



ST.PHILOMENA'S COLLEGE (AUTONOMOUS), MYSURU

(AFFILIATED TO UNIVERSITY OF MYSORE & REACCREDITED BY NAAC WITH A GRADE)

M.Sc BIOCHEMISTRY

SEMESTER SCHEME

CBCS WITH LEARNING OUTCOME BASED CURRICULUM

Academic year 2018-19 onwards

PREAMBLE

This syllabus is framed to give sound knowledge with understanding of Biochemistry to undergraduate students of three years of B.Sc. degree course. This programme endeavors to provide students a broad based training in biochemistry with a solid background of basic concepts as well as exposing them to the exciting advancements in the field. In addition to theoretical knowledge, significant emphasis has been given to provide hands on experience to the students in the forefront areas of experimental biochemistry.

The goal of the syllabus is to make the study of Biochemistry popular, interesting and encouraging to the students for higher studies including research. The new and updated syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research.

The syllabus is prepared after discussion at length with number of faculty members of the subject from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students.

VISION AND MISSION OF THE COLLEGE

VISION:

The college is guided by the visionary zeal of providing value- based education to everyone irrespective of religion, caste, creed or sex by which the character is formed, intellect is explained and one can stand on his/her feet.

MISSION:

To transform young men and women who come to learn not from books, but also from life and to share the experience of working and playing together, this inculcates life skills to become good citizens with integrity and discipline.

VISION AND MISSION OF THE DEPARTMENT

Vision:

To achieve academic excellence in biochemistry of imparting in-depth knowledge to the students, facilitating research activities and cater to the ever changing industrial demand & societal needs.

Mission:

1. To provide a learning environment that helps the students to enhance problem solving skills and be successful in their profession.
2. To prepare students to be lifelong learner by offering solid theoretical & practical foundation in various discipline of biochemistry and educating them about their professional and ethical responsibilities.
3. To Horne the skills and mould the students in such a way that they meet the requirements of the industry or to work independently.

4. To periodically update curriculum on par with emerging trends with inter and multi-disciplinary approach.

PO No.	Programme Educational Objectives (PEOs)
PEO-1	CORE PROFICIENCY To expertise the students to be able to apply fundamental knowledge related to pure sciences in an interdisciplinary manner for providing innovative solutions to need based problems for global impact.
PEO-2	PROFESSIONAL DEVELOPMENT To train students to critically analyze scientific data, draw objective conclusions and apply this knowledge for human welfare. Students should be able to demonstrate expertise and ethical perspective on areas related to Biochemistry.
PEO-3	PROFESSIONALISM To train the An ability to gain domain knowledge and know-how for successful career in academia, industry and research.
PEO-4	LEARNING ENVIRONMENT To Promoting lifelong learning to meet the ever evolving professional demands by developing ethical, inter personal and team skills.
PEO-5	TECHNICAL ACCOMPLISHMENTS To equip the students with the talent to interpret in core applications by building up a multi-disciplinary concept.

Mapping of Mission of the department with Programme Educational Objectives					
Mission	Programme Educational Objectives (PEOs)				
	PEOs-1	PEOs-2	PEOs-3	PEOs-4	PEOs-5
M1	✓			✓	
M2		✓			✓
M3			✓	✓	
M4	✓				✓

PO No.	Programme Outcomes (POs) Upon completion of the Programme the student will be able -
PO-1	Acquire practical skills to gather information, assess, create and execute new ideas to develop entrepreneurial skills
PO-2	Gain Proficiency in basic laboratory techniques and able to apply the scientific method on lab to land
PO-3	Inculcate a domestic and international perspective and be competent enough in the area of life sciences
PO-4	Learn to recognize potential laboratory safety and conserve nature and the environment and also To enable to get quality education in the areas of Biochemistry

PSO No.	Programme Specific Outcomes(PSOs) Upon completion of the Programme the student will acquire -
PSO-1	to use current biochemical and molecular techniques and carry out experiments
PSO-2	Develop skills in cultivation of plants& also Prepare them to do higher studies in other biological fields like Genetic, Entomology, Biological Oceanography etc
PSO-3	Monitoring the changes in modern life styles leads to modern diseases

PSO-4	Developed critical thinking skills/laboratory techniques to be capable of designing, carrying out ,interpreting scientific experiments
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Mapping of Programme Educational Objectives with Program Outcomes and Programme Specific outcomes

Programme Educational Objectives	Program Outcomes					Program Specific Outcomes				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
PEOs-1	✓			✓	✓		✓			
PEOs-2		✓				✓		✓		
PEOs-3			✓	✓			✓		✓	
PEOs-4					✓	✓				✓



ST. PHILOMENA'S COLLEGE (AUTONOMOUS), MYSURU-570 015

CHOICE BASED CREDIT SYSTEM

M.Sc., BIOCHEMISTRY COURSE STRUCTURE & SYLLABUS

Sl. No	Subject Code No	QP Code	TITLE OF THE PAPERS	Type	L	T	P	Credits	Total Credits	
FIRST SEMESTER										
1.	A0210	54001	Biochemical Techniques	HC	3	0	0	3	18	
2.	A0220	54002	Biomolecules	HC	3	0	0	3		
3.	A0230	54003	Enzymology	HC	3	0	0	3		
4.	AP210	NA	Practical- Biomolecules & Techniques	HC	0	0	6	3		
Any two of the following SC to be Chosen										
5.	A0310	54004	Physiology & Nutrition	SC	3	0	0	3		
6.	A0320	54005	Principles of Chemistry	SC	3	0	0	3		
7.	A0330	54006	Biotechnology	SC	3	0	0	3		
SECOND SEMESTER										
8.	B0210	54101	Cell & Membrane Biology	HC	3	0	0	3	22	
9.	B0220	54102	Molecular Biology	HC	3	0	0	3		
10.	B0230	54103	Carbohydrate & Lipid Metabolism	HC	3	0	0	3		
11.	BP210	NA	Practical- Enzyme & Metabolism	HC	0	0	6	3		
Any two of the following SC to be Chosen										
Note: Interdisciplinary papers										
<ul style="list-style-type: none"> Pharmacology of plant products-Shared by two departments-Chemistry & Biochemistry Biophysics- Shared by two departments-Physics & Biochemistry 										
12.	B0310	54104	Hormones & Cell Signalling	SC	3	0	0	3		
13.	B0510	96501	Biophysics(Interdisciplinary)	SC	3	0	0	3		
14.	B0530	96503	Pharmacology of plant products (Interdisciplinary)	SC	3	0	0	3		
OE from other Departments										
15.	-	-	-	OE	4	0	0	4		
THIRD SEMESTER										
16.	C0210	54201	Nitrogen Metabolism	HC	3	0	0	3	22	
17.	C0220	54202	Gene expression and genetic engineering	HC	3	0	0	3		
18.	C0230	54203	Immunology	HC	3	0	0	3		
19.	CP210	NA	Practicals: Metabolism, Genetic engineering and Immunology	HC	0	0	6	3		
Any two of the following SC to be Chosen										
20.	C0310	54204	Clinical Biochemistry	SC	3	0	0	3		
21.	C0320	54205	Genetics & Evolutions	SC	3	0	0	3		
22.	C0330	54206	Microbiology & Microbial technology	SC	2	2	0	3		
OE from other Departments										
23.				OE	4	0	0	4		
FOURTH SEMESTER										
24.	DP210	NA	Industry internship/project work	HC	0	2	26	13	16	
Any one of the following SC to be Chosen										
25.	D0310	54301	Biostatistics	SC	2	2	0	3		
26.	D0320	54302	Scientific writing and presentation	SC	2	2	0	3		
Total Credits (HC-49+SC-21+ OE- 08)									78	
HC= HARD CORE PAPER. SC= SOFT CORE PAPER. OE = OPEN ELECTIVE PAPER										



ST. PHILOMENA'S COLLEGE (AUTONOMOUS)

Programme: M.Sc Biochemistry

(For Candidates admitted during the Academic year 2018-19 onwards)

FIRST YEAR - SEMESTER - I

Course Title	BIOCHEMICAL TECHNIQUES						
Course Type	Hard Core- Theory	Total Hours	48	Hours/Week	0 3	Credits	03
Course Code	A0210	Evaluation	Internal	C1+C2 = 15+15		30 Marks	100
			External	Duration	C3	03Hrs	
COURSE OBJECTIVES (COs)							
CO No.	Course Objectives						
CO-1	Gain theoretical and practical knowledge about various techniques used in purification, characterization and estimation of cellular constituents						
CO-2	Develop key skills like practical research required in scientific work						
Mapping of CLOs with PSOs &CDLs							
CLOs No.	Course Learning Outcomes(CLOs) On completion of the course the student will learn to			PSOs Addressed	CLDs		
CLO-1	Use the current biochemical and molecular technique concept to plan and carry out experiments			PSO-2	Apply		
CLO-2	Understand construction, working principle and application of various techniques used in biochemistry with its limitations			PSO-3	Understand		
CLO-3	Understand the usage of live models in research and techniques in extraction of cellular components			PSO-1	Understand		
CLO-4	Generate and analyze data appropriately and appreciate the limitations of conclusions drawn from experimental data independently			PSO-4	Analyze		

Modules

COURSE CONTENTS

Duration

1.0 Models: Animal Models, Choice Of Animals, Types Of Studies Mutant Organisms (Auxotroph), Cultured Animal And Plant Cells As Models.

Cell Fractionation Techniques: Cell Lysis, Homogenization, Extraction, Salting In & Salting Out, Dialysis And Ultra Filtrations

4 hours

Keywords: live animal and plant models; isolation of cellular component

2.0 Analytical Ultracentrifuge: Construction, Svedberg's Constant, Sedimentation Velocity And Sedimentation Equilibrium, Schleiran Optics

Preparative: Differential And Density Gradient Centrifugation, Centrifugal Elutriation, Construction and applications of Preparative Ultra Centrifuge ,Marker Enzymes

6 hours

Keywords: construction and working principle; identification of cellular components

- 3.0 Chromatographic Techniques:** Principles and Applications of Paper Chromatography, Adsorption Chromatography, TLC, Ion Exchange Chromatography, Gel Filtration Chromatography Affinity chromatography, GLC, HPLC, FPLC & Chromatofocusing **10 hours**
Keywords: Construction, working principle and application
- 4.0 Electrophoretic Techniques:** Polyacrylamide Gel Electrophoresis, SDS-PAGE, 2D-Electrophoresis, Agarose Gel Electrophoresis, Isoelectric Focusing, Pulsed Field Electrophoresis, High Voltage Electrophoresis, Capillary Electrophoresis, Isotachopheresis. Separation Of Proteins, Lipoproteins And Nucleic Acids **8 hours**
Visualizing Separated Components- Staining: Coomassie Blue, Silver Staining, Ethidium Bromide, PAS Staining, Zymogram And Reverse Zymogram
Keywords: Construction, working principle and application
- 5.0 Spectroscopic Techniques:** Principle of Colorimeter: Molar Extinction coefficient, Beer's law. Principle of Fluoremetry, Fluorescent Probes And Their Applications: FRET And FRAP, Sorting of cell- flow cytometry **6 hours**
Keywords: Construction, working principle and application
- 6.0 Radioactivity:** Isotopes, Heavy Isotopes And Radio Isotopes, Theory and Construction of Mass Spectrometer Ionization, Fragmentation, M/E ,Time of Flight, MALDI And ESI, Quadrupole Analyser **12 hours**
Radioisotopes In Biology: ^3H , ^{14}C , ^{32}P , ^{131}I , ^{35}S . Concept of Half-Life, Decay Constant ,Specific Activity, carrier free isotope
Detection And Quantification: Geiger Muller Counter, Solid And Liquid Scintillation Counter, Autoradiography, Carbon Dating, Isotope Dilution, Pulse Chase
Radio labelling : Lipids-Choline, Fatty Acids, Proteins- I^{125} , Nucleic Acids Using ATP ($\gamma\text{-P}^{32}$)
Keywords: Radioactivity, Construction, working principle and application of radioactive detectors
Note: Course content involves 90% Theory and 10% Problems

Books for Reference:					
Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publicati
1.	A Guide to principles and techniques of practical biochemistry	K.Wilson & K.Goulding	Cambridge University Press	3	1994
2.	Principles and techniques of practical biochemistry	Bryan L.Williams and Keith Wilson	Cambridge University Press	4	1996
3.	Principles & Techniques of Biochemistry and Molecular Biology	Keith Wilson & John Walker	Cambridge University Press	7	2010
4.	Introductory Practical Biochemistry	S.K. Sawhney &, R. Singh	Alpha Science International Ltd	5	2005

Additional books for reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of Publication
1.	An Introduction to Practical Biochemistry	David Plummer	Mc Grow Hill education	3	2011
2.	Text book of Biophysical Chemistry	Upadyaya & Upadyaya	Himalaya Publishing House Pvt. Ltd.	4	2016
3.	Instrumental Methods of Analysis	Muralidhara Rao	CBS Publishers & Distributors	1	2013

FIRST YEAR - SEMESTER - I

Course Title	BIOMOLECULES						
Course Type	Hard Core- Theory	Total Hours	48	Hours/Week	03	Credits	03
Course Code	A0220	Evaluation	Internal	C1+C2 = 15+15		30 Marks	100
			External	Duration	C3	03Hrs	

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	Gain knowledge about various macromolecules present in biological system
CO-2	Understand structure, linkage and functions of macromolecules

Mapping of CLOs with PSOs &CDLs

CLOs No.	Course Learning Outcomes(CLOs) On completion of the course the student will learn to	PSOs Addressed	CLDs
CLO-1	Demonstrate knowledge and understanding of the molecular machinery of living cells and principles that govern the structures of macromolecules	PSO-1	Analyze
CLO-2	Isolation and characterization of macromolecules	PSO-4	Understand
CLO-3	Structural elucidation and physiochemical properties of macromolecules	PSO-1	Understand
CLO-4	Structure-Function relationship analysis	PSO-4	Apply

Modules	COURSE CONTENTS	Duration
1.0	<p>Carbohydrates: Structure And Classification Of Carbohydrates, Monosaccharides- pentose, hexose, ketose Disaccharides- Sucrose, Lactose, Maltose, Trehalose Polysaccharides- Homopolysaccharides, Heteropolysaccharides- Starch, Cellulose, Glycogen, Hyaluronic Acid, Chondroitin Sulphate, Chitin, Xylans</p> <p>Chemistry Of Monosaccharides: Structures Of Monosaccharides- Pentoses, Hexoses, Deoxyglucose, Amino Sugars, Muramic Acid, Neuraminic Acid Linkages in Lactose, Maltose, Trehalose and Glycosides.</p> <p>Isolation Of Polysaccharides, Bacterial Cell Wall Polysaccharides Blood Group Polysaccharides</p>	9 hours
2.0	<p>Methods of Structural Elucidation Degradation, Graded Acid Hydrolysis, Periodate Oxidation, Degradation of Oxopolysaccharides, Methylation, Acetylation, GC-MS</p> <p>Glycobiology: N- And O-Linked Glycoproteins, Lectins, Proteoglycans, Agreecan, Syndecan, Decorin, Pectin And Pectic Polysaccharides</p> <p>Amino Acids: Nomenclature, Classification General Reactions of Amino Acids Unusual Amino Acids, Non Protein Amino Acids</p> <p>Peptide Bond: Features of the Peptide Bond, Naturally Occurring Peptides- Glutathione, Enkaphalins and Endorphins</p> <p>Chemical Synthesis of Peptides- Khorana's Solution Phase Synthesis, Merrifield's Solid Phase Synthesis</p> <p>Determination of Amino Acid Compositions: Acid And Base Catalyzed Hydrolysis, Separation, Quantification : Determination of N- And C- Terminal Residues, Determination of Site of Glycosylation and Type of Glycosylation</p>	10 hours
3.0	<p>Structural Elucidation of Protein: isolation of proteins, overview of purification and criteria of purity</p> <p>protein structure: primary structure- sequencing strategies, n-terminal and c-terminal, sequencing methods, automated Sequanators, determination of s-s-bond position</p> <p>Secondary structure of protein: α, β sheet, β bend, β turn, super secondary structures- prediction method- Ramachandran plot: ϕ, ψ angles, tertiary and quaternary structures.</p> <p>weak forces of interaction: hydrogen bonding ,Vander waal's forces, London force, ionic interactions , hydrophobic interactions s-s bridges, peptide bond glycosidic bond , phosphodiester bond , Allolysine , molten globule, Levinthal paradox, denaturation and renaturation of proteins, Anfinsen's experiment</p> <p>3d structures of Myoglobin, hemoglobin ,immunoglobulin, collagen , keratin</p>	10 hours
4.0	<p>Chemistry of lipids: Classification, Occurrence and Properties of lipids: Oils, Fats, And Waxes. Occurrence and Properties of Fatty Acids, Esters of Fatty Acids, Cholesterol, Phospholipids, Glycolipids, Sphingolipids, Cerebrosides, Gangliosides.</p> <p>Lipid Mediators: Structure and major functions of Eicosanoids, Prostaglandins, Leukotrienes, Prostacyclins, Thromboxanes, DAG, Ceramide, PAF</p>	8 hours
	<p>Keywords: Chemistry, chemical structural elucidation and</p>	

biological significance of lipids

5.0 Chemistry of Nucleic Acids: : Isolation & Purification Of DNA And RNA From Biological Sources (Microbes, Plants And Animals) of Nucleic Acids

Physiochemical Properties of Nucleic Acids: Melting of DNA, T_m, Factors Affecting T_m, Cot Curve and Classification of DNA Based on Cot Curve, Chemical Reactions of DNA and RNA.

Sequencing of DNA: Maxam Gilbert Method, Dideoxy Method , Pyrosequencing, Chargaff's Rule, Secondary Structure Of DNA - Watson And Crick Model, B and Z DNA , Other Models of DNA Structure (A DNA)

10 hours

Secondary Structural Features of DNA: Steam Loop Structure, Palindromic Sequences, Cruciform, Secondary Structure Of t-RNA - Clover Leaf Model

Keywords: *isolation, classification, chemical reactions*

Note: Course content involves 100% Theory

Books for reference:					
Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Lehninger Principles of Biochemistry	David L. Nelson & Michael M. Cox	W.H. Freeman	6	2012
2.	Fundamentals of Biochemistry	J L Jain , Sunjay Jain , Nitin Jain	S Chand	7	2016
3.	Biochemistry	U.Sathyanarayana & Chakrapani	Elsevier	4	2013
4.	Harpers Illustrated Biochemistry	Robert K. Murray, Peter J. Kennelly, David A. Bender	McGraw-Hill Medical	29	2012

Additional books for reference:					
Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Biochemistry	U.Sathyanarayana & Chakrapani	Elsevier	5	2017
2.	Textbook of Biochemistry for Medical Students	DM Vasudevan Sreekumari S Kannan Vaidyanathan	Jaypee Brothers Medical Publishers	6	2011
3.	Color Atlas of Biochemistry	Jan Koolman	Thieme	3	2013

FIRST YEAR - SEMESTER - I

Course Title	ENZYMOLGY						
Course Type	Hard Core-Theory	Total Hours	48	Hours/Week	03	Credits	03
Course Code	A0230	Evaluation	Internal	C1+C2 = 15+15		30 Marks	
			External	Duration	C3	03Hrs	70 Marks
							100

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	Understand the Thermodynamic terms and basic concepts.
CO-2	Understand the classification, structure, properties and functions of enzymes.
CO-3	Understand the mechanism of action of enzymes and analyse the different types of Catalysis.
CO-4	Understand and apply the kinetic studies in the derivation of the M.M equation and their modification and understand different types of inhibition.
CO-5	Apply and evaluate the role of enzymes in different areas like industries, clinical labs etc.

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Remember and understand the major classes of enzyme and their functions in the cell.	PSO- 1	Understand
CLO-2	Explain the role of co-enzyme cofactor in enzyme catalyzed reaction.	PSO- 2	Remember
CLO-3	Differentiate between equilibrium and steady state kinetics and analyzed simple kinetic data and estimate important parameter (Km, Vmax, Kcatetc).	PSO- 2	Remember
CLO-4	Define and describe the properties of enzymes in and regulates biochemical pathway (inhibition)	PSO- 3	Remember
CLO-5	Explain the role of enzymes in different fields.	PSO- 4	Analyse

Modules

COURSE CONTENTS

Duration

1.0 General Aspects: Nature Of Enzymes, Localization, Isolation, Purification And Characterization Of Enzymes. Criteria Of Purity Of Enzymes, Fold Purity. Nomenclature And IUB Classification Of Enzymes. Enzyme Specificity, Specific Activity, Assay Methods; Coupled Enzyme Assays, Continuous, End Point And Kinetic Assay. Units Of Enzyme Activity, IU And Katal.

7hours

Key words: Katal ,rpm, Centrifugation, Prosthetic group

2.0 Enzyme Kinetics: Michaelis-Menten Equation, Initial Velocity Approach, Steady State Approach. Vmax, Km And Their Significance. Linear Transformation Of Michaelis-Menten Equation; Line weaver-Burk Plot, Eadie-Hofstee, Wolf And Cornish-Bowden. Scatchard Plot. Rate Of A Reaction, Order And Molecularity. I Order Reaction Kinetics. Rectangular Hyperbola, Michaelis-Menten Equation As Rectangular Hyperbola, Asymptote, Linear Transformation, Calculation Of Slope, Intercepts.

7hours

Inhibition: Reversible And Irreversible Inhibition; Competitive, Non Competitive, Uncompetitive Product Inhibition And Suicide Inhibition. Determination Of Ki And Kd.

Bisubstrate Reaction: Cleland's Notation With Examples Of Ordered,

Ping-Pong, And Random Reactions. General Rate Equation. Primary And Secondary Plots

Key words: *Inhibition, order of reaction, Vmax, Km*

3.0 Mechanisms Of Enzyme Catalysis: Active Site Structure; Methods Of Determining Active Site Structure, Isolation Of ES Complex, Affinity Labeling, Chemical Modification Studies And Active Site Structure Investigation

7hours

Nature Of Enzyme Catalysis: Transition State Theory, Proximity And Orientation, Orbital Steering, Acid Base Catalysis, Covalent Catalysis, Metal Ion Catalysis, Nucleophilic and Electrophilic Catalysis, Intra Molecular Catalyses, Entropy Effects. Effect Of Temperature And Ph On Enzyme Catalyzed Reaction.

Key words: *Active site, Catalysis.*

4.0 Cooperativity: binding of Ligands to macromolecules; Scatchard plot, Cooperativity, positive and Negative Cooperativity. Oxygen binding to hemoglobin. Hill equation, Homotropic and Heterotropic effectors, Aspartyl transcarbamylase as an allosteric enzyme.

7hours

Key words: *Co-operativity, Allosteric Enzyme*

5.0 Mechanisms of action of Specific Enzyme: Chymotrypsin; Zymogen Activation, Acid-Base Catalysis, Charge Relay Net Work. Lysozyme, Alcohol Dehydrogenase, Ribonuclease, Carboxypeptidase A, RNA as an Enzyme, Abzymes, Coenzymic Action of NAD⁺, FAD, TPP, PLP, Biotin, CoA, Folic Acid And Lipoic Acid.

7hours

Key words: *Abzymes, Acid-Base Catalysis*

Isoenzymes: LDH, Multifunctional Enzymes (DNA Polymerase) and Multi Enzyme Complex (PDC).

6.0 Metabolic regulation of enzyme activity: Feedback regulation, fine control of enzyme activity.

7hours

Fast reactions - Stopped flow, temperature jump method with examples of enzymes.

Key words: *Isoenzymes, Fast reactions, Metabolic regulation*

Note: Course content involves 100% Theory

Books for Reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Enzymes	Malcolm Dixon & Edwin C. Webb	Academic press Inc	2	1964
2.	Enzymes- Biochemistry, Biotechnology, Clinical Chemistry	Trevor Palmer	East West	2	2004
3.	Fundamentals of Enzymology.	Nicholas Price & Lewis Stevens	Oxford university press.	3	1999
4.	Enzyme Assays: A Practical Approach	R Eisenthal & M.J. Dauson	Oxford University Press	2	2002

Additional books for reference:

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Enzymes	P. Asokan	Chinnaa Publications	2	2005
2.	Enzymology and Enzyme Technology	Dr. Bhatt S.M	S Chand & Company	1	2014
3.	Enzymology	T. Devasena	Oxford University Press	1	2010

FIRST YEAR - SEMESTER - I

Course Title	BIOMOLECULES & TECHNIQUES						
Course Type	Hard Core- Practical	Total Hours	48	Hours/Week	06	Credits	03
Course Code	AP210	Evaluation	Internal	C1+C2 = 15+15		30 Marks	100
			External	Duration	C3	03Hrs	

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	Gain technical experience and handle adjustable micro pipettes in a reproducible manner
CO-2	Perform logical reasoning and criticizing data
CO-3	The isolation and detection of various Biomolecules by different chromatographic techniques.
CO-4	Techniques for lysis, electrophoresis and cholinesterase activity detection in erythrocytes

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes (CLOs) On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Accurate use of pipettes, making solutions for biochemical study	PSO- 1	Understand
CLO-2	The estimation of Biomolecules	PSO -4	Understand
CLO-3	Purify and characterize enzymes	PSO -3	Application
CLO-4	Understand and interpretation experimental results	PSO- 2	Analyse

Modules**COURSE CONTENTS****Duration****1.0****Enzymes****1.1**

Purification of sweet potato amylase- Extraction, ammonium sulphate precipitation

4hours**1.2**

Km and Vmax

4hours**1.3**

Optimum temperature and energy of activation

4hours**1.4**

pH optimum of salivary amylase

4hours

1.5	Assay of invertase from yeast- initial velocity calculation	4hours
1.0	Biomolecules	
1.1	Determination of Protein - Lowry, Biuret methods	4hours
1.2	Determination of Reducing sugar-DNS method	4hours
1.3	Determination of Amino acids	4hours
2.0	Techniques	
2.1	Paper chromatography- Circular , Ascending(amino acids) descending (sugars)	4hours
2.2	Isolation of lipids from egg yolk- TLC of Lipids	4hours
2.3	Gel filtration-purification of cytochrome C	4hours
2.4	Ion Exchange chromatography	4hours
2.5	Affinity chromatography- preparation of Paraoxonase	4hours
2.6	Molar Extinction coefficient	4hours

Note: Course content involves 100% Practicals

Books for reference:					
Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Text book of Medical laboratory technology	Praful. B. Godkar	Bhalani Publishing house	3, Volume I and II	2014
2.	Biochemical Methods	Sadasivam, S. and Manickam, A	New Age International (P) Ltd	3	2010

Additional books for reference:					
Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Medical Laboratory Technology	Kanai L. Mukerjee	Tata McGraw Hill Education	2	2011

FIRST YEAR - SEMESTER – I

Course Title	PHYSIOLOGY AND NUTRITION						
Course Type	Soft Core- Theory	Total Hours	48	Hours/Week	03	Credits	03
Course Code	A0310	Evaluation	Internal	C1+C2 = 15+15		30 Marks	
			External	Duration	C3	03Hrs	70 Marks
COURSE OBJECTIVES (COs)							

CO No.	Course Objectives
CO-1	Gain knowledge regarding biochemistry of various physiological processes specialized tissues and hormone action in animal system
CO-2	Understand structure, operational mechanism and functions of the various organs and organ system in human body
CO-3	Understand aspects of various nutrients and their interactions in foods

Mapping of CLOs with PSOs &CDLs

CLOs No.	Course Learning Outcomes(CLOs) On completion of the course the student will learn to	PSOs Addressed	CLDs
CLO-1	Understand the mechanism of circulatory system and its function	PSO- 1	Remember
CLO-2	Understand the structure, mechanism and functions of respiratory digestive and excretory system	PSO- 2	Understand
CLO-3	Understand concept of macro, micro, essential and non-essential nutrients	PSO -2	Understand
CLO-4	Understand the concept of diet	PSO- 4	Analyse

Modules

COURSE CONTENTS

Duration

- 1.0 Physiology:** Basic Body Plan In Humans, Location Of Organs.
Keywords: Human organs **1hours**
- 2.0 Blood:** Composition, Cells, Plasma Proteins And Lipoproteins. Erythrocytes; Structure And Function. WBC; Types, Differential Count, Functions. Platelets And Its Function. Buffer Systems, Hemostasis, Blood Clotting, Classical And Alternate Pathway, Digestion Of Clot, Anticoagulants, Blood Volume, Blood Pressure And Their Regulations. Plasma Lipoproteins And Their Formation And Functions, HDL, LDL, VLDL, Chylomicrons. CSF And Its Functions
Keywords: Blood , clotting pathway , body fluids **8hours**
- 3.0 Respiratory System:** Lungs, Structure And Functions, Gas Exchange, Oxygen Binding By Hemoglobin, Factors Affecting Oxygenation And Acid-Base Balance.
Excretory System: Ultra Structure Of The Nephron, Glomerular Filtration, Formation Of Urine, Acid - Base Balance.
Hepatobiliary System: Anatomy Of The Liver, Blood Supply, Cells; Hepatocytes, Endothelial Cells And Kupffer Cells, Secretory And Excretory Function And Formation Of Bile.
Digestive System: GI Tract, Digestion And Absorption of Carbohydrates, Proteins, Lipids. Mechanism of HCl Production in the Stomach , Gastrointestinal Hormones Role of Pancreas in Digestion
Muscle Physiology: Skeletal Muscle And Smooth Muscle, Muscle Proteins; Actin, Myosin, Tropomyosine, Troponins
Keywords: Respiratory mechanics and regulation, excretory function of liver and kidney, absorption of food, hormonal regulation, muscle Proteins, muscle contraction **18hours**
- 4.0 Nutrition:**
Concepts of Macro And Micro Nutrients, Essential Nutrients And Their Classification. **10hours**
Food Groups- Proximate Analysis Of Foods, Chemical And

Biological Analysis For Nutrients.

Food As Source Of Energy: Methods Of Determining Energy Value Of Foods, Calorimetry

Physiological Fuel Value: Daily Requirement Of Energy, High And Low Calorie Diets. Basal Metabolic Rate (BMR) Factors Affecting BMR, Specific Dynamic Action Of Foods. Energy Expenditure, NEAT (Non Exercise Activity Thermogenesis)

Keywords: essential and non essential nutrients, energy value, BMR

5.0 **Macronutrients**

Carbohydrates: Dietary Sources, Dietary Fiber, Essentiality Of Carbohydrates.

Proteins: Essential Amino Acids, Evaluation Of Nutritive Value Of Dietary Proteins, PER, BV, Nutritional Classification Of Proteins, Supplementary Value Of Proteins, Protein Calorie Malnutrition; Kwashiorkor And Marasmus.

Fats: Sources, Invisible Fat, Essential Fatty Acids, PUFA

16hours

Micronutrients:

Vitamins: Fat Soluble And Water Soluble Vitamins, Pro-vitamins, Anti-vitamins, Dietary Sources, Daily Requirements, Structure And Function. Deficiency Symptoms Of B And C Vitamins And Fat Soluble Vitamins, Hypervitaminosis, Vitamin - Like Compounds.

Minerals: Macro And Micro Nutrients, Sources, Requirements, Functions And Deficiency Symptoms.

Keywords: Macronutrients, Micronutrients

6.0 **Water Metabolism:** Distribution In Body, Function, Water Balances, Factors Affecting Water Balance.

4hours

Keywords: Water Balance

7.0 **Diet:** Recommended Daily Allowances, Special Nutrition For Infants, Children, During Pregnancy, Lactation And Old Age. Nutrition For Diabetes And Cardiovascular Disease Patients. Wellness Diets, Medeterranean Diet, Paleo Diet, Fitness Diets, Obesity And BMI. Diet And Inflammation, Anti-Inflammatory Diets.

8hours

Keywords: special Diets, Recommended Daily Allowances

Note: Course content involves 100% Theory

Books for Reference:					
Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Textbook of Biochemistry with Clinical Correlations	Thomas M. Devlin	John Wiley & Sons	7	2010
2.	Textbook of Medical Biochemistry	MN Chatterji & Rana Shinde	Jaypee Brothers Medical Publishers	8	2011
3.	Textbook of Biochemistry for Medical Students	DM Vasudevan Sreekumari S Kannan Vaidyanathan	Jaypee Brothers Medical Publishers	6	2011
4.	Pocket Companion to Guyton and Hall Textbook of Medical Physiology	John E. Hall	Saunders	12	2011

5.	Handbook of Food and Nutrition	Dr. M. Swaminathan	Bappco	6	2010
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Additional books for reference:

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Guyton and Hall Textbook of Medical Physiology	John E. Hall	Saunders	13	2015
2.	Fundamentals of Foods, Nutrition and Diet Therapy	Sumati R. Mudambi	New Age International Private Limited	6	2018
3.	Food Science	B Srilakshmi	New Age International Private Limited	7	2018

FIRST YEAR - SEMESTER - I

Course Title	PRINCIPLES OF CHEMISTRY						
Course Type	Soft Core- Theory	Total Hours	48	Hours/Week	03	Credits	03
Course Code	A0320	Evaluation	Internal	C1+C2 = 15+15		30 Marks	
			External	Duration	C3	03Hrs	70 Marks
							100

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	Understand the stereochemistry, spatial arrangement of atoms/groups and apply it on the course of reactions and mechanism , prediction.
CO-2	Describe the fundamental scientific principles in the subfields of chemistry and apply these principles to problems.
CO-3	Solve problems, think critically and reason analytically as these are applied to scientific problems

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Remember & Understand the stereochemistry, spatial arrangement of atoms/groups and apply it on the course of reactions and mechanism prediction.	PSO -1	Understand
CLO-2	Analyse/Describe the fundamental scientific principles in the subfields of chemistry and apply these principles to problems.	PSO- 2	Analyse
CLO-3	critically think & Solve problems, reason analytically as these are applied to scientific problems	PSO- 4	Apply

Modules	COURSE CONTENTS	Duration
1.0	Bonding -covalent bond ,coordinate bond, coordinate bond formation in transition metals crystal field theory ligand field theory valence bond theory structure, bonding and special properties of water iron in hemoglobin and cytochromes bonding of cobalt in vit-B ₁₂ magnesium in chlorophyll chelates, types of ligands and complexes Keywords: transition metals, theories, ligands	14hours
1.1	Electrolytes And Non-Electrolytes -osmotic pressure reflection coefficient vapour pressure vapour pressure osmometer donnan membrane equilibrium Electrodes -electrode potential ,hydrogen electrode, oxygen electrode Keywords: electrodes	8hours
2.0	Stereochemistry -importance of stereochemistry position and order of groups around carbon geometric and optical isomerism absolute and relative configuration symmetry view of chirality relation between chirality and optical activity representation of chiral structures by fischer structure and stereochemistry of glucose; anomer, epimer, stereoisomer, d and l, + and - r and s and stereochemistry of amino acids Keywords: stereomers, significance, chirality	6hours
3.0	Mechanism of organic reactions -intermediates and rearrangements in organic reaction, reaction energetics classification of reagents and reactions effects of substituents on the benzene ring and the reaction mechanism reaction rates, order and Molecularity of reaction Keywords: organic reactions	14hours
4.0	Mechanisms and stereochemistry -substitution (electrophilic and nucleophilic - sn ¹ and sn ² reactions) addition reactions, elimination reactions, rearrangement reactions, ester hydrolysis, property of Aromaticity and resonance Keywords: substitution , addition	14hours
5.0	Heterocyclic compounds -chemistry and biological Occurance of the following Furan, Indole, Thiazole, Pterine, Pteridine, Isoalloxazine, Pyrrole, Porphyrins, Heme Keywords: heterocycles, significance Note: Course content involves 100% theory	8hours

Books for Reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Inorganic Chemistry: Principles of Structure and Reactivity	Huheey / Medhi	Pearson Education India	4	2006
2.	Concise Inorganic Chemistry	J.D. Lee	Oxford University Press;	5	2008
3.	Organic Chemistry	Morrison Boyd & Bhattacharjee	Pearson Education India	7	2010

Additional books for reference:					
Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	A Textbook of Organic Chemistry	Bahl Arun & Bahl B.S	S Chand & Company	22	2016
2.	Principles of physical chemistry	B.R. Puri, L.R. Sharma, M.S. Pathania	Vishal Publishing Co.	47	2017
3.	Chemistry for Degree Students	R L Madan	S Chand Publishing	3	2011

FIRST YEAR - SEMESTER - I

Course Title		BIOTECHNOLOGY					
Course Type	Soft Core- Theory	Total Hours	48	Hours/Week	03	Credits	03
Course Code	A0330	Evaluation	Internal	C1+C2 = 15+15		30 Marks	
			External	Duration	C3	03Hrs	70 Marks

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	To impart knowledge on foundation of modern biotechnology
CO-2	To explain the principles that forms the basis for recombinant DNA technology

Mapping of CLOs with PSOs &CDLs

CLOs No.	Course Learning Outcomes (CLOs) On completion of the course the student will learn to	PSOs Addressed	CLDs
CLO-1	Understand the difference between old biotechnology and modern biotechnology.	PSO-1	Understand
CLO-2	Provide examples of current applications of biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, plant and animal.	PSO-4	Application
CLO-3	Explain the concept and application of monoclonal antibody technology	PSO-2	Application
CLO-4	Provide examples on how to use microbes and mammalian cells for the production of pharmaceutical products.	PSO-1	Analyse

Modules

COURSE CONTENTS

Duration

- 1.0 Cell culture techniques:** Introduction to plant and animal tissue/cell culture, Laboratory design, aseptic conditions, equipments and materials for cell culture. Different constituents of culture medium - types of media and their applications
Plant cell culture: Micro propagation, callus culture, haploid production, somatic embryogenesis, somatic hybridization, Protoplast fusion, cybridization, somaclonal variation, Production of disease free plants.
Keywords: Media, aseptic condition, transfer methods
- 2.0 Animal cell culture:** Culture techniques, media, preparation of primary culture, disaggregation of tissue and primary cultures, chick embryo, HUVEC, characterization of cultures, ploidy, cell doubling time, cell surface markers
Keywords: Media, aseptic condition, transfer methods

12hours

8hours

3.0 Cell lines: Characteristics and routine maintenance, cell separation techniques, measurement of viability and cytotoxicity, scaling-up of animal cell culture, bioreactors used in animal cell culture, amplified cultures, continuous cultures and their applications

8hours

Keywords: *sub-culturing, media, aseptic condition,*

4.0 Fermenter: Stirred fermenter, microcarrier, encapsulation, hollow fiber chambers packed, cell immobilization techniques, glass bead reactors, organ and histotypic cultures, three-dimensional culture, tissue engineering eg skin, characterization of the cultured cells, measuring parameters of growth, cell synchronization, somatic cell fusion, cell cloning, cryopreservation

10hours

Keywords: *Types, growth parameters, reactors*

Note: Course content involves 100% Theory

Books for reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Biotechnology	U Satyanarayana	Books & Allied Ltd	1	2008
2.	Plants from Test Tubes: An Introduction to Micro propagation	Lydiane Kyte & John Kleyn	Timber Press, Incorporated	3	1996
4.	A Textbook of Biotechnology	R C Dubey	S Chand	5	2014
5.	Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications	R. Ian Freshney	Wiley-Blackwell	6	2010

Additional books for reference:

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Practical Book of Biotechnology & Plant Tissue Culture	Madhavi Adhav & Nagar Santosh	S Chand & Co Ltd	1	2010
2.	Animal Cell Culture: Essential Methods	John M Ed Davis	John Wiley & Sons	1	2010
3.	Introduction to Plant Cell, Tissue and Organ	Sunil D. Purohit	PHI Learning	1	2013

FIRST YEAR - SEMESTER -II

Course Title		CELL & MEMBRANE BIOLOGY						
Course Type	Hard Core- Theory	Total Hours	48	Hours/Week	03	Credits	03	
Course Code	B0210	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	Study structure and functions of bio membranes, structure-function relationships, membrane biogenesis
CO-2	Demonstrate knowledge on membrane associated cellular events

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes (CLOs) On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Appreciate the Evolution In Concept Of Membrane Models	PSO-3	Analyze
CLO-2	Understand intracellular targeting of molecules and biogenesis of sub-cellular organelles	PSO-2	Understand
CLO-3	Understand the techniques used to study membrane structures	PSO-1	Apply
CLO-4	Understand the mechanism underlying neurotransmission, muscle contraction and cell cycle	PSO-4	Understand

Modules	COURSE CONTENTS	Duration
1.0	<p>Biomembranes: physicochemical properties of biological membranes; compositions, lipid phases-hexagonal i and ii, Micellar phase, Bilayer phase, phase transition temperature. Supra molecular organization. Models of membrane; Gorter and Grendel's experiment, Daniell - Davson model of membrane. Evolution in concept of membrane models, Singer and Nicholson's model. newer models</p> <p>Keywords: Membrane Models, molecular organization Models</p>	8hours
2.0	<p>Membrane Asymmetry: lipids, proteins and carbohydrates and their lateral diffusion. Biogenesis of lipids and proteins, polarized cells, membrane domains; Caveolae, rafts, membrane lipid and protein turnover, intracellular Targeting Of Proteins. Biogenesis Of Sub Cellular Organelles</p> <p>Keywords: Properties Of Membranes, models of membrane</p>	8hours
3.0	<p>Methods Of Study Of Membrane Structure: Lipid Transfer Proteins, Phospholipases, Chemical Methods, Amino-Phospholipid Translocation, TNBS Reagent, Freeze Fracture And Freeze Etching, Liposome Preparations And Application, Function Of Sterols In Membranes. FRET, FRAP, Single Particle Tracking, Calorimetry, Cell Fusion.</p> <p>Keywords: Principle and application of methods used in analyzing membrane structure</p>	8hours
4.0	<p>Membrane Transport: Laws of Diffusion Across Membranes, Simple Diffusion and Facilitated Diffusion, Active Transport, Glucose Transporters, Na⁺-K⁺ATPase (Structure And Mechanism of Action) Bacterial Phosphotransferase System, Receptor Mediated Endocytosis, exocytosis, Membrane flow hypothesis</p> <p>Ion Channels: Gated Ion Channels-Ligand and Voltage, Non- Gated Ion Channels Aquaporin Channel, Ionophores</p> <p>Keywords: Transporters, carriers, channels, mode of membrane transport</p>	8hours
5.0	<p>Mechanisms Of Nerve Conduction: Acetylcholine Receptor And Neurotransmitters, Mechanisms Of Nerve Conduction, Resting And Action Potential, Patch Clamp Technique. Pre-synaptic And Postsynaptic Membranes. Nicotinic And Muscarinic Neurons. GABA, NMDA, Structure And Function.</p> <p>Keywords: Structure and mechanism of neuronal signals</p>	8hours
6.0	<p>Muscle Contraction: Structure Of Skeletal Muscle, Mechanisms Of Muscle Contraction , Role Of Calcium, Calmodulin, Phospholamban</p> <p>Cell Cycle and its Regulation: Phases Of The Cell Cycle, Check Points, Cdks and Cyclins, Cell Cycle Control, Aging and senescence, Apoptosis</p> <p>Keywords: Molecular mechanisms in muscles, ,molecular events of a cell, pathways of apoptosis</p> <p>Note: Course content involves 100% Theory</p>	8hours

Books for Reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Lehninger Principles of Biochemistry	David L. Nelson And Michael M. Cox	W.H. Freeman & Company	4	2004
2.	Biochemistry	Geoffrey Zubay	WBC Publishers	4	1998

Additional books for reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Fundamentals Of Biochemistry, Life At The Molecular Level.	Donald Voet, Judith G. Voet, Charlotte W. Pratt	Wiley	4	2012
2.	Outlines Of Biochemistry	Eric E. Conn, P.K. Stumpf, G Bruening, R.H. Doi	Wiley	5	2006
3.	Harper's Biochemistry	Robert K. Murray, Daryl K. Grammer, Peter A. Mayer, Victor W. Rodwell	Appleton & Lange	27	2006

FIRST YEAR - SEMESTER -II

Course Title	MOLECULAR BIOLOGY						
Course Type	Hard Core-Theory	Total Hours	48	Hours/Week	03	Credits	03
Course Code	B0220	Evaluation	Internal	C1+C2 = 15+15		30 Marks	
			External	Duration	C3	03Hrs	70 Marks
						100	

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	Understand the mechanism of Prokaryotic replication, transcription and Regulation.
CO-2	Understand the mechanism of Eukaryotic replication, transcription and regulation.
CO-3	Understand the features of Genetic code and translation mechanism.
CO-4	Understand and the cellular mechanism of Gene expression and regulation.

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Explain the mechanism of Prokaryotic replication, transcription and regulation.	PSO- 1	Analyse
CLO-2	Describe the mechanism of Eukaryotic replication, transcription and regulation.	PSO- 2	Remember
CLO-3	Enumerate the features of Genetic code and translation mechanism.	PSO- 2	Understand
CLO-4	Evaluate the cellular mechanism of Gene expression and regulation.	PSO -3	Evaluate
CLO-5	Understand the concept of Protein- DNA interactions. And molality.	PSO -4	Understand

Modules	COURSE CONTENTS	Duration
1.0	<p>Introduction: historical perspective, composition of rna and dna. bases, chargaff's rule. types of rna. isolation and purification of rna and dna, structure of rna and dna, central dogma of molecular biology. dna as genetic material, experiment of griffiths, avery and colleagues, hershey and chase experiment. rna as genetic material of viruses, frenkel-conrat experiment</p> <p>Key words: Purines, Pyrimidines, N¹⁴, Genetic content, Bacteria</p>	6hours
2.0	<p>DNA-Anti parallel Nature: nearest neighbour base frequency analysis. replication of dna, semi conservative nature; messelson and stahl experiment. replication of double stranded dna, direction of replication, cairn's experiment, semi discontinuous replication, okazaki fragments. dna polymerase i ii and iii, dna ligase, dna topoisomerases. fidelity of replication, trombon model, translesion synthesis (dna pol iv and v). replication in viruses, rolling circle model, single stranded dna virus. replications of mitochondrial dna</p> <p>Key words: Replication, enzymes, Virus</p>	10hours
3.0	<p>Transcription: colinearity of genes and proteins, rna polymerase i, ii and iii. rna biosynthesis in prokaryotes and eukaryotes; initiation, elongation and termination. abortive cycling. rna dependent rna synthesis, rna replicase of qβvirus. processing of eukaryotic rna, cap addition, intron splicing, poly a tail addition, rna editing. processing of trna and mrna transcripts. enzymes in dna and rna degradation: nucleases, ribonucleases, classification and role.</p> <p>Key words: Post transcriptional events, enzymes</p>	10hours
4.0	<p>Translation: genetic code, triplet codon, universality features of the genetic code, assignment of codons, studies of khorana, nirenberg, triplet binding techniques, degeneracy, wobble hypothesis, evolution of genetic code and codon usage, variation in the codon usage.</p> <p>Key words: Codes, codons, Bias</p>	8hours
5.0	<p>3d structure of prokaryotic and eukaryotic ribosomes, ribosomal protein synthesis; initiation elongation and termination. role of mrna and trna. amino acyl trna synthesis and its role in translation accuracy. internal ribosome entry sites.</p> <p>Key words: Translation, factors</p>	6hours
6.0	<p>Post Translation Modification Of Proteins, signal cleavage, disulphide bond formation, O and N-glycosylation, folding of nascent protein, role of chaperones, attachment of glycosyl anchor, and other modifications. dna binding protein motifs-zinc finger, leucine zipper, h-t-h motif.</p> <p>Key words: Significance of PTM</p> <p>Note: Course content involves 100% theory</p>	8hours

Books for Reference					
Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Genes VII	Lewin B	Oxford univ. Press,	5	1994
2.	Molecular Biology	Robert F. Weaver	McGraw-Hill	4	2008
3.	Cell and Molecular Biology-Concepts and experiments	Karp, G.	Wiley & son	2	1999
4.	The Cell-A Molecular Approach.	Cooper, Geoffrey M	Sinauer Associates	2	2000
5.	Cell and Molecular Biology.	De Robertis, E.D.P. and De Robertis	B. I. Waverly pvt. Ltd.	8	1995

Additional Books for Reference					
Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Molecular cell biology	Harvey Lodish & David Baltimore.	WH. Freeman and company	4	2000
2.	Principles of Cell and Molecular Biology	Kleinsmith, L. J. & Kish, V.M..	Harper Collins Publishers	2	1995
3.	Molecular cell biology	Harvey Lodish & David Baltimore.	WH. Freeman and company	6	2005

FIRST YEAR-II SEMESTER

Course Title	CARBOHYDRATE & LIPID METABOLISM							
Course Type	Hard Core-Theory	Total Hours	48	Hours/Week	03	Credits	03	
Course Code	B0230	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)			
CO No.	Course Objectives		
CO-1	understand the metabolism of pathways that yield energy from carbohydrate & lipid		
CO-2	Analyze & understand the diversity of metabolic regulation involved carbohydrate metabolism		
CO-3	Analyze & understand the metabolic regulation involved lipid metabolism		
CO-4	understand and analyze how these biochemical processes are integrated with lipids & carbohydrate metabolism		
MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Understand and explain major pathways like Glycolysis, TCA cycle, Urea cycle etc.	PSO- 1	Remember
CLO-2	Understand biosynthesis and elongation of fatty acids.	PSO- 2	Understand

CLO-3	Analyse bioenergetics of carbohydrates, fatty acids etc. in plants and animals	PSO- 3	Remember
CLO-4	understand and analyze how these biochemical processes are integrated with lipids & carbohydrate metabolism	PSO -4	Analyse

Modules	COURSE CONTENTS	Duration
1.0	<p>Introduction: Catabolism, Anabolism, Catabolic, anabolic and amphibolic pathways</p> <p>Carbohydrate Metabolism :Cellular ingestion of glucose, Glycolysis, Energetics regulation , pathways of utilization of Pyruvate, lactate, ethanol, Gluconeogenesis, regulation, Cori cycle, glucose paradox , citric acid cycle its regulation, Energetics , Anaplerosis, Glyoxylate cycle , HMP shunt pathway, Interconversion of Hexoses , utilization of non glucose sugars : uptake and metabolism of fructose Biosynthesis of Sucrose, Starch , Glycogen</p> <p>Keywords: Metabolic pathways, non glucose sugars</p>	14hours
2.0	<p>Hormonal Regulation: Effect and action of Insulin ,Glucagon, Catecholamines, Growth Hormones Thyroid hormone & Corticosteroids on Carbohydrate And Lipid Metabolism in Liver And Adipose tissue. Disorders of Carbohydrate Metabolism: Diabetes Mellitus: Classification.</p> <p>Keywords: Hormonal Regulation</p>	6hours
3.0	<p>Lipid Metabolism: Degradation of Triacylglycerols, Phospholipids and Sphingolipids , fatty acid degradation : α, β-oxidation, regulation, Knoop's experiment , saturated and unsaturated fatty acids</p> <p>Energetics And Biosynthesis of Fatty Acids : Fatty Acid Synthetase Complex, Chain Elongation And Desaturation, Pathways In Plants And Animals : Conversion of Linoleate to Arachidonic (Scheme Only), Ω3 And Ω6 Fatty Acids And Their Conversion To Pro/Anti Inflammatory Mediators , Regulations : Lipase, Hormone Sensitive Lipase, Phospholipases And Sphingomyelinase.</p> <p>Keywords: Biosynthesis & degradation of lipids</p>	10hours
4.0	<p>Biosynthesis , Degradation & Regulations: Metabolism of Circulating Lipids: Chylomicrons, HDL, LDL And VLDL, Reverse Cholesterol Transport By HDL, Oxidized Lipids And Their Metabolism : Foam Cell Formation , Regulation Of Blood Cholesterol, Triglycerides, LDL And HDL, Cholesterol Biosynthesis : Conversion Of HMG CoA To Cholesterol And Other Lipids</p> <p>Keywords: Circulating Lipids, Foam Cell Formation</p>	9hours
5.0	<p>Phospholipid Biosynthesis and Regulations: Denovo pathway and inter conversion, biosynthesis of phospholipids, Sphingolipids, ether lipids and glycolipids, degradation and biosynthesis of gangliosides and cerebroside. biosynthesis of prostaglandins, thromboxanes, leukotrienes</p> <p>Integration of Metabolic Pathways: Integration of Carbohydrate and Lipid Metabolism , their Regulation and Manipulation</p> <p>Keywords: inter conversion, metabolic integration , eicosanoids</p> <p>Note: Course content involves 100% Theory</p>	9hours

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Lehninger Principles Of Biochemistry	David L. Nelson And Michael M. Cox	W.H. Freeman & Company	4	2004
2.	Biochemistry	Lubert Stryer, Jeremy M. Berg, John L. Tymoczko,	Freeman & Co, New York,	5	1988
3.	Biochemistry	Geoffrey Zubay	WBC Publishers	4	1998
4.	Fundamentals of Biochemistry	Deb A.C	New Central Agency	3	1989

Additional Books for Reference:

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Fundamentals of biochemistry	Jain, J.L	S.Chand publication	6	2005
2.	Concepts in cell & molecular biology	Rastogi S.C, V.N. Sharma, Anuradha Tanden	New age publishers	3	2010

FIRST YEAR-II SEMESTER

Course Title	Cell Biology, Molecular Biology, Carbohydrate and Lipid Metabolism						
Course Type	Hard Core- Practical	Total Hours	48	Hours/Week	06	Credits	03
Course Code	BP210	Evaluation	Internal	C1+C2 = 15+15		30 Marks	
			External	Duration	C3	03Hrs	70 Marks
							100

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	Plan experiments, write protocols, understand and interpretation experimental results pertaining to Metabolism, Molecular Biology and Cell Biology
CO-2	Perform logical reasoning and criticizing data

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Isolate and purify Nucleic acid	PSO- 1	Understand
CLO-2	Make use of biochemical techniques in studying membrane function	PSO -4	Understand
CLO-4	Analyze activity of clinically significant enzymes	PSO- 4	Application

Modules	COURSE CONTENTS	Duration
1.0	Cell Biology	
1.1	Erythrocyte lysis profile in sodium chloride solution	4hours
1.2	Erythrocyte cholinesterase activity and inhibition by pesticide residues	4hours
1.3	Erythrocyte membrane protein electrophoresis- SDS, PAGE molecular weight calculation	4hours
1.4	Glucose uptake in Yeast cells. Kinetics of uptake	4hours
2.0	Molecular Biology	
2.1	Isolation of DNA and RNA from biological sources	4hours
2.2	Estimation of DNA by diphenylamine reagent	4hours
2.3	Estimation of RNA by orcinol reagent	4hours
2.4	Electrophoresis of DNA and RNA	4hours
3.0	Carbohydrate and Lipid Metabolism	
3.1	Determination of Pyruvate	4hours
3.2	Amino transferase reaction	4hours
3.3	Determination of Lactate, activity of LDH	4hours
3.4	Determination of Phospholipase and Lipase activity, Lipoprotein Lipase assay	4hours

Note: Course content involves 100% Practicals

Books for reference:					
Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Text book of Medical laboratory technology	Praful. B. Godkar	Bhalani Publishing house	3, Volume I and II	2014
2.	Biochemical Methods	Sadasivam, S. and Manickam, A	New Age International (P) Ltd	3	2010

Additional books for reference:					
Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Medical Laboratory Technology	Kanai L. Mukerjee	Tata McGraw Hill Education	2	2011

FIRST YEAR-II SEMESTER

Course Title	HORMONES AND CELL SIGNALLING							
Course Type	Soft Core- Theory	Total Hours	48	Hours/Week	03	Credits	03	
Course Code	B0310	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	Understand the Structure and functions of Hypothalamic and pituitary hormones.
CO-2	Understand the hormonal regulations of thyroid and parathyroid glands.
CO-3	Understand the synthesis, secretion, metabolism, regulation and biological effects of adrenal hormones
CO-4	Understand the structure, metabolism and biological actions of gonads and pancreatic hormones.
CO-5	Understand the Fundamentals concepts of signal transduction and signaling pathways

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Explain various hormones secreted by endocrine glands and their functions.	PSO -1	Understand
CLO-2	Understand the anatomy of the endocrine system.	PSO- 2	Remember
CLO-3	Understand the basic properties of hormones.	PSO- 2	Understand
CLO-4	Explain the role of the hormones in maintaining bodyfunction.	PSO -3	Remember
CLO-5	Understand and explain the major endocrine disorders	PSO -4	Apply

Modules

COURSE CONTENTS

Duration

- | | | |
|------------|--|----------------|
| 1.0 | <p>Endocrine System: Endocrine organs in man. Location and inter relationship of endocrine glands in man; hormones produced by hypothalamus, pituitary, thyroid, parathyroid, pancreas, adrenals, gonads. Hypo and hyper production of hormones secreted by; pituitary, thyroid, pancreas, adrenals and gonads. Heart and kidney as endocrine organs</p> <p>Key words: Hormones and organs</p> | 12hours |
| 2.0 | <p>Hormones produced by hypothalamus; GRH, somatostatin, TRH, CRH, GnRH. Hormones of anterior, posterior and median lobes. Pro-opiomelanocortin. Hormones produced by testes and ovaries, menstrual cycle.</p> <p>Key words: POMC, reproductive hormones, hypothalamus, pituitary</p> | 8hours |
| 3.0 | <p>Regulation of hormone production and release: hypothalamus-pituitary-target organ axis and regulation by feedback mechanism. Conversion of cholesterol to steroid hormone.</p> <p>Key words: Inhibition, steroid hormone</p> | 4hours |

- 4.0 Mechanism of hormone action:**
Peptide hormones: General mechanisms of cell signaling by hydrophilic factors, transmembrane receptors, G protein coupled receptors, α_i and α_s receptor tyrosine kinase. Visual cycle, gustatory and auditory signals. Ion Channel receptors, Sodium channel
Key words: Receptors, signal transduction **14hours**
- 5.0 Second messengers:** IP₃, DAG, cAMP, protein Kinases. Nitric oxide; generation and action.
Growth factors: Structure, mechanism of action and receptors of EGF, PDGF. Structure and function of insulin receptor.
Key words: NO synthase, insulin, endothelium, platelets **6hours**
- 6.0 Mechanism of action of steroid hormones:** Steroid receptors, mechanism of action of estrogen receptors. Receptor down regulation, desensitization and up regulation.
Key words: Steroid receptors, Regulation **6hours**
- 7.0** Pineal gland, melatonin and circadian rhythm. Chemistry and action of prostaglandins, Prostacyclins and Thromboxanes. Eicosanoidreceptors.
Key words: lipid mediators, melatonin, serotonin **6hours**
- 8.0 Insect hormones:** Structure and function of molting hormone, ecdysone, juvenile hormones,
Pheromones: Mechanism of perception and action. Special case of communication in honey bees -dance language
Key words: Significance of insect hormones, communication **8hours**
- Note: Course content involves 100% theory**

Books for Reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Biochemistry of Signal Transduction and Regulation	Gerhard Krauss	Wiley VCH	3	1999
2.	Concepts in cell & molecular biology	Rastogi S.C, Sharma, Anuradha Tanden	New age publishers	3	2010

Additional books for reference:

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Cell Biology, Genetics, Molecular Biology, Evolution & Ecology	Verma P.S. Agarwal V.K	S Chand publication	5	2006
2.	Biochemistry of Signal Transduction and Regulation	Gerhard Krauss	Wiley VCH	5	2014
3.	Biochemical Messengers: Hormones, neurotransmitters and growth factors	D. Hardie	Springer	2	2012

FIRSTYEAR-II SEMESTER

Course Title	BIOPHYSICS						
Course Type	Soft Core- Interdisciplinary	Total Hours	48	Hours/Week	03	Credits	03
Course Code	B0510	Evaluation	Internal	C1+C2 = 15+15		30 Marks	100

COURSE OBJECTIVES (COs)	
CO No.	Course Objectives
CO-1	Understand the basic concepts of atomic structure and explain the fundamental principles & origin of spectral lines
CO-2	Describe the structure of cell membrane, membrane transport systems and membrane potential.
CO-3	Relate and differentiate various biopotential measuring instruments
CO-4	differentiate working principle, instrumentation and applications of various bio-analytical instruments
CO-5	design an experiment with step-by-step instructions to address a research problem or bio-analytical practical.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Recall the basic concepts of atomic structure and explain the fundamental principles & origin of spectral lines	PSO-1	Understand
CLO-2	Recall and describe the structure of cell membrane, membrane transport systems and membrane potential.	PSO-2	Remember
CLO-3	Relate and differentiate various biopotential measuring instruments	PSO-2	Apply
CLO-4	Identify and differentiate working principle, instrumentation and applications of various bio-analytical instruments	PSO-3	Analyse
CLO-5	Reproduce and design an experiment with step-by-step instructions to address a research problem or bio-analytical practical/project	PSO-4	Apply

Modules

COURSE CONTENTS

Duration

1.0

Introduction :The broad characteristics of a typical cell, cell organelles, the molecular composition of a cell Biological molecules and their general character, cell behavior, viruses, genetics and biophysics

Molecular physics: The conservation of energy in biological process, metabolism or chemical energy turnover

Statistical thermodynamics and biology :The theory of absolute reaction rates, thermal inactivation, the entropy transfer of living organisms

Information theory: Relation between information and entropy, information content of some biological systems, information content of a bacterial cell

Keywords: cell, Statistical thermodynamics

16hours

2.0 Structure Analysis of Biomolecules: Determination of size and shape of molecules: Introduction - random motion, diffusion, sedimentation, Optical methods: rotational diffusion and birefringence

X-ray analysis and molecular structure: Diffraction of X-rays, crystal structure and the unit cell, Diffraction patterns of some protein fibers, The structure of globular proteins , The structure of polypeptide chains - the pleated sheets and beta-keratin, the alpha-helix and alpha-keratin, The structure of nucleic acids polymers, the structure of nucleoproteins, the analysis of virus structures

16hours

Keywords: Optical methods, X-ray analysis

3.0 Molecular Spectroscopy: Absorption spectroscopy and molecular structure: Vibrations of polyatomic molecules, characteristic bond frequencies, Raman spectra and the dipolar nature of amino acids, The vibrational spectra of proteins, the energy levels of hydrogen bonded structures, Absorption coefficient and cross section, Experimental techniques for absorption measurements, absorption by oriented dipoles, dichroic ratios of proteins and nucleic acids, electronic spectra of polyatomic molecules , Ultraviolet absorption by proteins and nucleic acids, the fine structure in spectra, polarized ultra violet light spectroscopy, Electron spin resonance (qualitative), nuclear magnetic resonance (qualitative)

16hours

Keywords: vibrational spectra, Ultraviolet absorption

Note: Course content involves 100% Theory

Books for Reference:

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	A Guide to principles and techniques of practical biochemistry	K.Wilson & K.Goulding	Cambridge University Press	3	1994
2.	Principles and techniques of practical biochemistry	Bryan L.Williams and Keith Wilson	Cambridge University Press	4	1996
3.	Principles &Techniques of Biochemistry and Molecular Biology	Keith Wilson & John Walker	Cambridge University Press	7	2010
4.	Introductory Practical Biochemistry	S.K. Sawhney & R. Singh	Alpha Science International Ltd	5	2005
5.	Introduction to spectroscopy	Pavia	Cengage Learning India Private Limited	3	1999

Additional Books for Reference:

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	An Introduction to Practical Biochemistry	David Plummer	Mc Grow Hill education	3	2011
2.	Text book of Biophysical Chemistry	Upadyaya & Upadyaya	Himalaya Publishing House Pvt. Ltd.	4	2016
3.	Instrumental Methods of Analysis	Muralidhara Rao	CBS Publishers & Distributors	1	2013

FIRSTYEAR-II SEMESTER

Course Title		PHARMACOLOGY OF PLANT PRODUCTS					
Course Type	Soft Core- Theory- ID	Total Hours	48	Hours/ Week	03	Credits	03
Course Code	B0530	Evaluation	Internal	C1+C2 = 15+15		30 Marks	100
			External	Duration	C3	03Hrs	
COURSE OBJECTIVES (COs)							
CO No.	Course Objectives						
CO-1	Understand the traditional uses of plants as medicines						
CO-2	Gain knowledge in pharmacokinetics and pharmacodynamics in drug development						
Mapping of CLOs with PSOs &CDLs							
CLOs No.	Course Learning Outcomes(CLOs) On completion of the course the student will learn to			PSOs Addressed		CLDs	
CLO-1	Understand the extraction techniques, isolation of plant derived products			PSO-1		Understand	
CLO-2	Understand the importance of phytochemicals and other plant products in drug formulation.			PSO-2		Application	
CLO-3	Standardization of the plant based drugs			PSO-4		Application	

Modules	COURSE CONTENTS	Duration
1.0	<p>Introduction to basic concepts of pharmacology: Definition, sources of drugs & routes of drugs administration, Therapeutic drug monitoring system-Basic principles of TDM, Therapeutic index, Prodrug concepts</p> <p>Plant products as drugs: Historical aspects of plant usage, Whole plants, Plant extracts, Tinctures, Teas, Portions</p> <p>Keywords: Prodrug, Therapeutic drug</p>	9 hours
2.0	<p>Terpenes- mevalonate, Phenols- CBD, Ferulic acid, Ellagic acid, Tannins-gallic acid, Flavonoids – Quercetin, Alkaloids- nicotine, caffeine, Nitrogenous Compounds</p> <p>Keywords: Terpenes, tannins, Alkaloids</p>	9hours
3.0	<p>Extraction and characterization of bioactive components from plants: Biochemical action of some phytochemicals- Quercetin, Ellagic acid, Curcumin</p> <p>Plants for treatment of diseases: Diabetes, CVD, Alzheimers, Cancers</p> <p>Drug delivery systems: Sustained release, Enteric coated formulations liposome and nanoparticles</p> <p>Keywords: Extraction and characterization of bioactive components</p>	9 hours
4.0	<p>Pharmacokinetics: Basics of pharmacokinetics, Calculation of pharmacokinetic estimates, Compartment models used in pharmacokinetics (oral and intravenous), Compartment fitting (one comp & two comp), Pharmacodynamic /pharmacokinetic (PK/PD) correlation</p> <p>Pharmacodynamics: Types of action, Mechanism of drug action</p> <p>Drug receptor interaction with examples: Agonist, Antagonist, Partial agonist</p> <p>Keywords: Pharmacokinetics, Pharmacodynamics</p>	9hours
5.0	<p>Clinical Trials: Clinical evaluation of new drug, Phases of clinical trial, Ethics and protocol, Preparation of clinical trial, New drug development process and drugs registration</p> <p>AYUSH and Ayurvedic drugs</p> <p>Pre-Clinical Pharmacokinetic and Dynamic studies: Lipinski's rule for drug like molecule, High throughput screening (<i>invitro and invivo</i>) for pre-clinical pharmacokinetic and pharmacodynamic studies</p> <p>Keywords: Clinical Trials</p> <p>Note: Course content involves 100% Theory</p>	12 hours

Books for reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Textbook of Pharmacology	Barar F S K	S Chand & Company	1	2012
2.	Text Book of Phytochemistry	Iqbal A	Discovery Publishing House Pvt. Ltd.	1	1993
3.	Pharmacognosy and Phytochemistry: v. II	Vinod D. Rangari	Career Publications	2	2009
4.	Medicinal Plants: 2: Phytochemistry, Pharmacology and Therapeutics	V. K. Gupta , Dr. Anpurna Kaul & Surjeet Singh	Daya Publishing House	2	2012

Additional books for reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Editi on	Year of publication
1.	Essential of Pharmacotherapeutuics	Barar F S K	S Chand & Company	1	2000
2.	Review of Pharmacology	Gobind Rai Garg & Sparsh Gupta	Jaypee Brothers	12	2018
3.	Medical Pharmacology	Padmaja Udaykumar	CBS publishers & distributors	5	2016

SECOND YEAR-III SEMESTER

Course Title	NITROGEN METABOLISM						
Course Type	Hard Core- Theory	Total Hours	48	Hours/Week	03	Credits	03
Course Code	C0210	Evaluation	Internal	C1+C2 = 15+15		30 Marks	
			External	Duration	C3	03Hrs	70 Marks

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	Describe the modes of nitrogen fixation (both biological and abiological)
CO-2	Explain the steps involved in nitrogen fixation by free living organisms & leguminous plants
CO-3	Describe the assimilation of nitrate and ammonia by plants
CO-4	Describe amino acid synthesis

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Explain the plant tissue structure, transport mechanism	PSO-2	Understand
CLO-2	Explain the role of the nitrogen cycle in plants	PSO-3	Apply
CLO-3	Describe amino acid synthesis	PSO-1	Understand

COURSE CONTENTS**Modules****Proposed Course Content****Duration**

- 1.0 Nitrogen Metabolism:** Importance Of Nitrogen In Biological Systems, Nitrogen Cycle. Nitrogen Fixation; Symbiotic And Non-Symbiotic, Nitrogenase Complex, Energetics And Regulation. Formation Of Root Nodules In Legumes. Assimilation Of Nitrate And Ammonium Ion.

8hours**Key words: Plant system, atmosphere**

- 2.0 Proteins:** General Mechanisms of Degradation In Cells; Ubiquitin-Proteasome Pathway, Lysosomal Pathway. Degradation And Biosynthesis Of Glycoproteins And Proteoglycans. Biosynthesis And Degradation Of Heme And Porphyrins. Non Ribosomal Peptide Synthesis: Glutathione, Gramicidine. Biosynthesis Of Creatine **10hours**
- Key words: protein degradation, GAGs, Glycans, blood**
- 3.0 General Mechanisms of Amino Acid Metabolism And Regulations:** Deamination, Transamination, Decarboxylation, Desulphuration, Degradation And Biosynthesis Of Individual Amino Acids. Ketogenic And Glucogenic Amino Acids. **14hours**
- Key words: enzymes**
- 4.0 Regulation Of Amino Acid Biosynthesis:** aspartate family, branched chain amino acids, aromatic amino acids, histidine, transglutaminase cycle, glutamate dehydrogenase, urea cycle. inborn errors of amino acid degradation; phenyl ketonuria, alkaptonuria, maple syrup urine. **8hours**
- Key words: Disorders, inhibition**
- 5.0 Purines And Pyrimidines:** pathways of degradation of nucleic acids, purines and pyrimidines, uric acid formation. salvage pathways, de novo biosynthetic pathways for purines and pyrimidines and regulations. gout and lysch-nyhan syndrome. conversion of nucleotides to deoxynucleotides. mechanism of action of methotrexate **12hours**
- Key words: Cancer, syndromes, nucleotides, nucleosides**
- 6.0 Biosynthesis of Cofactors:** NAD⁺, FAD And Coenzyme A, Polyamine Biosynthesis And Their Metabolic Role. Polyamine Biosynthesis– spermine and spermidine **6hours**
- Key words: Metabolism**
- Note: Course content involves 100% Theory**

Books for Reference:

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Plant Physiology	Kochhar	Cambridge India	1	2016
2.	Plant Physiology	Malik C.P	Kalyani Publishers	1	2014
3.	Textbook of Biochemistry	DrKondreddy Rambabu	Aitbs Publishers	1	2013

Additional books for reference:

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	A Textbook of Plant Physiology, Biochemistry and Biotechnology	S K Verma & Mohit Verma	S Chand publishers	4	1995
2.	Lehninger Principles of Biochemistry	David L. Nelson and Michael M. Cox	W.H. Freeman & company	4	2004
3.	Plant Physiology and Biochemistry	H. S. Srivastava & N. Shankar	Rastogi Publications	1	2005

Course Title	GENETIC ENGINEERING AND GENE EXPRESSION						
Course Type	Hard Core- Theory	Total Hours	48	Hours/Week	03	Credits	03
Course Code	C0220	Evaluation	Internal	C1+C2 = 15+15		30 Marks	
			External	Duration	C3	03Hrs	70 Marks
							100

COURSE OBJECTIVES (COs)	
CO No.	Course Objectives
CO-1	Understand the principles of the techniques of Gene transfer methods.
CO-2	Analyze the methods of screening for Tissue culture.
CO-3	Evaluate the various techniques used in In vitro fertilization and embryo transfer.
CO-4	Analyze and evaluate the different applications of Bioprocess Technology.

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	understand the concept of recombinant DNA technology or genetic engineering	PSO-2	Understand
CLO-2	Understand the Plant Tissue Culture and Transgenic plant technology	PSO-3	Apply
CLO-3	Explain the general principles and applications of Bioprocess Technology	PSO-1	Analyse
CLO-4	explain the concept and applications of In vitro fertilization and embryo transfer methods	PSO-1	Understand
CLO-5	Provide examples of current applications of biotechnology	PSO-4	Remember

Modules	COURSE CONTENTS	Duration
1.0	<p>Genetic Engineering: Extraction and purification of nucleic acids (DNA and RNA) from biological sources. Definition, aims and objectives of recombinant DNA technology, restriction-modification systems, restriction enzymes; type I, II and III, specificity, sticky ends and blunt ends, isoschizomers. Gene cloning; genomic cloning, shot gun cloning, cDNA cloning.</p> <p>Vectors: Plasmids, phage, cosmids and phagemid. Yeast cloning vectors, plant vectors, bacterial artificial chromosome, SV40, shuttle vectors, construction of expression vectors.</p> <p>Key words: methods, Sites-ORI, genes, significance, Vectors</p>	6hours
2.0	<p>Ligation: Blunt end and sticky end ligation, use of linkers and adopters, homo polymer tailing, colony hybridization, plaque hybridization.</p> <p>Transformation: Micro injection, electroporation, lipofection, calcium phosphate method, protoplast fusion/somatic cell hybridization and biolistic methods.</p> <p>Transgenic plants and animals, gene knock out</p> <p>Key words: identification, ligation, transformation, gene knock out</p>	6hours

- 3.0** **Techniques:** chromosome walking, PCR; analysis of products, nested PCR, applications of PCR in cloning, agriculture and medicine. RT-PCR technique and applications. Real time PCR for quantification.
Identifying the right clone: Direct screening; insertional inactivation of marker gene, visual screening, and plaque phenotype. Indirect screening; immunological techniques, hybrid arrest translation, hybrid select translation. Screening using probes; construction of gene probes, hybridization and labeling
6hours
- 4.0** **Mapping in Prokaryotes and Viruses:** Bacterial transformation and transduction, conjugation; F+ plasmids, Hfr cells, time of entry mapping. Arrangement of genes in phage chromosome, plaque formation and lytic cycle. Fine structure of rII locus of T4. Lysogeny and lambda phage.
Key words: Quantification, identification
6hours
- 5.0** **Blotting techniques:** Dot blot, Southern, Northern, Western blot, DNA foot print assay, DNA finger print assay, gel retardation assay, nuclease protection assay. RFLP, RAPD
Applications: Gene therapy, applications in agriculture medicine, industry. GM foods, terminator gene, negative impact of genetic engineering.
Key words: lysis, lysogeny, phages, genes
6hours
- 6.0** **Regulation of gene expression in prokaryotes:** Operon concept-Lac operon, structure and regulation Dual functions of the repressor in arabinose operon , gal operon- role of two operators, tryptophan operon- Transcriptional control by attenuation in tryptophan operon. **Riboswitches-** Role of riboswitches, CRISPR-CAS
Key words: operons, gene editing
6hours
- 7.0** **Regulation of Eukaryotic gene expression - Regulation at the level of genome-nucleosome structure, Chromatin remodelling, SWI/SNF complex, Chromatin immunoprecipitation (ChIP) analysis, Role of histone modification, Histone code Hypothesis, Transcription factors- NFkB, Si RNA, mi RNA, RNA stability, Regulation of GCN-4**
Key words: RNA types, gene regulation
Note: Course content involves 100% Theory
6hours

Books for Reference:					
Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Introduction to Genetic Engineering	Desmond S. T. Nicholl	Cambridge University Press	3	2008
2.	Genetic Engineering Handbook	David Rhodes	Syrawood Publishing House	1	2017
3.	Principles of Biotechnology and Genetic Engineering	A.J. Nair	Laxmi Publications	2	2009

Additional books for reference:					
Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Principles of Gene Manipulation and Genomics	Sandy B. Primrose, Richard Twyman	Wiley-Blackwell	7	2006
2.	Genetic Engineering	Smita Rastogi, Neelam Pathak	Oxford	1	2009
3.	Laboratory Manual for Genetic Engineering	Vennison& S John	Prentice Hall India Learning Private Limited	1	2009

SECOND YEAR-III SEMESTER

Course Title		IMMUNOLOGY						
Course Type	Hard Core-Theory	Total Hours	48	Hours/Week	03	Credits	03	
Course Code	C0230	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	Understand and apply the types of immunity and lymphoid organs and lymphocytes
CO-2	Understand Immunity and Complement System
CO-3	Understand and apply the various Immunological Techniques in daily life style
CO-4	Understand the Transplantation and Tumour Immunology and apply the mechanism of autoimmunity

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	State the role of the immune system in the human body	PSO-2	Understand
CLO-2	Describe the functions of Immunity and Complement System	PSO-3	Apply
CLO-3	Describe Immunological techniques	PSO-1	Analyse
CLO-4	Define the gene organization and explain their	PSO-1	Understand

	functions		
CLO-5	Explain Autoimmune and Immunodeficiency Disorders and explain their causes	PSO-4	Remember

Modules	COURSE CONTENTS	Duration
1.0	<p>Introduction: Historical Development And Milestones In Immunology, Antigenicity, Immunogenicity, Innate And Acquired Immunity, Primary And Secondary Lymphoid Organs , Self And Non Self Discrimination ,Antigens And Antibodies, Haptens , Determinants , Epitopes And Paratopes, Carbohydrates, Proteins, Nucleic Acids and Cells as Antigens , Valency of Antigen, Epitope Analysis, Classes And Subclasses of Immunoglobulins, Structure of Immunoglobulins, Hyper Variable Region- Isotypic , Allotypic & Idiotypic Variation</p> <p>Keywords: Epitope, Valency, Hyper Variable Region</p>	10hours
2.0	<p>Cellular Basis of Immunity : Primary And Secondary Immune Response, Reticuloendothelial System ,T, B And Accessory Cells, Development of T And B Cells, Sub Sets of T And B Cells : T-Helper Cells, T-Killer Cells, T-Suppressor Cells, T And B Cell Receptors, Antigen Processing and Presentation, T and B Interaction, Cytokines and Co-Stimulatory Molecules, Lymphokines, Interleukins, Structure And Function of Il-La, Il-2, Tnfa, Suppression of Immune Response, Immunoglobulin Genes, Generation of Immunoglobulin Diversity, Gene Rearrangement and Other Mechanisms, Clonal Selection theory of Burnet</p> <p>Keywords: Selection theory, Antigen Processing</p>	10hours
3.0	<p>Non-specific defenses in man: Barriers to infection : skin, mucous membranes, Inflammation, Complement hyper sensitivity reactions (Type I, II, III and IV) , Defensins, Toll-like receptors, DAMP , PAMP , Pattern recognition</p> <p>MHC: MHC gene and its polymorphism , Role of MHC in immune response and transplantation</p> <p>Transplantation: Autograft, Isograft, Allograft , Xenograft , Graft rejection : graft vs. host reaction</p> <p>Keywords: Transplantation, Barriers to infection</p>	10hours
4.0	<p>Tumour immunology: Tumour associated antigens , Factors favoring tumour growth, Immune surveillance ,Tumour necrosis factor- α and β.</p> <p>Disorders of immunity: Immunological tolerance, auto immune disorders, AIDS , SCID</p> <p>Keywords: Tumour associated antigens, Immunological tolerance</p>	10hours
5.0	<p>Vaccines: Adjuvants, vaccines and their preparations, Polyclonal and monoclonal antibodies , hybridoma technique</p> <p>In-vitro antigen-antibody reaction: Precipitation , Agglutination , Complement fixation, Immunodiffusion , Immuno electrophoresis , Defense system in lower organisms</p> <p>Keywords: Vaccines, hybridoma technique, Defense system</p> <p>Note: Course content involves 100% Theory</p>	8hours

Books for reference:					
Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Essentials of Immunology	Janis Kuby	Freeman, W. H. & Company	3	1997
2.	Monoclonal Antibodies – Principles and Practice	J. W. Goding	Academic Press	3	1996
3.	Immunology	Roitt Ivann, Jonathan Brastoff, David Male	Mosby-Year Book	1	1993

Additional books for reference:					
Sl. No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Roitt's Essential Immunology	Peter J. Delves , Seamus J. Martin Dennis R. Burton Ivan M. Roitt	Wiley-Blackwell	12	2011
2.	A Textbook of Immunology	Latha P.Madhavee	S Chand & Company	1	2012
3.	Immunology	Dulsy Fatima, N Arumugam	Saras Publication	1	2014

SECOND YEAR - SEMESTER - III

Course Title								
NITROGEN METABOLISM, IMMUNOLOGY AND GENE EXPRESSION								
Course Type	Hard Core-Practical	Total Hours	48	Hours/Week	06	Credits	03	
Course Code	CP210	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	understand and apply the knowledge of the theory and practice of various clinical techniques like genetic engineering and immunology
CO-2	Identify and analyze the staining techniques
CO-3	Understand principles, theory and calculations of each experiment
CO-4	Perform quantitative and qualitative analysis of known standards as well as unknown samples develop problem-solving skills and to nurture professional attitudes
CO-5	Understand the applicability of the biochemical methods to realistic situations.

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Gain technical experience and handle adjustable micro pipettes in a reproducible manner	PSO- 1	Understand

CLO-2	Plan experiments, write protocols	PSO- 2	Remember
CLO-3	Perform logical reasoning and criticizing data	PSO -2	Understand
CLO-4	Demonstrate the use of advance microscope.	PSO -3	Remember
CLO-5	Understand and interpretation of test results	PSO- 4	Analyse

Modules	COURSE CONTENTS	Duration
1.0	Nitrogen Metabolism	
1.1	Estimation of ammonia	3hours
1.2	Nitrogen content of food by digestion and nitrogen estimation	3hours
1.3	Estimation of Urea	3hours
1.4	Estimation of Uric acid	3hours
1.5	Estimation of creatine and creatinine	3hours
2.0	Genetic Engineering	

COURSE OBJECTIVES (COs)

2.1	Induction of Beta galactosidase in E.coli	3hours
3.0	Immunology	
3.1	Immunodiffusion	3hours
3.2	Purification of IgY	3hours
3.3	Demonstration of ELISA	3hours
3.4	Assay of superoxide, Hydrogen peroxide, free radicals and free radical scavenging	3hours
3.5	Macrophage phagocytosis	3hours
3.6	Cell counting of WBC and Platelets	3hours
3.7	Blood Grouping	3hours

Note: Course content involves 100% Practicals

Books for reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Varley's Practical Clinical Biochemistry	Alan H .Gowenhock	CBS publishers.	6	2014
2.	Text book of Medical laboratory technology	Praful. B. Godkar	Bhalani Publishing house	3, Volume I and II,	2014
3.	Biochemical Methods	Sadasivam, S. and Manickam, A	New Age International (P) Ltd	3	2010

Additional books for reference:

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Medical Laboratory Technology	Kanai L. Mukerjee	Tata McGraw Hill Education	2	2011

CO No.	Course Objectives
CO-1	Remember the historical background for Clinical Biochemistry and understand the basic elements of core biochemistry and specialized test in carbohydrates
CO-2	Analyze the lipid, protein and nucleic acid Metabolism abnormalities.
CO-3	Understand and identify the main test functions
CO-4	Understand the renal function test in clinical biochemistry.
CO-5	Evaluate the scientific explanations cancer and evaluate the role of biomarkers in disease diagnosis.

SECOND YEAR-III SEMESTER

Course Title	CLINICAL BIOCHEMISTRY						
Course Type	Soft Core-Theory	Total Hours	48	Hours/Week	03	Credits	03
Course Code	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
		External	Duration	C3	03Hrs	70 Marks	

MAPPING CLO'S WITH PSO's AND CD's			
CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Discuss the biochemistry and pathophysiology associated with tests performed in a clinical biochemistry laboratory	PSO -1	Understand
CLO-2	Compare and contrast the basic differences between carbohydrate, lipid and protein metabolism abnormalities.	PSO- 2	Remember
CLO-3	Describe and identify the main characteristics of diagnosis, screening, and prognosis of disease.	PSO- 2	Understand
CLO-4	Critically evaluate the role of clinical biochemistry in diagnosis, monitoring and treatment.	PSO -3	Remember
CLO-5	Applications of biochemistry on health, medical diagnostics and pharmacy.	PSO -4	Apply

Modules	COURSE CONTENTS	Duration
1.0	<p>Basic Concepts: Health and Disease , Normal and pathological changes affecting cells in the body, cell death and the physiological causes, physical, chemical, biological agents and nutritional deficiency</p> <p>Blood: Cells , Functions of Plasma Proteins</p> <p>Keywords: <i>cell death, Plasma Proteins</i></p>	4hours
1.1	<p>Disorders of Hemoglobin: Thalassemia, Sickle Cell Anemia, Anemias: Microcytic, Normocytic and Macrocytic.</p> <p>Diagnostic Enzymology: Mechanisms of Elevated Enzyme Activities, Clinically Important Enzymes and Isoenzyme Changes- Alkaline Phosphatase , Creatine Kinase, LDH , AST, ALT</p> <p>Keywords: <i>Anemias, Isoenzymes</i></p>	4hours
2.0	<p>Endocrinology: laboratory diagnosis to assess the health , function & disorders of : pituitary, adrenals & thyroid gland: Graves' disease, Hashimoto disease , Addison's disease hypo and hyper secretion of hormones : Acromegaly, gigantism</p> <p>Laboratory diagnosis to assess the health , function & disorders of Liver: Biochemical indices of hepatobiliary diseases, bile pigments: formation of Bilirubin, urobilinogen, bile acids. disorders: jaundice : pre-hepatic, hepatic and post hepatic, diagnosis of liver function tests, diseases : hepatitis , cholestasis , cirrhosis, fatty liver, gallstones</p> <p>Keywords: <i>laboratory diagnosis of endocrine and liver health</i></p>	8hours
3.0	<p>Laboratory diagnosis to assess the health , function & disorders of Kidney: Creatine Clearance, Renal Calculi , Uremia Laboratory Investigation of Kidney Disorders</p> <p>Gastrointestinal Disorders: Fractional Gastric Analysis, Hypo And Hyper Acidity , Gastric Ulcers, Malabsorption Syndrome, Steatorrhea , Diarrhea</p> <p>Keywords: <i>Kidney Disorders, Gastric Ulcers</i></p>	8hours
4.0	<p>Disorders of amino acid, lipid, nucleic acid metabolism : Phenylketoneurea, Alkaptonuria, Lysch-Nyhan, Gout, Diagnosis of Metabolic Disorders : Amniocentesis</p> <p>Disorders of Carbohydrate Metabolism: Diabetes Mellitus, Classification, Etiology, Management, Laboratory Investigations, GTT , HbA1c , Diabetic Complications And Advanced Glycation End Products</p> <p>In Born Errors of Carbohydrate Metabolism: Pentosuria, Galactosemia, Lactose Intolerance, Glycogen Storage Diseases</p> <p>Keywords: <i>In Born Errors of Metabolism</i></p>	8hours
5.0	<p>Disorders of Lipid Metabolism: Hyper Lipoproteinemia And Types of Modification in Lipoproteins, Taysach's, Niemen- Pick Disease, Fabry's Disease</p> <p>Cardiovascular Disorders: Lipoproteinemia's , HDL And Reverse Cholesterol Transport, Major Cardio Vascular System, Atherosclerosis, Oxidation Hypothesis, Response to Injury Hypothesis, Inflammation as a cause , Risk Factors And Pathogenesis, Diagnosis And Prognosis, ECG</p> <p>Keywords: <i>Lipoproteinemia's, Oxidation Hypothesis</i></p>	8hours
6.0	<p>Cancer: Etiology, Diagnosis, Treatment and Prognosis, Carcinogens, Oncogens, and Mechanism of oncogenesis</p> <p>Biochemistry of Ageing: Cellular Senescence, Cystic Fibrosis, and Mechanism of Detoxification of Xenobiotics.</p> <p>Keywords: <i>Cancer, Cellular Senescence</i></p> <p>Course content involves 100% Theory</p>	8hours

Books for reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Clinical Biochemistry	Maheshwai Nanda	Jaypee Brothers Medical Publishers	2	2000
2.	Practical Clinical Biochemistry	Harold Varley	CBS Publishers	4	2005
3.	Handbook of Clinical Biochemistry	R. Swaminathan	World Scientific Publishing Co.,	2	2011

Additional books for reference:

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Manipal Manual of Clinical Biochemistry	Nayak Shivananda	Jaypee Brothers Medical Publishers;	4	2013
2.	Lecture Notes: Clinical Biochemistry	Simon W. Walker ,Geoffrey J. Beckett Peter Rae , Ashby	Wiley-Blackwell;	9	2013

SECOND YEAR - SEMESTER - III

Course Title		Genetics and Evolution					
Course Type	Soft Core- Theory	Total Hours		Hours/Week	03	Credits	03
Course Code	Evaluation	Internal	C1+C2 = 15+15			30 Marks	
		External	Duration	C3	03Hours	70 Marks	
100							

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	Understand basic concepts of genetics, helps to develop their analytical, quantitative and problem- solving skills from classical to molecular genetics
CO-2	Appreciate the concept in evolution of an organisms

Mapping of CLOs with PSOs &CDLs

CLOs No.	Course Learning Outcomes(CLOs) On completion of the course the student will learn to	PSOs Addressed	CLDs
CLO-1	Understand of the chemical basis of heredity	PSO-1	Understand
CLO-2	Understand the genetic methodology and how quantification of heritable traits in families and populations provides insight into cellular and molecular mechanisms.	PSO-4	Application
CLO-3	Understanding the role of genetic mechanisms in evolution	PSO-4	Remember
CLO-4	Understand the species concepts and human history	PSO-2	Understand

Modules	COURSE CONTENTS	Duration
1.0	<p>Basic Principles Of Mendelism: Laws Of Inheritance, Dominance, Co-dominance, Epistasis, (Coomb Shape In Chickens) Pleiotropism. Cytoplasmic Inheritances (Male Sterility In Plants, Shell Coiling).</p>	4 hours
2.0	<p>Keywords: Mendelian principles, segregation, inheritance</p> <p>Gene Linkage And Chromosome: Linkage And Recombination Of Genes In A Chromosome. Crossing Over Gene Mapping With Three Point Test Cross, Mapping By Tetrad Analysis. X-Linked Inheritance. Polygenic Inheritance, Mitochondrial Inheritance, Y-Chromosome Inheritance. Map Unit.</p> <p>Organization Of Genes In Chromosomes: C Value Paradox, Single Copy Gene, Gene Families, Tandemly Repeating Genes, Pseudo Genes. Chromosome Number: Ploidy, Karyotyping, Sex Chromosome And Dosage Compensation. Mobile Genetic Elements.</p> <p>Chromosomal Basis Of Human Diseases: Extra Or Missing Chromosome, Abnormality In Chromosome Structure; Deletion, Duplication, Inversion, Translocation</p>	10 hours
3.0	<p>Population Genetics: Populations, Gene Pool, Gene Frequency; Hardy-Weinberg Law; Concepts And Rate Of Change In Gene Frequency Through Natural Selection, Migration And Random Genetic Drift; Adaptive Radiation And Modifications; Isolating Mechanisms; Speciation; Allopatry And Sympatry; Convergent Evolution; Sexual Selection; Co-Evolution Of Predator-Prey, Pollinating Insects And Flowering Plants.</p> <p>Molecular Genetics: Mutations; Nature Of Mutations, Spontaneous And Induced Mutation, Conditional, Lethal (Temperature Sensitive) Mutation. Biochemical Basis Of Mutation. Point Mutation, Base Substitution Mutation, Missense, Nonsense And Silent Mutation. Mutation Rates. Chemical Mutagens, Radiation Induced Mutation, Reverse Mutations And Suppressor Mutations - Intergenic And Intragenic Suppression, Reversion As A Means Of Detecting Mutagens - Ames Test</p>	5 hours
4.0	<p>Repair Mechanism: Reciprocal Recombination, Site Specific Recombination, E.Coli Rec System. Holliday Model Of Recombination.</p> <p>Keywords: Evolutionary aspects, mutation types, mutagens,</p> <p>Emergence Of Evolutionary Thoughts: Lamarck; Darwin- Concepts Of Variation, Adaptation, Struggle, Fitness And Natural Selection. Mendelism; Spontaneity Of Mutations; The Evolutionary Synthesis. Basis For Darwin's Theory; Confounding Observations From Embryology, Comparative Anatomy And Biochemistry, Haeckel's Drawings Of Embryos To Fit The Theory Of Evolution.</p> <p>Origin Of Cells And Unicellular Evolution: Origin Of Basic Biological Molecules; Abiotic Synthesis Of Organic Monomers And Polymers; Concept Of Oparin And Haldane; Experiment Of Urey And Miller (1953); The First Cell; Evolution Of Prokaryotes; Origin Of Eukaryotic Cells; Evolution Of Unicellular Eukaryotes; Anaerobic Metabolism, Photosynthesis And Aerobic Metabolism</p> <p>Keywords: Theories, biotic, abiotic, origin of cell</p>	4 hours
		10 hours

5.0 Paleontology And Evolutionary History: Big Bang Theory, Age Of Stars, Confounding Data From The Hubbel Space Telescope, Expanding Universe, The Evolutionary Time Scale; Eras, Periods And Epoch; Major Events In The Evolutionary Time Scale; Punctuated Equilibrium And Phylectic Gradualism, Stages In Primate Evolution Including Homo. Dating Of Fossils, Different Methods, Current Controversies Concerning Theory Of Evolution. Controversies Concerning Evolution Of Prokaryotes Vs. Eukaryotes, Birds Vs. Dinosaurs, Age Of Humans, Asexual Vs. Sexual Reproduction, Cold Blooded Vs. Warm Blooded; Living Fossils, Evolution Of Birds And Dinosaurs, Hoaxes And Falsification Of Data (Javaman).

8 hours

Keywords: Eras, periods, cosmological models, fossils, reproductions

6.0 Molecular Evolution: Concept Of Neutral Theory Of Evolution. Molecular Divergence And Molecular Clocks, Molecular Tools In Phylogeny, Classification And Identification; Protein And Nucleotide Sequence Analysis; Origin Of New Genes And Proteins; Gene Duplication And Divergence

4 hours

Keywords: Biological clocks, genetic contents

Note: Course content involves 100% Theory

Books for Reference:					
Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Principles of Genetics	J. Gardner	John Wiley and Sons	8	2003
2.	Basic Genetics	G. S. Miglani	Narosa Publishing House	1	2000
3.	Cell Biology, Genetics, Molecular Biology, Evolution & Ecology	Verma P.S. Agarwal V.K	S Chand publication	5	2006
4.	Evolution	Mark Ridley	Blackwell	3	2003

Additional books for reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publicati
1.	Biotechnology –2 (Cell Biology, Genetics, Microbiology)	Rajeshwari S. Setty and V. Sreekrishna	New Age International Publishers	1	2018
2.	Genetics Essentials: Concepts and Connections	Benjamin.A. Pierce	W. H. Freeman	3	2015
3.	Genetics: Analysis of Genes and Genomes	Daniel L. Hartl , Maryellen Ruvolo	Laxmi Publications	8	2011

SECOND YEAR - SEMESTER – III

Course Title	Microbiology & Microbial technology							
Course Type	Hard Core- Theory	Total Hours	48	Hours/Week	03	Credits	03	
Course Code	C0330	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	Impart knowledge about industrially useful microorganisms and use of fermenter for the production of various primary and secondary metabolites
CO-2	To explain the use and importance of biofertilizers

Mapping of CLOs with PSOs &CDLs

CLOs No.	Course Learning Outcomes(CLOs) On completion of the course the student will learn to	PSOs Addressed	CLDs
CLO-1	Illustrate basic techniques in microbiology and microbial physiology.	PSO-1	Understand
CLO-2	Portray the production methods for industrially important products of microbial origin such as antibiotics, vaccines, proteins, primary and secondary metabolites, as well as food and dairy products.	PSO-4	Application
CLO-3	Have knowledge on application of microorganisms in varied fields of environmental microbiology like bioremediation, bioenergy, biofertilizers and waste water treatment.	PSO-2	Remember

Modules	COURSE CONTENTS	Duration
1.0	<p>Microbiology Industrial concepts</p> <p>Basics: Isolation and improvement of industrially important strains, design of fermentation media, basic design of a fermentor, inoculum development, batch, fed batch and continuous mode of fermentations</p> <p>Sterilization: Thermal death kinetics, sterilization of medium , air and fermentors, concepts of process variables and scale up</p> <p>Keywords: inoculation methods, types,</p>	8 hours
2.0	<p>Bioprocess: Basic principles in bioprocess, advantages of bioprocess over chemical process, isolation and improvement of industrially important strains, design of fermentation media</p> <p>Bioreactors: Microbes, plant cells, animal cells</p> <p>Keywords: Microbial strains, large scale production</p>	8 hours
3.0	<p>Microbial production & Downstream processing</p> <p>Vitamin (B12), enzymes (amylase), organic acid (citric acid), amino acid (lysine), solvents (acetone, butanol), antibiotics (penicillin), single cell proteins, ethanol-wine & beer</p> <p>Keywords: Biomolecule production</p>	8 hours
4.0	<p>Design of fermenter: Criteria for ideal fermenter, aeration, agitation, valves, baffles, heat exchanges</p> <p>Types of fermenters: Waidhof-type fermenter, tower fermenter, cylindroconical vessels, air-lift fermenter, deep-jet fermenter, cyclone column, packed tower, rotating disc fermenter, photobioreactors, stability of microbial reactors, kinetics of fermentation processes</p> <p>Types of fermentation processes: Submerged fermentation, surface or solid substrate fermentation, batch fermentation, continuous fermentation</p> <p>Fermentation economics: Biofuels, bioconservation, gasohol, biogas, waste utilization to generate biofuels</p> <p>Keywords: Fermentation process, types of fermenters</p>	16 hours
5.0	<p>Downstream processing of biological molecules</p> <p>Separation of cells: Flocculation, foam separation, filtration, centrifugation (basket and bowl centrifugation), cell lysis methods - physical and chemical methods</p> <p>Large scale separation techniques: Distillation, solvent extraction, liquid-liquid extraction, chromatographic techniques, membrane filtration, ultra filtration, reverse osmosis, crystallization, spray drying, drum drying, freeze drying, whole broth processing</p> <p>Keywords: Biochemical techniques</p>	14 hours
6.0	<p>Biosensors: Construction and application</p> <p>Biofertilizers: Rhizobium, Azotobacter, Azospirillum, Cyanobacteria, Mycorrhizas, phosphate solubilizers, Frankia</p> <p>Keywords: Production, Nitrogen fixers</p> <p>Note: Course content involves 100% Theory</p>	6 hours

Books for Reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publicati
1.	Prescott's Microbiology	Joanne Willey , Linda Sherwood & Chris Woolverton	McGraw Hill Education	8	2010

2.	Benson's Microbiological Applications: Laboratory Manual in General Microbiology	Alfred Brown	McGraw-Hill	12	2011
3.	Microbial Processes and Products (Methods in Biotechnology)	José-Luis Barredo	Humana Press	2	2005
4.	Microbial Biotechnology: Fundamentals of Applied Microbiology	Alexander N. Glazer , Hiroshi Nikaido	Cambridge University Press	2	2007

Additional books for reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Editi on	Year of publicati
1.	Ananthanarayan and Paniker's Textbook of Microbiology	Reba Kanungo	Universities Press	10	2017
2.	Essentials of Microbiology	Sinha L. Bilgrani	CBS publisher	1	2005
3.	Microbial Biotechnology: Principles and Applications	Yuan Kun Lee)	World Scientific Publishing Company	3	2013

SECOND YEAR-IV SEMESTER

Course Title	INDUSTRY INTERNSHIP/PROJECT WORK						
Course Type	Hard Core-Theory	Total Hours	48	Hours/Week	03	Credits	13
Course Code	DP210	Evaluation	Internal	C1+C2 = 15+15		30 Marks	
			External	Duration	C3	03Hrs	70 Marks
							100

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	understand & acquire the ability to make links across different areas of knowledge
CO-2	generate ,develop and evaluate ideas and information so as to apply these skills to their projected task or work plan

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Students will acquire the ability to make links across different areas of knowledge and to generate,	PSO- 1	Understand

CLO-2	develop and evaluate ideas and information so as to apply these skills to their projected task or work plan	PSO- 2	Remember
Modules	COURSE CONTENTS		Duration
1.0	A student has to choose either Industry Internship or Project work. The duration is 12-15 weeks. At the end of the internship/Project, the student will prepare a report and submit it to the Department. The report will be evaluated for 30 Marks and a Viva Voce examination will be conducted for 40 marks An evaluation of the performance of the candidate either during internship or project work (in house or external) by the respective supervisor shall also be obtained to assist the evaluation process. The Supervisor's evaluation will be obtained in a structured format to enable the department to have a comparative evaluation Keywords: Project work, viva voce		26hours

SECOND YEAR-IV SEMESTER

Course Title	BIostatISTICS						
Course Type	Soft Core-Theory	Total Hours	30	Hours/Week	02	Credits	02
Course Code	D0310	Evaluation	Internal	C1+C2 = 15+15		30 Marks	100
			External	Duration	C3	03Hrs	

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	To understand fundamental concepts and definitions of biostatistics
CO-2	Application of statistical principles for problemsolving in medicine, public health or biology

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Select, use and interpret results of descriptive statistical methodseffectively	PSO -1	Remember
CLO-2	Demonstrate an understanding of the central concepts of modern statistical theory and their probabilistic foundation;	PSO -2	Understand
CLO-3	Select, use, and interpret results of, the principal methods of statistical inference and design	PSO- 2	Remember
CLO-4	Understand thescientific methods for data interpretation	PSO -3	Remember

Modules	COURSE CONTENTS	Duration
1.0	Population, Sample , Sampling Techniques- Random Sample, Mean, Median, Mode, Range, Variance , Coefficient Of Variation, Frequency, Standard Deviation , Standard Error. Representation Of Statistical Data Line Graph- Histogram Bar, Diagram Pie, Chart Scatter Diagram. keywords: graphs, sampling types	12 hours
2.0	Collection Of Data- Relevance Of Sample Size, Sources, Methods- Questionnaires, Records, Archives, Scaling-Likert And Gutman, Validation And Standardization Of The Methods, Modification And Experimental Design key words: Data, Designing, Collection	12 hours
3.0	Design Of Experiments- Factorial Experiments, Stratification And Randomization, Interaction Among Factors key words: Designing	10 hours
4.0	Probability- Rules Of Probability, Binomial Distribution, Normal Distribution, Area Under The Curve, Z Value, Choosing Sample Size, Hypothesis Testing, Student's T Test, One Way ANOVA, Correlation And Regression, Non Parametric Statistics, Sign Test, Rank Sum Test, Rank Correlation keywords: probability, regression, Tests for analysis	14hours

Note: Course content involves 60% Theory and 40% problems

Books for reference:					
Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Fundamentals of Biostatistics	Khan & Khanum	Ukaaz Publications	1	1994
2	Applied Statistics in Health Sciences	Rao	Jaypee Brothers Medical Publishers	2	2010
3	Biostatistics	P Ramakrishnan	Saras Publication	1	2015

Additional books for reference:

Sl.No	Title of the book	Name of the Author	Name of the Publisher	Edition	Year of Publication
1.	Fundamentals of Statistics	S. C. Gupta	Himalaya Publishing House Pvt. Ltd.	7	2018
2.	Biostatistics a Manual of Statistical Methods for Use in Health, Nutrition and Anthropology	Rao	Jaypee Brothers Medical Publishers	2	2009
3.	Introduction to Biostatistics and Research Methods	Rao S	PHI Learning Pvt. Ltd	5	2012

SECOND YEAR-IV SEMESTER

Course Title	SCIENTIFIC WRITING AND PRESENTATION							
Course Type	Soft Core-Theory	Total Hours	48	Hours/Week	03	Credits	03	
Course Code	D0320	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	C3	03Hrs	70 Marks	

COURSE OBJECTIVES (COs)

CO No.	Course Objectives
CO-1	Understand and apply the concept of various representations of data
CO-2	Understand Techniques involved in defining the problem.
CO-3	Understand Characteristics and Function of Research

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes On completion of the course the student will learn to	PSOs Addressed	CD's
CLO-1	Select, use and interpret results of descriptive statistical methods effectively	PSO- 1	Understand
CLO-2	Demonstrate an understanding of the central concepts of modern statistical theory and their probabilistic foundation	PSO- 2	Remember
CLO-3	Select, use, and interpret results of, the principal methods of statistical inference and design	PSO- 2	Remember
CLO-4	Understand the Research and scientific methods	PSO- 3	Remember
CLO-5	Understand the Goals and Criteria for identifying	PSO- 4	Analyse

Modules	COURSE CONTENTS	Duration
1.0	Reading and comprehension: Sources of literature, Importance of literature review, Reading and comprehension Keywords: literature review	6hours
2.0	The art of writing: Basic principles, Creative writing skills The organization of content: Structure and flow of ideas , Cohesive devices in written texts of various types Keywords: art of writing	6hours
3.0	Structures of writing: Sentences, Paragraphs , Parts of a paragraph, Flow of ideas connection between paragraphs Types: Writing laboratory records, journal articles, textbooks, research reports , reviews, scientific papers, scientific communications , thesis Types of journals, Journal impact factor Keywords: Journals, Articles	14hours
4.0	Oral communication : Types of lectures: Popular, Scientific , Short presentation, Preparation of power point slides, Flow of ideas, Continuity of thought, Simplicity of presentation material Animation Effects, Graphic Representation ,Use of cartoon diagrams, Microsoft Excel, Processing of data and presentation using appropriate diagrams, Bar diagrams , Line graphs , Scatter diagrams, 3D plots and use of standard deviation and error bars Keywords: communication, graphic representation, error bar	14hours
5.0	Each student will have to choose a scientific article and present it Keywords: Research Articles	8hours

Books for reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Research Methodology, Methods and Techniques	C.R. Kothari,	New Age International Publishers. New Delhi	2	2001

Additional books for reference:

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Introduction to bioinformatics	Wayne W. Daniel	John Willey and Sons Inc., USA.	9	2006

Blue print of question papers for practical exams from I-IV semesters

St. Philomena's College (Autonomous), Mysore		
M.Sc Biochemistry		
Time: 4 Hours		Max Marks: 70
1.	Procedure writing	5 marks
2.	Major experiment	35 marks
3.	Minor experiment/ spotters/calculations	20 marks
4.	Viva	10 marks

Blue print of question papers from I-IV semesters

St. Philomena's College (Autonomous), Mysore		
M.Sc Biochemistry		
Time: 3 Hours		
Max Marks: 70		
PART-A		
Answer any TEN of the following:		
10x2=20		
1.	a	
	b	
	c	
	d	
	e	
	f	
	g	
	h	
	i	
	j	
	k	
	l	
PART-B		
Answer any FIVE questions:		5x10=50
2.	a	
	b	
3.	a	
	b	
4.	a	
	b	
5.	a	
	b	
6.	a	
	b	
7.	a	
	b	
8.	a	
	b	
