PROGRAMME SPECIFIC OBJECTIVES OF M. Sc BIOCHEMISTRY:

- An ability to apply fundamental knowledge related to Biochemistry in an interdisciplinary manner for providing innovative solutions to need based problems for global impact.
- An ability to critically analyze scientific data, draw objective conclusions and apply this knowledge for human welfare.
- Promoting lifelong learning to meet the ever evolving professional demands by developing ethical, inter personal and team skills.
- An ability to gain domain knowledge and to develop core competencies for successful career in academia, industry and research.
- To impart critical thinking, hypothesizing and problem solving skills.

J.J. COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS), PUDUKKOTTAI – 622 422

DEPARTMENT OF BIOCHEMISTRY

M.Sc. BIOCHEMISTRY

Proposed Course Structure based on UGC - LOCF and TANSCHE

(Choice Based Credit System)

(Applicable for the candidates admitted from academic year 2022-2023 onwards)

Sem	Course Code	Course Title	Hrs/ Week	Credit	Exam Hrs	Marks		Total
						Int.	Ext.	
I	P1R2BCCC1	Structure and Functions of Biomolecules	6	5	3	25	75	100
	P1R2BCCC2	Analytical Biochemistry and Biomedical instrumentation	6	5	3	25	75	100
	P1R2BCCC3P	Major Practical-I(Covering CC1, CC2 and CC4)	6	5	6	40	60	100
	P1R2BCCC4	Computational Biology	6	5	3	25	75	100
	P1R2BCDSE 1:1/1:2	Any One from the List	6	3	3	25	75	100
Total			**30**	**23**	**-**	-	-	**500**
II	P2R2BCCC5	Enzyme and Industrial Biochemistry	5	5	3	25	75	100
	P2R2BCCC6	Genetics and Molecular Biology	5	5	3	25	75	100
	P2R2BCCC7	Metabolism and regulation	5	5	3	25	75	100
	P2R2BCCC8P	Major Practical-II (Covering CC5, CC6 and CC7)	5	5	6	40	60	100
	P2R2BCCC9	Biotechnology and Genetic Engineering	5	5	3	25	75	100
	P2R2BCDSE 2:1/2:2	Any One from the List	5	3	3	25	75	100
Total			**30**	**28**	**-**	-	-	**600**
III	P3R2BCCC10	Nutritional and Clinical Biochemistry	5	5	3	25	75	100
	P3R2BCCC11	Molecular Endocrinology	5	5	3	25	75	100
	P3R2BCCC12	Immunology	5	5	3	25	75	100
	P3R2BCCC13	Pharmacology and Toxicology	5	5	3	25	75	100
	P3R2BCCC14 P	Major Practical-III (Covering CC9)	5	5	6	40	60	100
	P3R2BCSEC 1:1/1:2	Any One from the List	5	3	3	25	75	100
Total			**30**	**28**	**-**	-	-	**600**
	P4R2BCGEC1	To be opted from other department	5	3	3	25	75	100
IV	P4R1BCPW15	CC15 - Project Work	25	8	-	-	-	100
Total			**30**	**11**	**-**	-	-	**200**
Grand Total			**120**	**90**	**-**	-	-	**1900**

Discipline Specific Elective 1

1.Stem cell & reproduction

2.Medicinal Plants and Phytotherapy

Discipline Specific Elective 2

1.Environmental Biochemistry

2.Bioprocess Technology

Skill Enhancement Course

1.Internship programme

2.Genomics and Proteomics

Generic Elective Course

1. Evolutionary Biology

Title of the Course	**: STRUCTURE AND FUNCTIONS OF BIOMOLECULES**		
Category of the Course	**: CORE COURSE**	**Semester**	**: I**
Course Code	**: P1R2BCCC1**	**Nature of the Skill**	**: EMPLOYABILITY**
Marks	**: CIA:25+ Ext: 75 = 100**	**Hrs/Week**	**: 6**
Credits	**: 5**	**Total Inst. Hrs**	**: 72**

Course objectives:

CO1: To Understand the basis of macromolecules and their structure.

CO2: A Biomolecule is a molecule which is involved in the maintenance and metabolic processes of living organisms.

CO3: To Know the properties of different biomolecules.

CO4: To Know the physiological functions of biomolecules.

Unit I **(14 Hours)**

CARBOHYDRATES

Monosaccharides & Disaccharides: structure, occurrence, properties and biological functions. Homo and Hetero: Polysaccharides - occurrence, structure, properties and functions of homoglycans - starch, glycogen, cellulose, dextrin, inulin, chitin, xylans and galactans. Occurrence, structure, properties and functions of hetero glycans - hyaluronic acid, keratan sulphate and chondroitin sulphate. Mucopolysaccharides – bacterial cell walls polysaccharides and sialic acid. Blood group substances. Lectins structure and functions.

Unit II **(16 Hours)**

PROTEINS

Classification, structure and properties of amino acids, Essential and non-essential amino acids. Non protein amino acids. Proteins - Classification based on solubility, shape, composition function & Properties of proteins. Structure of peptide bonds. Chemical synthesis of polypeptides. Physical interactions that determine the properties of proteins – short range repulsions, electrostatic forces, van der waals interaction, hydrogen bond and hydrophobic interactions. Protein structure - Primary, secondary – α-helix, β-sheet and β-turns, tertiary and quaternary structures of protein. The Ramachandran plot Pauling and Corey model for fibrous proteins. Structure and biological functions of fibrous proteins (keratins, collagen and elastin), globular proteins (hemoglobin, myoglobin), lipoproteins, metalloproteins, glycoprotein and nucleoproteins.

Unit III **(14 Hours)**

LIPIDS

Definition and classification of lipids. Fatty acids - classification, nomenclature, structure and properties. Saturated and unsaturated fatty acids. Derived lipids: Phospholipids, glycolipids, structure and function. Cholesterol and Triacylglycerols. Eicosanoids- structure and biological actions of prostaglandins, prosracyclins, thromboxanes, leukotrienes and lipoxins. Lipoproteins- Classification and composition and liposomes.

Unit IV **(14 Hours)**

NUCLEIC ACIDS

Structure of purines and pyrimidines. Components of nucleic acids - nucleosides, nucleotides, and poly nucleotides. Occurrence and isolation of nucleic acids. Properties of DNA: buoyant density, viscosity, hypochromicity, denaturation and renaturation– the cot curve. DNA: structure of different types (A, B and Z DNA), biological role. DNA binding motifs in proteins – the basic helix loop helix (bHLH) motif, zinc finger, the leucine zipper and helix-loop helix. Structure and role of different types of RNA (mRNA, rRNA, tRNA, sn RNA, hn RNA).

Unit V **(14 Hours)**

VITAMINS, MINERALS AND PORPHYRINS

Structure and biochemical properties of water soluble and fat soluble vitamins and their coenzyme activity. Macro minerals (Ca, P, Mg, Na, K, Cl) and micro minerals/trace elements (Co, I, Fe, Mn, Zn, and F) - their sources, daily requirements, functions and deficiency diseases symptoms. Porphyrins the porphyrin ring system, chlorophyll, hemoglobin, myoglobin and cytochrome.

Text Books:

1. Nelson, D.L. and Cox, M.M. 2013. Lehninger Principles of Biochemistry, 6th Edition, W.H. Freeman & Co.
2. Berg, J.M. et al., 2012. Biochemistry,7th Edition, W. H. Freeman & Co.
3. Voet, D. et al., 2012. Fundamentals of Biochemistry: Life at the Molecular level, 4th Edition, John Wiley and Sons.

Reference Books:

1. Sathyanarayana, 2017, Essentials of Biochemistry, Books and Allied (P) Ltd.
2. Zubay, G.L. 1998. Biochemistry, Wm.C. Brown Publishers.
3. Sinden, S.R. DNA structure and function, First Edition, Academic Press, 1994.
4. Carl Branden and John Tooze, Introduction to Protein Structure, Second Edition, Garland Publishing, 1999.
5. Garrett, R. and Grisham,C. 2010. Biochemistry, 4th Edition, Saunders College Publishing.
6. Pankaja Naik, Essentials of Biochemistry, 2017, 2nd editions, Jaypee Brothers.

e-Learning Resources:

1. Textbook of Biochemistry,2011 by Thomas M. Devlin
2. lippincotts-biochemistry-6th-edition,2014 by Ferrier, Denise R.

Course Outcomes

After the successful completion of the course the students shall be able to

CO. NO	CO Statement	Knowledge Level
CO1	Explain the significance of hydrophobic and hydrophilic forces for the structure of biomolecules with examples.	K2,K3
CO2	Explain the significance of steric effects for the structure of biomolecules and give examples.	K2, K3
CO3	Discuss the four structure levels of proteins.	K3, K4
CO4	Draw the basic structure of carbohydrates, nucleic acids, peptides/proteins and lipids.	K3, K4
CO5	Name the functional groups in carbohydrates, nucleic acids, peptides/proteins and lipids.	K2, k3

Relationship Matrix for CO, PO and PSO:

Course Outcome (CO)	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Average
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	1	2	3	3	3	3	3	3	2.6
CO2	3	3	2	2	3	2	3	3	2	3	2.6
CO3	3	1	2	3	2	3	3	2	3	3	2.5
CO4	3	2	1	3	3	2	3	2	3	3	2.3
CO5	3	3	2	1	3	3	3	3	2	3	2.6
											2.52

Mean Overall Relationship is **2.52** which is **High**

Relationship of Outcomes:

Low Level Relation – 01 (If it is related less than 40 %)

Medium Level Relation – 02 (If it is related between 40 – 70 %)

High Level Relation – 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2 : Low

Greater than or equal to 1.2 and less than 2.2 : Medium

Greater than or Equal to 2.2 : High

Title of the Course	**: ANALYTICAL BIOCHEMISTRY AND BIOMEDICAL INSTRUMENTATION**		
Category of the Course	**: Core Course**	**Semester**	**: I**
Course Code	**: P1R2BCCC2**	**Nature of the Skill**	**: EMPLOYABILITY**
Marks	**: CIA:25+Ext:75=100**	**Hrs/Week**	**: 6**
Credits	**: 5**	**Total Inst. Hrs**	**: 72**

Course Objective:

CO1: To Impart Knowledge about possible hazards in a laboratory and follow safety rules.
CO2: To appreciate electrophoretic and electrochemical principles in separation of compounds.
CO3: To understand the fundamentals of Chromatography techniques.
CO4: To expose students to various methods to diagnose different diseases.
CO5: To expose students to common therapeutic procedures.

UNIT I **(14 Hours)**

Safe Laboratory practices and Centrifugation:

Protection from Physical, Chemical and Biological hazards, Hazardous waste disposal, Containment facility, Levels of Biosafety, GLP, GCP (ICT).

Centrifugation Techniques - Basic principles of Sedimentation, Preparative and Analytical centrifugation, Differential and Density gradient centrifugation, Separation of sub cellular organelles.

UNIT II **(16 Hours)**

Chromatography Electrochemical techniquues

General principle and operational procedure of column chromatography, Gel permeation, Ion exchange, Affinity, Gas liquid and high performance liquid chromatography (ICT), Capillary electro chromatography.

Electrochemical Techniques: Potentiometry - Ion Selective Electrodes, Amperometry Clarkes oxygen electrode, Biosensors, Polarography

UNIT III **(14 Hours)**

Electrophoresis

General principle, Factors affecting Electrophoretic separation, Isoelectric focussing, SDS PAGE, 2D PAGE, 3 D gel electrophoresis (Assignment), Estimation and recovery of proteins in gels Electrophoresis of nucleic acids, DNA sequencing gels, Pulse field gel electrophoresis, Immunoelectrophoresis, Blotting techniques.

UNIT IV **(14 Hours)**

Diagnostic procedures

X-ray, Angiography. Types of Scan- Ultrasound (Assignment), CAT, PET, MRI (ICT) Tests based on electrical activity – ECG, EEG, Blood pressure measurement, Respiratory gas analyzer, Spirometry

UNIT V **(14 Hours)**

Therapeutic procedures

Blood banking, Dialysis unit- Hemo and Peritoneal dialysis, Ventilator, Pacemaker, Defibrillator, Artificial valves, Heart lung machine, Lithotriptors, Radiotherapy equipment

Reference Books:

1. Instrumental methods of Chemical Analysis- Chatwal& Anand, Himalaya Publishing House. Reprint 2005
2. Analytical Biochemistry- Mohammed raees
3. Analytical Biochemistry- David J Holme, Prentice Hall ,1998
4. Text Book of Analytical Biochemistry-Jessica Carol, Syrawood Publishing house ,2016
5. Analytical Biochemistry- Artie Weissberg, Syrawood Publishing house ,2016

COURSE OUT COMES

After the successful completion of the course the students shall be able to'

CO. NO	CO Statement	KNOWLEDGE LEVEL
CO1	Able to apply various chromatographic techniques and radioisotopes and gain knowledge of electromagnetic radiation and apply them practically.	K2
CO2	Use appropriate electrophoretic methods in separation of biomolecules and the properties of buffers and measurement of pH by glass electrode.	K2
CO3	Discuss about protein structural organization, predict protein Structure and utilize structure prediction & visualization tools	K4
CO4	Acquire knowledge about centrifugations, types and its applications.	K4
CO5	Appreciate the principle, instrumentation and the difference between various Therapeutic procedures to choose analysing biological samples	K4

Relationship Matrix for CO, PO and PSO:

Course Outcome (CO)	PROGRAMME OUTCOME(PO)					PROGRAMME SPECIFIC OUTCOME(PSO)					TOTAL AVREAGE
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	2	3	3	2	3	2	3	2	2.5
CO2	2	3	3	3	2	3	2	3	3	2	2.6
CO3	2	3	3	3	3	3	2	2	3	3	3.1
CO4	2	2	3	2	3	3	3	2	3	3	2.6
CO5	3	3	3	3	2	3	3	3	3	3	2.9
											2.74

Mean Overall Relationship is **2.74** which is **High**

Relationship of Outcomes:

Low Level Relation – 01 (If it is related less than 40 %)

Medium Level Relation – 02 (If it is related between 40 – 70 %)

High Level Relation – 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2	: Low
Greater than or equal to 1.2 and less than 2.2	: Medium
Greater than or Equal to 2.2	: High

Title of the Course	**: MAJOR PRACTICAL I**		
Category of the Course	**: Core Course**	**Semester**	**: I**
Course Code	**: P1R2BCCC3P**	**Nature of the Skill**	**: Skill Development**
Marks	**: CIA:40+Ext:60=100**	**Hrs/Week**	**: 6**
Credits	**: 5**	**Total Inst. Hrs**	**: 72**

Course Objectives:

CO1: To Understand the biological functions of biomolecules

CO2: To Perform quantitative analysis of known standards as well as unknown samples

CO3: To Follow the method of nucleic acids assay of DNA and RNA.

CO4: To understand the Biomedical Instruments working Principles and their Applications

CO5: To gain knowledge about the Biological databases and Sequence Analysis

Corse Content:

1. Estimation of Reducing Sugar by Benedicts Titrimetric Method
2. Estimation of Amino Acids by Formal Titration Titration method
3. Estimation of Ascorbic Acid by Titrimetric Method Using 2,6-Dichlorophenol-Indophenol Dye.
4. Determination of Acid Number of an edible oil.
5. Determination of Saponification number
6. Estimation of protein by Lowry's method
7. Estimation of albumin
8. Estimation of Ascorbic acid in fruits.
9. Estimation of DNA and RNA
10. Biological databases and its Types-Nucleic acid databases
11. Protein databases and Specialized Genome databases
12. Software for Systems Biology.
13. Searching Sequence using BLAST and FASTA

Demonstration:

14. Biochemical Autoanalyser
15. Hematological Autoanlyser
16. ELISA
17. RT PCR
18. Flow cytometry
19. MRI
20. Spirometry

Reference Books:

1. Manuals in Biochemistry, Dr. J. Jeyaraman
2. Practical Biochemistry, Warley
3. Practical Biochemistry, Phummer
4. Practical Clinical Biochemistry, Herald warley
5. David T.Plummer,An Introduction to Practical Biochemistry
6. Pattabiraman, Laboratory Manual in Biochemistry
7. Kaneko K., 2006 Life: An Introduction to Complex Systems Biology, Springer
8. Alon U., 2006 An Introduction to Systems Biology: Design Principles of Biological Circuits, CRC

Course Outcomes

After the successful completion of the course the students shall be able to

CO. NO	CO Statement	Knowledge level
CO1	To Carry out the quantitative analysis of all the biomolecules	K2
CO2	To Estimate the amount of biomolecule present in the given unknown sample	K3
CO3	To Understand the practical aspects of analytical techniques in Biochemistry	K2
CO4	To Demonstrate the Biochemical and Hematological Autoanalyser	K3
CO5	To gain knowledge about the Sequence Analysis	K2

Relationship Matrix for CO, PO and PSO:

COURSE OUTCOM (CO)	PROGRAMME OUTCOME (PO)					PROGRAMME SPECIFIC OUTCOME (PSO)					Average
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	3	2	2	3	3	2	2	2.3
CO2	3	3	2	3	3	2	3	3	2	3	2.7
CO3	2	2	2	2	2	3	3	3	2	3	2.4
CO4	2	2	3	2	2	3	3	2	3	2	2.3
CO5	3	2	2	2	2	3	3	2	3	3	2.5
											2.44

Mean Overall Relationship is **2.44** which is **High**

Relationship of Outcomes:

Low Level Relation – 01 (If it is related less than 40 %)

Medium Level Relation – 02 (If it is related between 40 – 70 %)

High Level Relation – 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2 : Low

Greater than or equal to 1.2 and less than 2.2 : Medium

Greater than or Equal to 2.2 : High

Title of the Course	**: COMPUTATIONAL BIOLOGY**		
Category of the Course	**: Core Course**	**Semester**	**: I**
Course Code	**: P1R2BCCC4**	**Nature of the Skill**	**: Skill Development**
Marks	**: CIA:25+Ext:75=100**	**Hrs/Week**	**: 6**
Credits	**: 5**	**Total Inst. Hrs**	**: 72**

Course Objectives:

CO1: A student completing a major in Bioinformatics shall be able to apply: knowledge and awareness of the basic principles and concepts of biology,
CO2: To apply Computer science and mathematics. existing software effectively
CO3: To extract information from large databases and to use this information in computer modeling.
CO4: To understand the concept of Sequence alignment & gene prediction.
CO5: To enable students, understand protein structural organization, prediction and visualization.

Unit I **(15 Hours)**

Introduction bioinformatics

Definition, Scope, importance and applications of bioinformatics. Emerging areas of bioinformatics. An introduction to Servers-World Wide Web (www). internet and intranet packages. Biological databases and its Types-Nucleic acid databases (NCBI, DDB and EMBL) **(ICT)**, Protein databases (primary, composite and secondary). Specialized Genome databases (SGD, TIGR), Structural databases (CATH, SCOP and PDB sum).

Unit II **(15 Hours)**

Sequence alignment

Dot matrix, local alignment (Smith and Watermen algorithm), Global alignment (Needleman and wunsch algorithm), similarity searching using BLAST and FASTA **(ICT)** Crustal-W- Multiple sequence alignment and methods and application

Unit III **(15 Hours)**

Phylogenetic analysis

phylogenetic trees, Distance based and character based methods, automated tools for phylogenetic analysis. **(ASSINGMENT).**

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Unit IV **(15 Hours)**

Basic concepts and perspectives of Systems Biology

Introduction to Modelling in Systems Biology and some biological models: Population Ecology and Epidemiological models. Biological Networks: Representation, Network visualization and structural analysis of Biological Networks – Metabolic Networks **(ICT)**; Transcription Regulation Networks and Protein-protein Interaction Networks.

Unit V **(12 Hours)**

Metabolome

Interact me and Transcriptome (basic concepts), Protein- Protein Interaction Databases **(ASSINGMENT),** Systems Biology databases. Software for Systems Biology.

Text Books:

1. Attwood, T.K. and Parry – Smith, D.J. (1999). Introduction to Bio – Informatics, Person Education, Pvt, LTD. Singapore.
2. Gibas, C, Jam beck, P. Developing Bioinformatics Computer Skills, Shroff Publisher Calcutta.

Reference Books:

1. Kitano H. (ed.), 2001 Foundations of Systems Biology. MIT Press.
2. Bock G. and Goode J.A. (ed.), 2002 In Silico Simulation of Biological Processes, Novartis Foundation Symposium, John Wiley & Sons.
3. Klipp E., Herwig R., Kowald A., Wierling C., and Lehrach H., 2005 Systems Biology in Practice, Wiley-VCH.
4. Sneppen K. and Zocchi G., 2005 Physics in Molecular Biology, Cambridge University Press.
5. Noble D., The Music of Life, 2006 Biology Beyond the Genome Oxford University Press.

e-Learning Resources:

1. https://www.coursera.org/courses?query=computational%20biology
2. https://www.coursera.org/learn/bioinformatics
3. https://www.coursera.org/learn/systems-biology

Course Outcomes

After the successful completion of the course the students shall be able to

CO. NO.	CO Statement	Knowledge level
CO1	Significant knowledge will be obtained basic concepts and tools of Bio informatics.	K1
CO2	utilize *"in silico"* knowledge for elucidating biomolecules.	K3
CO3	A thorough understanding of the Sequence alignment	K4
CO4	Understand the fundamental concepts Phylogenetic analysis-phylogenetic trees.	K4
CO5	Understand about the Basic concepts and perspectives of Systems Biology	K3

Relationship Matrix for CO, PO and PSO:

Course Outcom (CO)	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Average
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	1	2	2	3	2	2	3	3	2	2	2.2
CO2	2	2	2	3	3	2	3	3	2	3	2.5
CO3	2	2	2	2	2	3	3	3	2	2	2.3
CO4	1	2	2	2	2	3	3	2	3	1	2.1
CO5	2	2	2	2	2	3	3	2	3	2	2.3

Mean Overall Relationship is **2.3** which is **High**

Relationship of Outcomes:

Low Level Relation – 01 (If it is related less than 40 %)

Medium Level Relation – 02 (If it is related between 40 – 70 %)

High Level Relation – 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2	: Low
Greater than or equal to 1.2 and less than 2.2	: Medium
Greater than or Equal to 2.2	: High

Title of the Course	**: ENZYMES AND INDUSTRIAL BIOCHEMISTRY**		
Category of the Course	**: Core Course**	**Semester**	**: II**
Course Code	**: P2R2BCCC5**	**Nature of the Skill**	**: Skill Development**
Marks	**: CIA: 25+Ext: 75 = 100**	**Hrs /Week**	**: 05**
Credits	**: 05**	**Total Inst. Hrs**	**: 60**

COURSE OBJECTIVES:

CO1: Enhance the understanding of enzymes and their mechanisms.

CO2: To study about kinetics, purification and characterization of enzymes.

CO3: Influence the various factors of physicochemical characteristics upon enzyme activity.

CO4: Gain an understanding of buffers and their importance in the context of pH control.

CO5: To develop the skill on industrial applications of enzymes.

UNIT I **(13 Hours)**

Enzyme classification and types

Nomenclature and classification of enzymes. General properties of enzymes. Enzyme structure –Apo enzyme and holoenzyme, co-enzyme and co-factors. Structure of active site of enzyme - Mechanisms of enzyme action (Assignment), concept of active site and energetic of enzyme substrate complex formation - Specificity of enzyme.

Types of enzymes

Constitutive enzyme, induced enzymes, intracellular and extracellular enzymes. Monomeric and oligomeric enzymes- Monomeric enzymes; serine proteases, zymogen activation, multifunctional enzymes, oligomeric enzymes and multi- enzyme complexes. Structure of pyruvate dehydrogenase complex. Isoenzymes - properties and significance (ICT). Lactate dehydrogenase; soluble and membrane bound enzymes. Ribozymes, Abzymes – structure, properties and functions.

UNIT II **(13 Hours)**

Enzyme Catalysis

Principles of catalysis: Acid- base catalysis, electrostatic catalysis, covalent catalysis, proximity, orientation effect, Strain & distortion theory. Mechanism of reaction catalyzed by enzymes - lysozyme and chymotrypsin. Metal activated enzymes and metalloenzymes. Role of metal ions in mechanism- carbonic anhydrase, superoxide dismutase, carboxy pepditase. Chemical modification of active site groups - Site directed mutagenesis of enzymes (ICT).

Enzyme regulation- Enzyme inhibition - Competitive and non-competitive and uncompetitive inhibition. Inhibitor constant (KI) and its determination feedback inhibition, feed forward stimulation, sequential feedback, concerted feedback, cumulative feedback and enzyme multiplicity and covalent modification(Seminar).

UNIT III **(12 Hours)**

Enzyme Kinetics

Enzyme kinetics of single substrate reactions – Pre steady state and steady state kinetics, factors affecting enzyme activity, Michaleis - Menten Plot, Lineweaver - Burk plot, eadien - hofstee plot and hanes plot. kinectics of allosteric enzymes-MWC and KNF models, Kinetic data evaluation-linear transformation of MM equation - catalytic efficiency- Haldane relationship- Hill's plot- Bisubstrate reactions- sequential - ping-pong reactions- rate equations and examples equation. King-Altman procedure for deriving the rate equation.

UNIT IV **(11 Hours)**

Clinical Applications of Enzymes

Enzyme-based diagnostic techniques (as diagnostic reagents and diagnostic kits, antibodies as analytical reagents) – ELISA (Assignment). Determination of enzymes activities for clinical diagnosis-Transaminases (ALT, AST), phosphatases, amylase, cholinesterase. Enzyme inhibitors and drug design, enzyme therapy (thrombolytic & anti-inflammatory agents). Enzyme data repositories and their types and classification. Datamining – software types and its usage.

UNIT V **(11 Hours)**

Industrial application of enzymes

Industrial large scale enzyme extraction, purification and stabilization. Industrial applications of carbohydrates, proteolytic enzyme, lingo cellulose degrading enzyme, pectin and pectic enzyme. Applications of enzymes in food industry, leather industry. Additional industrial enzymes-lipase, enzyme in animal nutrition. Overview of applications of immobilized enzyme systems **(Seminar)**. Applications of enzymes in genetic engineering and biotechnology. Taq Polymerase and reverse transcriptases – their applications. Restriction endonucleases and ligases - their applications -methods and applications of enzyme engineering and artificial enzymes.

Text Books:

1. Palmer Trevor, Enzymes: Biochemistry, Biotechnology and Clinical chemistry, Horwood Publishing, Chichester
2. Price Nicholas C, Fundamentals of Enzymology, Oxford city press, New York.

Reference Books:

1. Voet Donald & Voet Judith, Biochemistry, John Wiley sons, US
2. Dixon & Webb, Enzymes, Acdemic press
3. Conn E E, Stump P K Bruening G and Doi R H Outlines of Biochemistry, 5 th Ed, John Wiley & Sons, New York.
4. Creighton Thomas E, Proteins: Structures and molecular properties, W H Freeman & Co New York.

e-Learning Resources:

1. https://youtu.be/AusY2gGf0Ao
2. https://www.easybiologyclass.com/topic-bioc
3. https://youtu.be/j00Ep0Byu0Y
4. https://youtu.be/7h0XrF1BleM

Course Outcomes

After the successful completion of the course the students shall be able to

CO. NO	CO Statement	knowledge level
CO1	Course material will help in understanding of nomenclature and classification of enzymes and also the fundamentals of enzyme assay.	K2
CO2	Students will thoroughly understand the Kinetics of enzyme essay and derivation of velocity equations.	K3
CO3	Course will advance the knowledge of students on mechanism of enzyme action.	K4
CO4	Understanding of detailed mechanism in enzyme regulation with relevant examples.	K3
CO5	Students will gain knowledge in various immobilization techniques and industrial application of enzymes.	K4

Relationship Matrix for CO, PO and PSO:

COURSE OUTCOM (CO)	PROGRAMME OUTCOME (PO)					PROGRAMME SPECIFIC OUTCOME (PSO)					Average
	PO_1	PO_2	PO_3	PO_4	PO_5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	1	2	2	3	2	3	3	3	3	3	2.6
CO2	3	2	1	2	3	2	3	3	2	2	2.3
CO3	2	3	2	2	3	3	2	2	3	3	2.5
CO4	2	3	3	2	2	3	3	3	3	3	2.7
CO5	3	2	3	3	2	3	3	3	3	3	2.8
											2.58

Mean Overall Relationship is **2.58** which is **High**

Relationship of Outcomes:

Low Level Relation – 01 (If it is related less than 40 %)

Medium Level Relation – 02 (If it is related between 40 – 70 %)

High Level Relation – 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2 : Low

Greater than or equal to 1.2 and less than 2.2 : Medium

Greater than or Equal to 2.2 : High

Title of the Course	**: GENETICS AND MOLECULAR BIOLOGY**		
Category of the Course	**: Core Course**	**Semester**	**: II**
Course Code	**: P2R2BCCC6**	**Nature of the Skill**	**: Skill Development**
Marks	**: CIA: 25+Ext: 75 = 100**	**Hrs/Week**	**: 5**
Credits	**: 5**	**Total Inst. Hrs**	**: 60**

Course Objectives:

CO1: To explain the concept of classical Genetics and basic principles of Mendelian inheritance

CO2: To outline the structure and functions of DNA & RNA and to highlight the enzymes involved in DNA replication

CO3: To Impart Knowledge About Chromosome structure and functions

CO4: To understand the Organization of prokaryotic and eukaryotic genomes

CO5: To gain knowledge about the molecular mechanisms of Gene Expression

Unit I **(12 Hours)**

Mendelian Inheritance-Laws of inheritance. Mendelian traits in man. Gene interaction -codominance, incomplete dominance, Epistasis. – Multiple alleles (Blood group inheritance in human) – crossing over – cytological proof for crossing over – significance of crossing over - chromosome mapping

Unit II **(12 Hours)**

Structure and functions of DNA — Watson & Crick model of DNA – Polymorphic forms of DNA – Mechanism of DNA replication - steps in prokaryotic replication – enzymes involved in DNA replication. RNA structure, types and functions – Genetic code - Protein synthesis (prokaryotes). Transcriptional control – Lac Operon.

UNIT III **(12 Hours)**

Chromosome –Composition, structure and function, Human Karyotype, Types of chromosomal Anomalies-Ploidy, Chromosomal types - linkage and crossing over - gene mapping - mutation - chromosomal aberrations.

UNIT IV **(12 Hours)**

Replication of DNA- replication in prokaryotes and eukaryotes. Enzymes involved in replication. types of replication-semiconservative, conservative and dispersive. evidence of mode of replication- meselson and stahls experiment. Cairns autoradiographic experiment and Inhibitors of DNA replication.

UNIT V **(12 Hours)**

Gene Expression: Transcription-Transcription in Prokaryotes – overview, Eukaryotic Transcription, RNA polymerases, Promoters, Enhancers, Insulators, Silencers, Post Transcriptional modifications of t RNA, r RNA, mRNA – Capping, Tailing, Splicing, Reverse transcription.

Text Book:

1. Principles of Genetics – Gardner, Simmons and Snustad. John Wiley & Sons, 8th Edition 1993.
2. Essentials of Molecular Biology- V. Malathi, 2013, First Edition, Pearson Publishers.

Reference Books:

1. Molecular cell biology – Lodish, Harvey, Berk, Arnold, Zipursky, Lawrence, Matsudaira, Paul, Baltimore: 2006, 4th Edition, W.H Freeman & Co.
2. Lewin's Genes X– Krebs Jocelyn, Lewin Benjamin, Goldstein, Eliottt, Kilpatrick, Stephen: 2009. Jones and Bartlett.
3. Biochemistry - Voet Donald and Voet Judith: 2004. Wiley International Edition, 3rd Edition: John Wiley & Sons.
4. Lewin's Genes X– Krebs Jocelyn, Lewin Benjamin, Goldstein, Eliottt , Kilpatrick ,Stephen : 2009 . Jones and Bartlett
5. Human Genetics (Third Edition), S.D. Gangane, ISBN 10: 8131211282 / ISBN

Course Outcomes

After the successful completion of the course the students shall be able to

CO. NO	CO Statement	Knowledge level
CO1	Explain and analyze Mendelian Genetics & Deviation from Mendelian Genetics.	K2
CO2	To outline the structure and functions of DNA & RNA and to highlight the molecular basis of gene mutation	K3
CO3	Discuss the basis of protein formation & Segregation, analyze the use of translation inhibitors.	K2
CO4	Explain the Molecular mechanisms of Gene expression	K3
CO5	Understand about the Basic concepts of Post Transcriptional modifications	K2

Relationship Matrix for CO, PO and PSO:

COURSE OUTCOM (CO)	PROGRAMME OUTCOME (PO)					PROGRAMME SPECIFIC OUTCOME (PSO)					Average
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	3	2	2	3	3	2	2	2.3
CO2	3	3	2	3	3	2	3	3	2	3	2.7
CO3	2	2	2	2	2	3	3	3	2	3	2.4
CO4	2	2	3	2	2	3	3	2	3	3	2.4
CO5	3	2	2	2	2	3	3	3	3	3	2.6
											2.48

Mean Overall Relationship is **2.48** which is **High**

Relationship of Outcomes:

Low Level Relation – 01 (If it is related less than 40 %)

Medium Level Relation – 02 (If it is related between 40 – 70 %)

High Level Relation – 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2 : Low

Greater than or equal to 1.2 and less than 2.2 : Medium

Greater than or Equal to 2.2 : High

Title of the Course : METABOLISM AND REGULATION

Category of the Course	**: CORE COURSE**	**Semester**	**: II**
Course Code	**: P2R2BCCC7**	**Nature of the Skill**	**: Skill Development**
Marks	**: CIA:25+ Ext: 75 = 100**	**Hrs/Week**	**: 5**
Credits	**: 5**	**Total Inst. Hrs**	**: 60**

Course Objectives:

CO1: Understand the energy transformation and metabolic pathways in living organism.

CO2: Learn the fate of dietary carbohydrates, proteins and lipids.

CO3: Study the various catabolic and biosynthetic pathways of biomolecules & their significance.

CO4: Understand the interrelationship between carbohydrate, protein and fat metabolism.

UNIT I **(12 Hours)**

METABOLISM INTRODUCTION

General scheme of metabolism, historical and experimental details in derivation of a metabolic pathway, catabolic, anabolic and amphibolic pathways. Thermodynamics and metabolism: Cell bioenergetics, laws of thermodynamics, standard free energy, enthalpy, entropy (ICT). Exergonic and endergonic reactions. Metabolic profile of liver. Adipose tissue and brain. Caloric value of metabolism: fuels use, metabolic relationship of tissues nutritional & hormonal states. Altered metabolism of starvation.

UNIT II **(18 Hours)**

METABOLISM OF CARBOHYDRATES

An overview & energetics of glycolysis and gluconeogenesis. Regulation of glycolysis and gluconeogenesis - phosphofructokinase, hexokinase and pyruvate kinase as regulatory enzymes in glycolysis; hormone regulation (ICT). Anaphlerotic reactions 'filling up reactions Gluconeogensis: Regulation by allosteric and substrate level control mechanisms. TCA - cycle - steps: Regulation at branch points: -Pyruvate dehydrogenase. alpha - keto glutarate dehydrogenase, and citrate synthase. Glycogen metabolism - Regulation of glycogen phosphorylase; glycogen synthase by effectors, covalent modification and hormones. Metabolism of fructose. Uronic acid pathway (Assignment).

UNIT III **(12 Hours)**

METABOLISM OF LIPIDS

Fatty acid synthesis and its regulation. Fatty acid oxidation – β-oxidation, α- oxidation & ω- oxidation (ICT). Phospholipids and Triacylglycerol -Synthesis, degradation and regulation. Lipoproteins - classification, metabolism and importance. Cholesterol - Biosynthesis, regulation and degradation. ketone bodies – pathway, utilization and regulation. Synthesis and regulation of prostaglandins, eicosonids, thromboxins and leucotriens

UNIT IV **(9 Hours)**

METABOLISM OF AMINO ACIDS

Biosynthesis and degradation of amino acids and their regulation. Transamination and deamination, ammonia formation. The urea cycle and regulation of ureogenesis (Seminar).

UNIT V **(9 Hours)**

NUCLEIC ACID METABOLISM

Biosynthesis and catabolism of purines and pyrimidines and their regulation. PRPP aminotransferase & Aspartate carbamoyl transferase.

Text Books:

1. Murray et al., Harpers Biochemistry,27th edition,2006, Mc Graw Hill publication
2. Zubay G. Biochemistry, John Wiley and Sons-Ltd.3rd edition, 2002.

Reference Books:

1. Nelson DL and Cox MM. Leninger Principles of Biochemistry, W.H. Freeman, 5th edition.2008.
2. Garratte and Grishman. Principles of Biochemistry, saunders college publishing ,1994.

Course Outcomes

After the successful completion of the course the students shall be able to

CO. NO	CO Statement	Knowledge Level
CO1	Understand the Regulation of Metabolic system	K1, K2
CO2	Prevent the hormonal disorder in future	K2, K4
CO3	To understand the energy production and utilization in the body	K3, K4
CO4	To expose the knowledge of metabolism to our society	K3, K4
CO5	To understand the avoid of starvation	K2, k3

Relationship Matrix for CO, PO and PSO:

COURSE OUTCOM (CO)	PROGRAMME OUTCOME (PO)					PROGRAMME SPECIFIC OUTCOME (PSO)					Average
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	1	2	3	3	3	3	3	3	2.6
CO2	3	3	2	2	3	2	3	3	2	3	2.6
CO3	3	1	2	3	2	3	3	2	3	3	2.5
CO4	3	2	1	3	3	2	3	2	3	3	2.3
CO5	3	3	2	1	3	3	3	3	2	3	2.6
											2.52

Mean Overall Relationship is **2.52** which is **High**

Relationship of Outcomes:

Low Level Relation – 01 (If it is related less than 40 %)

Medium Level Relation – 02 (If it is related between 40 – 70 %)

High Level Relation – 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2 : Low

Greater than or equal to 1.2 and less than 2.2 : Medium

Greater than or Equal to 2.2 : High

Title of the Course	**: Major Practical II**		
Category of the Course	**: Core Course**	**Semester**	**: II**
Course Code	**: P2R2BCCC8P**	**Nature of the Skill**	**: Skill Development**
Marks	**: CIA:40+ Ext: 60 = 100**	**Hrs/Week**	**: 5**
Credits	**: 5**	**Total Inst. Hrs**	**: 60**

Course Objectives:

CO1: Get practical knowledge of the Enzyme Assays Procedures.

CO2: To understands the Electrophoresis Techniques

CO3: To Follow the Enzyme Kinetics methods

CO4: To understand the Polymerase chain reaction Procedures

CO5: To gain knowledge about the Blotting Techniques

Corse Content

1. Determination of total and specific activity amylase
2. Effect of pH on enzyme activity
3. Effect of temperature on enzyme activity and determination of activation energy.
4. Effect of inhibitor on activity of salivary amylase/urese.
5. Effect of activator on activity of salivary amylase/urease.
6. Agarose gel electrophoresis of DNA
7. Separation of purines and pyrimidines by paper chromatography
8. Separation of phospholipids by thin layer chromatography
9. Separation of amino acids by ion exchange chromatography
10. Estimation of DNA and RNA

Demonstration:

11. SDS-PAGE Electrophoresis
12. Transformation
13. Polymerase chain reaction (Demonstration)
14. Southern blotting
15. Northern blotting

Reference Books:

1. Manuals in Biochemistry, Dr. J. Jeyaraman
2. Practical Biochemistry, Warley
3. Practical Biochemistry, Phummer
4. Practical Clinical Biochemistry, Herald warley
5. David T.Plummer,An Introduction to Practical Biochemistry

6. Pattabiraman, Laboratory Manual in Biochemistry
7. Kaneko K., 2006 Life: An Introduction to Complex Systems Biology, Springer
8. Alon U., 2006 An Introduction to Systems Biology: Design Principles of Biological Circuits, CRC

Course Outcomes

After the successful completion of the course the students shall be able to

No. CO	CO Statement	Knowledge level
CO1	To carry out the quantitative analysis of all the biomolecules	K2
CO2	To understands the Electrophoresis Techniques	K3
CO3	To understand the Enzyme Kinetics methods	K2
CO4	To demonstrate the Polymerase chain reaction Procedures	K3
CO5	To gain knowledge about the Blotting Techniques	K2

Relationship Matrix for CO, PO and PSO:

COURSE OUTCOM (CO)	PROGRAMME OUTCOME (PO)					PROGRAMME SPECIFIC OUTCOME (PSO)					Average
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	3	3	2	3	3	2	3	2.5
CO2	3	3	2	3	3	2	3	3	2	3	2.7
CO3	2	2	2	2	2	3	3	3	2	3	2.4
CO4	2	2	3	3	2	3	3	3	3	2	2.5
CO5	3	2	2	2	2	3	3	2	3	3	2.5
											2.52

Mean Overall Relationship is **2.52** which is **High**

Relationship of Outcomes:

Low Level Relation – 01 (If it is related less than 40 %)

Medium Level Relation – 02 (If it is related between 40 – 70 %)

High Level Relation – 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2 : Low

Greater than or equal to 1.2 and less than 2.2 : Medium

Greater than or Equal to 2.2 : High

Title of the Course	**: BIOTECHNOLOGY AND GENETIC ENGINEERING**		
Category of the Course	**: Core Course**	**Semester**	**: II**
Course Code	**: P2R2BCCC9P**	**Nature of the Skill**	**: Skill Development**
Marks	**: CIA:25+Ext:75=100**	**Hrs/Week**	**: 5**
Credits	**: 5**	**Total Inst. Hrs**	**: 60**

Course Objectives:

CO1: Develop skills in biotechnological methods.

CO2: Have a brief knowledge about the industrial applications of biotechnology.

CO3: Also know about the ethical issues.

UNIT I **(11 Hours)**

TOOLS OF GENETIC ENGINEERING

Introduction, scope and history of genetic engineering. Restriction enzymes-types and restriction sites. Joining of DNA molecules by ligase, linkers, adapters, homopolymer tailing. Overview of enzymes used in genetic engineering. Cloning vehicles-plasmids, pBR322, pUC, YAC and its derived plasmids and its properties. λ bacteriophages as vectors, cosmids and phasmids (ICT).

UNIT II **(11 Hours)**

DNA CLONING AND SEQUENCING

Cloning strategies-cloning with single stranded DNA vectors. C DNA cloning, c DNA library and gene library. Recombinant selection and screening methods. Expression of cloned genes-problem and solution. Shuttle vectors, DNA sequencing Methods-Sangers and Gilbert methods. PCR- principle, methods, types and applications. DNA hybridization-southern, northern and western blotting (ICT).

UNIT III **(11 Hours)**

GENE TRANSFER AND APPLICATIONS (Digital Learning)

Methods of gene transfer to bacteria, plant and animals-transformation, transduction, conjugation, transfection, electroporation, liposome mediated gene transfer. Techniques of tissue culture-protoplast fusion and its application. Transgenic plants and transgenic animals, GM foods and biopesticides, animal farming.

UNIT IV **(11 Hours)**

INDUSTRIAL BIOTECHNOLOGY AND GENE THERAPY

Industrial biotechnology-fermentation-principle, types of fermentor, product recovery and purification of ethanol, citric acid, Vitamin B12 and streptomycin. Industrial production and applications of amylase, protease and cellulase. Solid waste treatment, Biogas production. Gene therapy-principle, type, method and its application (Assignment).

UNIT V **(11 Hours)**

BIOSAFETY AND BIOETHICS

Biosafety-potential hazard, biosafety in GM foods and GMOs and safety testing. Human genome project-objectives, method and approaches. Genomics and genome prospectings-social and scientific issues of biotechnology. IPR-patenting of genes and cells. Bioethics-ethics and guidelines for animal and human research (Seminar).

Text Books:

1. Dubey R. C- Book on Biotechnology, S. Chand and company PVT. LTD., 5th edition,2014.
2. Singh B. D –Biotechnology, Kalyani publishers, 3rd edition, 2007.
3. Jogdand S.N- Gene Biotechnology, Himalaya Publishing House, 2nd edition, 2006.

Reference Books:

1. Wulf Crueger, Anneliese Crueger –Biotechnology, Panima Publishing corporation, 2ndedition, 2003
2. Tyagi I. D- Biotechnology and Genetic Engineering, Jain Brothers, 1st edition, 2005.
3. Mohan P. Arora- Biotechnology, Himalaya Publishing, 2004.
4. Dr Ignacimuthu S.-Immunology, Tata McGraw Hill publishing company limited, 13th edition 2006.

e- Learning Resources:

1. Introduction to biotechnology and genetic engineering 2007 by Vishal Nanda
2. Molecular Biology and Biotechnology 5th Edition 2009 by John M Walkerse

Course Outcomes

After the successful completion of the course the students shall be able to

CO. NO	CO Statement	Knowledge level
CO1	At the end of the course the student would have:	K2
CO2	Gained insight in applications or recombinant DNA technology.	K3
CO3	Understood the principles of animal culture, media preparation.	K2
CO4	Known the bio safety hazards.	K3
CO5	Acquired knowledge about the IPR patent and about the bioethics and human research	K2

Relationship Matrix for CO, PO and PSO:

COURSE OUTCOM (CO)	PROGRAMME OUTCOME (PO)					PROGRAMME SPECIFIC OUTCOME (PSO)					Average
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	3	3	2	3	3	2	3	2.5
CO2	3	3	2	3	3	2	3	3	2	3	2.7
CO3	2	2	2	2	2	3	3	3	2	3	2.4
CO4	2	2	3	3	2	3	3	3	3	2	2.5
CO5	3	2	2	2	2	3	3	2	3	3	2.5
											2.52

Mean Overall Relationship is **2.52** which is **High**

Relationship of Outcomes:

Low Level Relation – 01 (If it is related less than 40 %)

Medium Level Relation – 02 (If it is related between 40 – 70 %)

High Level Relation – 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2 : Low

Greater than or equal to 1.2 and less than 2.2 : Medium

Greater than or Equal to 2.2 : High

Title of the Course	**:**	**NUTRITIONAL AND CLINICAL BIOCHEMISTRY**		
Category of the Course	**:**	**Core Course**	**Semester**	**: III**
Course Code	**:**	**P3R2BCCC10**	**Nature of the Skill**	**: Employability**
Marks	**:**	**CIA: 25+Ext: 75 = 100**	**Hrs /Week**	**: 05**
Credits	**:**	**05**	**Total Inst. Hrs**	**: 60**

COURSE OBJECTIVES:

CO1: Understand the organ function tests for various diseases.

CO2: Impart thorough knowledge about the biochemical basis of various disorders.

CO3: Study the various tests were used to understand the functions of body

CO4: Gain the concept on role of organs in the body

CO5: Know about the latest techniques used in clinical lab

UNIT I **(12 Hours)**

Specimen Collections

Basic understanding of clinical samples - Blood, urine, stool, bile. Methods for collection (anticoagulants) and preservation of samples. Clinical significance of urinary compounds with reference to sugars, proteins, ketone bodies, bilirubin and porphyrins. CSF-composition, collection, chemical examination for infections. Amniotic fluid: origin, collection, composition and analysis of amniotic fluid. Instruments used in an automated Biochemistry laboratory: Auto-Analyzers, spectrophotometer, colorimeter, haematology counter, Blood gas analyzers; ELISA reader (ICT).

UNIT II **(11 Hours)**

Water and Electrolyte Balance

Hydrogen ion homeostasis, factors regulating blood pH-buffers, respiratory and renal regulation, acid-base balance-biochemical findings and management of metabolic and respiratory acidosis. Water and electrolyte homeostasis: distribution of water and electrolytes in the ECF and ICF. Role of ADH, rennin - angiotensin and aldosterone system. Disturbances in water and electrolyte balance (Assignment).

UNIT III **(12 Hours)**

Organ function tests (Lab Oriented Learning)

Liver function test: Clinical features (pathogenesis, biochemical findings) and test based on bile pigments level, plasma changes, prothrombin time and consequences of jaundice, cirrhosis, hepatitis and gall stones. Kidney function test: Renal function tests, Clinical features and consequences of glomerulonephritis, acute and chronic renal failure renal failure, nephrotic syndrome and nephrolithiasis (ICT). Gastric function test: Pathogenesis, management of peptic ulcer and gastritis. Pancreatic function test: Causes, Biochemical findings, consequences of pancreatitis and cystic fibrosis.

UNIT – IV **(13 Hours)**

Inborn Errors Metabolism

Disorders of carbohydrate metabolism: Glycogen storage diseases (Seminar), Diabetes mellitus; Galactosemia and lactose intolerance. Mucopolysaccharides and Glucose tolerance tests. Disorders of lipid metabolism: Hyperlipidemia, Hyper cholesterolemia;, sphingolipidosis; diseases associated with lipoprotein metabolism - Atherosclerosis and coronary artery diseases; fatty liver, and lipotrophic factors. Disorders of protein metabolism: Phenylketonuria, hartnup's disease, alkaptonuria, albinism, maple syrup urine diseases. Disorders of purine and pyrimidine metabolism: Gout, orotic aciduria. Disorders of porphyrin metabolism - porphyrias.

UNIT V **(12 Hours)**

Molecular diagnosis of genetic defects and cancer

Diagnosis of genetic diseases by molecular biology techniques:

Hemachromatosis, thalassemias, sickle cell diseases, DNA probes; restriction fragment length polymorphism (RFLP); polymerase chain reaction (PCR) (ICT). amplification of mRNA. AIDS: Clinical diagnosis. Cancer: Types, invasion and metastasis (ICT). Tumor markers-neuron specific enolase, prostate specific antigen, on cofetal antigen, AFP, CEA. Carbohydrate markers, genetic marker, p53 gene, Ras gene. Free radicals in diseases and its management.

Text Books:

1. Chatterjee, M.N. and Rana Shinde.Text book of Medical. Biochemistry, 8th ed. Jaypee Medical Publishers, 2012U.
2. Sathyanarayana U. Chakrapani. Reprint2009. Biochemistry. Booksand Allied Private Limited, Kolkata.
3. Harold Varley. Practical Clinical Biochemistry NewYork, Interscience Publishers, Inc., 1954, 558.

Reference Books:

1. Teitz NW., fundamentals of clinical Chemistry, W.B. saunders company, second edition,1994.
2. Varley *et al*. practical clinical bio chemistry, vol I and II, CBS publishers, 5th edition, 1980.

e-Learning Resources:

1. https://www.easybiologyclass.com/topic-bioc

2. https://pdfs.semanticscholar.org

3. https://www.mayoclinic.org

Course Outcomes

After the successful completion of the course the students shall be able to

CO. NO	CO Statement	Knowledge Level
CO1	Students will acquire insight into disorders of carbohydrates, lipids and nucleic acid.	K3
CO2	Students will learn about functional tests and enzymatic assays to diagnose the function of liver, kidney, thyroid, gastrointestinal and pancreas.	K5
CO3	Students will gain knowledge about disorders of nitrogen metabolism	K4
CO4	Students will learn about the disorders of haemoglobin metabolism	K3
CO5	Students will learn about the applications of Artificial Intelligence in health and medicine	K4

Relationship Matrix for CO, PO and PSO:

Course Outcome (CO)	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Average
	PO_1	PO_2	PO_3	PO_4	PO_5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	1	2	2	3	2	3	3	3	3	3	2.6
CO-2	3	2	1	2	3	2	3	3	2	2	2.3
CO-3	2	3	2	2	3	3	2	2	3	3	2.5
CO-4	2	3	3	2	2	3	3	3	3	3	2.7
CO-5	3	2	3	3	2	3	3	3	3	3	2.8
											2.58

Mean Overall Relationship is **2.58** which is **High**

Relationship of Outcomes:

Low Level Relation – 01 (If it is related less than 40 %)

Medium Level Relation – 02 (If it is related between 40 – 70 %)

High Level Relation – 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2 : Low

Greater than or equal to 1.2 and less than 2.2 : Medium

Greater than or Equal to 2.2 : High

Title of the Course : MOLECULAR ENDOCRINOLOGY

Category of the Course	**: Core Course**	**Semester**	**: III**
Course Code	**: P3R2BCCC11**	**Nature of the Skill**	**: Skill Development**
Marks	**: CIA:25+ Ext: 75 = 100**	**Hrs/Week**	**: 5**
Credits	**: 5**	**Total Inst. Hrs**	**: 60**

Course objectives:

CO1: Learn about endocrine system of our body

CO2: Understand the function of the endocrine organs, metabolism of their hormones and their effect on the body

CO3: Understand the pathogenesis and pathophysiology of diseases of the pituitary, thyroid, Parathyroid, adrenal, Pancreas, testes and ovary

CO4: Explore the various hormonal cell signalling mechanisms

CO5: To Gain Knowledge and Prevent the hormonal disorder in future.

UNIT I **(14 Hours)**

Pituitary Hormone

Hormones-classification, biosynthesis, circulation, modification and degradation (ICT). Hormone receptors-structure and regulation. Mechanism of hormone action. Hypothalamic releasing factors. Anterior pituitary hormone: biological actions, regulation and disorders of growth hormone, ACTH and prolactin. Posterior hormone-biological actions and regulation of vasopressin. Diabetes insipidus and SIADH secretion. Oxytocin. Hypopituitarism.

UNIT II **(14 Hours)**

Thyroid and Parathyroid Hormone

Thyroid hormones-synthesis, secretion, regulation, transport, metabolic fate and biological actions. Antithyroid agents. Thyroid functions tests. Hyper and hypothyroidism. Hormonal regulation of calcium and phosphate metabolism. Secretion and biological actions of Parathyroid hormone, Calcitonin and calcitriol- mechanism of action, regulation and role. Hypocalcaemia and hypocalcaemia, rickets and osteomalacia (Assignment).

UNIT III **(14 Hours)**

Adrenal Hormone

Adrenal cortical hormones - Synthesis, regulation, transport, metabolism and biological effects of glucocorticoids and mineralocorticoids. Adrenal funcation tests. Cushing `s syndrome, aldosteronism, congenial adrenal hyperplasia, adrenal cortical insufficiency, Adrenal medullary hormone-synthesis, secretion, metabolism, regulation and biological effect of catecholamines. Phaeochromocytoma (Seminar)**.**

UNIT IV **(14 Hours)**

Sex Hormone and Pancreatic Hormoneas

Gonadal Hormones-Biosynthesis, regulation, transport, metabolism and biological actions of androgens. Hypogonadism and gynecomastia. Biosynthesis, regulation, transport, metabolism and biological effects of oestrogen and progesterone. Ammenorrhoea. Steroids: the superfamily of steroid, pheromones. Pancreatic hormone-synthesis, regulation, biological effects and mechanism of action of insulin glucagon and somatostatin.

UNIT V **(11 Hours)**

Signal Transduction

Fundamentals concepts and definitions of signals, ligands and receptors, endocrine, paracrine and autocrine signaling. Receptors and signaling pathways-cell surface receptors, ion channels, G-protein coupled receptors, receptors kineses(tyr, ser/thr). Signal transduction through cytoplasmic and nuclear receptors. The Ras-raf MAP kinase cascade, second messengers-cyclic nucleotides, lipids and calcium ions. Crosstalk in signaling pathways (ICT).

Text Books:

3. Biochemistry – Lehninger
4. Mammalian Biochemisity -white, Handler & Smith
5. Harper`s Biochemistry-Murray et al., 26th ed., McGraw Hill 2003
6. Mammalian Biochemisity- Smith et al., McGraw Hill 7 th ed.
7. Greenspan's Basic and Clinical Endocrinology by Gardner, D.G. and Shoback, D. 9th Edition.

Reference Books:

1. Biochemistry-Geoffry Zubay
2. Biochemistry-D. Voet & Judith G. Voet

Course Outcomes

After the successful completion of the course the students shall be able to

CO. NO	CO Statement	Knowledge Level
CO 1	Understand the endocrine system of the study	K2,K3
CO 2	Prevent the hormonal disorder in future	K3, K4
CO3	To Explore the structure levels of Hormones.	K3, K4
CO4	Protect the body from diabetes mellitus	K3, K4
CO5	Apply the knowledge of hormonal changes and its important in life	K2, K3

Relationship of Outcomes:

Course Outcome (CO)	Programme outcome (PO)					Programme Specific Outcome (PSO)					Average
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	1	2	3	3	3	3	3	3	2.6
CO2	3	3	2	2	3	2	3	3	2	3	2.6
CO3	3	1	2	3	2	3	3	2	3	3	2.5
CO4	3	2	1	3	3	2	3	2	3	3	2.3
CO5	3	3	2	1	3	3	3	3	2	3	2.6
											2.52

Mean Overall Relationship is **2.52** which is **High**

Relationship of Outcomes:

Low Level Relation – 01 (If it is related less than 40 %)

Medium Level Relation – 02 (If it is related between 40 – 70 %)

High Level Relation – 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2	: Low
Greater than or equal to 1.2 and less than 2.2	: Medium
Greater than or Equal to 2.2	: High

Title of the Course	**: IMMOUNOLOGY**		
Category of the Course	**: Core Course**	**Semester**	**: III**
Course Code	**: P3R2BCCC12**	**Nature of the Skill**	**: Skill Development**
Marks	**: CIA:25+ Ext: 75 = 100**	**Hrs/Week**	**: 5**
Credits	**: 5**	**Total Inst. Hrs**	**:60**

Course Objectives:

CO1: To Understand the knowledge about Role of immunologically important organs and cells
CO2: To know outline the antigen and Antibodies
CO3: To Impart Knowledge about Major histocompatibility complex (MHC) genes
CO4: To understand the Immunization
CO5: To gain knowledge about the Types of hypersensitivity

Unit I **(12 Hours)**

Immunity:

Historical Perspective, Cellular and humoral immunity. Role of immunologically important organs and cells, bone marrow, thymus, spleen and lymphocytes. Formation and functions of T and B Lymphocytes. Helper T-cells and killer T-cells. Macrophages. Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation, regulation and complement deficiencies.

Unit II **(12 Hours)**

Antigens:

Definition, epitopes, haptens, carriers, adjuvants, antigenicity. Antibodies: Definition, types and structure of immunoglobulin's (IgG – light chain, heavy chain, hyper variable region, constant domains, Fab and Fc). Effector functions of antibody, antigenic determinants on Ig, Ig super family. Monoclonal antibodies production and applications.

Unit III **(12 Hours)**

Major histocompatibility complex (MHC)

Major histocompatibility complex (MHC) genes and products – Polymorphism of MHC genes, role of MHC antigens in immune responses, MHC antigens in transplantation. Antigen–antibody reaction in vitro: Formation of antigen-antibody complex. Application of immunodiffusion, RIA, ELISA (Basic principles only).

Unit IV **(12 Hours)**

Immunization:

Vaccination – vaccines and their preparations, primary and secondary immune response, active and passive immunization, types of vaccines, immunosuppressive therapy.

Unit V **(12 Hours)**

Autoimmunity and hypersensitivity:

Self-tolerance and possible mechanisms of induction of autoimmunity, Organ specific and systemic autoimmune diseases, Types of hypersensitivity. Immunological disorders: Allergy and AIDS. Structure of HIV, mode of transmission.

Text Books

1. Immunology – Janis Kuby – W. H. Freeman and Co. 7th edition (2019)
2. Richard Coico, Geoffrey Sunshine, Eli Benjamini. Immunology – A Short Course. Wiley-Liss, New York. 5th ed., 2003
3. Janeway Travers, Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd ed., 1997.

Reference Books

1. I.M. Riott, J. Brostoff, D. Male "Immunology" 3rd edn. W.H. Freeman and Pub. Company, USA.
2. J. Kuby "Immunology" 3rd edn., Mosby Year Book Co., England Introduction to Immunology – NandiniShetty (2003)
3. Janeway'sImmunobiology 2012 8th ed., Murphy, K., Mowat, A., and Weaver, C.T., Garland Science (London & New York), ISBN:978-0-8153-4243-4

e - Learning Resources

1. https://onlinelearning.hms.harvard.edu/hmx/courses/hmx-immunology/
2. https://www.coursera.org/courses?query=immunology

EXPECTED COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

No. CO	CO Statement	Knowledge level
CO1	Significant knowledge on immunologically important organs and cells	**K1**
CO2	Understand the Helper T-cells and killer T-cells. Macrophages	**K2**
CO3	To outline the antigen and Antibodies	**K3**
CO4	Understand genes and products – Polymorphism of MHC genes	**K2**
CO5	Gaining Knowledge about Immunological disorders	**K3**

Relationship Matrix for CO, PO and PSO:

COURSE OUTCOM (CO)	PROGRAMME OUTCOME (PO)					PROGRAMME SPECIFIC OUTCOME (PO)					Average
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	2	2	3	3	3	2	2	3	2	3	2.5
CO-2	2	2	2	2	3	2	2	2	3	3	2.3
CO-3	2	2	2	3	2	2	2	3	3	3	2.3
CO-4	2	3	3	3	3	3	3	3	2	2	2.7
CO-5	3	2	3	2	2	2	2	2	2	2	2.2
											2.4

Mean Overall Relationship is **2.2** which is **High**

Relationship of Outcomes:

Low Level Relation	– 01 (If it is related less than 40 %)
Medium Level Relation	– 02 (If it is related between 40 – 70 %)
High Level Relation	– 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2	: Low
Greater than or equal to 1.2 and less than 2.2	: Medium
Greater than or Equal to 2.2	: High

Title of the Course	**: Pharmacology and Toxicology**		
Category of the Course	**: Core Course**	**Semester**	**: III**
Course Code	**: P3R2BCCC13**	**Nature of the Skill**	**: Skill Development**
Marks	**: CIA:25+ Ext: 75 = 100**	**Hrs/Week**	**: 5**
Credits	**: 5**	**Total Inst. Hrs**	**: 60**

Course Objectives:

CO1: To introduce the pharmacokinetic, pharmacodynamic and drug development processes

CO2: To expose the students to the mechanism of action and the toxic effects of various anti-infective agents.

CO3: To Impart Knowledge About the Divisions of toxicology and Classification of toxic agents

CO4: To understand the mechanism of reactive oxygen species production

CO5: To gain the knowledge about the Ant oxidative Defence Mechanisms

Unit I **(12 Hours)**

Introduction to Pharmacology – Preview of Drug development and Regulations. Pharmacokinetics – Routes of Drug administration, Absorption, Distribution, Metabolism –Microsomal cytochrome P 450 system, Excretion, Factors modifying effects of drugs. Pharmacodynamics – Types of Drug receptors, Drug- receptor interaction and Drug tolerance, Drug- Drug Interactions

Unit II **(12 Hours)**

Anti Infective agents- Sulfonamides- β lactam antibiotics, Amino glycosides, Antifungal agents, Antiviral agents, Antiprotozoal agents, Antiretroviral drugs Drugs for helminthiasis. Anti mycobacterial drugs for TB. Drugs acting on haemopoietic system, Anti coagulants and coagulants

Unit III **(12 Hours)**

Definition, Types - Scope of toxicology, sub-divisions of toxicology. Routes of Entry and Testing Procedures: Absorption – distribution –Excretion – Bio-Transformation-Bioassay – Acute toxicity - Chronic toxicity. Dose-effect and dose-response relationship. Classification of toxic agents, natural toxins, animal toxins, plant toxins, food toxins, genetic poisons and chemical toxins.

Unit IV **(12 Hours)**

Mechanism of reactive oxygen species production, The key role of super oxide anion radical, Hydrogen peroxide and hydroxyl radicals in toxicity of xenobiotics, Basics of organ toxicity- Target organs, Organ selectivity and specificity, Hepatic toxicity- liver, Actions of toxins on the liver, Chronic liver injury.

Unit V **(12 Hours)**

Oxidative stress –Toxicological consequences of oxidative stress, Oxidative stress and protein damage, Oxidative stress and DNA, damage, Oxidative stress and lipid damage, Antioxidative defence mechanisms – Enzymatic and Non enzymatic antioxidants, Role of glutathione, Superoxide dismutase, Metallothionein and α-tocopherol. as antioxidants

Text books:

1. Pharmacology (III edition)- George.M Brenner and Craig.W.Stevans. Elsevier Publication, 2010.
2. Pharmacology and Pharmacotherapeutics - R.Satoskar andSD Bhandkar, Saurabh Printers, Revised XIX Edition, 2005.

Reference Books:

1. Pharmacology- Don.A Ballington, Mary. M Laughlin. CBS publisher III edition First
1. Indian Reprint 2008
2. Essentials of Medical Pharmacology – Tripathi. JP Publishers, 7th Edition 2013.
3. Pharmacology – Anthony J. Trevor,12th Edition,2018
4. Basic and Clinical Pharmacology – Betram G. kartzuyng,14th edition,2018.
5. Pharmaceuticals and Pharmacokinetics – J.S. Kulkarni, A.P. Power,2nd Edition,2008
6. Toxicology Laboratory Lab Manual by 5. Oberdorster Eva. 2009. Kendall Hunt Publishing
7. Phillip L. Williams, 2000. Principles of Toxicology, JOHN WILEY & SONS, INC.

e - Learning Resources

1. https://www2.bc.edu/~anderswb/pharmacologyonlineresources.html
2. libguides.utep.edu › UTEP Library Research Guides › Pharmacology
3. https://you tu.be/Qtd6RhfUA
4. https://you tu.be/QVO8fm- 3AE
5. https;//you tu.be/n7GCSKMBMVM

Course Outcomes

After the successful completion of the course the students shall be able to

CO. NO	CO Statement	Knowledge level
CO-1	Explain the Pharmacokinetic, Pharmacodynamic and drug development Processes	**K2**
CO-2	Discuss the mechanism of action and the toxic effects of various anti-infective agents	**K3**
CO-3	To understand the Acute and Chronic toxicity Mechanisms	**K2**
CO-4	Explain the Mechanism of reactive oxygen species production	**K3**
CO-5	Understand about the Toxicological consequences of oxidative stress	**K2**

Relationship Matrix for CO, PO and PSO:

COURSE OUTCOM (CO)	PROGRAMME OUTCOME (PO)					PROGRAMME SPECIFIC OUTCOME (PO)					Average
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	3	2	3	3	3	2	2	2.5
CO2	2	3	2	2	3	2	3	3	3	3	2.6
CO3	3	2	2	3	2	3	3	3	3	3	2.7
CO4	2	3	3	2	2	3	3	2	3	2	2.4
CO5	3	3	2	2	3	3	3	3	3	3	2.8
											2.6

Mean Overall Relationship is **2.6** which is **High**

Relationship of Outcomes:

Low Level Relation	– 01 (If it is related less than 40 %)
Medium Level Relation	– 02 (If it is related between 40 – 70 %)
High Level Relation	– 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2	: Low
Greater than or equal to 1.2 and less than 2.2	: Medium
Greater than or Equal to 2.2	: High

Title of the Course	**:**	**MAJOR PRACTICAL III**		
Category of the Course	**:**	**Core Course**	**Semester**	**: III**
Course Code	**:**	**P3R2BCCC14P**	**Nature of the Skill**	**: Skill Development**
Marks	**:**	**CIA= 40+Ext 60=100**	**Hrs/Week**	**: 5**
Credits	**:**	**5**	**Total Inst. Hrs**	**: 60**

Course objectives:

CO1: To understand the nutritional requirements.
CO2: To perform various Nutritional assays.
CO3: Familiarize the students with specific characteristics of a laboratory of clinical biochemistry.
CO4: To know the analytical methods commonly used in the clinical laboratory
CO5: To verify how can the clinical laboratory contribute to assess the health status of individuals

Course content

Nutritional Biochemistry:

1. Quantitative estimation of Sugars (Glucose, lactose, starch)
2. Estimation of acid value, iodine value, Saponification value of fats
3. Estimation of blood Glucose
4. Estimation of serum cholesterol

Clinical biochemistry:

1. Determination of A/G ratio in serum.
2. Determination of Lipid Profile
3. Isolation and estimation of serum cholesterol.
4. Blood sugar determination by glucose oxidize method.
5. Differential, cell count.
6. Serum enzyme assays: alkaline phosphatase, SGOT, SGPT
7. Gel Electrophoresis of serum proteins.
8. Estimation of serum enzymes - Creatine phosphokinase (CPK), ALP, AST, SGPT and SGOT

Text Books:

1. Joshi SA. (2010). Nutrition and Dietetics. 3rd Ed. New Delhi: McGraw Hill Education
2. (India) Put Ltd.
3. Raut SK., Mitra K and Chowdhury P., AdhunikPustibigyan, Academic Publishers.

Reference Books:

1. Practical Biochemistry- Keith Wilson and John Walker, Cambridge University Press, 1997
2. R. Boyer, Modern Experimental Biochemistry, 3rd., Pearson Education (Singapore) Pvt. Ltd.,2001.
3. D.T. Plummer, Practical Biochemistry - TATA McGraw-Hill education; 3rd edition,2006
4. Wilson and J. Walker, Practical Biochemistry, Principles and Techniques, Cambridge University Press, eighth edition 2018.

Course Outcomes

After the successful completion of the course the students shall be able to

CO. NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Apply and practice the methods to improve blood typing	K1, K2
CO 2	Analyse the isolation ofblood cells.	K2, K3
CO3	Helps the students to understand, evaluate and analysis the abnormal constitutes in various serum biological profile	K3, K4
CO4	Apply the knowledge on the Nutritional value.	K2, K3
CO5	Understand and familiarize in the modern clinical Laboratory techniques and its applications	K3, K4

Relationship Matrix for CO, PO and PSO:

Course Outcome (CO)	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Average
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	3	1	3	3	3	3	2	3	2.5
CO2	1	2	2	3	3	2	3	3	3	3	2.5
CO3	2	3	3	3	2	3	3	3	3	3	2.8
CO4	3	2	3	2	2	3	2	3	2	2	2.4
CO5	2	3	3	1	2	2	2	3	3	3	2.4
											2.52

Mean Overall Relationship is **2.52** which is **High**

Relationship of Outcomes:

Low Level Relation – 01 (If it is related less than 40 %)

Medium Level Relation – 02 (If it is related between 40 – 70 %)

High Level Relation – 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2 : Low

Greater than or equal to 1.2 and less than 2.2 : Medium

Greater than or Equal to 2.2 : High

Title of the Course	**: STEM CELL AND REPRODUCTION**		
Category of the Course	**: Discipline Specific Elective**	**Semester**	**: I**
Course Code	**: P1R2BCDSE1:1**	**Nature of the Skill**	**: EMPLOYABILITY**
Marks	**: CIA:25+Ext:75=100**	**Hrs/Week**	**: 6**
Credits	**: 3**	**Total Inst. Hrs**	**: 72**

Course Objective

CO1: Relate the importance of stem cells to the development and maintenance of multicellular organisms.

CO2: Describe how stem cells can be used for medical purposes and cite specific examples.

CO3: Understand how defects in stem cell behaviour can lead to medical problems.

CO4: Understand complex molecular, cellular, and genetic techniques used to investigate stem cell Reproduction.

CO5: Describe current limitations of stem cell biology applications and areas of active research

Unit I **(12 Hours)**

Cell division:

Cell cycle, Mitosis, significance of mitosis, Meiosis – Kinds of meiosis and Significance of meiosis. **Cell death**: Overview of programmed cell Death-Apoptosis & Necrosis (ICT). Cell renewal, Stem Cells-Embryonic and adult stem cell.

Unit II **(12 Hours)**

Stem cells

Introduction, Definition and basics of stem cells. Classification of stem cellsdifferent types of stem cells- Human embryonic stem cells, Adult stem cells. Sources of stem cells - Fetus and various adult tissues (ICT) – Advantages of stem cells. Blastocyst culture- Various stages of embryonic development. In vitro fertilization.

Xenofree derivation of stem cells – Alternative feeder cells and feeder free culture. **Cryopreservation of stem cells** – Conventional slow- freezing method and Vitrification method. Properties of stem cells - self renewel, (ASSIGNMENT) clonality and plasticity.

Unit III **(12 Hours)**

Hematopoietic stem cells (HSC) - Basics, Development and Regulation of HSC. Clinical Application of HSC – Gene Therapy – using haematopoietic stem cells HSC for Leukemia. **Mesenchymal stem cells (MSC) -** Differentiation and Identification. Characteristics of mesenchymal stem cells. Clinical applications of stem cells(ASSIGNMENT). Stem cells and regenerative medicine. Ips –induced pluripotent stem cells.

Unit IV **(12 Hours)**

Stem Cells and their developmental potentials: Characteristics of stem cells Transdifferntiation of stem cells. Controlled differentiation of human embryonic stem cells. In vivo and invitro differentiation of stem cells(ICT). Application of stem cells.

Unit V **(12 Hours)**

Therapeutic cloning strategies

derivation and propagation of human embryonic stem cells. Reproductive cloning by SCNT. Use of SCNT(ASSIGNMENT). Stem cell research and ethics – translational medicine ethics.

Reference Books:

1. Cell Biology by Pollard, T. D., and Earnshaw, W. C.; Saunders.
2. Handbook of stemcells- Robert Lanza.
3. Stem cell research and therapeutic.s. – Yanhong Shi
4. Stem cells reviews- Humana Press
5. Stem cells – C.S. Potten
6. Adult stem cells – KursadTurksen.

Course Outcomes

After the successful completion of the course the students shall be able to

CO. NO	CO Statement	Knowledge Level
CO1	Relate the importance of stem cells to the development and maintenance of multicellular organisms.	K2
CO2	Describe how a niche can regulate stem cell biology and cite some specific examples.	K2
CO3	The major paradigms in the field OF stem cell, with the research approaches and tools used in it.	K4
CO4	Acquire knowledge about stem cell therapy, types and its applications.	K4
CO5	Develop informed opinions of the science, policy, and ethics of modern applied stem cell biology.	K4

Relationship Matrix for CO, PO and PSO:

Course Outcome (CO)	Programme Outcome(PO)					Programme Specific Outcome(PSO)					Avreage
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	2	3	2	3	2	2	3	2	3	2	2.4
CO-2	2	3	1	2	2	3	2	3	3	2	2.3
CO-3	2	3	2	2	3	3	1	2	3	3	2.3
CO-4	2	2	3	2	3	2	3	1	2	3	2.2
CO-5	2	3	2	3	1	2	2	3	2	3	2.3
											2.3

Mean Overall Relationship is **2.3** which is **High**

Relationship of Outcomes:

Low Level Relation	– 01 (If it is related less than 40 %)
Medium Level Relation	– 02 (If it is related between 40 – 70 %)
High Level Relation	– 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2	: Low
Greater than or equal to 1.2 and less than 2.2	: Medium
Greater than or Equal to 2.2	: High

Title of the Course : MEDICINAL PLANTS AND PHYTOTHERAPY

Category of the Course	**: Discipline Specific Elective**	**Semester**	**: I**
Course Code	**: P1R2BCDSE1:2**	**Nature of the Skill**	**: Skill Development**
Marks	**: CIA:25+ Ext: 75 = 100**	**Hrs/Week**	**: 6**
Credits	**: 3**	**Total Inst. Hrs**	**: 72**

Course objectives:

The student will be able to

CO1: To provide knowledge of general medicinal plants.

CO2: To understand the mechanism of action of drugs

CO3: To provide the basic methodology of the structure extraction and separation techniques

UNIT I **(15 Hours)**

Medicinal plants and their importance

Plants with hepatoprotective, nephroprotective, hypoglycaemic, anticancer, antimalarial, antifungal, antiviral, anti-inflammatory and anticholinergic Properties. Phytochemical studies: Primary metabolites and secondary metabolites in Medicinal plants; alkaloids, flavonoids, tannins, Terpenoids, Phenols, saponins, glucosides, carbohydrates, protein and steroids, Occurrence, distribution and functions (ICT).

UNIT II **(15 Hours)**

Plant Identification and Extraction, separation techniques

Elementary knowledge of Binomial nomenclature – Outline of Bentham and Hooker classification – Herbarium techniques. Collection, storage, vouchering of plants and preparation of plant material for different extraction methods: Solvent extraction, fractionation, distillation and rotary evaporation. Principles and use chromatographic and spectroscopic techniques like column chromatograph. TLC, HPTLC, LCMS, IR and NMR for the purification and separation of compounds (Assignment).

UNIT III **(15 Hours)**

Biochemical studies

Free radicals, free radicals induced damages, disease caused by free radicals. Antioxidants- enzymic and non-enzymic antioxidants, role of antioxidants in prevention of diseases (Seminar).

UNIT IV **(15 Hours)**

Biotechnology of medicinal plants

Production of secondary metabolites, culture techniques, micro propagation of endangered species and conservation of herbal plants. Elicitors and immobilization techniques for the enhanced synthesis of pharmaceutical compounds.

UNIT V **(12 Hours)**

Mechanism of action

Metabolism, excretion and side effects of allopathic drugs –sulfonyl ureas and biguanides, Mechanism os herbal drugs –vincristine, vinblastine and silymarin (ICT).

Text Books:

1. Satoskar et al., Pharmacology and Pharmacotherapeutics, Popular Prakam, Mumbai, 1999.

2. Foye, O.W. et al., Medicinal Chemisty, B.I. Waverly Pvt.Ltd. New Delhi 1995.

Course Outcomes

After the successful completion of the course the students shall be able to

CO. NO	CO Statement	Knowledge Level
CO 1	Understand the Important of the Medicinal plants	K1, ,K2
CO 2	Prevent the disorders using Medicinal Plants in future	K2, K3,
CO3	Acquired knowledge about the identification of the medicinal plant and their use	K3, K4
CO4	Gained skill in extracting the secondary metabolites from the plants.	K3, K4
CO5	Obtained knowledge about quantifying and identifying the various biochemical components present in the plant extract.	K2, k3

Relationship Matrix for CO, PO and PSO:

Course Outcome (CO)	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Average
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	1	2	3	3	3	3	3	3	2.6
CO2	3	3	2	2	3	2	3	3	2	3	2.6
CO3	3	1	2	3	2	3	3	2	3	3	2.5
CO4	3	2	1	3	3	2	3	2	3	3	2.3
CO5	3	3	2	1	3	3	3	3	2	3	2.6
											2.52

Mean Overall Relationship is **2.52** which is **High**

Relationship of Outcomes:

Low Level Relation – 01 (If it is related less than 40 %)

Medium Level Relation – 02 (If it is related between 40 – 70 %)

High Level Relation – 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2 : Low

Greater than or equal to 1.2 and less than 2.2 : Medium

Greater than or Equal to 2.2 : High

Title of the Course	**: ENVIRONMENTAL BIOLOGY**		
Category of the Course	**: Discipline Specific Elective**	**Semester**	**: II**
Course Code	**: P2R2BCDSE2:1**	**Nature of the Skill**	**: Skill Development**
Marks	**: CIA:25+ Ext: 75 = 100**	**Hrs/Week**	**: 5**
Credits	**: 3**	**Total Inst. Hrs**	**:60**

Course Objectives:

CO1. The candidates undertaking this course will gain knowledge about the structure of atmosphere;
CO2. To know about types of soil; biogeochemical cycles;
CO3. The main themes include managing water quality and air resources,
CO4. Candidates undertaking Protection from radiation, to maintain industrial hygiene etc
CO5. Global environmental issues and International laws.

Unit I **(12 Hours)**

Environmental components:

Atmosphere, structure and chemical composition of atmosphere, Internal structure of the Earth, rocks and their classification, minerals and their classification. Weathering and soil formation, soil profile, soil classification, soils of India. Global Water Balance **(ICT),** Origin and composition of sea water. Hydrological cycle. Classification of trace elements, mobility of trace elements, biogeochemical cycles **(ICT)**.

Unit II **(12 Hours)**

Fundamentals of Ecology:

Definition, subdivisions. Ecosystems: concept of ecosystems, aquatic ecosystem, terrestrial ecosystem, energy flow in ecosystems, nutritional flux. Food chains, Food web, ecotone, edge effects **(ICT),** ecological habitat & niche, ecological pyramids and ecosystem stability, concept of habitat and niche.

Unit III **(12 Hours)**

Biomes and Habitat Diversity:

Classification of biomes, major biotic elements of each biome and their characteristics. Population and community ecology, population growth curves, life history strategies (r &k selection); concept of metapopulation. Ecological succession **(ICT)**, primary and secondary, mechanism of succession.

Unit IV **(12 Hours)**

Global environmental issues and International laws:

Global warming, Greenhouse effect, ozone depletion, acid rains, hazardous waste, CITES etc. Earth's carbon cycle **(ASSINGMENT)**, carbon sequestration, sustainable development.

Unit V **(12 Hours)**

Bioremediation:

Introduction and types of bioremediation, bioremediation of surface soil and sludge, bioremediation of subsurface material, In situ and Ex-situ technologies, Phytoremediation.

Chemical toxicology: Biochemical effects of heavy metals (Pb, As, Hg, Cd), pesticides, insecticides, herbicides, weedicides, larvicides **(ICT).**

Text Books:

1. Fundamentals of Ecology 5th Edition by Eugene Odum (Author), Gary W.Barrett (Author)
2. Environmental Chemistry Paperback –by V. K. Ahluwalia (Author), Lalita S.Kumar (Author), ANE Books

References Books:

1. Environment and Ecology: Biodiversity, Climate Change and Disaster Management, by Majid Husain (Author), Access Publishing
2. Environmental Biology (Principles of Ecology), 4/e DR. P.S. VERMA• & DR. V.K. AGARWAL, S. Chand Publishing Ecology Environmental Science and Conservation, 1/e, J.S. SINGH, S. R. GUPTA& S P Singh, S. Chand Publishing.
3. Textbook of Environmental Chemistry, by Ayodhya Singh, Publisher: Neha Publishers• & Distributors.

Related Online Contents.

1. https://www.concordia.ca/library/guides/chemistry/chem470.html
2. https://en.wikipedia.org/wiki/Environmental_toxicology
3. https://www.environmentalscience.org/career/biochemist

Course Outcomes

After the successful completion of the course the students shall be able to

CO No.	CO Statement	Knowledge level
CO1	Significant knowledge will be obtained about structure and chemical composition of atmosphere.	K1
CO2	Complete information about, Origin and composition of sea water.	K2
CO3	A thorough understanding of the ecological habitat & niche	K3
CO4	Understand the fundamental concepts Population and community ecology.	K4
CO5	Understand about the phytoremediation and chemical toxicology.	K3

Relationship Matrix for CO, PO and PSO:

CO/PO	Programme Outcome (PO)					Programme Specific Outcome (PO)					Average
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	2	3	3	2	2	3	3	3	2.6
CO2	2	3	3	3	3	2	2	2	2	3	2.5
CO3	2	3	3	2	2	2	3	3	3	3	2.6
CO4	3	3	2	2	3	3	3	3	3	2	2.6
CO5	2	3	2	2	3	3	3	3	2	2	2.5

Mean Overall Relationship is **2.5** which is **High**

Relationship of Outcomes:

Low Level Relation	– 01 (If it is related less than 40 %)
Medium Level Relation	– 02 (If it is related between 40 – 70 %)
High Level Relation	– 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2	: Low
Greater than or equal to 1.2 and less than 2.2	: Medium
Greater than or Equal to 2.2	: High

Title of the Course	**:**	**BIOPROCESS TECHNOLOGY**		
Category of the Course	**:**	**Discipline Specific Elective**	**Semester**	**: II**
Course Code	**:**	**P2R2BCDSE2:2**	**Nature of the Skill**	**: Employability**
Marks	**:**	**CIA: 25+Ext: 75 = 100**	**Hrs/Week**	**: 05**
Credits	**:**	**03**	**Total Inst. Hrs**	**: 60**

COURSE OBJECTIVES:

CO1: To learn the production of various biological compounds by fermentation process.

CO2: To study the different techniques used by the various industries.

CO3: To acquaint students with technical and biological aspect of microbial utilisation for production of metabolites.

CO4: To gain knowledge on designing of bioreactors.

CO5: Know about the latest techniques used in Bioprocess Industries.

UNIT I **(10 Hours)**

Types fermentation technology

Introduction to fermentation processes; Microbial culture; Preservation and improvement of industrially important microorganisms; Inoculum production for bacterial and fungal processes (ICT).

UNIT II **(12 Hours)**

Raw material and media formulation for fermentation process

Types of Fermentation – Continuous culture, Batch Culture; Fermentation media; Natural media; synthetic media and Media Sterilization methods. Sources of Carbon(Seminar); Nitrogen and vitamins; antifoams and optimization; Process parameters: measurement of temperature; pressure and pH; dissolved Oxygen; foam etc. Strain improvement for primary and secondary metabolites with relevant examples Preservations of culture.

UNIT III **(13 Hours)**

Types of reactors

Types of reactors: Stirred tank reactor, plug flow reactor (PFR), fluidized bed reactor, Immobilized system and packed bed reactors and Photo bioreactors and air lift reactor**(ICT)**.

Agitation and Aeration: Mechanical agitation, power consumption in agitation, bubble aeration. Transport phenomena in bioprocess systems; gas-liquid mass transfer, oxygen transfer to microbes and respiration and rheology of fermentation fluids.

UNIT IV **(12 Hours)**

Downstream Processing

Biomass separation by centrifugation**(Assignment)**; filtration; flocculation and other methods; Cell disintegration: Physical; chemical and enzymatic methods;

UNIT V **(13 Hours)**

Monitoring of Bioprocesses

Computer based data acquisition of isolation and purification techniques for proteins and other products based on different physico-chemical properties, automation and application of computers in bio processing; recombinant products with representative examples.

Text Books:

1. Shuler M L, Kargi F, "Bioprocess Engineering- Basic Concepts", 2nd ed, Prentice Hallof India Ltd. (2002)
2. Stanbury P F and Whitaker A, "Principles of Fermentation Technology," 2nd edition,Elsevier. (1995).

Reference Books:

1. Aiba S, Humphrey A E and Millis N F,"Biochemical Engineering" , Academic Press(1973).
2. Harvey W. Blanch and Douglas S.Clark, "Biochemical Engineering", Marcel Dekker(1996).
3. Lee J M, "Biochemical Engineering", PrenticePrentice Hallof India Ltd. (2005)

E-Learning Resources:

1. https://www. biochemical engineering /topic-bioc

2. https://www.bio fermentation technology .org

3.https://www.bioprocess techonology.org

Course Outcomes

After the successful completion of the course the students shall be able to

CO. NO	CO STATEMENT	KNOWLEDGE LEVEL
CO1	Students would be able to measure extent of biochemical growth, types of biochemical interactions for living processes.	K3
CO2	Ability to analyze the microbial growth kinetics	K5
CO3	To enable to design the fermentor for bio processing of different products.	K4
CO4	The student can scale up the bioprocess for large scale production	K3
CO5	The students can monitor the bioprocess for higher production efficiency	K4

Relationship Matrix for CO, PO and PSO:

Course Outcome (CO)	Programme Outcome (PO)					programme specific Outcome (PSO)					Average
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	1	2	2	3	2	3	3	3	3	3	2.6
CO2	3	2	1	2	3	2	3	3	2	2	2.3
CO3	2	3	2	2	3	3	2	2	3	3	2.5
CO4	2	3	3	2	2	3	3	3	3	3	2.7
CO5	3	2	3	3	2	3	3	3	3	3	2.8
											2.58

Mean Overall Relationship is **2.58** which is **High**

Relationship of Outcomes:

Low Level Relation	– 01 (If it is related less than 40 %)
Medium Level Relation	– 02 (If it is related between 40 – 70 %)
High Level Relation	– 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2	: Low
Greater than or equal to 1.2 and less than 2.2	: Medium
Greater than or Equal to 2.2	: High

Title of the Course	**: GENOMICS AND PROTEOMICS**		
Category of the Course	**: Skill Enhancement course**	**Semester**	**: III**
Course Code	**: P3R2BCSEC1:2**	**Nature of the Skill**	**: EMPLOYABILITY**
Marks	**: CIA:25+Ext:75=100**	**Hrs/Week**	**: 5**
Credits	**: 3**	**Total Inst. Hrs**	**: 60**

COURSE OBJECTIVES:

CO1: To appraise the students to the vital concepts of technologies pertinent to Genomics and Proteomics

CO2: Genome organization, gene identification, expression and applications of genomics analysis

CO3: Their applications and demonstrate skills to apply the knowledge in scientific queries.

CO4: They should have the molecular biology laboratory skills needed to generate the data.

CO5: Their characteristics and sequencing to the students and their applications in comparative genomics and anscriptomics.

Unit I **(12 Hours)**

Introductory genomics Introduction to Genomics

Anatomy of prokaryotic and eukaryotic genome, content of genome, Cvalue paradox, CoT curve analysis(ICT), repetitive DNA, tools to study genome diversity (PCR/ RFLP).

UNIT II **(12 Hours)**

Applied Genomics

Strategies for major genome sequencing projects, approaches and assembly methods, NGS methods and advantages, gene analysis and annotation (ICT).

UNIT III **(12 Hours)**

Transcriptomics and expression profiling Genome

expression analysis, RNA content and profiling, genetic mapping, Microarray (cDNA and protein microarray) (ASSINGMENT).

UNIT 4 **(12 Hours)**

Introductory proteomics

Importance of proteomics, strategies in analysis of proteome: 2-D PAGE, Mass spectrometry, Protein sequencing method (Edman degradation, MALDI TOF/TOF) (ICT). Structure of protein and formation of oligomers, Protein solubility and interaction with solvents and solutes, activity of proteins.

UNIT 5 **(12 Hours)**

Applied proteomics

Databases and search engines in proteomics, post translational protein modifications, protein localization Protein: protein interaction: Yeast two hybrid system, phage display, GST pull down, affinity based methods, Disease related proteins and drug discovery, Disease diagnosis, identification and characterization of novel proteins, protein engineering principles.

References Books:

1. Database Annotation in Molecular Biology: Principles and Practice, Arthur M. Lesk
2. Bioinformatics: Sequence and genomic analysis by D. W. Mount, Cold Spring Harbour Laboratory Press.
3. Recombinant DNA (Second Edition), James D. Watson and Mark Zoller
4. Gene Cloning and DNA Analysis – An introduction (Fourth Edition), T.A. Brown
5. Protein array, Biochips and Proteomics by Smith and Albala (Eds), Marcel Dekkar, New York.

Course Outcomes:

After the successful completion of the course the students shall be able to

CO. NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Be able to classify the complexity of genome/ proteome structural and functional organization.	K3
CO2	Formulate and assess experimental design for solving theoretical and experimental problems in Genomics and Proteomics fields.	K3
CO3	To know transcriptomics and metabolomics and their applications in various applied areas of biology	K2
CO4	They would know strategies and challenges of genome sequencing, comparative genomics, transcriptomics using microarray technology.	K4
CO5	The students will also know about metagenomics, and different methodologies used in proteomics as well as structural proteomics.	K3

Relationship Matrix for CO, PO and PSO:

Course Outcome (CO)	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Avreage
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	1	2	2	1	2	3	2	3	2	3	2.1
CO2	3	2	2	2	3	2	3	3	2	2	2.4
CO3	2	3	2	2	2	3	2	2	3	2	2.3

CO4	2	3	3	2	2	2	3	2	3	3	2.5
CO5	2	2	2	3	2	3	2	3	2	3	2.4
											2.34

Mean Overall Relationship is **2.34** which is **High**

Relationship of Outcomes:

Low Level Relation – 01 (If it is related less than 40 %)

Medium Level Relation – 02 (If it is related between 40 – 70 %)

High Level Relation – 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2 : Low

Greater than or equal to 1.2 and less than 2.2 : Medium

Greater than or Equal to 2.2 : High

Title of the Course	**: Evolutionary Biology**		
Category of the Course	**: Generic Elective Course**	**Semester**	**: IV**
Course Code	**: P4R2BCGEC1**	**Nature of the Skill**	**: Skill Development**
Marks	**: CIA:25+Ext:75=100**	**Hrs/Week**	**: 5**
Credits	**: 3**	**Total Inst. Hrs**	**: 60**

Course Objectives:

CO1: To Understand the knowledge about Evolutionary Biology

CO2: To outline the theories or organic evolution

CO3: To Impart Knowledge About hardy Weinberg equilibrium

CO4: To understand the Theories of Evolution

CO5: To gain knowledge about the Evolution of Man

Unit I **(12 Hours)**

Historical aspects of evolutionary concepts - Origin of life- chemical and biological evolution - Urey & Miller Experiment. Evidences in favour of evolution – comparative - morphology and anatomy – embryology – physiology and Biochemistry

Unit II **(12 Hours)**

Origin of life,concepts of evolution,theories or organic evolution,mechanism of speciation, hardy Weinberg equilibrium,genetic polymorphism and selection, origin and evolution of economically important microbes,plants and animals.

Unit III **(12 Hours)**

Theories of Evolution - Lamarckism, Neo - Lamarckism, Darwinism, Neo - Darwinism, mutation theory - Modern synthetic theory – genetic basis of evolution.

Unit IV **(12 Hours)**

Modes of evolution- Speciation- Types- Isolating mechanisms – Geographic and reproductive isolation – adaptive radiation- convergent and Parallel evolution- Mimicry and colouration – living fossil – Insular fauna

Unit V **(12 Hours)**

Evolution of vertebrate groups- fishes, amphibians, reptiles, birds and mammals. Evolution of Horse and Man - Biological & Cultural evolution

Text Books:

1. Ridley, M. (2004) Evolution. III Edn. Blackwell

2. Hall, B. K. and Hallgrimson, B. (2008) Strickberger's Evolution. IV Edn. Jones and Barlett

3. Zimmer, C. and Emlen, D. J. (2013) Evolution: Making Sense of Life. Roberts & Co.

4. Futuyma, D. (1998) Evolutionary Biology. III Edn. Sinauer Assoc. Inc.

5. Barton, Briggs, Eisen, Goldstein and Patel. (2007) Evolution. Cold Spring Harbor Laboratory Press

Reference Books:

1. Mark Ridley. Evolution. 3rd Edition. Blackwell Pubishing. (2004).
2. Mathur, Tomar, Singh. Evolution and Behaviour. Rastogi Publication, Merrut.
3. Mohan P. Arora. Evolutionary Biology, Himalaya Publishing House, Bombay.
4. 4.P. S. Verma and V. K. Agarwal. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, Revised Edition. S. Chand Publication (2004).
5. Strick berger. Evolution. Prentic Hall. (2002).
6. 6.Theodore H., Jr Eaton. Evolution. 1st Edition. W. W. Norton Publication. (1970).

Course Outcomes

After the successful completion of the course the students shall be able to

CO. NO	CO Statement	Knowledge level
CO1	Significant knowledge on Historical aspects of evolutionary concepts	K1
CO2	Understand the evolutionary theories by Lamark, Darwin and other evolutionist.	K2
CO3	To outline the theories of organic evolution	K3
CO4	Understand the Modes of evolution Concept	K2
CO5	Gaining Knowledge about the Evolution of Man	K3

Relationship Matrix for CO, PO and PSO:

Course Outcome (CO)	Programme Outcome (PO)					Programme Specific Outcome (PO)					Average
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	2	2	2	3	3	2	3	3	2	2	2.4
CO-2	2	2	2	3	3	2	3	3	2	3	2.5
CO-3	2	2	2	2	2	3	3	3	2	2	2.3
CO-4	1	2	2	2	2	3	3	3	3	1	2.2
CO-5	2	2	2	2	2	3	3	2	3	2	2.4
											2.36

Mean Overall Relationship is **2.36** which is **High**

Relationship of Outcomes:

Low Level Relation	– 01 (If it is related less than 40 %)
Medium Level Relation	– 02 (If it is related between 40 – 70 %)
High Level Relation	– 03 (If it is related greater than 70 %)

Mean overall Score Range

Less than 1.2	: Low
Greater than or equal to 1.2 and less than 2.2	: Medium
Greater than or Equal to 2.2	: High

M.Sc BIOCHEMISTRY PROGRAM SPECIFIC OUTCOMES:

- An ability to properly understand the technical aspects of existing technologies that help in addressing the biological and medical challenges faced by humankind.
- An ability to translate knowledge of Biochemistry to address environmental, intellectual, societal and ethical issues through case studies presented in the class.
- Capacity to identify, analyze and design safe experimental process to provide efficient solutions by fair interpretation of data
- Perfect gain insight into biochemical research ethics for production of quality research and publication.
- An ability to get engaged them in lifelong learning to foster their growth as a successful researcher and established as an entrepreneur in the field of biochemistry.