure to learn about malnutrition, starvation, protein metabolism in prolonged fasting and diseases that occur due to malnutrition. 3. This course teaches about inherited metabolic disorders and naturally borne food toxicants and allergy causing foods. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To learn energy content in foods. techniques involved in the measurement of energy expenditure, Dietary requirements of carbohydrates, dietary fibre and dietary lipids					K1 & K2
2	To learn essential and non-essential aminoacids, protein reserves in human body, Protein malnutrition, techniques for the study of starvation, concepts for weight reduction diets.					K1, K2 & K4
3	To know about nutritional requirement during pregnancy, lactation, infants and childs, Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper.					K1, K2 & K4
4	To learn about role of diet and nutrition in the prevention and treatment of diseases, learn about inherited metabolic disorders					K1, K2 & K4
5	To learn naturally occurring food borne toxicants, Allergy causing foods and management.					K1, K2
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Dietary Sources and Energy content of Foods					15 Hours
Composition of human body. Energy content of foods. Measurement of energy expenditure: direct and indirect colorimetry. Definition of BMR and SDA and factors affecting these. Carbohydrates – Dietary requirements and sources of available and unavailable carbohydrates. Physico-chemical properties and physiological actions of unavailable carbohydrates (dietary fibre). Lipids – Major classes of dietary lipids. Properties and composition of plasma lipoproteins. Dietary needs of lipids. Essential fattyacids and their physiological functions.						

Unit:2	Protein Nutrition and Malnutrition	15 Hours
Protein reserves of human body. Nitrogen balance studies and factors influencing nitrogen balance. Essential aminoacids for men and concept of protein quality. Cereals proteins and their limiting aminoacids. Nutritional requirements at different stages of life. Protein energy malnutrition, clinical features, metabolic disorders and management of marasmus and Kwashiorkar diseases: starvation – Techniques for the study of starvation. Protein metabolism in prolonged fasting. Proteins bearing treatments during fasting. Basic concepts of high protein and low calorific weight reduction diets.		
Unit:3	Nutrition Requirements During Different Stages	10 Hours
Dietary sources, biochemical functions and specific deficiency diseases associated with fat and water soluble vitamins. Hyper vitaminosis and their symptoms. Nutrition requirements during pregnancy, lactation and of infants and children. Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper.		
Unit:4	Inherited Metabolic Disorders	10 Hours
Role of diet and nutrition in the prevention and treatment of diseases: Dental carries, Fluorosis, Renal failure, Hyperlipidemia, Atherosclerosis, Inherited metabolic disorders: Phenylketonuria, Maple syrup diseases, Hemocystinuria, Galactosemia, Gout, Diabetes Insipidus and Diabetes Mellitus.		
Unit:5	Allergy	10 Hours
Types of diagnosis and management of allergy. Naturally occurring food borne toxicants: protease inhibitors, Antinutritional factors, Hepatotoxins, Allergens, Oxalates, Toxins from mushrooms, animal food stuffs and sea foods.		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
Total Lecture hours		62 Hours
Text Book(s)		
1	Krause,M.V and Hunsher,M.A, Food, Nutrition and Diet Therapy, 11th edition, W.B.Saunders company, Philadelphia, London, 2004.	
2	Bamji M.S, Prahlad Rao N, Reddy V ,Textbook of Human Nutrition II Edition, Oxford and PBH Publishing Co. Pvt. Ltd , New Delhi,2004	
3	Srilakshmi. E .(2016) Nutrition Science, New Age International Publishers.	
4	Gopalani, S. (2008) Diet and Nutrition, Cyber Tech. Publication.	
5	Swaminathan, M. (2009) Advanced Textbook on Food Science and Nutrition, Vol: 2, 2nd Edition, Reprinted, Bangalore Printed and Publishing Co Inc, Bangalore	
Reference Books		
1	Gopalan, C., Ramasastry, B.V and Balasubramanian, S. (2007) Nutritive Value of Indian Foods,	

	National Institute of Nutrition, Hyderabad.
2	Swaminathan, M. (2010) Essentials of Food and Nutrition, Volume I and II Ganesh and Co., Madras.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/content/storage2/courses/126104004/LectureNotes/Week-5_03-Balanced%20diet%20and%20food%20groups.pdf
2	https://nptel.ac.in/content/storage2/courses/126104004/LectureNotes/Week-1_01-Relationship%20between%20Food,%20Nutrition%20and%20Health%201-A.pdf
Course Designed By: Dr. M. Rajesh	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO3	S	S	S	L	S	S	S	S	M	S
CO3	S	M	S	M	S	S	S	S	S	S
CO4	S	M	S	M	S	S	S	S	S	S
CO5	M	M	S	L	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low





**Second
Semester**

Course code	23A	ENZYMOLOGY	L	T	P	C
Core/Elective/Supportive	Core - V		3	1	-	4
Pre-requisite	Background ideas on enzyme catalyzed reactions		Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
1. To understand the classification of enzymes and fundamentals of enzyme assay. Also, understanding of kinetics of enzyme catalyzed reactions and derivation of Michaelis Menten equation.						
2. To advance the knowledge on mechanism of enzyme action as well as regulation of enzyme action with relevant examples.						
3. To study about the techniques of immobilization and application in enzymes in food and pharmaceutical industries.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Course material will help in understanding of nomenclature and classification of enzymes and also the fundamentals of enzyme assay.					K2
2	Students will thoroughly understand the Kinetics of enzyme essay and derivation of velocity equations.					K2 & K4
3	Course will advance the knowledge of students on mechanism of enzyme action.					K2 & K3
4	Understanding of detailed mechanism in enzyme regulation with relevant examples.					K1, K2 & K3
5	Students will gain knowledge in various immobilization techniques and industrial application of enzymes					K2, K3 & K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Introduction to Enzymes				15 Hours	
Concept of convergent and divergent evolution of enzymes. Nomenclature and classification of enzymes. Specificity and active site- Lock & key model, Induced fit model. Fundamentals of enzyme assay – enzyme Units, coupled kinetic assay, immobilized enzymes. Enzyme localization. Criteria of purity of enzymes. Monomeric and oligomeric enzymes- Monomeric enzymes; serine proteases, zymogen activation, multifunctional enzymes, oligomeric enzymes and multi- enzyme complexes.						
Unit:2	Kinetics of Enzyme-catalyzed Reactions				15 Hours	
Methods used in the investigation of the kinetics of enzyme-catalyzed reactions, initial velocity studies, rapid reaction techniques and relaxation technique. Enzyme kinetics of single substrate reactions – Michaelis Menten and Briggs and Haldane theory (rapid equilibrium and steady state						

theory). Kinetic data evaluation-linear transformation of Michaelis-Menten equation. Pre-steady state kinetics. Integrated velocity equation. Haldane equation. King-Altman procedure for deriving the rate equation. Mechanism of enzyme inhibition-Competitive, Non-competitive and Un-competitive. Effect of pH & temperature on enzymatic reactions, Arrhenius plot, determination of activation energy.		
Unit:3	Mechanism of Enzyme Action	11 Hours
Acid-base catalysis, covalent catalysis, proximity, orientation effect. Strain & distortion theory. Chemical modification of active site groups. Site directed mutagenesis of enzymes. Mechanism of action of chymotrypsin, lysozyme, glyceraldehyde 3- phosphate dehydrogenase, aldolase, carboxypeptidase.		
Unit:4	Enzyme Regulation	11 Hours
General mechanisms of enzyme regulation, product inhibition. Reversible (glutamine synthase & phosphorylase) and irreversible (proteases) covalent modifications of enzymes. Mono cyclic and multicyclic cascade systems with specific examples. Feedback inhibition and feed forward stimulation. Allosteric enzymes, qualitative description of “concerted” & “sequential” models for allosteric enzymes. Half site reactivity, Flipflop mechanism, positive and negative co-operativity with special reference to aspartate trans carbamoylase & phosphofructokinase. Protein ligand binding measurement, analysis of binding isotherms, Hill and Scatchard plots.		
Unit:5	Applications of Enzymes	11 Hours
Application of enzymes in food, Pharmaceutical, pulp, textile and other industries; diagnostic & therapeutic applications. Enzyme data repositories and their types and classification. Datamining – software types and its usage. Immobilized enzymes-Techniques of enzyme immobilization; applications of immobilized enzymes.		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	65 Hours
Text Book(s)		
1	Fundamentals of Enzymology, 3rd Edition – 2009 by Nicholas C. Price; Oxford University Press.	
2	Molecular Enzymology (Tertiary Level Biology)- 2013 by Christopher W. Wharton; Springer	
3	ENZYMES– 2008 by Trevor Palmer and Philip Bonner; East West, New Delhi.	
Reference Books		
1	Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis – 2008 by Robert A. Copeland; Wiley India Pvt Ltd.	
2	Enzyme Kinetics and Mechanism – 2007 by Paul F. Cook and W. W. Cleland; Publisher: Garland Science.	

3	Fundamentals and Application of New Bioproduction Systems (Advances in Biochemical Engineering/Biotechnology) – 2016 by An-Ping Zeng; Publisher: Springer
4	Enzyme Kinetics: Rapid–Equilibrium Applications of Mathematica: 53 (Methods of Biochemical Analysis) – 2011 by Robert A. Alberty; Publisher: Wiley-Blackwell.
5	Fundamentals of Enzyme Kinetics – 2004 by Athel Cornish-Bowden; Publisher: Portland Press.
6	Fundamentals of Enzyme Engineering 2017 by Young Je Yoo, Yan Feng, Yong- Hwan Kim and Camila Flor J. Yagonia; Publisher: Springer.
7	Enzyme Kinetics: Behavior and Analysis of Rapid Equilibrium and Steady–State Enzyme Systems (Wiley Classics Library)-1993 by Irwin H. Segel; Publisher: Wiley
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.classcentral.com/course/swayam-enzymology-19860
2	https://www.udemy.com/course/enzymology/
3	https://www.mooc-list.com/course/biochemistry-biomolecules-methods-and-mechanisms-edx
4	Introduction to Data Mining, Pang-NingTan (2018) Pearson Education India https://books.google.co.in/books?id=64GVEjpTWIAC
Course Designed By: Dr. S. Selvakumar	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	L	S	M	M	S	M
CO3	S	S	M	M	S	L	S	M	M	S
CO3	S	M	L	M	S	M	M	M	M	M
CO4	S	S	S	S	M	M	L	M	S	S
CO5	S	S	M	L	M	L	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code	23B	INTERMEDIARY METABOLISM	L	T	P	C
Core/Elective/Supportive	Core - VI		3	1	-	4
Pre-requisite	Basic knowledge in Chemistry Biomolecules		Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
1. To understand the metabolism of carbohydrates, lipids, proteins and nucleic acids.						
2. To impart knowledge of the concepts of regulation of metabolism.						
3. To offer basic knowledge about Big Data analytics and its applications in metabolic pathway analysis						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the concepts of carbohydrate metabolism and its regulation					K2
2	Understand the concepts of lipids metabolism and its regulation					K2
3	Understand the concepts of metabolism of amino acids and urea cycle					K2
4	Understand the concepts of nucleotide metabolism and regulation mechanism					K2
5	Apply the knowledge about Big Data analytics in Metabolic Pathway Analysis					K3
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Metabolism of Carbohydrates				15 Hours	
Metabolism of carbohydrates - Reactions, energetics and regulation of glycolysis; Feeder pathways for glycolysis; Fate of pyruvate under aerobic and anaerobic conditions; Pyruvate dehydrogenase complex and its regulation; Reactions, regulation and amphibolic nature of TCA cycle; Anaplerotic reactions; Glyoxalate cycle; Polyol pathways; ED pathway: Pentose phosphate pathway; Gluconeogenesis; Cori cycle; Biosynthesis of lactose, sucrose and starch; Glycogenesis and Glycogenolysis; Control of glycogen metabolism.						
Unit:2	Metabolism of Lipids				15 Hours	
Fatty acid oxidation - Franz Knoop's experiment; β oxidation of saturated, unsaturated and odd carbon fatty acids; Peroxisomal β oxidation; α - and ω - oxidations of fatty acids; Ketone bodies – Formation and utilization; Biosynthesis of saturated fatty acids; Elongation and desaturation of fatty acids; Triacylglycerols – Biosynthesis, and mobilization from adipose tissue; Regulation of fatty acid metabolism; Cholesterol biosynthesis and its regulation; Biosynthesis of phosphoglycerides and sphingolipids. Biosynthesis of Eicosanoids. Lipoprotein metabolism.						
Unit:3	Amino Acid Metabolism				11 Hours	
Amino acid metabolism - Degradation of amino acids, oxidative and nonoxidative deamination, transamination, decarboxylation, detoxication of ammonia - Urea cycle catabolism of carbon skeletons of amino acids - ketogenic and glucogenic amino acids - nitrogen balance-Factors						

affecting nitrogen balance-conversion of amino acids to specialized products.		
Unit:4	Nucleic Acid Metabolism	11 Hours
Biosynthesis of purines and pyrimidines- De novo and salvage pathways and their regulation. Catabolism of purine and pyrimidines. Structure and regulation of ribonucleotide reductase. Biosynthesis of ribonucleotides and deoxyribonucleotides.		
Unit:5	Integration of Metabolism	11 Hours
Tissue specific metabolism - brain, muscle and liver. Overview of metabolism of Porphyrins, Biosynthesis and degradation of heme. Metabolic Pathway Analysis – Methodologies - Machine Learning Methods for Analysis of Metabolic Data and Metabolic Pathway Modeling.		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	65 Hours
Text Book(s)		
1	Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York).	
2	Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, -T.M., John Wiley & Sons, Inc. (New York).	
Reference Books		
1	Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J.L. and Stryer L., W.H. Freeman and Company (New York).	
2	Harper's Biochemistry (2012) 29th ed., Murray, R.K., Granner, D.K., Mayes and P.A., Rodwell, V.W., Lange Medical Books/McGraw Hill.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.researchgate.net/publication/322407168_Machine_Learning_Methods_for_Analysis_of_Metabolic_Data_and_Metabolic_Pathway_Modeling	
2	https://www.nature.com/articles/s41540-018-0054-3	
3	https://www.researchgate.net/publication/263474674_A_Comprehensive_View_on_Metabolic_Pathway_Analysis_Methodologies	
Course Designed By: Dr. R. Kavitha		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	M	S	S	S	S
CO3	S	S	S	S	S	M	S	S	S	S
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	S	S	S	S	M	S	S	S	S
CO5	S	S	S	S	S	M	S	S	S	S

*S-Strong; M-Medium; L-Low



Course code	23C	HUMAN PHYSIOLOGY	L	T	P	C
Core/Elective/Supportive	Core – VII		3	1	-	4
Pre-requisite	Understand function of each organ		Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
1. This course presents an Introduction and provides a comprehensive, balanced introduction to this exciting, evolving and multi-disciplinary field.						
2. To enable the students to learn or to know the biological, physiological activities along with the mechanism of action of various organs.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Obtain a deep knowledge regarding blood.		K1 & K2			
2	Gives an idea about heart and its regulation.		K1 & K2			
3	Provides Knowledge about digestive secretion and urine formation.		K2 & K3			
4	Obtain an insight about respiration and Neurons.		K2 & K3			
5	Provides knowledge about Hormone and its regulation.		K2, K3 & K4			
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Blood and Its Components		15 Hours			
Composition, types and functions of blood and plasma. Blood volume, blood volume regulation, immunity, haemostasis, blood groups. Haemopoiesis. Blood coagulation - mechanism, fibrinolysis, anticoagulants. Hemoglobin - structure, abnormal types, anemia, Blood corpuscles.						
Unit:2	Anatomy of Heart and Functions of Sense Organs		15 Hours			
Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above. Sense organs – Vision, hearing and tactile response.						
Unit:3	Digestive System		11 Hours			
Digestive secretions - composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestions and absorption of carbohydrates, lipids, proteins and nucleic acids. Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, electrolyte balance, acid-base balance.						
Unit:4	Respiratory and Nervous System		11 Hours			
Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration. Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Muscle physiology.						

Unit:5	Exocrine and Endocrine Glands	11 Hours
Exo and Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, neuroendocrine regulation. Introduction to big data .Data source and Biological data		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars – webinars		
Total Lecture hours		65 Hours
Text Book(s)		
1	Human Physiology by C. C. Chatterjee, CBS Publishers & Distributors; 13th revised edition, volume 2 (2020).	
2	Textbook of Medical Physiology, Guyton and Hall 15th Edition, <i>Publisher: Saunders</i> (2015)	
Reference Books		
1	Review of Medical Physiology by William. F. Ganong. McGraw-Hill Medical; 22nd editions (2005).	
2	Physiology and Mechanisms of Disease by Arthur C. Guyton, John E. Hall. Saunders, 6th Edition (1997).	
3	V. Bhuvanewari, T. Devi, Big Data Analytics, Scitech Publisher, 2018	
4	Han Hu, Yonggang Wen, Tat- Seng, Chua, Xuelong Li ‘Toward Scalable Systems for Big Data Analytics: A Technology Tutorial’, IEEE, 2014.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	NOC: Animal Physiology https://nptel.ac.in/courses/102/104/102104058/	
2	Animal Physiology https://nptel.ac.in/courses/102/104/102104042/#	
3	Introductory Human Physiology https://www.coursera.org/learn/physiology	
Course Designed By: Dr. S. Suja		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	S	S	M	S	M	S
CO3	S	S	S	M	M	M	S	M	M	S
CO3	S	S	S	M	M	M	S	S	M	S
CO4	S	M	M	M	S	S	M	S	M	S
CO5	S	S	S	M	M	M	S	M	M	S

*S-Strong; M-Medium; L-Low

Course code	23D	IMMUNOLOGY	L	T	P	C
Core/Elective/Supportive	Core - VIII		3	1	-	4
Pre-requisite	Prior knowledge on the components of immune system		Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. The study of immunology helps the students in understanding the immune system in all organism especially the physiological functioning of the immune system in states of both health and disease. 2. To understand the malfunctions of the immune system in immunological disorders such as autoimmune disease, hypersensitive, immune deficiency and transplant rejection. 3. 3. To understand the physical, chemical and physiological characteristics of the components of immune system in in vitro, in situ and in vivo. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To obtain the knowledge about the immune system, as a host defense system comprising many biological structures and processes within an organism that protects against disease.				K1 & K2	
2	To concentrate on the antigen and antibody reactions and immunological techniques				K1 & K2	
3	Understanding about the two branches of immune system such as humoral immunity and cellular immunity, cytokines and complement system.				K1 & K2	
4	Clear about the hypersensitivity reaction or intolerance with undesirable reactions produced by the normal immune system, including allergies and autoimmunity.				K1 & K2	
5	To obtain the knowledge about the hybridoma technology is to produce large numbers of identical antibodies (monoclonal antibodies) and a recombinant DNA technology that involves inserting the DNA encoding an antigen that stimulates an immune response				K1, K3 & K4	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Cells of The Immune System				15 Hours	
Cells of the immune System - Macrophages, B and T lymphocytes, Dendritic cells, Natural killer and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells. Organs of the immune system: Thymus, Bone marrow, Spleen, lymph nodes, MALT, GALT. Haemopoiesis and differentiation, lymphocyte trafficking. Structure and functions of different classes of Immunoglobulin. Biology of antigen and Superantigens.						
Unit:2	Antigen-Antibody Reactions				15 Hours	
Antigen antibody reactions, Applications of Immunological techniques, genetic control of immune response, effector mechanisms, MHC, antigen recognition and presentation, activation of B and T lymphocytes.						

Unit:3	Humoral and Cell Mediated Immunity	11 Hours
Humoral and cell mediated immunity. Cell mediated Cytotoxicity: Mechanism of T cell and NK Cell mediated lysis, Antibody dependent cell mediated Cytotoxicity and macrophage mediated Cytotoxicity. Cytokines and their role in immune regulation, Biology of Complement system, Complement fixation test and assessment of immune complexes in tissues. Immune suppression and immune tolerance.		
Unit:4	Immunity Versus Diseases	11 Hours
Hyper sensitivity reactions, Autoimmune disorders, Transplantation immunology- MLR, HLA Typing, Bone marrow transplantation, Organ transplants. Immunity to Infectious agents - Bacteria, Viruses, Malaria, and Helminthes. Tumor immunology, Tumor antigens, immune response to tumors, cancer immunotherapy, Vaccines. AIDS and other immune deficiencies, Structure of HIV, envelope glycoproteins, destruction of T cells: immunologic symptoms of AIDS, AIDS vaccine. Using the Internet of Things to fight virus outbreaks.		
Unit:5	Applications of Antibodies	11 Hours
Vaccine technology and recombinant vaccines, Identification of B and T epitopes for vaccine development. In situ characterization of cells from tissues, Immunoscreening of Recombinant library, Hybridoma – Monoclonal Antibody production and applications; MAbs in diagnosis and therapy. AI- Machine learning cloud computing in Immunotherapy.		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
Total Lecture hours		65 Hours
Text Book(s)		
1	J.Kuby, 2018, Immunology 8th edition , W.H. Freeman and Company, Newyork.	
2	C.V.Rao. 2005, An Introduction to Immunology, Narosa Publishing House, Chennai.	
3	K.M.Pavri. 1996, Challenge of AIDS, National Book Trust, India.	
4	I.R.Tizard, 1995, Immunology: An Introduction , 4 edition , Saunders College Publishers, New York.	
Reference Books		
1	I.Roitt, 2017, Essential Immunology, 13 th edition, Blackwell Science, Singapore.	
2	Abul Abbas Andrew H. Lichtman Shiv Pillai, 2017, Cellular and Molecular immunology 9th Edition	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.hindawi.com/journals/bmri/2014/437987/	
2	https://www.tandfonline.com/doi/full/10.1080/1744666X.2019.1623670	
3	https://www.technologynetworks.com/immunology/articles/using-the-internet-of-things-to-fight-virus-outbreaks-331992	
Course Designed By: Dr. K. M. Saradhadevi		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	S	S	S	M	S	W
CO3	S	S	M	L	S	M	S	M	W	W
CO3	S	S	S	L	S	M	S	M	M	M
CO4	S	S	S	L	S	M	M	L	M	M
CO5	S	S	S	M	S	M	M	L	S	W

*S-Strong; M-Medium; L-Low



Course code	23P	IMMUNOLOGY AND ENZYMOLOGY LAB	L	T	P	C
Core/Elective/Supportive		Core Practical - II	-	-	4	4
Pre-requisite		Basic knowledge in Biochemical Analysis	Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are:						
<ol style="list-style-type: none"> To familiarize students with the various immunological techniques that includes antigen-antibody interactions, quantitation of antigens or antibody, ELISA, agglutination reactions etc. To gain knowledge on enzymology in the aspects of isolation and purification, kinetics as well as native PAGE analysis. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understood the principles of immunology and the methods of studying immune reactions				K2	
2	Apply basic techniques for identifying antigen antibody interactions.				K2, K3	
3	Analyse the kinetics of enzyme catalysis and learn the basics of isolation and purification of enzymes.				K2, K3, K4	
4	Understand the concepts of isoenzyme analysis and inhibitory mechanisms of enzyme activity				K2, K3, K5	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Immunology						
1	Immuno diffusion – single radial and double diffusion				3 Hours	
2	Immunohistochemistry for the detection of antigens in tissues				3 Hours	
3	Rocket immunoelectrophoresis				3 Hours	
4	Genomic In situ Hybridization				3 Hours	
5	Identifying blood group and Rh typing				3 Hours	
6	ELISA-Direct and Indirect				3 Hours	
7	Isolation and purification of IgG from serum				3 Hours	
8	Dissection and identification of Thymus, Spleen, Lymph node from rat				3 Hours	
Enzymology						
1	Isolation and Purification of Salivary Amylase enzyme.				3 Hours	
2	Determination of total and specific activity of salivary amylase.				3 Hours	
3	Effect of pH on enzyme activity (Acid phosphatase/Alkaline phosphatase).				3 Hours	
4	Effect of temperature on enzyme activity (ACP/ALP) and determination of activation energy.				3 Hours	
5	Effect of substrate concentration on enzyme activity (Salivary Amylase) and determination of Km value.				3 Hours	

6	Effect of inhibitor on activity of Salivary Amylase.	3 Hours
7	Assay of lactate dehydrogenase (LDH).	3 Hours
8	Isoenzyme analysis (LDH) from serum sample- Native PAGE.	3 Hours
Total practical hours		48 Hours
Text Book(s)		
1	K. Wilson and J. Walker, Practical Biochemistry, Principles and Techniques, Cambridge University Press, eighth edition 2018.	
2	J. Jayaraman, Laboratory Manual in Biochemistry - New age international pvt. ltd, 2011	
3	D.T. Plummer, Practical Biochemistry - TATA McGraw-Hill education; 3rd edition, 2006	
4	R.C.Gupta & S. Bhargava Practical Biochemistry - CBS publishers and distributors, 5th revised edition, 2013	
5	Experimental Biochemistry – A Student Companion - B.S. Rao & V. Deshpande, I.K. Interational Pvt. Ltd. (N. Delhi, Mumbai, Bangalore) 2005.	
Reference Books		
1	R. Boyer, Modern Experimental Biochemistry, 3rd., Pearson Education (Singapore) Pvt. Ltd.,2001.	
2	R. L. Switzer and L. F. Garrity, Experimental Biochemistry, 3rd edition., W. H. Freeman,1999.	
Course Designed By: Dr. S. Selvakumar and Dr. K. M. Saradhadevi		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	M	M	S	S	M	S
CO2	S	S	S	L	M	M	S	S	M	S
CO3	S	S	M	S	S	M	L	S	M	S
CO4	S	S	M	M	M	M	M	S	L	S

*S-Strong; M-Medium; L-Low

Course code	2EB	MOLECULAR PHYSIOLOGY	L	T	P	C
Core/Elective/Supportive		Elective - II	3	1	-	4
Pre-requisite	Knowledge about basic concepts of cell signaling		Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
1. To understand the signaling components and receptor mediated signaling process.						
2. To advance the knowledge on nuclear receptor mediated signaling as well as on G- protein signaling mechanism and its regulation.						
3. To learn about the various signaling Pathways that control the gene activity. Also, to enhance the understanding of integration of Signals and gene control.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Course will advance the understanding of various signaling components and their functions.			K1		
2	Students will understand the nuclear receptor mediated signaling mechanism and its regulation.			K1 & K2		
3	Advancement in knowledge in the field of G protein coupled signal transmission and its regulation.			K2 & K3		
4	Thorough understanding of signaling Pathways that controls gene activity			K1, K2 & K4		
5	Understanding in signal integration and gene controls.			K2, K3 & K5		
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Signaling Components			15 Hours		
Endocrine, Paracrine and Autocrine signaling; Signaling molecules - Hormones (agonists and antagonists) NO; Receptor Classification: Receptor linked to Trimeric G proteins (G proteins linked Receptors), Receptors with intrinsic or associated enzymic activity (TGF- , cytokine, Receptor Tyrosine kinase, Receptor guanylyl cyclase, Receptor Phosphotyrosine phosphatase ,T-Cell Receptor), Ion Channels as receptors, receptors involving proteolysis (Wnt, Hedgehog Hh, Notch/ Delta, NF - κ), intracellular receptor (NO. Pathway, Nuclear receptor). Membrane anchoring process - myristoylation, palmitoylation, Farnesylation, Geranylation, GPI anchor.						
Unit:2	Nuclear Receptors			15 Hours		
Principle of signaling with nuclear receptors, classification and structures; Transcriptional regulation by nuclear receptors coactivators, co-repressors; Regulation and variability of signaling; Signaling path ways via steroids hormones receptors, Nuclease localized (retinoid, vit D3 and T3 hormones).						
Unit:3	Signal Transmission and its Regulations			10 Hours		
G Protein Coupled Signal Transmission: GPCR Structure and classification, ligand binding domain; Signaling path ways via cAMP, ion Channel regulation, Phospholipase C; Trimeric and						

monomeric G proteins and their effectors; Regulation – GTPase super family and GTP hydrolysis; Regulation of GPCR signaling – GDPGTP cycling, GTPase activity, phosphodiesterase activity, feedback inhibition, heterologous desensitization, phosphorylation of receptors, β -arrestin in regulation of GPCR.		
Unit:4	Signaling Pathways that Regulates Gene Activity	10 Hours
TGF Receptors and Smad activation; cytokine receptors and JAK –STAT path way; RTK and Ras activation; MAP Kinase pathways; phosphoinositides as signal transducers; Signal induced protein cleavage (NF-kB, Notch /Delta, Wnt, Hedgehog). Inflammatory signaling. Classifications of Bio Database (Primary and Secondary). Types of the database - Nucleotide and Protein Database		
Unit:5	Integration of Signals and Gene Controls	10 Hours
Responses of cells to environmental influences control of cell fates by graded amounts of regulators, boundary creation by different combination of transcription factors; Boundary creation by extra cellular signals; Reciprocal induction and lateral inhibition; Integrating and controlling signals; Down modulation of receptor signaling.		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
Total Lecture hours		62 Hours
Text Book(s)		
1	Biochemistry of Signal Transduction and Regulation – 2014 by Gerhard Krauss; Publisher: Wiley VCH; 5th edition.	
2	The Cell: A Molecular Approach -2013 by Geoffrey M. Cooper, and Robert E. Hausman; Publisher: Sinauer Associates Inc; 6 edition.	
3	Xiong J. (2006). Essential Bioinformatics. Texas A & M University. Cambridge University Press.	
Reference Books		
1	Molecular Cell Biology– 2016 by Arnold Berk, Chris A. Kaiser, Harvey Lodish, Angelika Amon, Hidde Ploegh, Anthony Bretscher, Monty Krieger and Kelsey C. Martin; Publisher: WH Freeman; 8 edition.	
2	Molecular Biology of the Cell – 2014 by Bruce Alberts, Alexander D. Johnson, Julian Lewis, David Morgan, Martin Raff, and Keith Roberts; Publisher: W. W. Norton & Company; 6 edition.	
3	Arthur M Lesk (2014). Introduction to bioinformatics. Oxford University Press. Oxford, United Kingdom	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.edx.org/course/essential-human-biology-cells-and-tissues	

2	https://study.com/directory/category/Biological and Biomedical Sciences/Physiology and Related Sciences/Molecular Physiology.html
3	https://www.fmed.uniba.sk/uploads/media/Introduction to Medical and Molecular Biology .pdf
4	https://nptel.ac.in/courses/102/104/102104052/
Course Designed By: Dr. S. Selvakumar	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	L	M	M	S	L	S	S
CO3	S	S	M	L	S	M	L	M	M	M
CO3	M	S	L	L	L	M	S	S	M	M
CO4	S	M	S	M	S	L	S	S	L	S
CO5	S	L	S	M	M	L	L	M	M	M

*S-Strong; M-Medium; L-Low



Course code	2EC	NANOSCIENCE AND TECHNOLOGY	L	T	P	C
Core/Elective/Supportive		ELECTIVE – II	3	1	-	4
Pre-requisite			Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. The main objective of this course is to introduce about concepts in Nanoscience and technology and the internet of nano-things and applications 2. This course emphasizes to learn about nanoparticles and its types, synthesis, characterization of nanoparticles and microscopy techniques 3. Nanocarriers and drug delivery system in nanomedicine provides the learner to know about the treatment of diseases using nanoparticles and to know about Big data in Nanomedicine. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Learn history of nanotechnology, Properties of nanoparticles, types and internet of nano-things and applications				K1&K2	
2	know the bottom up and top down approaches and synthesis of nanoparticles using physical, chemical and biological method				K1&K2, K3	
3	Understand the characterization of nanoparticles using Microscopy techniques such as SEM, TEM, AFM, STM				K2, K3 & K4	
4	Learn about surface modification of biomolecules and conjugation to nanomaterials and to know about Nano-biomimetics				K2 & K3	
5	Learn about treatment of diseases using nanoparticles in nanomedicine and to know about nanotechnology in Big data analysis				K2, K3&K4	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Introduction to Nanoscience and Nanotechnology				15 Hours	
Milestones in Nanotechnology; Overview of Nanobiotechnology and Nanoscale processes; Physicochemical properties of materials in Nanoscales. Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes). The internet of Nano-things and its applications						
Unit:2	Nanomaterials				15 Hours	
Top down and bottom up synthesis -Gas, liquid, and solid phase synthesis of nanomaterials; Polymers in nano material synthesis- natural and synthetic polymers. Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials.-Green synthesis.						

Unit:3	Characterization techniques	10 Hours
Characterization of Nano material; Absorption, Fluorescence, and Resonance; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.		
Unit:4	Biomolecules and Biomimetics	10 Hours
Reactive groups on biomolecules (DNA & Proteins); Surface modification and conjugation to nanomaterials. Fabrication and application of DNA nanowires; Nanofluidics to solve biological problems. Nano-biomimetics.		
Unit:5	Nanocarriers	10 Hours
Properties of nanocarriers; drug delivery systems used in nanomedicine; Enhanced Permeability and Retention effect; Blood-brain barrier; Active and passive targeting of diseased cells; Health and environmental impacts of nanotechnology. Big data at Nanoscale; Use of data mining and machine learning in Nanomedicine		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	62 Hours
Text Book(s)		
1	Bio-nanotechnology Concepts and applications. Madhuri Sharon, Maheshwar Sharon, Sunil Pandey and Goldie Oza, Ane Books Pvt Ltd, 1 edition 2012.	
2	Nanobiotechnology: Bioinspired Devices and Materials of the Future by Oded Shoseyov and Ilan Levy, Humana Press; 1 edition 2007.	
3	Microscopy Techniques for Material Science. A. R. Clarke and C. N. Eberhardt (Editors) CRC Press. 1st Edition, 2002.	
Reference Books		
1	Nanobiotechnology: Concepts, Applications and Perspectives, Christof M. Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley-VCH; 1 edition, 2004.	
2	Nanobiotechnology Protocols (Methods in Molecular Biology) by Sandra J Rosenthal and David W. Wright, Humana Press; 1 edition, 2005.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Nanotechnology and Big data analysis for computer aided diagnosis https://pubmed.ncbi.nlm.nih.gov/26979668/	
2	The use of data mining and machine learning in Nanomedicine https://www.oatext.com/the-use-of-data-mining-and-machine-learning-in-nanomedicine-a-survey.php#gsc.tab=0	
3	Kethineni P. Applications of internet of nano things: A survey Proc. of the IEEE International Conference for Convergence in Technology (I2CT)	

Mumbai, India (2017), pp. 371-375
Course Designed By: Dr. M.Rajesh

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10
CO1	L	M	S	M	L	S	M	S	S	S
CO2	M	S	S	M	M	S	M	S	S	S
CO3	M	S	S	M	L	S	M	S	S	S
CO4	L	M	S	M	M	S	S	S	S	S
CO5	L	L	S	M	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low





**Third
Semester**

Course code	33A	CLINICAL BIOCHEMISTRY	L	T	P	C
Core/Elective/Supportive	Core - IX		3	1	-	4
Pre-requisite	Basic knowledge in Metabolism of Biomolecules and Analytical Techniques		Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. Provide knowledge about carbohydrate, lipid and nucleic acid metabolic disorders 2. Offer knowledge about hemoglobin metabolism and associated diseases 3. Give knowledge about functional tests of organs and clinical diagnosis of diseases by enzymatic assays 4. Give basic knowledge about free radicals and diseases. 5. Provide awareness about application of Artificial Intelligence in health and medicine. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Students will acquire insight into disorders of carbohydrates, lipids and nucleic acid					K2
2	Students will learn about functional tests and enzymatic assays to diagnose the function of liver, kidney, thyroid, gastrointestinal and pancreas.					K4
3	Students will gain knowledge about disorders of nitrogen metabolism					K3
4	Students will learn about the disorders of hemoglobin metabolism					K3
5	Students will learn about the applications of Artificial Intelligence in health and medicine					K3
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Disorders of Carbohydrate and Lipid Metabolism				15 Hours	
Clinical investigation of sugar levels in blood and urine; factors influencing blood glucose level, Glycosylated hemoglobin; carbohydrate tolerance tests-procedures and interpretation. Biochemical basis of Diabetes, glycogen storage diseases; carbohydrate metabolic disorders. Disorders associated with lipid metabolism and its therapeutic intervention, ketone bodies and ketosis; Fatty liver, Atherosclerosis.						
Unit:2	Disorders of Nitrogen Metabolism				15 Hours	
Abnormalities of nitrogen metabolism - uremia, aminoaciduria- phenylketonuria, Alkaptonuria, Albinism. Excretion of nitrogenous waste products-ammonia, urea, uric acid, creatine, creatinine. Disorders of acid base balance.						
Unit:3	Disorders of Nucleotide and Heme Metabolism				11 Hours	
Gout, Xanthinuria, orotic aciduria. Lesch- Nyhan syndrome. : Heme metabolism associated diseases- porphyrias, porphyrinurias, sickle cell anemia, thalassemia. Hemorrhagic disorders, disseminated intravascular coagulation, acquired prothrombin complex disorders. Biochemical basis of Jaundice.						

Unit:4	Biochemical Diagnosis of Diseases	11 Hours
Functional tests of liver, kidney, thyroid, gastrointestinal and pancreas, biochemical diagnosis of diseases by enzymatic assays- ALP, SGOT, SGPT, creatinine, cholinesterase, creatine kinase and LDH. Case studies. Clinical research guidelines.		
Unit:5	Free Radical and Diseases	11 Hours
Free radicals - reactive oxygen species and reactive nitrogen species. Formation of free radicals- Oxidative stress- Free radical and diseases. Metabolism of iron, calcium and phosphorus, Trace elements and their deficiency. Applications of Artificial Intelligence in Medicine.		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	65 Hours
Text Book(s)		
1	Chatterjee and Shindae (: 2012). Text book of medical biochemistry, Eighth Edition	
2	Textbook of Biochemistry with Clinical Correlations, 7th Edition ISBN: 978-0-470-60976-7 June 2010	
Reference Books		
1	Clinical Biochemistry 5th Edition (2013) Allan Gaw Michael Murphy Rajeev Srivastava Robert Cowan Denis O'Reilly	
2	Sembulingam, K and Sembulingam, P 6th Edition (2010). Essentials of Medical Physiology, fifth edition. Jaypae Brothers (p) ltd, New Delhi.	
3	Carl A. Burtis, Edward R. Ashwood and David E. Bruns (eds): Tietz Textbook of Clinical Chemistry and Molecular Diagnosis (5th edition) Elsevier, St. Louis, USA, 2012, 2238 pp, 909 illustrations. ISBN: 978-1-4160-6164-9	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Big Data Analytics and Its Applications https://www.researchgate.net/publication/320345031_Big_Data_Analytics_and_Its_Applications	
2	Big Data Analytics in Medicine and Healthcare https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6340124/	
3	Implications of big data analytics in developing healthcare https://www.sciencedirect.com/science/article/pii/S1319157817302938	
4	Critical analysis of Big Data challenges and analytical methods www.sciencedirect.com > science > article >	
5	Artificial Intelligence in Medicine https://www.datarevenue.com/en-blog/artificial-intelligence-in-medicine https://www.frontiersin.org/articles/10.3389/fmed.2020.00027/full	
Course Designed By: Dr. R. Kavitha		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	L	S	S	S	S
CO3	S	S	S	L	S	M	S	S	S	S
CO3	S	S	S	M	S	M	S	S	S	S
CO4	S	S	S	M	S	M	S	S	S	S
CO5	S	S	S	M	S	M	S	S	S	S

*S-Strong; M-Medium; L-Low



Course code	33B	RECOMBINANT DNA TECHNOLOGY	L	T	P	C
Core/Elective/Supportive	Core – X		3	1	-	4
Pre-requisite	Knowledge on basic concepts of recombinant DNA technology and DNA sequencing		Syllabus Version		20-21	
Course Objectives:						
The main objectives of this course are to:						
1. To study about the DNA modifying enzymes and Vectors used in recombinant DNA technology						
2. Understanding the cloning strategies and preparation of probes. In addition, acquiring thorough knowledge about confirmation of rDNA expression by various techniques, including blotting and immunological screening.						
3. Upon completion of the course, students might also be thorough about various types of sequencing techniques as well as on biotechnological applications of rDNA technology.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	The course material will provide clear understanding about DNA modifying enzymes and their uses in rDNA technology				K1 & K2	
2	Students will advance their knowledge on host cells and vectors that are highly suitable for rDNA-based expression of desirable genes.				K1 & K2	
3	The course will provide detailed understanding of cloning strategies and various methods adapted for confirmation of rDNA expression.				K1 & K2	
4	Students will learn about advances in sequencing techniques and their advantages.				K1 & K2	
5	Course material provides detailed understanding of Biotechnological applications of rDNA technology.				K1, K3 & K4	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	DNA modifying enzymes				15 Hours	
DNA modifying enzymes and their uses in Molecular Biology a) Restriction enzymes b) DNA Polymerase i) Klenow ii) DNA polymerase I iii) T4/T7 DNA Polymerase c) Reverse Transcriptase d) Terminal Transferases e) T4 Polynucleotide kinases & Alkaline phosphatase f) DNA dependent RNA polymerases. g) DNA ligases h) Nucleases: - Bal 31, S1 nucleases, DNase I, Mungbean nucleases, Ribonucleases, EXO III. Thermostable DNA polymerases used in PCR.						
Unit:2	Vectors and plasmids				15 Hours	
Host cells and Vectors - Host Cell Types (Prokaryotic and eukaryotic). Plasmid vectors for use in E. coli and Gram-positive bacteria. Bacteriophage - Lambda and M13 vectors c) Cosmids d) Phagemids. Artificial chromosomes (YACs, PACs, BACs, MACs and HACs). Specialized vectors & their uses a) Expression vectors for Prokaryotes & Eukaryotes - Inducible vectors; vectors with tags (Histidine tags, signalling peptides for exportation), b) Gene fusion vectors.						

Unit:3	Cloning and Screening strategies	11 Hours
Cloning strategies: DNA cloning a) Sticky ends b) Blunt ends c) Homopolymeric tailing d) Use of adapters & linkers. Methods of gene transfer into plant and animal cells: chemical, biological and mechanical methods. Construction of genomic DNA libraries (shotgun cloning) and cDNA libraries. Screening of recombinants - Antibiotic resistance, lacZ complementation (Blue-white selection), fluorescent markers (e.g. GFP). Preparation of radiolabelled/non-radiolabelled DNA & RNA probes. Southern/Northern/Western blot, dot blot and Zoo blot. Screening of genomic libraries with oligo-probe. Immunological screening for expressed genes.		
Unit:4	Gene sequencing	11 Hours
PCR – basic process, types and applications. DNA sequencing- Principle of chemical and enzymatic methods. Automated DNA sequencing, high throughput Pyrosequencing, next generation sequencing - Lynx Therapeutics' Massively Parallel Signature Sequencing (MPSS), Polony sequencing, Ligation based sequencing (SOLiD sequencing), Ion semiconductor sequencing, DNA nanoball sequencing, sequencing based on reversible dye-terminators (Illumina or Solexa sequencing), Biological sequence retrieval and data accession. Real-Time DNA sequencing, Optical sequencing, Microchip based Sanger Sequencing of DNA, Deep sequencing. DNA footprinting, chromosome jumping, chromosome walking.		
Unit:5	Applications of rDNA technology	11 Hours
Biotechnological applications of rDNA technology: CRISPR-Cas9 gene editing, Synthesis and purification of proteins from cloned genes- Native and fusion proteins. Yeast expression system. Production of enzymes. Therapeutic products for use in human health care- insulin, growth hormones, TPA, alpha interferon, Hepatitis B vaccine and Factor VIII. Big data analytics for genomic medicine and its application. Medical and forensic applications of rDNA technology- DNA Profiling, Multiplex PCR, Diagnosis of inherited disorders and infectious diseases, diagnosis and management of cancer. Treatment using rDNA technology- gene therapy. Gene therapy for ADA and cystic fibrosis.		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	65 Hours
Text Book(s)		
1.	Principles of Gene Manipulation and Genomics – 2013 by Sandy B. Primrose, Richard Twyman; Publisher: Wiley-Blackwell; 7 edition.	
2.	Molecular Cloning: A Laboratory Manual (3 Volume Set): 4th Edition – 2013 by Michael R Green, Joseph Sambrook; Publisher: Viva Books Private Limited	
3.	Gene Cloning and DNA Analysis: An Introduction – 2016 by T. A. Brown; Publisher: Wiley-Blackwell; 7th edition	
4.	Gene cloning and DNA analysis: an introduction (Dr. Hansie peterson) – 2015 by Dr. Hansie Peterson; Publisher: Koros	

Reference Books	
1.	Gene Cloning -2006 by Julia Lodge, Peter Lund, Steve Minchin; Publisher: Taylor & Francis; 1 edition
2.	An Introduction to Genetic Engineering – 2008 by Desmond S. T. Nicholl; Publisher: Cambridge University Press; 3 edition.
3.	Next-Generation Genome Sequencing: Towards Personalized Medicine 1st Edition-2011 by Michal Janitz; Publisher: Wiley-Blackwell.
4.	Recombinant DNA: Genes and Genomes – 2007 by James D. Watson, Amy A. Caudy, Richard M. Myers and Jan A. Witkowski; Publisher: WH Freeman; 3rd ed.
5.	Gupta SK, Bencurova E, Srivastava M, Pahlavan P. Improving re-annotation of annotated eukaryotic genomes. In: Big data analytics in genomics. Cham: Springer; 2016. p. 171–95.
6.	Big Data Analytics: Systems, Algorithms, Applications (2019) Authors: Prabhu, C.S.R., Sreevallabh Chivukula, A., Mogadala, A., Ghosh, R., Livingston, L.M.J. Springer Book Archives – ISBN 978-981-15-0093-0
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.nptel.ac.in/noc19_bt15/preview
2	https://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090
3	http://biology.kenyon.edu/courses/biol114/Chap08/Chapter_08a.html
Course Designed By: Dr. S. Selvakumar	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	L	M	M	S	L	L	S
CO2	S	S	L	M	L	M	M	L	M	S
CO3	S	S	M	M	S	M	M	L	S	M
CO4	S	S	M	L	S	M	M	M	M	M
CO5	S	M	L	M	S	M	S	M	M	S

*S-Strong; M-Medium; L-Low

Course code	33C	PHARMACOLOGY AND TOXICOLOGY	L	T	P	C
Core/Elective/Supportive	Core - XI		3	1	-	4
Pre-requisite	Basic knowledge in Human Physiology Cellular Biochemistry		Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To study about the basic principles about pharmacokinetics, routes of drug administration Understanding the mechanism of drug action, drug receptor interactions, factors affecting the drug receptor interaction This course also provides knowledge about drug discovery process, AI in drug discovery process ethical issues and preclinical toxicological studies. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To understand about basic principles involved in pharmacokinetics and routes of drug administration processes.			K1& K2		
2	To gain knowledge on metabolism and excretion of drugs			K1, K2		
3	To understand mechanism of drug action, drug receptor interactions, Factors affecting the drug receptor interaction			K2, K3& K4		
4	To obtain knowledge on drug discovery process, ethical issues and able to understand the scope and applications of AI in drug discovery			K2& K4		
5	To gain knowledge in preclinical toxicological studies			K2& K4		
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Basic Principles of Pharmacokinetics			15 Hours		
General Principles: Basic principles of drug action-Pharmacokinetics: Absorption, distribution and elimination of drugs, routes of drug administration. Pharmacogenetics. origin of drug from plants and animals.						
Unit:2	Drug Metabolism			15 Hours		
Drug metabolism – general pathways of drug metabolism (different types of reaction in phase I and phase II with examples), metabolism and excretion of drugs. Mechanism of drug action, combined effect of drugs. Factors modifying drug action, tolerance and dependence.						
Unit:3	Pharmacodynamics			11 Hours		
Pharmacodynamics - receptor concepts, theory, drug receptor interaction (DRI), Factors affecting DRI, Cholinergic and anticholinergic drugs, Adrenergic and adrenergic blockers, General anesthetics, Local anesthetics. Adverse reactions to drugs and common drug receptor interactions.						
Unit:4	Application for New Drug Discovery			11 Hours		
Application for New Drug Discovery (NDD) according to Indian Control Authority and USFDA						

guidelines. Ethical considerations in utilizing human subjects for drug discovery process. Helsinki's declaration. Regulatory requirements for conducting clinical trials. Overview of drugs and cosmetics act.		
Unit:5	Toxicology	11 Hours
Toxicology: Principles of toxicology and treatment of poisoning. Heavy metals and antagonists. Non metallic environmental toxicants. Methods involved in the development of new drugs. Role of Artificial intelligence in drug discovery. Preclinical toxicological studies: Calculation of LD50 and ED50. Acute, subacute and chronic toxicity studies; Irwin profile test, Pre-clinical pharmacokinetic and dynamic studies. Lipinski's rule for drug like molecule, High throughput screening (in-vitro and in-vivo) for pre-clinical pharmacokinetic and pharmacodynamic studies.		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
Total Lecture hours		65 Hours
Text Book(s)		
1	Satoskar, R.S and Bhandarkar, S.D. (2000) Pharmacology and Pharmacotherapeutics, 13 th edition, Vol. I and II, Popular Prakeshan PVT Ltd, Mumbai.	
2	Tripathi, K.D. (2013) Essentials of Medical Pharmacology, 7 th edition, Jaypee brothers medical publishers, New Delhi.	
3	Rang, H.P., Dale, M.M., Ritter, J. and Flower, R.J. (2007) Pharmacology, 6 th edition, Churchill Living Stone Elsevier	
4	Brenner, G.M. and Stevens, C.W. (2010) Pharmacology, Reed Elsevier India Pvt. Ltd.	
5	Sharma, P.D. (2003) Toxicology, 2 nd edition, Rastogi Publications, Meerut.	
Reference Books		
1	Barar, F.S.K. (2013) Text Book of Pharmacology, 1 st edition, S.Chand and Company Pvt. Ltd.	
2	Shargel, L. et al., 2012. Applied Biopharmaceutics and Pharmacokinetics, 6 th Edition, McGraw-Hill Medical	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://dth.ac.in/medical/courses/pharmacology/1/8/index.php	
2	Mak, K.-K. & Pichika, M. R. (2019) Artificial intelligence in drug development: present status and future prospects. <i>Drug Discov. Today</i> . https://doi.org/10.1016/j.drudis.2018.11.014	
3	https://www.nature.com/articles/d41586-018-05267-x	
4	https://nptel.ac.in/courses/127/106/127106137/	
Course Designed By: Dr. M. Rajesh and Dr. R. Kavitha		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	M	S	M	S	S	S
CO3	S	S	S	M	M	S	S	S	S	S
CO3	S	M	M	M	S	S	S	S	S	S
CO4	M	S	S	L	S	S	S	S	S	S
CO5	S	L	S	M	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low



Course code	33D	BIostatistics and Research Methodology	L	T	P	C
Core/Elective/Supportive	Core - XII		3	1	-	4
Pre-requisite	Basic knowledge in Mathematics		Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To understand the statistical tools commonly used in biological research To assimilate the concepts of hypothesis testing and its importance in research To know the aspects fundamental to research and to understand the methods of research To know the nuances of technical writing of scientific documents like thesis and journal articles. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Helps to collect data and organize the data				K1 & K2	
2	Gives a clear understanding about the basic statistical analysis				K1 & K2	
3	A Clear Knowledge on probability and its application				K2 & K3	
4	Provides the sampling distribution techniques and its analysis				K2 & K3	
5	Gives an idea about thesis writing, funding agencies and patenting				K3 & K4	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Statistical Survey				15 Hours	
Organising a statistical survey - Planning and executing the survey. Source of data - Primary and secondary data, Collection - observation; interview; enquiry forms, questionnaire schedule and check list. Classification and tabulation of data. Diagrammatic & graphic presentation of data.						
Unit:2	Measures of central tendency and Measures of Variation				15 Hours	
Measures of central tendency; arithmetic mean, median, mode, quartiles, deciles and percentiles. Measures of variation: range, quartile, deviation, mean deviation, standard deviation. Correlation analysis: Scatter diagram, Karl Pearson's coefficient of correlation and Spearman's rank method. Regression analysis.						
Unit:3	Probability				11 Hours	
Probability - definition, concepts, theorems (proof of the theorems not necessary) and calculations of probability. Theoretical, distributions. Binomial - Poisson and normal distribution. Normal - importance, properties, conditions and constants of the distribution (proof not necessary). Simple problems.						
Unit:4	Sampling Distribution and Experimental Design				11 Hours	
Sampling distribution and test of significance: Testing of hypothesis errors in hypothesis testing, standard error and sampling distribution. sampling of variables (large samples and small samples). Student's 't'						

distribution and its applications. Chi - square test & goodness of fit. Analysis of variance one-way and two-way classification, Duncans Multiple Range Test. Design of experiment - completely randomized block design. Introduction to SPSS and R programming.		
Unit:5	Research Methodology	11 Hours
Thesis writing, Publication in a scientific journal, Preparation of Abstract and manuscript. Contents-Preamble, the problem, objectives, hypothesis to be tested, study, design, setup, measurement procedures, analysis of data, organization of report; Displaying data tables, graphs and charts – preparation of project proposal: Thrust area – funding agencies (National and International) – kinds of research program in India and abroad – career development in laboratory research – principle and method of patenting.		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	65 Hours
Text Book(s)		
1	Statistical Methods, S.P.Gupta 45th Edition; Sultan Chand & Sons, 2017	
2	Research methodology: Methods and Techniques, C. R. Kothari. New Age International, 2004	
Reference Books		
1	Biostatistics: A Foundation for Analysis in the Health Sciences, 11th Edition, Wayne W. Daniel, Chad L. Cross, Wiley, 2018.	
2	Biostatistical analysis - Jerrold H.Zar. Pearson Education, 5th Edition Pearson Education, 2010.	
3	Arshdeep Bahga, Vijay Madisetti, 'Internet of Things: A Hands-on Approach, 2014. ISBN: 978-0996025515.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Data handling and Analytics– Lecture 55 http://nptel.ac.in/courses/106/105/106105166	
2	Introduction to IoTs Part I & Part II - Lectures 1 & 2 http://nptel.ac.in/courses/108108098/	
3	Introduction to IoT – Lecture I – https://ocw.cs.pub.ro/course/iot/courses/01	
4	Mathematical Biostatistics Boot Camp 1 https://www.coursera.org/learn/biostatistics	
5	Mathematical Biostatistics Boot Camp 1 https://www.coursera.org/learn/biostatistics-2	
6	Application of big data https://journalofbigdata.springeropen.com/articles/10.1186/s40537-019-0217-0	
Course Designed By: Dr. S. Suja		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	S	L	S	S	M	M	S
CO3	M	S	S	S	M	M	M	S	M	S
CO3	M	S	M	S	M	M	S	S	M	S
CO4	M	S	S	S	M	S	S	S	M	S
CO5	M	M	S	M	M	S	S	S	M	M

*S-Strong; M-Medium; L-Low



Course code	33P	CLINICAL BIOCHEMISTRY AND MOLECULAR BIOLOGY	L	T	P	C
Core/Elective/Supportive		Core Practical-III	-	-	4	4
Pre-requisite		Familiarity in Principles of Clinical and Molecular Biological Techniques	Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
1. Familiarize the students with specific characteristics of a laboratory of clinical biochemistry, know the analytical methods commonly used in the clinical laboratory and know how can the clinical laboratory contribute to assess the health status of individuals.						
2. Obtain hands on experience in some of the important molecular biology techniques and to learn the basic principles of recombinant DNA technology						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	It trains the students to gain concepts of assessing the human physiology using Biological fluid.				K2	
2	Helps the students to understand, evaluate and analysis the abnormal constitutes in various serum biological profile				K2, K3, K5	
3	Aids in the technical understanding of the bacterial transformation and isolation of genetic components				K2, K3, K5	
4	Understand and familiarize in the modern molecular biological technics and its applications				K2, K3, K4, K5	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Clinical Biochemistry						
1.	Differential, cell count				3 hours	
2.	Blood sugar determination by glucose oxidase method				3 hours	
3.	Estimation of bilirubin				3 hours	
4.	Estimation of blood urea				3 hours	
5.	Estimation of serum enzymes - Creatine phosphokinase (CPK), ALP, AST, SGPT and SGOT				3 hours	
6.	Normal and abnormal constituents of urine				3 hours	
7.	Determination of Lipid Profile				3 hours	
8.	Estimation of glycosylated haemoglobin				3 hours	
9.	Estimation of total protein and albumin from serum				3 hours	
Molecular Biology						
1.	Subcellular fractionation of organelle				3 hours	
2.	Bacterial Transformation				3 hours	
3.	Isolation of DNA from E. coli/ liver/ plant				3 hours	
4.	Agarose gel electrophoresis of DNA				3 hours	
5.	Restriction digests of DNA.				3 hours	

6.	Isolation of plasmid	3 hours
7.	Separation of serum protein by SDS -PAGE	3 hours
8.	Western blotting	3 hours
9.	Polymerase chain reaction	3 hours
Total practical hours		50 Hours
Text Book(s)		
1.	Experiments in Molecular Biology-R. J. Slater, Humana Press, 1986.	
2.	Molecular cloning -Sambrook and Russell, Cold Spring Harbor Laboratory Press, 2001	
3.	Practical Biochemistry- David T Plummer, Tata McGraw-Hill, 1988.	
Reference Books		
1	Experimental Biochemistry- B. S. Rao and V. Deshpande, I.K. International Pvt.Ltd.	
2	Practical Biochemistry- Keith Wilson and John Walker, Cambridge University Press, 1997.	
3	Experiments in Molecular Biology-R. J. Slater, Humana Press, 1986.	
Course Designed By: Dr. S. Selvakumar and Dr. K. M. Saradhadevi		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	S	L	M	M	S	S	M	S
CO2	S	S	S	L	M	S	M	M	M	S
CO3	S	M	M	S	L	S	M	L	M	S
CO4	S	S	S	S	L	S	L	M	M	M

*S-Strong; M-Medium; L-Low

Course code	3EC	PLANT BIOCHEMISTRY AND ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	C
Core/Elective/Supportive		Elective - III	3	1	-	4
Pre-requisite			Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. This course emphasizes to learn about principles involved in photosynthesis process, types and nitrogen fixation. 2. The course aims to give exposure to learn the concepts involved in plant tissue culture, secondary metabolite production, Machine learning for big data analytics in plants and genetic transformation techniques for the generation of transgenic plants. 3. This course provides basic concepts about environmental pollution 4. This course also provides knowledge about Disaster management and role of Big data in Disaster management. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Learn the organization of photosynthesis process and types			K1 & K2		
2	Understand about nitrogen fixation in plants and enzymology of nitrogen fixation.			K1 & K2		
3	Understand about plant tissue culture, plant secondary metabolites, elicitation and methods involved in gene transfer of plants and machine learning in analysis of plant			K2, K3 & K4		
4	Learn about types of environmental pollution			K1 & K2		
5	Students will learn about Disaster management and role of Big data in disaster management			K2, K3 & K4		
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Photosynthesis and Its Types			15 Hours		
Photosynthesis –organization of thylakoid; role of photosynthetic pigments; light absorption and energy conservation. Light absorption by pigment molecules; the reaction center complex. The photo systems I and II; cyclic and noncyclic photophosphorylation. Carbon reactions in C3, C4 and CAM plants - Calvin cycle; Hatch- Slack pathway. pathways of glucose oxidation in plants; starch biosynthesis and degradation. Photorespiration: role of photorespiration in plants						
Unit:2	Nitrogen Fixation and Enzymology of Nitrogen Fixation			15 Hours		
Nitrogen fixation – symbiotic and non-symbiotic. Symbiotic nitrogen fixation in legumes by Rhizobia– enzymology of nitrogen fixation; regulation of nif and nod genes of nitrogen fixation. Interaction between nitrate assimilation and carbon metabolism. Sulphur chemistry and functions; reductive sulfate assimilation pathway. Synthesis and function of glutathione and its derivatives. Metabolic transport between organelles.						

Unit:3	Plant Tissue Culture and Genetic Transformation	10 Hours
Plant cell and tissue culture. Tissue culture media-composition and preparation. Micropropagation; somoclonal variation. callus. Protoplast culture-isolation and purification of protoplast. Alkaloids, Flavanoids, terpenoids, phenol- Nature, distribution and functions. Production of secondary metabolites in plants, elicitation, Machine learning for big data analytics in plants. Gene transfer to plant; <i>Agrobacterium</i> mediated transformation-Ti plasmids, Ri plasmids, Direct DNA transfer to plants- Protoplast transformation, Plant viruses as vectors- CAMV, Gemini viruses, RNA viruses (TMV, Potato virus X) as vectors. Advantages and uses of transgenic plants.		
Unit:4	Concept of Ecology and Ecosystem	10 Hours
Concept of Ecology and Ecosystem: Environmental pollution-water, soil, air, noise and thermal. Global environmental problems – Green house effect, reforestration through micropropagation, biodiversity, species conservation. Treatment of Waste water from distillery, dairy and tannery industries –parameters – BOD, COD, TSS, TDS - physical, chemical and biological wastewater treatment - primary, secondary and tertiary treatment - Solid waste management.		
Unit:5	Disaster Management	10 Hours
Disaster management: Types of environmental hazards and Disasters; Natural - volcanic eruption, earthquakes, landslides, cyclones, lightning, hailstorms; Man Induced Hazards - Soil erosion, chemical hazards, sedimentation problems, biological hazards. Disaster management - pre-disaster stage (preparedness), emergency stage, post disaster stage (rehabilitation); Integrated approach- role of Institutions and Media. Role of Big data in natural disaster management.		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
Total Lecture hours		62 Hours
Text Book(s)		
1	Buchanan, B.B., Gruissem,W. and Jones, R.L., (2002); Biochemistry and Molecular Biology of Plants; ISBN: 978-0-943088-39-6; American Society of Plant Physiologists, 2 nd Indian Reprint (2007), I.K. International Pvt. Ltd. N. Delhi.	
2	Srivastava, H.S. (2006), Plant Physiology, Biochemistry and Biotechnology,Rastogi Publications, Meerut.	
3	Chawla,H.S. (2004) Introduction to plant Biotechnology, Science Publishers, Plymouth,U.K.	
4	Razdan, M.K. (2007), Introduction to Plant Tissue culture, II edition, Oxford and IBA Publications Co Pvt Ltd.	
5	Russell Jones, Helen Ougham, Howard Thomas, Susan Waaland, (2012), The Molecular life of Plants, ISBN 978-0-470-87011-2; Wiley-Blackwell Publishers	
Reference Books		
1	Saikia,R., Bezbarrah,R.L.,Bora,T., (2008) Microbial Biotechnology, New India Publishing agency, New Delhi	

2	Dubey,R.C. (2010) A textbook of Biotechnology, S.Chand and Company Ltd, New Delhi
3	Wang, L.K. (2010), Environmental Biotechnology, 1st edition, A Product of Humana Press.
4	Ghosh, G.K.(2007), Disaster Management, 1st edition, Delhi
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	<u>Yu, M., Yang, C., & Li, Y. (2018). Big data in natural disaster management: A review. <i>Geosciences</i>, 8(5), 165.</u>
2	<u>Akter, S., & Wamba, S. F. (2017). Big data and disaster management: A systematic review and agenda for future research.<i>Annals of Operations Research</i>. https://doi.org/10.1007/s10479-017-2584-2.</u>
3	Ma C, Zhang HH, Wang X. (2014) Machine learning for big data analytics in plants.Trends Plant Sci. Dec;19(12):798-808.
Course Designed By: Dr. M. Rajesh and Dr. K. M. Saradhadevi	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	L	S	M	M	S	S
CO3	S	L	S	L	M	S	S	S	M	S
CO3	M	S	S	M	M	S	M	M	M	S
CO4	L	M	S	M	M	S	S	S	S	S
CO5	L	L	S	M	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	3ED	BIOLOGY OF CANCER AND STEM CELL	L	T	P	C
Core/Elective/Supportive	Elective - III		3	1	-	4
Pre-requisite	Preliminary knowledge on cell Signaling and Characteristics of Stem Cells		Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
1. To update knowledge on types of cancer, causes of cancer as well as on molecular mechanism of carcinogenesis.						
2. To be familiar with various methods used for cancer diagnosis and on therapeutic strategies used to control tumor cell proliferation.						
3. To become updated on types of stem cell, its characterization, pluripotency and niche specification.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	The course will introduce the biology of cancer metabolism and its impact on life expectancy				K2, K3 & K4	
2	Students will become updated on types of cancer, causes of cancer as well as on molecular mechanism of carcinogenesis.				K1 & K2	
3	The course will help in detailed understanding of cancer, its diagnosis & therapy.				K2 & K4	
4	Course material provides understanding on types of stem cell, its characterization, pluripotency and niche specification.				K1, K2 & K4	
5	Students will understand the types and differentiations of stem cell and its biological applications				K2, K3 & K5	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Introduction to Cancer Biology				15 Hours	
Definition; Cancer incidence and mortality; Origin of neoplastic cells; Cancer as cellular disease; Types of Cancer: Benign Tumors Vs. Malignant Tumors, Common Symptoms, Causes of Cancer: Carcinogenesis-Chemical and Irradiation; Oxygen Free Radicals, Aging and Cancer; Genetic Susceptibility and Cancer; Viral Carcinogenesis.						
Unit:2	Cancer Molecular Mechanism & Diagnosis				15 Hours	
Molecular Mechanism of cancer: protooncogenes, oncogene, tumour suppressor genes involved in cancer, errors in cell cycle (Cyclins and CDKs). Apoptosis in cancer – mechanism of apoptosis, intrinsic and extrinsic pathways. Principles and methods of cancer diagnosis- Biochemical, genetic, cytotoxic, cell growth and viability tests, cancer biomarkers.						
Unit:3	Cancer Diagnosis & Therapy				10 Hours	
Cancer, Diagnosis & Therapy: Tumor Markers; Gene Expression Microarrays; Proteomic Methods; Circulating Epithelial Cells; Circulating Endothelial Cells and Endothelial Progenitor						

Cells; Molecular Imaging; Application of cancer database in health care and industries. Haplotype Mapping. Cancer therapy: Surgery, Radiotherapy, Chemotherapy, Hormone therapy, Immune, Prodrug and Targeted therapies, Bone marrow transplantation.		
Unit:4	Stem Cell Biology	10 Hours
Introduction to Stem Cell: Definition, Types of Stem cell, characterization, pluripotency, niche specification – Drosophila germ line stem cells, self-renewal and differentiation, tooth primordia, gut specifications. Occurrence of stem cell in mammals: In Mesenchymal cells - Hemangioblasts, skeletal muscle cells, adipose cells, bladder cells; In Epidermal cells – skin, mammary gland, dental and neural cells; In Endodermal cells – liver, GI tract, pancreatic cells		
Unit:5	Stem Cell Types and Applications	10 Hours
Embryonic Stem Cells: Blastocyst and inner cell mass cells, Organogenesis, Adult versus embryonic stem cells, post genomic adult stem cells, stemness, characteristics, hierarchy, stem cell niche; Adult stem cell from amniotic fluid and cord blood; induced pluripotency stem cells (ips cells).- Stem cell characterization techniques and cryopreservation, Shelf life of stored stem cells.		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
Total Lecture hours		62 Hours
Text Book(s)		
1	Principles of Cancer Biology – 2016 by Kleinsmith; Publisher: Pearson Education India; First edition	
2	Molecular biology of cancer, 3rd edition – 2014 by Pecorino; Publisher: Oxford University Press	
3	The Biology of Cancer – 2013 by Robert Weinberg; Publisher: W. W. Norton & Company; 2 nd edition	
Reference Books		
1	The Molecular Basis of Human Cancer – 2018 by William B. Coleman (Editor), Gregory J. Tsongalis; Publisher: Humana Press Inc.; Softcover reprint of the original 2nd ed. 2017 edition.	
2	Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics– 2012 by Pecorino; Oxford University Press; 3rd edition.	
3	Stem Cells: Current Challenges and New Directions (Stem Cell Biology and Regenerative Medicine) – 2013 by Kursad Turksen; Publisher: Humana Press; 2013 edition.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd2_aic20_ge02/preview	
2	https://nptel.ac.in/content/storage2/courses/104103068/module1/lec1/2.html	
3	https://www.coursera.org/learn/cancer	

4	https://www.classcentral.com/course/stem-cells-10745
Course Designed By: Dr. S. Selvakumar	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	M	S	M
CO3	S	S	L	M	S	S	S	S	M	S
CO3	M	S	S	S	L	S	M	S	M	S
CO4	S	M	M	M	S	M	S	M	S	L
CO5	M	S	S	M	M	L	M	M	S	M

*S-Strong; M-Medium; L-Low





**Supportive
Course**

Course code	GS108	TOOLS AND TECHNIQUES IN BIOSCIENCE	L	T	P	C
Core/Elective/Supportive		Supportive - I	1	1	-	2
Pre-requisite		Prior knowledge on modern methods and technologies used in biochemical analysis	Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. Methods and tools in biosciences represents a new standard of comprehensive paper for all students in various fields of biology and medicine. 2. The series emphasizes important developments in methodology and research tools and their potential for application to human and other biologic systems 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To obtain the knowledge on the cell fractionation techniques to separate cellular components and to demonstrate the cellular location of various biochemical processes. Understood about radionuclide as an unstable atom and are used in biology and nuclear medicine				K2& K3	
2	Understood about the centrifugation technique to separate particles from a solution according to their size, shape, density, viscosity of the medium and rotor speed.				K2,K3& K4	
3	To learn the chromatographic techniques for the separation of the individual compound from the mixture of compound and measuring the relative proportions of analytes in a mixture.				K3& K4	
4	To obtain knowledge about the separation and analysis of macromolecules and their fragments, based on their size and charge				K2& K4	
5	To study the interaction between matter and electromagnetic radiation and visible light dispersed according to its wavelength, by a prism				K2	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Fractionation Techniques				7 Hours	
Cell fractionation techniques: Cell lysis, homogenization, extraction, salting in, salting out, dialysis and ultra-filtration. Radioisotopes in Biology: Concept of half-life, decay constant, detection and quantitation - GM counter and solid and liquid scintillation counter. Specific activity, autoradiography and Applications of radioactivity.						
Unit:2	Centrifugation and Microscopy				7 Hours	
Centrifugation: Svedberg's constant, sedimentation velocity and sedimentation equilibrium. Differential and density gradient centrifugation, centrifugal elutriation, construction of preparative and analytical ultra-centrifuge. Microscopy: Principles and application of light phase contrast, fluorescence, scanning and transmission electron microscopy.						
Unit:3	Chromatographic Techniques				6 Hours	

Chromatographic techniques: Principles and applications of paper, TLC, HPTLC, adsorption, ion exchange, gel filtration, affinity, GLC, chromatofocusing, HPLC and FPLC.		
Unit:4	Electrophoretic Techniques	5 Hours
Electrophoretic techniques: Polyacrylamide gel electrophoresis, SDS PAGE, 2D electrophoresis, agarose gel electrophoresis, isoelectric focusing, and pulse field electrophoresis		
Unit:5	Spectroscopic Techniques	5 Hours
Spectroscopic techniques: Principles of colorimeter, spectrophotometer, fluorimeter. Beer Lambert's Law and its limitations. Extinction coefficient, Atomic absorption spectroscopy, UV-Visible, Spectro fluorimetry, Flame Photometry.		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	32 Hours
Text Book(s)		
1	Wilson, K. and Walker, J. (2012) Practical Biochemistry – Principles and techniques of Biochemistry and Molecular Biology, 7th Edition, Cambridge University Press, India	
2	Upadhyay, A. Upadhyay, K. and Nath, N. 2009. Biophysical Chemistry: Principles and Techniques, Third Edition, Himalaya Publishing. 11th Edition	
Reference Books		
1	Sharma, B. K. 2004. Instrumental Methods of Chemical analysis, 23rd Edition Goel Publications.	
2	Homie, D. J. and Peck, H. Analytical Biochemistry, Third Edition, Longman group, 1998.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	http://epgp.inflibnet.ac.in/	
2	http://epgp.inflibnet.ac.in/Home/ViewSubject?catid=944	
Course Designed By: Dr. K. M. Saradhadevi		

Course code	GS102	MEDICAL LAB TECHNOLOGY	L	T	P	C
Core/Elective/Supportive		Supportive - II	1	1	-	2
Pre-requisite			Syllabus Version		20 - 21	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. The main objective of this course is to introduce basic concepts in Medical laboratories. 2. This course emphasizes to understand about the functioning of medical laboratories and laboratory personnel with good clinical practices 3. Automation in clinical biochemistry provides the learner to know about the instrumental concept and quality control. solution preparation provides exposure to prepare normality, molarity and percent solutions. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Learn basic laboratory concepts and principles, Know about the role of medical laboratory personnel, safety measures in laboratory, know about clinical born infections and personnel hygiene					K1 & K2
2	Acquire knowledge on sterilization methods and staining techniques.					K1 & K2
3	Know about Quality control, Quality assurance and Instrumentation.					K2 & K3
4	Get wide knowledge on Clinical samples, common laboratory infections and Anticoagulants					K1 & K2
5	Calculate Normality, Molar and percent solutions. know about pH and methods to measure liquids					K4, K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	Basic Laboratory Principles					7 Hours
Basic laboratory principles - Code of conduct of medical laboratory personnel - Organization of clinical laboratory - Role of medical laboratory technician - Safety measures - Medical laboratory professional and professionalism in laboratory workers - communication between physician and lab technician - hospital and clinic borne infection and personnel hygiene. Overview of laboratory accreditation.						
Unit:2	Sterilization Methods and Staining Techniques					6 Hours
Common glass wares in clinical laboratory - care and maintenance - Calibration of pipettes and volumetric apparatus - Cleaning and sterilization methods - antiseptics and disinfectants - staining techniques – vital stains						
Unit:3	Automation in Clinical Biochemistry					6 Hours
Automation in Clinical Biochemistry- Instrumental concept, Selection of Instrument, Quality						

assurance, Control of pre-analytical and analytical variables, External and internal quality control measurements. Good Clinical Practices. Clinical laboratory records- Modern laboratory set up - Quality control: Accuracy, Precision, and Reference values.		
Unit:4	Clinical Samples and Specimens	6 Hours
Clinical samples and specimens - Specimen collection, transport, storage and disposal –common laboratory infections - Anticoagulants: EDTA, Di-potassium salts of EDTA, double oxalate, single oxalate, sodium citrate and sodium fluoride.		
Unit:5	Buffers and Solutions Preparation	5 Hours
Acid - Base balance – Electrolytes - Buffer and pH- Preparation of solution: Normal, per cent and Molar solution - normal saline -Methods of measuring liquids.		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	32 Hours
Text Book(s)		
1	Mukerjee, K. L. and S. Ghosh, 2010. Medical Laboratory Technology, Volume I, McGraw Hill, New Delhi	
2	Sood.R., 2006. Textbook of Medical Laboratory Technology, Jaypee, New Delhi.	
3	Fischbach, F.T. and M.B. Dunning, 2009. A Manual of laboratory and Diagnostic Tests, Lippincott Williams Wilkins, New York.	
Reference Books		
1	Sonnenwirth, A.C. and L. Jarret, 2000 Gradwohls“ Clinical laboratory methods and diagnosis. M.D.B.I., New Delhi.	
2	Ochei, J. and A. Kolhatkar, 2000. Medical Laboratory Science, Theory and Practice, McGraw Hill, New Delhi.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/102/103/102103015/	
2	https://nptel.ac.in/content/storage2/courses/102103047/PDF/mod1.pdf	
Course Designed By: Dr. M. Rajesh		

Course code	GS109	CLINICAL DIAGNOSIS IN HEALTH AND DISEASES		L	T	P	C
Core/Elective/Supportive	Supportive - III		1	1			2
Pre-requisite			Syllabus Version		20 - 21		
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> To introduce basic concepts in Clinical diagnosis in health and diseases. This course emphasizes to understand about analysis of body fluids, detection of body metabolites, organ functions and communicable and Non Communicable diseases 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Learn about general health and common diseases, To learn how to analyse the samples (Blood, urine, pleural fluid, synovial fluid, cerebro spinal fluid and tissues and histology)			K1, K2 & K4			
2	Acquire knowledge on detection of body metabolites and its importance, liver function and kidney function			K2 & K4			
3	Know about heart function, lung function test			K2, K3 & K4			
4	Get wide knowledge on Bacterial viral and fungal infections			K1 & K2			
5	Know about Non-communicable diseases and cancer markers			K1, K2			
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit:1	Introduction to Diagnosis			7 Hours			
General health, syndrome and common diseases – communicable and noncommunicable diseases. Samples for analysis: Blood, urine, pleural fluid, synovial fluid, cerebro spinal fluid and tissues and histology. General check up: Blood group, Hb, height and weight, waist to hip ratio, electro cardio gram, X-ray, abdomen scan and appearance of scars, urine analysis – routine analysis (protein, sugar, pigments and cells). Big data analysis in health care management.							
Unit:2	Detection of Metabolites and Its Importance			6 Hours			
Tests for liver function: Enzyme assay (SGOT, SGPT, Alkaline phosphatase, GGT), Total protein, albumin /globulin ratio and their significance. Test for kidney function: Urea and creatinine estimation and their significance.							
Unit:3	Diagnosis for Organ Function			6 Hours			
Test for heart function: Blood pressure (cystolic and diastolic), lipid profile (cholesterol, triglycerides, HDL, LDL estimation) and their importance. Test for lung function: Chest X-ray, Spirometry. Test for Brain function: EEG, MRI, CT. Test for Surgery: Bleeding time, clotting time. Special test: X-ray, CT, MRI, Doppler, TMT, angioplasty.							

Unit:4	Diagnosis of Infections	5 Hours
Infection: Bacterial, viral, fungal and protozoans. Blood: Total cell count, differential count, erythrocyte sedimentation rate. Infectious diseases: Tuberculosis, Leprosy, Malaria, Hepatitis, Cholera, Dengue, HIV, Chikun gunya and H1N1. TORCH – Panel (infertility profile), Infection in pregnancy, Koch postulations – Microscopic examination of body fluids, ELISA and PCR tests.		
Unit:5	Non-communicable Diseases	6 Hours
Diabetes: Blood sugar, urine sugar, glucose tolerance test, HbA1c. Hyper tension: Lipid profile, electrolyte (sodium, potassium, chloride and biocarbonate) investigation. Cancer markers: ELISA and DNA Probes.		
Unit:6	Contemporary Issues	2 Hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	32 Hours
Text Book(s)		
1	Burtis,C. and Brunson,D. 2007.Teitz Fundamentals of Clinical Chemistry, 3rd Edition, W.B. Saunders Company.	
2	Devlin,T.M. 1998. Text book of Biochemistry with Clinical Correlation,4th Edition, John Wiley and Sons.	
3	Mayne,P.D. 1994. Clinical Chemistry in Diagnosis and Treatment, 6th Edition, Hodder Arnold Publication	
4	Marshall,W.J. and Bangeit, S.K. 1995. Clinical Biochemistry - Metabolic concepts and Clinical aspects, Churchill Livingstone.	
Reference Books		
1	Guyton, A.C. and Hall,J.E. 2010. Text Book of Medical Physiology, 12 Edition, Saunders.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.verywellhealth.com/liver-enzyme-and-function-3157004	
2	https://nptel.ac.in/content/storage2/courses/109104029/pdf_lecture/Lecture10.pdf	
Course Designed By: Dr. M. Rajesh		



**Value Added
Course**

Value added course: I

ANIMAL CELL CULTURE TECHNIQUES		
Name of the Department		BIOCHEMISTRY
Name of the Faculty Member i/c With Complete Address with Phone and e-mail		Dr. S. SELVAKUMAR ASSISTANT PROFESSOR DEPARTMENT OF BIOCHEMISTRY BHARATHIAR UNIVERSITY E-mail: selvs20@yahoo.com Phone: 8220119898
Inter / Intra Department Course		Intra Department Course
Duration of the Course		40 Hours
Eligibility		B.Sc., Biochemistry
Number of Candidates to be Admitted		10
Registration Procedure		Application will be issued by the department office. Filled in applications will be evaluated based on their Undergraduate percentage.
Job Opportunities:		
Build their career as Cell Culture analyst, Downstream Process development officer in various companies like Pharmaceutical Industries, Research laboratories, Stem cell laboratories, Vaccine production industries, etc.,		
The objectives of the Course are:		
The main objectives of this course are to:		
	Learn aseptic techniques involved in handling of animal cell cultures	
	Focus on practical aspects of cell culture, like design and layout of the laboratory.	
	Provide proper procedure to make and sterilize media.	
	Focus on principles of cryopreservation and Nutritional requirements of cultured cells.	
Course Content	Lecture / Practical / Project / Internship	
Lecture / Practical		
Module 1	Theory: Safety Procedures - Design of the Cell Culture Laboratory - Maintenance of sterility - Do's & Don'ts in Tissue Culture Lab.	2 Hours
Module 2	Theory: Essential facility equipment - biological safety cabinets, inverted microscopes, table top centrifuges, pH meters, cell culture incubators, refrigerator, and vacuum pumps – its importance and uses	2 Hours
Module 3	Theory: Preparation of medium and required solutions: Chemical constituents - its importance – uses. Primary Cell Culture Establishment.	3 Hours
Module 4	Theory: Cell line revival (recovery) - Maintaining Cells...Contamination and Storage- Sub-culturing (passaging) -	3 Hours

	Counting & viability test for cells. Freezing of cells (cryopreservation) and Reviving cryopreservation cells	
Module 5	Practical: 1. Preparation of medium and required solutions.	6 Hours
Module 6	2. Primary Cell Culture Establishment.	6 Hours
Module 7	3. Cell line revival (recovery) - Maintaining Cells.	6 Hours
Module 8	4. Sub-culturing (passaging) - Counting & viability test for cells.	6 Hours
Module 9	5. Freezing of cells (cryopreservation).	3 Hours
Module 10	6. Reviving cryopreservation cells.	3 Hours
Book(s) for Study		
	Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, <u>R. Ian Freshney</u> , John Wiley & Sons, 2016, Seventh edition.	
	Animal Cell Culture - Practical Approach, Ed. John R.W. Masters, OXFORD, Third edition, 2000.	
	Animal Cells: Culture and Media, D. C. Darling and S. J. Morgan, BIOS Scientific Publishers Limited, 1994.	
	Methods in Cell Biology, Jennie P. Mathur and David Barnes, Animal Cell Culture Methods Academic Press, Volume 57, 1998.	
Book(s) for reference		
	Animal Cell Culture Techniques. Ed. Martin Clynes, springer, 1998.	
	Cells: a Laboratory Manual, Spector, D. L., Goldman, R.D., and Leinwand, L.A., Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 1998.	
Related Online Contents		
	Verma, A. (2014). Animal tissue culture: Principles and applications. In <i>Animal Biotechnology</i> (pp. 211-231). Academic Press. https://doi.org/10.1016/B978-0-12-416002-6.00012-2	
	NPTEL : NOC:Cell Culture Technologies , by Prof. Mainak Das, IIT Kanpur. https://nptel.ac.in/courses/102/104/102104059	
	ATCC® ANIMAL CELL CULTURE GUIDE tips and techniques for continuous cell lines. https://www.atcc.org/~media/PDFs/Culture%20Guides/AnimCellCulture_Guide.ashx	

Value Added Course: II

NUTRACEUTICALS		
Name of the Department		BIOCHEMISTRY
Name of the Faculty Member i/c With Complete Address with Phone and e-mail		Dr. R. KAVITHA ASSISTANT PROFESSOR DEPARTMENT OF BIOCHEMISTRY BHARATHIAR UNIVERSITY Email : kavitha@buc.edu.in Phone: 9944353524
Inter / Intra Department Course		Intra Department Course
Duration of the Course		40 Hours
Eligibility		B.Sc BIOCHEMISTRY
Number of Candidates to be Admitted		10
Registration Procedure		
Job Opportunities:		
Build their career in nutraceutical and allied industries or entrepreneurs for new ventures in nutraeuticals		
The objectives of the Course are:		
The main objectives of this course are to:		
1	Provide Basic knowledge about nutraceuticals	
2	Understand the health benefits of nutraceuticals	
3	Apply basic techniques for the production of nutraceuticals	
4	Give exposure to basic analytical instruments relevant to nutraceutical industries	
Course Content		Lecture / Practical /
Lecture / Practical		
Module 1	Theory: Introduction to nutraceuticals, Classification and sources of nutraceuticals. Dietary supplements, fortified foods and functional foods	2 Hours
Module 2	Theory: Introduction to Phytonutraceutical. Classification - Plant secondary metabolites, Extraction and purification of Phytonutraceuticals	2 Hours
Module 3	Theory: Probiotics, prebiotics, and synbiotics. Health benefits Probiotics- principle, mechanism, production technology. Role of nutraceuticals in management of health and diseases.	3 Hours
Module 4	Practical: 1. Extraction and quantification of polyphenols	3 Hours
Module 5	2. Extraction and quantification of flavonoids	2 Hours
Module 6	3. Extraction and quantification of saponins	2 Hours
Module 7	4. Extraction and quantification of alkaloids	2 Hours
Module 8	5. Isolation probiotic bacteria	6 Hours

Module 9	6. Identification of probiotic bacteria	12 Hours
Module 10	7. <i>In-vitro</i> characterization of probiotics	6 Hours
		40 Hours
Book(s) for Study		
1	L. Rapport and B. Lockwood (2002) Nutraceuticals, 2nd Edition, Pharmaceutical Press.	
2	M. Maffei (Ed.) (2003) Dietary Supplements of Plant Origin, Taylor & Francis	
3	Nutraceuticals by L. Rapport and B. Lockwood, Pharmaceutical Press	
Book(s) for reference		
1	Israel Goldberg (Ed.) (1999) Functional foods, designer foods, pharma foods, Nutraceuticals, Aspen publishers Inc., USA	
2	Shahidi and Weerasinghe (Ed.) (2004) Nutraceutical beverages Chemistry, Nutrition and health Effects, , American Chemical Society	
3	L. Rapport and B. Lockwood (2002) Nutraceuticals, 2nd Edition, Pharmaceutical Press.	
4	M. Maffei (Ed.) (2003) Dietary Supplements of Plant Origin, Taylor & Francis	
Related Online Contents		
1	Food is Medicine - An introduction to Nutraceuticals https://www.researchgate.net/publication/283076818	
2	Phytopharmaceutical applications of Nutraceuticals Functional foods https://www.researchgate.net/publication/308116783 <u>Phytopharmaceutical applications of Nutraceuticals Functional foods</u>	
3	Nutraceuticals, Nutritional Therapy, Phytonutrients, and Phytotherapy for Improvement of Human Health: A Perspective on Plant Biotechnology Application iteseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.321.9494&rep=rep1&type=pdf	
4	Effects of Probiotics, Prebiotics, and Synbiotics on Human Health https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5622781/pdf/nutrients-09-01021.pdf	
5	Production of High quality Probiotics by fermentation https://www.researchgate.net/publication/280057164 <u>Production of High quality Probiotics by fermentation</u>	



Job-oriented Certificate courses

MEDICAL LABORATORY TECHNICIAN		
Name of the Department	Biochemistry	
Name of the Faculty Member i/c With Complete Address with Phone and e-mail	Dr. S. Suja, Professor and Head, Department of Biochemistry, Bharathiar University, Coimbatore- 641 046.	
Inter / Intra Department Course	Intra Department Course	
Duration of the Course	1 Year	
Eligibility	B.Sc.	
Number of Candidates to be Admitted	30	
Mode of the Course	Regular	
Collaboration if any with Companies (if Yes, Full Address of the Company Address , Name of the Contact Person, Phone, e-mail etc.)	Bioline Research Institute, Civil Aerodrome Road, Sitra,Coimbatore-641014	
Registration Procedure		
Job Opportunities:		
Students who complete medical laboratory technology program can pursue employment in settings such as hospitals, clinics, commercial laboratories, public health facilities, or diagnostic laboratories.		
The objectives of the Course are:		
The main objectives of this course are to:		
1	Perform complex tests for diagnosis, treatment, and prevention of disease	
2	Know what is implied by the presence of abnormal constituents in body fluid	
3	Provide technical information about test results	
4	Prepare and document medical tests and clinical results	
5	Have sound knowledge of the functioning of lab equipment's and protocols for their cleaning and calibration	
Course Content	Lecture / Practical / Project / Internship	
Module 1	Healthcare Systems, Laboratory and Delivery; Role of the Medical Laboratory Technician, Introduction to Laboratory related Medical Terminology	8 Hours
Module 2	Introduction to Biochemistry, Haematology and Clinical Pathology	12 Hours
Module 3	Introduction Clinical Biochemistry	12 Hours
Module 4	Analytical Laboratory Testing Process and Personnel Hygiene; Safety & First Aid, Bio Medical Waste Management	8 Hours
Module 5	Biochemistry Practical - 1	10 Hours
Module 6	Biochemistry Practical - 2	10 Hours
Module 7	Haematology Practical	10 Hours
Module 8	Clinical Pathology Practical	10 Hours
Module 9	Clinical Biochemistry Practical - 1	10 Hours
Module 10	Clinical Biochemistry Practical - 2	10 Hours

		100 Hours
Book(s) for Study		
1	Textbook of Medical Laboratory Technology , Praful B. Godkar, Darshan P. Godkar, Edition 3, Bhalani Publishing House, 2014.	
2	Textbook of Biochemistry for Medical Students, DM Vasudevan, Sreekumari S, Kannan Vaidyanathan, Edition 8, Jaypee Brothers Medical Publishers (P) Ltd, 2016.	
3	Basic Pathology , Robbins Saunders, Edition 10, An imprint of Elsevier Inc.,2017.	
4	Hematology: Basic Principles and Practice , Ronald Hoffman, Edition 7, Elsevier, 2017.	
5	Clinical Biochemistry , Maheshwari Nanda, Edition 2, Jaypee Brothers Medical Publishers, 2016.	
Book(s) for reference		
1	Harpers Illustrated Biochemistry , Rodwell, Edition 31, Overruns publisher, 2018	
2	Clinical Chemistry: Principles, Techniques, Correlations , Michael Bishop, Edition 8, Lippincott Williams and Wilkins publishing, 2017	
3	Clinical Hematology: Theory & Procedures , Mary Lou Turgeon, Edition 6, Jones & Bartlett Learning, 2017.	
4	https://www.pdfdrive.com/medical-laboratory-technology-e34330445.html	
Related Online Contents		
1	https://www.youtube.com/c/MedicalLaboratoryTechnologistVideos/featured	

Quality Control Biologist	
Name of the Department	BIOCHEMISTRY
Name of the Faculty Member i/c With Complete Address with Phone and e-mail	Dr. K. M. Saradhadevi Assistant Professor Department Of Biochemistry Bharathiar University Email : saradhadevi@buc.edu.in Phone: 9445285328
Inter / Intra Department Course	Intra Department Course
Duration of the Course	460 Hours 00 Minutes (100 hours of OJT is Mandatory)
Eligibility	B. Pharma / Graduation in Biotechnology/ B. Sc with Chemistry/ Biology/Microbiology/ Biochemistry as major subject (Preferable)
Number of Candidates to be Admitted	30
Registration Procedure	
Job Description :	
To deliver accredited training service, mapping to the curriculum detailed above, in accordance with the Qualification Pack “LFS/Q2301, V1.0”.	
The objectives of the Course are:	
The main objectives of this course are to:	
1	Define life sciences industry, legal and regulatory framework and pharmacopeia to enable him/herself for establishing the industry standards in his/her performance.
2	Maintain a healthy, safe and secure working environment at the pharmaceutical manufacturing shop floor, laboratory and area around in conformance with environmental health and safety (EHS) rules.
3	Apply scientific knowledge about biological product and process in quality control analysis of bio-pharmaceutical products.
4	Prepare, preserve and ensure stability of biological samples as per good laboratory practices (GLP) and good manufacturing practices (GMP).
5	Operate analytical equipment and instruments as per standard operating procedures (SOP) and good laboratory practices (GLP).
6	Perform routine analysis of biopharmaceuticals in lab in compliance with good manufacturing practices (GMP) and good laboratory practices (GLP).
7	Conduct quality check for bio-pharmaceutical samples in conformance of acceptance limits as per standard operating procedures (SOP).
8	Apply good documentation practice (GDP) and data integrity while reporting and documentation as per standard operating procedures (SOP) and good laboratory practices (GLP).
9	Work effectively in a team.
10	Respond to audit queries by citing evidence of work done.
11	Apply core communication skills and professional skills such as planning and organizing, problem solving, analytical and critical skills, decision making and customer centricity at

	work.	
Course Content	Lecture / Practical /	
Lecture / Practical		
Module 1	Life Sciences Industry and Quality related regulations	Theory Duration (hh:mm) 08:00 Practical Duration (hh:mm) 00:00
Module 2	GLP guidelines and production overview	Theory Duration (hh:mm) 04:00 Practical Duration (hh:mm) 16:00
Module 3	Health and safety	Theory Duration (hh:mm) 08:00 Practical Duration (hh:mm) 16:00
Module 4	Workplace cleanliness	Theory Duration (hh:mm) 08:00 Practical Duration (hh:mm) 16:00
Module 5	Sample Preparation, preservation and Storage	Theory Duration (hh:mm) 08:00 Practical Duration (hh:mm) 40:00
Module 6	Test and analysis of Biological samples for Plant/ Animal/Human cell culture	Theory Duration (hh:mm) 22:00 Practical Duration (hh:mm) 40:00
Module 7	Inspection of samples	Theory Duration (hh:mm) 32:00 Practical Duration (hh:mm) 56:00
Module 8	Instrumentation in Biological Analysis	Theory Duration (hh:mm) 08:00 Practical Duration (hh:mm) 30:00
Module 9	Quality Analysis	Theory Duration(hh:mm) 08:00 Practical Duration (hh:mm) 40:00
Module 10	Reporting and Documentation	Theory Duration (hh:mm) 12:00 Practical Duration (hh:mm) 16:00
Module 11	Coordinate with Supervisor, within team and cross functional the teams	Theory Duration (hh:mm) 16:00 Practical Duration (hh:mm) 08:00
Module 12	Information Technology Skills at work	Theory Duration (hh:mm) 16:00 Practical Duration (hh:mm) 32:00
Module 13	On the Job Training	Theory Duration (hh:mm) 00:00 Practical Duration (hh:mm) 00:00
Book(s) for Study		
1	Bisen P. S. (2016) Life Science In Tools and Tecniques, CBS Publishers.	
2	R. Scott Stricoff and Douglas B. Walters (1995) Handbook of Laboratory Health and Safety 2nd Edition, Wiley-Interscience.	
3	G. Barrie Wetherill (1969) Sampling Inspection and Quality Control, Methuen young books.	
Book(s) for reference		
1	Aashka Jain, Hina Bagada, Priya Patel (2019) Good Manufacturing Practises and Good Laboratory Practises, Vallabh prakashan publisers.	
2	Shubhangi Tambwekar (2015) Handbook of Quality Assurance in Laboratory Medicine, Wolters Kluwer Lippincott Williams and Wilkins publications.	
3	PK Bajpai (2006) Biological Instrumentation and Methodology, S Chand & Company.	
4	Pamposh Kumar and V.P.S. Tomar (2005) Laboratory Manual Quality Systems Standardization Quality Assurance Accreditation Quality Management, CBS publication.	

Related Online Contents	
1	Hand book good laboratory practice – World Health Organization https://www.who.int/tdr/publications/documents/glp-handbook.pdf
2	Importance of cleanliness in laboratories https://lab-training.com/2017/08/21/importance-cleanliness-laboratories/
3	CELL CULTURE BASICS Handbook https://www.vanderbilt.edu/viibre/CellCultureBasicsEU.pdf
4	Biological sample collection, processing, storage and infomtion management https://publications.iarc.fr/_publications/media/download/1398/68b153f74693289ae66d767a8cbe1ca667df4f1b.pdf
5	Lab Safety Rules and Guidelines https://www.labmanager.com/lab-health-and-safety/science-laboratory-safety-rules-guidelines-5727

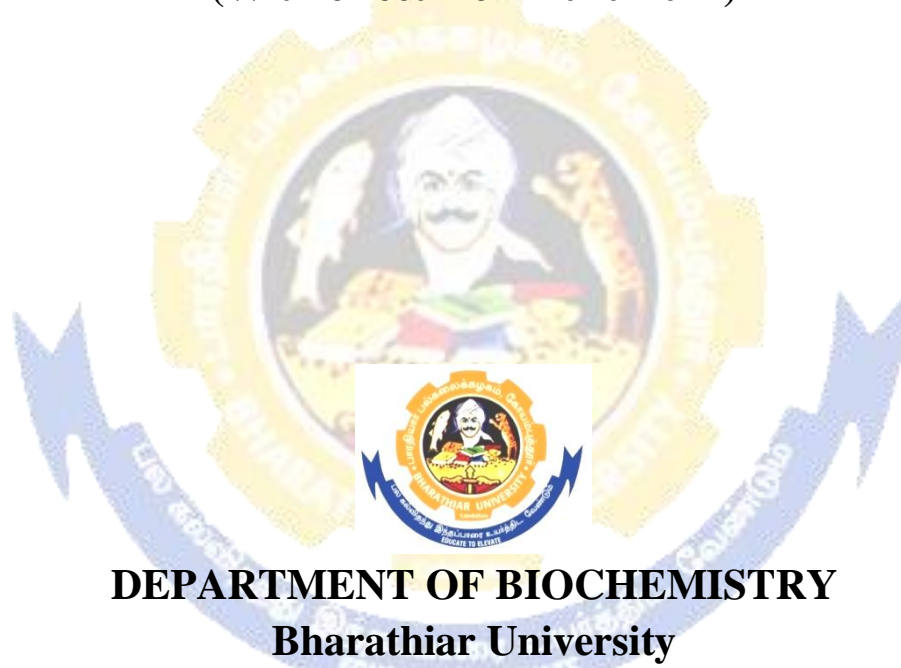




Annexure

M. Sc., BIOCHEMISTRY

Syllabus
(With effect from 2020-2021)

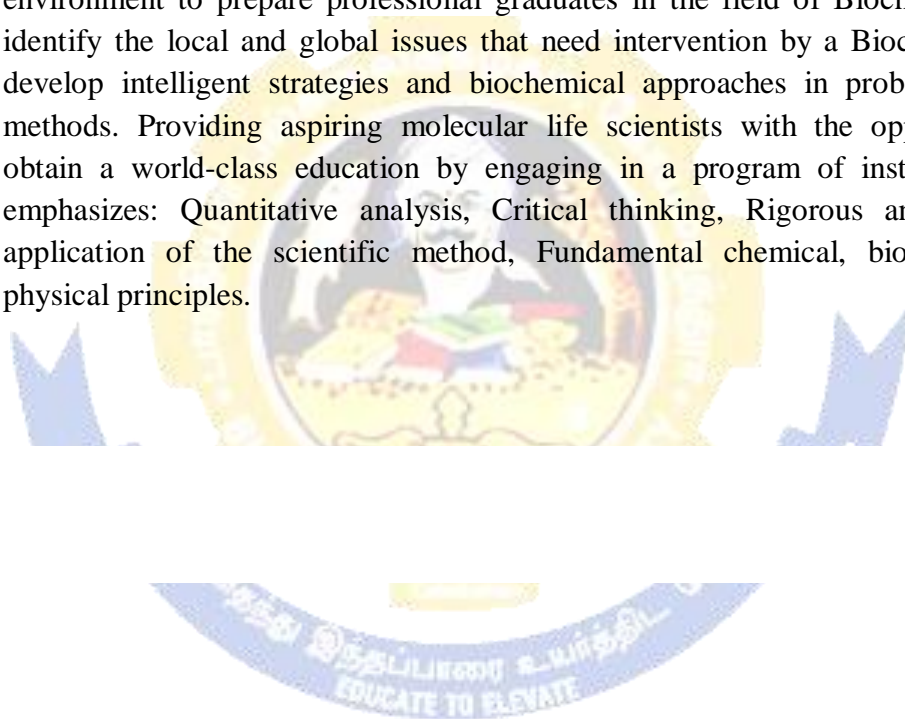


DEPARTMENT OF BIOCHEMISTRY
Bharathiar University
(A State University, Accredited with “A“ Grade by NAAC and
13th Rank among Indian Universities by MHRD-NIRF)
Coimbatore 641 046, INDIA

BHARATHIAR UNIVERSITY: COIMBATORE 641046
DEPARTMENT OF BIOCHEMISTRY

MISSION

To educate and inspire the young minds from the basics to the latest innovations in science. To inculcate the traditional culture of ethics. To captivate unexplored sectors in research. Develop and enhance conservation of optimum academic environment to prepare professional graduates in the field of Biochemistry. To identify the local and global issues that need intervention by a Biochemist, and develop intelligent strategies and biochemical approaches in problem solving methods. Providing aspiring molecular life scientists with the opportunity to obtain a world-class education by engaging in a program of instruction that emphasizes: Quantitative analysis, Critical thinking, Rigorous and effective application of the scientific method, Fundamental chemical, biological and physical principles.



Candidate who has presented the work as “Not qualified as per CBCS” must resubmit the project again in the ensuing academic year.

SUPPORTIVE PAPERS OFFERED FOR OTHER DEPARTMENT STUDENTS

Paper I : Tools and techniques in bioscience
Paper II : Medical lab technology
Paper III : Clinical diagnosis in health and disease

#VALUE ADDED COURSES

Semester	Paper	Subject	Hrs Per week	University examination		Credits
				Durati on in Hrs.	Max. Mar ks	
ODD SEMESTER	20BCVAC1	Animal Cell Culture Techniques	2	3	50	2
EVEN SEMESTER	20BCVAC2	Nutraceuticals	2	3	50	2

##JOB ORIENTED COURSES

Semester	Paper	Subject	Hrs Per week	University examination		Credit
				Hrs.	Max. Mar ks	
SEMESTER I	20BCJOC1	Quality control Biologist	2	3	50	2
SEMESTER II	20BCJOC2	Medical Labouratory Technologist	2	3	50	2

- Offered in collaboration with industries. The candidate will be evaluated by NSDC skill sectors and certification by NSDC

PRACTICAL COMPONENTS:

The M.Sc., Biochemistry Core Practical Examination having the following Marks:

INTERNAL MARKS: 40

Major Practical	20 Marks
Minor Practical	10 Marks
Spotters (A, B, C, D and E)	5x2 = 10Marks
<hr/>	
Total = 40 Marks	
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EXTERNAL MARKS: 60

Major Practical	25 Marks
Minor Practical	10 Marks
Spotters (A, B, C,D and E)	5x2 =10 Marks
Record and Viva	10+5 = 15 Marks
<hr/>	
Total = 60 Marks	
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THEORY COMPONENTS:

The M.Sc. Biochemistry Core and Elective theory Examination having the following Marks.

CORE AND ELECTIVE PAPERS: MAXIMUM MARKS– 100

INTERNAL MARKS: 25

Test	– 15Marks
Assignment	– 5 Marks
Seminar	– 5 Marks

EXTERNAL MARKS: 75

SECTION – A:10x1=10 Marks (Question No. 1 to 10)

Choose the best Answer type. Answer all questions. All questions carry equal marks.

SECTION – B: 5x5=25 Marks (Either or type– Question No. 11 to 15)

Answer all questions. All question carry equal marks. Each answer should not exceed 2 pages.

SECTION – C: 5x8=40 Marks (Either or type– Question No. 16 to 20)

Answer all questions. All Question carry equal marks. Each answer should not exceed 4 pages.

SUPPORTIVE PAPERS: MAXIMUM MARKS– 50

INTERNAL MARKS: 12

Test –6 Marks

Assignment –3 Marks

Seminar – 3 Marks

EXTERNAL MARKS: 38

SECTION – A: 5x1=5 Marks (Question No. 1 to 5)

Choose the best Answer type. Answer all questions. All questions carry equal marks.

SECTION – B: 3x3=9 Marks (Either or type– Question No. 6 to 8)

Answer all questions. All Question carry equal marks. Each answer should not exceed 1 page.

SECTION – C: 4x6=24 Marks (Either or type– Question No. 9 to 12)

Answer all questions. All Question carry equal marks. Each answer should not exceed 2 pages.

