THIRUVALLUVAR UNIVERSITY

BACHELOR OF SCIENCE
B.Sc. BIOCHEMISTRY
UNDER CBCS

(With effect from 2022-2023)

The Course of Study and the Scheme of Examinations

S. No.	Part	Study Components / Course Title		Ins. Hrs / week	Credit	Title of the Paper	Maximum Marks		
		SEMESTER I					**CIA**	**Uni. Exam**	**Total**
1.	I	Language	Paper-1	6	4	Tamil/Other Languages	25	75	100
2.	II	English (CE)	Paper-1	6	4	**Communicative English I**	25	75	100
3.	III	Core Theory	Paper-1	6	4	Cell biology	25	75	100
	III	Core Practical	Practical -1	4	0	Titrimetric and Qualitative analysis	0	0	0
4.	III	Allied -1	Paper-1	4	3	Chemistry I	25	75	100
	III	Allied- 1	Practical -1	2	0	Chemistry I & II	0	0	0
5.	**III**	**PE**	**Paper 1**	**6**	**3**	**Professional English I**	**25**	**75**	**100**
6.	IV	Environmental Studies		2	2	Environmental studies	25	75	100
		Sem. Total		**36**	**20**		**150**	**450**	**600**
		SEMESTER II					**CIA**	**Uni. Exam**	**Total**
7.	I	Language	Paper-2	6	4	Tamil/Other Languages	25	75	100
8.	II	English (CE)	Paper-2	4	4	**Communicative English II**	25	75	100
9.	**II**	**NMSDC I : Language Proficiency for Employability**	**Paper-1**	**2**	**2**	**Effective English**	**25**	**75**	**100**
10.	III	Core Theory	Paper-2	5	4	Biomolecules	25	75	100
11.	III	Core Practical	Practical -1	3	2	Titrimetric and Qualitative analysis	25	75	100
12.	III	Allied-1	Paper-2	4	3	Chemistry II	25	75	100
13.	III	Allied Practical – 1	Practical -1	2	2	Chemistry I & II	25	75	100
14.	**III**	**PE**	**Paper 1**	**6**	**3**	**Professional English II**	25	75	100
15.	IV	Value Education		2	2	Value Education	25	75	100
16.	IV	Soft Skill		2	1	Soft Skill	25	75	100
		Sem. Total		**36**	**27**		**225**	**675**	**900**

S.NO	Part	Study Components Course Title		Ins. hrs /week	Credit	Title of the Paper	Maximum Marks		
SEMESTER III							CIA	Uni. Exam	Total
17.	I	Language	Paper-3	6	4	Tamil/Other Languages	25	75	100
18.	II	English	Paper-3	6	4	English	25	75	100
19.	III	Core Theory	Paper-3	4	5	Analytical Biochemistry	25	75	100
	III	Core Practical	Practical-2	3	0	1. Colorimetry 2. Biochemical Preparation 3. Chromatographic Separation 4. Electrophoretic Technique	0	0	0
20.	III	ALLIED-2	Paper-3	4	3	(To choose 1 out of 2) 1. Microbiology I 2. Zoology I	25	75	100
	III	Allied Practical	Practical-2	3	0		0	0	0
21.	IV	Skill based Subject	Paper-1	2	2	First Aid	25	75	100
22.	IV	Non-major elective	Paper-1	2	2	Food & Nutrition	25	75	100
				30	**20**		**150**	**450**	**600**
SEMESTER IV							CIA	Uni. Exam	Total
23.	I	Language	Paper-4	6	4	Tamil/Other Languages	25	75	100
24.	II	English	Paper-4	6	4	English	25	75	100
25.	III	Core Theory	Paper-4	4	4	Plant Biochemistry	25	75	100
26.	III	Core Practical	Practical-2	3	3	1. Colorimetry 2. Biochemical Preparation 3. Chromatographic Separation 4. Electrophoretic Technique	25	75	100
27.	III	ALLIED-2	Paper-4	4	3	(To choose 1 out of 2) 1. Microbiology II 2. Zoology II	25	75	100
28.	III	Allied Practical-2	Practical-2	3	2		25	75	100
29.	**IV**	**NMSDC II : Digital Skills for**	**Paper-2**	**2**	**2**	**Office Fundamentals**	25	75	100

S.NO	Part	Study Components		Ins. hrs /week	Credit	Title of the Paper	Maximum Marks		
		Course Title							
		Employability							
30.	IV	Non-major elective	Paper-2	2	2	Life style diseases and prevention	25	75	100
				30	**24**		**200**	**600**	**800**
SEMESTER V							CIA	Uni. Exam	Total
31.	III	Core Theory	Paper-5	6	6	Enzymes and Intermediary Metabolism	25	75	100
32.	III	Core Theory	Paper-6	6	5	Molecular Biology	25	75	100
33.	III	Core Theory	Paper-7	6	5	Physiology and Nutrition	25	75	100
	III	Core Practical	Practical-3	3	0	1. Colorimetric Estimations 2. Enzyme Assay	0	0	0
	III	Core Practical	Practical-4	3	0	1. Hematology 2. Microbiology 3. Urine Analysis	0	0	0
34.	III	Internal Elective	Paper-1	3	3	Molecular Endocrinology	25	75	100
35.	IV	Skill based Subject	Paper-2	3	2	Medical Lab technology	25	75	100
				30	**21**		**125**	**375**	**500**
SEMESTER VI							CIA	Uni. Exam	Total
36.	III	Core Theory	Paper-8	5	5	Clinical Biochemistry	25	75	100
37.	III	Core Theory	Paper-9	5	5	Biotechnology	25	75	100
38.	III	Core Practical	Practical-3	3	3	3. Colorimetric Estimations 4. Enzyme Assay	25	75	100
39.	III	Core Practical	Practical-4	3	3	1. Hematology 2. Microbiology 3. Urine Analysis	25	75	100
40.	III	Core Project		5	5	**(Individual / Group Project)**	25	75	100
41.	III	Internal Elective	Paper-2	3	3	Immunology	25	75	100

S.NO	Part	Study Components		Ins. hrs /week	Credit	Title of the Paper	Maximum Marks		
		Course Title							
42.	III	Internal Elective	Paper-3	3	3	Pharmaceutical Biochemistry	25	75	100
43.	IV	Skill based Subject	Paper-3	3	2	Research Methodology	25	75	100
44.	V	Extension Activities		-	1		100	0	100
45.	-	**NMSDC III : Employability Readiness**	**Paper-3**	**0**	**0**	**(choose any one)** **• Naandi** **• Unnati** **• Quest** **• Izpay** **• IBM Skills build**	-	-	-
				30	**30**		**300**	**600**	**900**
					142				

PAPER - 1

CELL BIOLOGY

COURSE OBJECTIVES

1. To analyse the structures and basic components of cells.
2. To study the difference between prokaryotes and eukaryotes.
3. To understand the compartmentalisation in cell biology.
4. To gain knowledge on the biological role of extra cellular matrix
5. To acquire knowledge on the importance of gap and tight junction

COURSE OUTCOMES

1. After studying unit 1, students will be able to Explain the structures and functions of basic components of prokaryotic and eukaryotic cells
2. After studying unit 2, students will be able to Describe the structure, function and composition of cell membrane and communicate the types and mechanism of membrane transport
3. After studying unit 3, students will be able to Discuss the structure and functions of cellular organelles
4. After studying unit 4, students will be able to Understand the types of microfilaments and mitochondria
5. After studying unit 5, students will be able to Illustrate the phases of cell cycle and Relate the structure and biological role of extra cellular matrix and cell -cell junction with physiological processes

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	No	Yes	No
5	Yes	Yes	Yes	No	Yes	No

UNIT - I **Teaching Hours: 15 hrs**

An overall view of cells - origin and evolution of cells.Cell theory.Classifications of cell - Prokaryotic and Eukaryotic cells.Differences between prokaryotic and eukaryotic cells. Scope of cell biology

UNIT - II **Teaching Hours: 15 hrs**

Cell membrane- Evolution, Fluid Mosaic Model of membrane structure.Membrane proteins and their properties.Membrane carbohydrates and their role. Transport mechanism –Uniport, Symport and Antiport. Simple, facilitated diffusion, active and passive transport.

UNIT – III **Teaching Hours: 15 hrs**

Endoplasmic reticulum - types, structure and functions.Golgi apparatus- structures and functions. Ribosomes - types, structure and functions. Lysosomes- structure and functions.

UNIT - IV **Teaching Hours: 15 hrs**

Cytoskeleton: Types of filaments and their functions. Microfilaments and Microtubules: Chemistry and function (esp. cilia and flagella). Actin and Myosin. Mitochondria: Structure and function

UNIT – V **Teaching Hours: 15 hrs**

Nucleus and nucleolus- structure and functions. Chromosome-chromatin structure, the cell cycle - phases of cell cycle. Meiotic and mitotic cell divisions, cell- cell communications, cell recognition, cell adhesion and cell functions.

TEXT BOOKS/ REFERENCE BOOKS

1. Devasena.T, Cell Biology, Oxford University Press India. First edition (2012).
2. Cooper, G.M. and Hausman, R.E. The Cell: A Molecular Approach. Sinauer Associates, Inc 6th edition (February 1, 2013)
3. Verma.P.S and Agarwal.V.K. Cell biology, Genetics, Molecular biology, Evolution and Ecology, S.Chand& Co Ltd, 2004.
4. Rastogi .S.C.Cell Biology. Newage Publishers, (2008).

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	M	M	S	M	S	M
CO2	M	S	S	S	S	S	S	M	M	M
CO3	S	S	S	S	M	S	S	S	M	M
CO4	M	M	S	S	M	S	S	S	S	M
CO5	S	S	S	S	M	M	S	M	M	M

PO – Programme Outcome, CO – Course outcome
S – Strong, M – Medium, L – Low (may be avoided)

SEMESTER II

CORE THEORY
PAPER – 2

BIOMOLECULES

COURSE OBJECTIVES

1. To Understand the structures and functions of carbohydrates
2. To Illustrate the classification, structure, properties of amino acids.
3. To Acquire knowledge about the classification of proteins, levels of structural organization of proteins
4. To Gain knowledge on the structure and properties of nucleic acids.
5. To study the importance of various lipids

COURSE OUTCOMES

1. **After studying unit 1, students will be able to** gain the knowledge about the classification, structure, properties and functions of carbohydrates.
2. **After studying unit 2, students will be able to** understand the classification, structure, properties and importance of amino acids.
3. **After studying unit 3, students will be able to** understand and gain knowledge about the classification of proteins, levels of structural organization of proteins and its properties.
4. **After studying unit 4, students will be able to gain insights about the types, structure and properties of nucleic acids.**
5. **After studying unit 5, students will be able to explain the classification, structure and properties of different types of lipids**

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	No	Yes	No
5	Yes	Yes	Yes	No	Yes	No

UNIT I: CHEMISTRY OF CARBOHYDRATES

Teaching Hours: 15 hrs

Introduction -Definition of carbohydrates, classification – monosaccharide, oligosaccharides and polysaccharides; occurrence, structure and functions of monosaccharide (glucose and fructose).General properties with reference to glucose, anomer, epimer, enantiomer and mutarotation.Structure, occurrence, properties and biological importance of disaccharides (sucrose, lactose, maltose) and Polysaccharides-Storage polysaccharides (starch, glycogen), Structural polysaccharides (cellulose, chitin), Heteropolyasaccharides (hyaluronic acid, heparin).

UNIT II: CHEMISTRY OF AMINOACIDS

Teaching Hours: 15 hrs

Amino acids- structure and classification based on structure. Standard and non standard amino acids, Essential and non essential amino acid. Physical properties: isoelectric points and zwitter ion. General reactions of amino acids – Edman's reaction, Sanger's reaction, reaction with Dansyl chloride and Ninhydrin reaction.

UNIT III: CHEMISRTY OF PROTEINS

Teaching Hours: 15 hrs

Definition, classification of proteins based on size, solubility, chemical composition functions , structure of proteins- peptide bond, primary, secondary, tertiary and quaternary structure of proteins, forces that determine folding and conformation and structural organization, Physical properties: salting in and salting out and denaturation.

UNIT IV: CHEMISTRY OF NUCLEIC ACIDS

Teaching Hours: 15 hrs

Nucleic acids – Definition, bases, Nucleotides and Nucleosides, phosphodiester linkage; Nucleic acid types –DNA and RNA; structure- double helical structure of DNA; Properties of DNA – Denaturation , Renaturation, Tm and hyperchromicity, structure of RNA and its major types -tRNA, mRNA and rRNA.

UNIT V: CHEMISTRY OF LIPIDS

Teaching Hours: 15 hrs

Introduction, definition and classification of lipids- simple, compound (phospholipids) and derived lipids (cholesterol).Classification of fatty acids – saturated fatty acids, unsaturated fatty acids. Physical property-emulsification.Chemical properties- saponification number, Rancidity, acid number, Iodine number and Reichert – Meissl number.

TEXT BOOKS/ REFERENCE BOOKS

1. Ambikashunmugam, "Fundamendals of Biochemistry(8th Edition)2016, Wolters Kluwer India Pvt Ltd
2. Dr.A.C.Deb, "Fundamentals of Biochemistry" (8th edition), Kolkata, New Central Book Agency
3. Nelson, D. L. & Cox, M. M. Lehninger Principles of Biochemistry. Freeman, 5th edn, 2008.
4. Harper's Illustrated Biochemistry.30th edition -McGraw Hill
5. U.Sathayanarayana,(2006). Biochemistry. 3rd Edition by Books and Allied (P) Ltd., India.
6. Donald Voet and Judith Voet,"Biochemistry",2nd edition,John Wiley &Sons,Inc,NY

Mapping with Programme Outcomes
CO vs PO

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	S	M	S	M
CO2	M	M	M	M	M	M	S	M	S	M
CO3	M	M	M	M	M	M	S	M	S	M
CO4	M	M	M	M	M	M	S	M	S	M
CO5	M	M	M	M	M	M	S	M	S	M

PO – Programme Outcome, CO – Course outcome
S – Strong, M – Medium, L – Low (may be avoided)

SEMESTER I

CORE PRACTICAL-1
PRACTICAL-1

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	**CO STATEMENT**
CO1	Qualitatively analyze the carbohydrates and amino acids and report the type of carbohydrate based on specific tests
CO2	Differentiate the carbohydrates based microscopic examination of the crystal structure.
CO3	Quantify glucose by benedicts method
CO4	Quantify ascorbic acid in lemon by Dichlorophenol indo phenol dye method
CO5	Quantify glycine by Sorenson's formol titration method
CO6	Determine lipid properties of unsaturation and fatty acid content by SAP

	number and iodine number

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	No	Yes	No
5	Yes	Yes	Yes	No	Yes	No

I. QUALITATIVE ANALYSIS

A) Qualitative analysis of Carbohydrates

- Qualitative analysis of Glucose,
- Qualitative analysis of Fructose,
- Qualitative analysis of Arabinose/Xylose,
- Qualitative analysis of Maltose,
- Qualitative analysis of Sucrose
- Qualitative analysis of Starch
- Qualitative analysis of unknown sugar.

B) Qualitative analysis of Amino acids

1. Qualitative analysis of Arginine,
2. Qualitative analysis of Cysteine,
3. Qualitative analysis of Tryptophan
4. Qualitative analysis of Tyrosine
5. Qualitative analysis of unknown amino acids.

II. QUANTITATIVE ANALYSIS:

1. Estimation of ascorbic acid using 2, 6 – dichlorophenol indophenol as link solution, present in unknown solution
2. Estimation of Glycine by Sorenson formal titration.
3. Determination of glucose by Benedict's method.

DEMONSTRATION EXPERIMENTS

1. Determination of SAP number.
2. Determination of Acid number.

TEXT BOOKS/ REFERENCE BOOKS

1. J. Jayaraman, Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011.
2. S. K. SawhneyRandhir Singh, Introductory Practical Biochemistry, Alpha Science International, Ltd 2 edition, 2005.
3. Irwin H.Saegal, Biochemical calculations, Liss, Newyork, 1991

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**S**	**S**	M	M	M	M	S	**S**	S	**S**
CO2	**S**	**S**	M	M	M	M	S	**S**	S	**S**
CO3	**S**	**S**	M	M	M	M	S	**S**	S	**S**
CO4	**S**	**S**	M	M	M	M	S	**S**	S	**S**
CO5	**S**	**S**	M	M	M	M	S	**S**	S	**S**

SEMESTER III
CORE PAPER - 3

ANALYTICAL BIOCHEMISTRY

COURSE OBJECTIVES

1. To obtain analytical skills and practical knowledge on various techniques involved in biochemistry.

2. To determine pH &poH using electrochemical techniques.

3. To gain knowledge on the methodology involved in separation and characterization of proteins, Nucleic acid by various electrophoretic techniques.

4. To understand the separation and purification of macromolecules using chromatography

5. Tounderstand atomic structure, radiation and its hazards, detection and measurement of radioactivity using GM counter and Scintillation counter.

Course Outcomes:

1. After studying unit 1, students will be able to Prepare solutions and separate and separate the sample using centrifugation

2. After studying unit 2, students will be able to explain the principle, methodology and applications of types of chromatography
3. After studying unit 3, students will be able toAcquire knowledge about the interactions of electromagnetic radiation and their applications in spectroscopy and spectrofluorimetry.
4. After studying unit 4, the students will be able to demonstrate the methodology involved in separation and characterization of proteins, Nucleic acid by various electrophoretic techniques.
5. After studying unit 5, students will be able toUnderstand atomic structure, radiation and its hazards, detection and measurement of radioactivity using GM counter and Scintillation counter.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

UNIT - I

CENTRIFUGATION **Teaching Hours: 15 hrs**

Definition - pH, pOH. Molarity, Molality and Normality. Examples for preparing solutions (1N, 1 M solutions etc.,). Buffers-Definition**.**Basic principles of centrifugation, RCF, sedimentation coefficient / Svedberg unit, differential centrifugation, density gradient centrifugation, Analytical Ultracentrifuge-Components and its application in separation of macromolecules

UNIT - II

CHROMATOGRAPHY **Teaching Hours: 15 hrs**

Principles of chromatography, Partition coefficient- Rf value. Principle, operation procedure and applications of Paper chromatography, Thin layer chromatography, Ion exchange, Gel permeation chromatography and affinity chromatography and its applications in separation of macromolecules.

UNIT - III

SPECTROSCOPY **Teaching Hours: 15 hrs**

Electromagnetic spectrum-Regions.Definitions fot wavelength, wavenumber and frequency, Stoke's shift.Absorption and emission spectra.Beer- Lambert law.Absorbance and transmittance. UV and Visible spectrophotometry, Principle, Instrumentation, and applications on coupled enzyme assays. Spectrofluorimetery and Atomic absorption and Flame emission spectroscopy-Principle, Instrumentation, and applications

UNIT - IV

ELECTROPHORETIC TECHNIQUES Teaching Hours: 15 hrs

Principles of electrophoresis, electrophoretic mobility.Factors affecting electrophoretic mobility - sample, electric field, supporting medium, composition of buffer.Sodium dodecyl sulphate polyacryl amide gel electrophoresis (SDS- PAGE), methodology and its application.Determination of molecular weight of proteins by SDS PAGE.

UNIT - V

RADIOACTIVITY Teaching Hours: 15 hrs

Atomic structure, radiation, types of radioactive decay, half-life, units of radio activity. Detection and measurement of radioactivity - methods based upon ionization (GM counter), methods based upon excitation (Scintillation counter). Autoradiography.Applications of radioisotopes in the elucidation of metabolic pathways.Biological hazards of radiation and safety measures in handling radio isotopes.

TEXT BOOKS/ REFERENCE BOOKS:

1. Wilson Walker, Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press. 2018.
2. ChatwalAnand. Instrumental methods of Analysis. Himalaya Publishing house. 2014.
3. Dr.AvinashUpadhyay, Dr.KakoliUpadhyay, Dr.Nirmalendunath. Biophysical Chemistry. Himalaya Publishing house. 2016.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	M	M	S	M	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	M	S	S	M	S	S
CO4	M	M	S	S	M	S	S	S	S	M
CO5	S	S	S	S	M	M	S	S	S	S

PO – Programme Outcome, CO – Course outcome
S – Strong , M – Medium, L – Low (may be avoided)

SKILL BASED SUBJECT

PAPER - 1

FIRST AID

COURSE OBJECTIVES

1. To understand the importance of first aid
2. To gain practical knowledgeon the treatment for medical emergency
3. To acquire knowledge on the treatment for various wounds.

COURSE OUTCOMES:

1. After studying unit 1, the student will be able to Summarize the importance of first aid
2. After studying unit 2, the student will be able to analyse the symptoms and treatment for various medical emergencies
3. After studying unit 3, the student will be able to Illustrate the causes and effects of poisoning and its treatment
4. After studying unit 4, the student will be able to identify the causes and treatment for various aches in the body
5. After studying unit 5, the student will be able to Identify the treatment for various wounds

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	No	Yes	Yes
2	Yes	Yes	Yes	yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	No	Yes	No	Yes

UNIT- 1

PRINCIPLES AND TECHNIQUES OF FIRST AID

Teaching Hours :6Hrs

Definition, objects and principles of First Aid.Important rules of first aid. Content of first aid kit First Aid Techniques: Dressings, Bandages and Transport techniques.

UNIT- 2

ACUTE AND CHRONIC ILLNESSES

Teaching Hours :6Hrs

Diabetic emergencies - Hyperglycemia, Hypoglycemia - symptoms, signs and treatment.Liver emergency, Kidney emergency, Hemorrhage and its types. Chocking - symptoms, signs and treatment, Asphyxia - causes, symptoms, signs and treatment, Drowning effects - symptoms, signs and treatment, Suffocation by poisonous gases,

UNIT- 3

INJURIES AND ANAPHYLACTIC SHOCK

Teaching Hours :6Hrs

Insect bites, Snake bites, Dog bites - symptoms and treatment. Injuries - Head injuries, burns and scalds, Chemical burns, Electric burns, Radiation burns and cold burns - signs, symptoms and treatment. Poisoning-Routes of poisoning, Effects poisoning, treatment and measures. Stroke, Heart attack, Coronary obstruction and Cardiac arrest - signs, symptoms and treatment.

UNIT- 4

COMMON AILMENTS

Teaching Hours :6Hrs

Blood Pressure, Constipation - travel sickness - signs, symptoms and treatment. Head ache, Tooth ache, Ear ache, - causes and treatment, Common Cold, Cough, Diarrhoea and Dysentery - causes, symptoms, signs and treatment.

UNIT- 5

WOUNDS AND SAFETY MEASURES

Teaching Hours :6Hrs

Emergencies in Rural area, Auto safety, Disasters and multiple casualty accidents. Wounds - Types- Open and Closed wounds. Emergency care for general wounds. Wound with foreign body, Special wound, Wounds to the palm of hand, abdominal wounds.

TEXT BOOKS/ REFERENCE BOOKS:

1. Manual of First aid - L.C.GuptaAbhitab -2004, Jaypeebrothers, medical publishers (p)ltd, new delhi, India.
2. Sathya Narayanan U, 1999, “Biochemistry”,(2nd Edition),Kolkata, Allied publishers.
3. First aid and Safety Hand book by American Red Cross and Kathleen A .Handal .M.D Foreword by Elizabeth Dole, Little brown and company Boston, New York, London.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	M	M	S	M	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	M	S	S	M	S	S
CO4	M	M	S	S	M	S	S	S	S	M
CO5	S	S	S	S	M	M	S	S	S	S

NON-MAJOR ELECTIVE
PAPER - 1

FOOD AND NUTRITION

COURSE OBJECTIVES

1. To realizing the fact that "Food as medicine"
2. To analyse the importance of carbohydrates with their sources
3. To gain knowledge on the sources and functions of fats in the body
4. To illustrate the biological significance of proteins in the body
5. To gain insights on the types of vitamins and minerals with their biomedical significance

COURSE OUTCOMES:

1. After studying Unit 1, the student will be able to Classify carbohydrates and analyse their sources and functions in the body
2. After studying Unit 2, the student will be able to Classify fats and analyze their sources and functions in the body
3. After studying Unit 3, the student will be able to Identify and explain proteins in foods and the specific functions in maintaining health.
4. After studying Unit 4, the student will be able to Identify the types of vitamins and their biomedical significance of vitamins present in food
5. After studying unit 5, the students will be able to Analyse the biological importance of major and minor trace elements (Minerals) in the food

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	No	Yes	No
5	Yes	Yes	Yes	No	Yes	No

UNIT – I **Teaching Hours :6Hrs**

Food -Definition.Balanced diet and its composition.Nutrition and nutrients.Macro and micronutrients. Carbohydrates - Sources, classification, RDA and nutritional significance in the body. Glucose as a chief source of energy. Dietary fibre and its importance

UNIT – II **Teaching Hours :6Hrs**

Lipids, Classification.Sources of dietary lipids.Essential fatty acids and their importance.Saturated and unsaturated fatty acids.Mono unsaturated and Poly unsaturated fatty acids and their importance.

UNIT – III **Teaching Hours :6Hrs**

Proteins as a body building food.Classification of proteins.Major functions of proteins in the body. Rich sources of Protein in diet. RDA for protein.Protein deficiency disorders-Kwashiorkor and marasmus.

UNIT – IV **Teaching Hours :6Hrs**

Vitamins- Fat soluble - Vitamin A, D, E and K. - Sources, RDA and functions.Water soluble vitamins- Thiamine, riboflavin, folic acid, cobalamine and pantothenic acid- Sources, RDA and function.Ascorbic acid as a free radical scavenger- Sources and RDA.

UNIT –V **Teaching Hours :6Hrs**

Minerals - Macro and micro minerals. Sources, RDA and biological functions of Iron, Calcium, Iodine, magnesium, Sodium, potassium and chlorine.

TEXT BOOKS/ REFERENCE BOOKS:

1. R.K. Murray, D.K. Granner, P.A. Mayes, D.W. Rodwell (2006), Harper's Biochemistry, twenty fifth edition, Prentice Hall, New Jersey.
2. D.L.Nelson, and M.M. Cox (2008) Lehninger Principles of Biochemistry, 5th Ed, W.H. Freeman and Company, New York.
3. Sathyanarayanan. U (2002), Essentials of Biochemistry Books and allied (p) Ltd.
4. D. Voet, and G.Voet (2006), Biochemistry, John Wiley and Sons, New York.
5. G.L Zubay (1999) Biochemistry, 4th Ed, WCB, McGraw-Hill, New York.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	M	M	S	M	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	M	S	S	M	S	S
CO4	M	M	S	S	M	S	S	S	S	M
CO5	S	S	S	S	M	M	S	S	S	S

SEMESTER IV

CORE PAPER - 4

PLANT BIOCHEMISTRY

COURSE OBJECTIVES:

1. To gain knowledge on the plant physiology
2. To understand the events of photosynthesis
3. To identify the functions of growth hormones
4. To understand the mechanism of nitrogen fixation
5. To illustrate the responses of plants to the stress

COURSE OUTCOMES

1. After studying unit 1, the students will be able to Summarize the events in Photosynthesis
2. After studying unit 2, Classify Plant Hormones And Explain Their Functions. Discuss Secondary Metabolites In Plants
3. After studying unit 3, the students will be able to Illustrate Nitrogen Fixation By Symbiosis Biochemistry Of Nitrogen Fixation
4. After studying unit 4, Distinguish Between Types of Stress Tolerance in plants
5. After studying unit 5, understand the mechanism of Anti-Oxidant Defence In Plants

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	No	Yes	No
5	Yes	Yes	Yes	No	Yes	No

UNIT - I

PHOTOSYNTHESIS **Teaching Hours:15Hrs**

Various plants of a plant and its uses.Photosynthesis - Chlorophyll -Structure and functions.Light reactions, Photosystem I and II, Z scheme.Dark reaction- Calvin cycle, Rubisco- Importance.Proton gradient and ATP synthesis of chloroplast.Regulation of photosynthesis and photorespiration.

UNIT - II

PLANT HORMONES **Teaching Hours:15Hrs**

Definition**.**Plant hormones, their types and functions.Structure, action, transport, distribution and physiological functions of Auxin, Gibberillin, Cytokinins, Abiscic acid and Ethylene.Plant secondary metabolites/PPhytochemicals-Definition. Types of phytochemicals - Flavonoids, alkaloids, tannins, terpenoids and anthocynanins- their functions

UNIT - III **Teaching Hours:15Hrs**

NITROGEN FIXATION IN PLANTS

Nitrogen fixation in plants.Nitrogen cycle. Nitrate assimilation, Nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. Nitrogen fixation - nodule formation - regulatory factors involved in modulation - Role of nif genes.

UNIT - IV **Teaching Hours:15Hrs**

STRESS IN PLANTS

Stress in plants - Environmental stresses, salinity, water stress. Stress due to heavy metals. Impact of stresson plant growth and metabolism, criteria of stress tolerance.Toxins of plant origin - mycotoxins, phytohemagglutinins, nitriles, protease inhibitors, protein toxins.

UNIT - V **Teaching Hours:15Hrs**

ANTIOXIDANT MECHANISM IN PLANTS

Antioxidant mechanism in plants - Reactive oxygen species and sources of ROS generation in plants.Formation of triplet chlorophyll.Oxidative stress.Enzymatic and non-enzymatic antioxidant system.Role of superoxide dismutase, catalase, glutathione peroxidase.Antioxidant vitamins - Role of VitaminC (Ascorbic acid) and vitamin E.

TEXT BOOKS/ REFERENCE BOOKS:

1. Verma, Plant Physiology, Athena Academic Publishers, 2015
2. Lincoln Taiz, Angns Murphy, Fundamentals of Plant Physiology, Oxford University Press, 2018
3. S. K. Verma and MohitVerma, Plant Physiology, Biochemistry and biotech S Chand Publishers , 2018
4. Dr. V. K. Jain Fundamentals of Plant physiology, S Chand Publishers 2016

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	M	M	S	M	S	S
CO2	M	**M**	**M**	**M**	S	S	S	S	S	S
CO3	M	**M**	**M**	**M**	M	S	S	M	S	S
CO4	M	M	S	S	M	S	S	M	S	M
CO5	S	S	S	S	M	M	S	S	S	S

CORE PRACTICAL-II

COURSE OUTCOMES: At the end of the Course, the Student will be able to:

CO1	Estimate phosphorus and protein using colorimetric method
CO2	Exhibit the knowledge of isolation of biomolecules like starch, casein and albumin from biological samples
CO3	Obtain hands on training in basic separation technique like paper chromatography, thin layer chromatography to separate amino acids and sugars
CO4	Obtain hands on training to separate chlorophyll, carotenes of flower pigments and protein using column Chromatography
CO5	Demonstrate the principle and working of SDS PAGE and its applications

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	No	Yes	No
5	Yes	Yes	Yes	No	Yes	No

1. COLORIMETRY

1. Estimation of inorganic phosphorus by Fiske and Subbarow method.
2. Estimation of protein by Biuret method.

2. BIOCHEMICAL PREPARATION

1. Preparation of starch from potatoes.
2. Preparation of Caesin from milk.
3. Preparation of albumin from eggs.

3. CHROMATOGRAPHIC SEPARATION

1. Paper chromatography separation and detection of amino acids and simple sugars (group experiment).
2. Chromatographic separation of chlorophyll, carotenes of flower pigments and protein using column Chromatography (Demo).

4. ELECTROPHORETIC TECHNIQUE

1. Separation of protein by SDS-PAGE (Demo)

TEXT BOOKS/ REFERENCE BOOKS:

1. J. Jayaraman Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011
2. S. Sadasivam A. Manickam , Biochemical Methods, New age publishers, 2009
3. Keith Wilson and John Walker, Principles and techniques of Practical Biochemistry Cambridge University Press. 2010, Seventh edition
4. S. K. SawhneyRandhir Singh, Introductory Practical Biochemistry, Alpha Science International, Ltd, 2 edition, 2005.

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	M	M	S	M	S	S
CO2	M	M	M	M	S	S	S	S	S	S
CO3	M	M	M	M	M	S	S	M	S	S
CO4	M	M	S	S	M	S	S	M	S	M
CO5	S	S	S	S	M	M	S	S	S	S

NON MAJOR ELECTIVE
PAPER - 2

LIFESTYLE DISEASES & PREVENTION

COURSEOBJECTIVES:

- To understand the basics of lifestyle diseases.
- To identify lifestyle Prone Disorders
- To gain knowledge on the Communicable And Non-Communicable Disease
- To understand the importance of maintaining good health
- To lead a healthy life style to cope up with modern life.

COURSE OUTCOMES:

1. After studying unit 1, students will be able to define a balanced Diet and understand the importance of vitamins and minerals
2. After Studying unit 2, students will be able to identify lifestyle Prone Disorders
3. After studying unit 3, students will be able to manage physiological and psychological disorders
4. After studying unit 4, students will be able to categorize Communicable And Non-Communicable Disease
5. After studying unit 5, students will be able to understand the importance of maintaining good health.

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

UNIT – I **Teaching Hours:6 hours**

Balanced diet- composition and functions.Nutrients and their role.Types of nutrients-Macronutrients- carbohydrates, proteins, fats.Micronutrients, Vitamins and minerals Importance of water.Dietary Fibre and its major role in the body.

UNIT – II **Teaching Hours:6 hours**

Life style disorders: Lack of Physical activity, Incompatible food, irregular food habits, fast foods. Alcohol intake, cigarette smoking- Consequences.Technology in health deterioration-Computer vision syndrome, mobile vision syndrome.

UNIT – III **Teaching Hours:6 hours**

Physiological disorders: Food poisoning-Signs and symptoms, Vomiting, diarrhea, head ache, stomach ache, hormonal imbalance, premenstrual syndrome, Renal Calculi and gall stones.

Psychological disorder- Stress, Memory dysfunction. Depression, mood swings, Lack of motivation Suicides-causes. Self-medications.

UNIT – IV **Teaching Hours:6 hours**

Communicable diseases and Non-communicable diseases - Definition and examples Communicable diseases - AIDS, Tuberculosis, Cholera, typhoid- Causes and treatment. Non-communicable diseases- Type 2 diabetes, Cancer, Coronary Heart diseases, Stroke, Obesity-Definition, causes and treatment.

UNIT – V **Teaching Hours:6 hours**

Good health- Improved life style, Improved Food habits, Proper deep sleep, Exercise in good health maintenance -Yoga, Swimming, Walking, Outdoor games, Stress management-Meditation.

TEXT BOOKS/ REFERENCE BOOKS:

1. B. Srilakshmi, Dietetics - Multi Colour Edition, New age inter Pbs 2019
2. B. Srilakshmi, Food Science (Multi Colour Edition) , New age inter Pbs 2017
3. DC SHARMA and DEVANSHI SHARMA Nutritional Biochemistry, CBS Publisher and Distributers, 2017
4. B. Kumar, Meenal Kumar, Guide to prevention of lifestyle diseases b. kumar, Deep and Deep Publications, 2004

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	M	M	S	S	S	S	S
CO2	M	M	M	S	M	S	S	S	S	S
CO3	M	S	M	M	M	S	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	M	S	S	S	S	S	S

SEMESTER V

CORE PAPER - 5

ENZYMES AND INTERMEDIARY METABOLISM

COURSE OBJECTIVES

1. Toacquirefundamentalknowledgeonenzymesandtheirimportanceinbiological reactions.
2. To know the mechanism of enzyme anditsimportanceinbiological reactions.
3. To determine the biochemical reactions, central metabolic pathways and kinetics of energy and homeostasis of metabolism.

4. To gain insights into metabolic engineering for the production of useful biomolecules.
5. To understand the importance of high energy compounds, electron transport chain, and synthesis of ATP under aerobic and anaerobic conditions.

COURSE OUTCOMES

1. After studying unit-1, the student will be able to acquire Fundamental knowledge in relevant principles of enzyme, mechanism of enzyme kinetics, enzyme catalysis emphasizes on capability of the students to work in a group and gather the information.
2. After studying unit-2, the student will be able to illustrate the reactions of carbohydrate metabolism. Summarize the steps involved in ATP formation.
3. After studying After studied unit-3, the student will be able to identify the steps involved in oxidation o fatty acids.
4. After studying unit-4, the student will be able to obtain knowledge on the metabolism of amino acids and formation of urea.
5. After studying unit-5, the student will be able to summarize the steps involved in purine and pyrimidine synthesis.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	No	Yes	Yes
5	Yes	Yes	Yes	No	Yes	No

UNIT-1: ENZYMES **Teaching Hours: 15 hrs**

Definition, units, various classifications, nomenclature, specificity, isoenzymes, factors affecting enzyme activity - pH, temperature, enzyme concentration and substrate concentration. Active site, Mechanism - Lock and key mechanism and Induced Fit theory.MichaelisMenten equation, Line weaver Burk plot.Enzyme inhibition - Competitive, Non competitive and Uncompetitive (Concepts with example) inhibition and Irreversible inhibition.

UNIT-2:CARBOHYDRATES METABOLISM **Teaching Hours:15hrs**

Definition - Metabolic pathways (Anabolic and catabolic) and Amphibolic pathways. Glycolysis, Glycogenesis and glycogenolysis, PDH complex, Citric acid cycle, HMP shunt. High energy compounds, Electron transport chain, Oxidative phosphorylation, ATP synthase and Uncouplers.

UNIT-3: LIPID METABOLISM **Teaching Hours:15hrs**

Oxidation of fatty acids - Beta oxidation of palmitic acid, Role of carnitine in beta oxidation.Alpha oxidation and omega oxidation (Only definition).Oxidation of fatty acids with odd number of carbon atoms.Ketogenesis- Formation of ketone bodies. Biosynthesis of saturated fatty acids.Biosynthesis of triacyl glycerol and phospholipids.Biosynthesis of cholesterol with regulation.

UNIT-4:PROTEIN METABOLISM **Teaching Hours:15hrs**

Amino acid pool, Transamination- Role of transaminases-SGPT and SGOT, PLP as a coenzyme in transamination, Degradation of proteins - Oxidative, Non-oxidative deamination.Role of Glutamate dehydrogenase in aminoacid metabolism. Decarboxylation of amino acids- Formation of serotonin, GABA, Histamine, Epinephrine and nor epinephrine. Urea Cycle, Relationship between urea and TCA cycle. Biosynthesis of creatinine.

UNIT-5:NUCLEIC ACID METABOLISM **Teaching Hours:15hrs**

Purine and Pyrimidine - Sources of nitrogen and carbon atoms in Purine and Pyrimidine.Denovo synthesis of purine and degradation.Pyrimidine nucleotides- biosynthesis and degradation Regulation of purine and pyrimidine biosynthesis.

TEXT BOOKS/ REFERENCE BOOKS:

1. J.L Jain S. (2005), Fundamentals of Biochemistry, Chand Publishing, New Delhi.
2. Enzymes by Boyer. Academic Press, 3rd edition (November 1983).
3. U. Sathya Narayanan and U. Chakrapani. (2007), Text book of Biochemistry - 3rdedition, Pvt Ltd.
4. Biochemistry by Stryer. W. H. Freeman; 6th Edition (2006).
5. A.C. Deb (2001), Fundamentals of Biochemistry, New Central Book Agency Pvt., Ltd., Calcutta.
6. Biochemistry by Metzler, Academic Press (2000).
7. D. Voet, and G.Voet (2006), Biochemistry, John Wiley and Sons, New York.
8. D.L.Nelson, and M.M. Cox (2008) Lehninger Principles of Biochemistry, 5th Ed, W.H. Freeman and Company, New York

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	M	M	S	M	S	M
CO2	S	S	S	M	S	S	S	S	M	M
CO3	M	S	M	M	M	S	S	S	M	S
CO4	M	M	M	S	M	S	S	S	S	M
CO5	S	S	M	S	M	M	S	S	M	M

PO – Programme Outcome, CO – Course outcome
S – Strong , M – Medium, L – Low (may be avoided)

CORE PAPER - 6

MOLECULAR BIOLOGY

COURSE OBJECTIVES

1. To understand the major experimental approaches
2. To gain knowledge about the steps involved in replication, transcription and translation
3. To study the salient features of genetic code
4. To acquire knowledge of gene & to know how genes are expressed
5. To be aware of the regulation of cellular processes, signalling and proliferation in prokaryotic cells.

COURSE OUTCOMES: At the end of the Course, the Student will be able to:

1. After studying unit 1, the student will be able to Infer the central dogma of molecular biology, Show how DNA acts as vehicle of inheritance through experimental evidences, Outline the steps involved in replication and explain the events, enzymology, fidelity and inhibitors of replication in prokaryotes
2. After studying unit 2, the student will be able to Summarize the process of prokaryotic transcription
3. After studying unit 3, the students will be able to Define genetic code and Relate it to translation process and explain protein biosynthesis
4. After studying unit 4, illustrate the regulation of gene expression in prokaryotes using lac and trp operon
5. After studying unit 5 , gain knowledge on gene mutation and DNA Repair mechanisms

UNIT - I

REPLICATION **Teaching Hours:15Hrs**

DNA as a Genetic material - Experimental evidence -Bacterial Transformation, Transduction and Conjugation. DNA Replication-types, evidence to show DNA replication is semi conservative; Messelson and Stahl experiment.DNA Replication mechanism in Prokaryotes and Inhibitors.

UNIT - II

TRANSCRIPTION **Teaching Hours:15Hrs**

Transcription in Prokaryotes: Central Dogma, DNA dependent RNA polymerases, Transcription Mechanism and Inhibition. Post transcriptional modification-mRNA, rRNA and tRNA processing. Reverse transcription and Retro virus.

UNIT - III

TRANSLATION **Teaching Hours:15Hrs**

Genetic Code-Definition, deciphering of the genetic code, codon dictionary and salient features, Mechanism of Translation in Prokaryotes-initiation, elongation, translocation, termination and Inhibition. Protein targeting.

UNIT - IV

GENE REGULATION AND AMPLIFICATION Teaching Hours:15Hrs

Operon model - Lac operon (positive and negative control), Trp Operon (repression and attenuation), recombination and Gene amplification.

UNIT - V

MUTATION AND REPAIR Teaching Hours:15Hrs

Gene mutation-Base pair substitution, frame shift mutation, missense mutation, nonsense mutation, mutation in termination codons, silent mutation.Molecular mutation- spontaneous and induced mutation. Chromosome mutation - Changes in the number of chromosomes and changes in the structure of chromosomes. DNA Repair-Definition and mechanism.

TEXT BOOKS/ REFERENCE BOOKS:

1. James D Watson, Molecular Biology of the gene 7th edition, Pearson, 2017.
2. David. L. Nelson, Michael. M. Coil Lehninger. Principles of Biochemistry Freeman. W. H. and Company , 2019.
3. Donald Voet, Judith Voet, Charlotte Wiratt. Fundamentals of Biochemistry: life at molecular level. 5th edition John Wiley & Sons 2016
4. Bruce Albert,Molecular Biology of the cell, W.W. Norton and company, 2014.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	M	M	M	M	S	M
CO2	S	S	S	M	S	S	S	S	S	M
CO3	M	S	M	M	M	S	S	S	S	S
CO4	M	S	M	M	M	S	S	S	S	S
CO5	M	S	M	M	M	S	S	S	S	S

PO – Programme Outcome, CO – Course outcome
S – Strong , M – Medium, L – Low (may be avoided)

CORE PAPER - 7

PHYSIOLOGY AND NUTRITION

COURSE OBJECTIVES:

1. To Understand the types and functions of blood cells
2. To learn the structure and functions of the different organs

3. To understand the mechanism of digestion, absorption and respiration in the body
4. To gain knowledge on the importance of nutrients in body
5. To acquire a deep insight on the significance of vitamins and minerals in the body

COURSE OUTCOME:

1. After studying unit 1, the student will be able to Gain knowledge about the various types of RBC and WBC cells, different types of blood groups and basic structure and functions of heart.
2. After studying unit 2, the student will be able to Illustrate the Mechanism of digestion and absorption of macromolecules.
3. After studying unit 3, the students will be able to acquire the knowledge about the structure and functions of kidney, nephron and mechanism of urine formation.
4. After studying unit 4, the students will be able to describe the significance of carbohydrates, lipids and proteins and analyze their sources and functions in the body
5. After studying unit 5, the students will be able to analyse the biological importance of vitamins and Minerals

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	Yes	Yes	No
5	Yes	Yes	Yes	Yes	No	No

UNIT - I

CIRCULATORY SYSTEM **Teaching Hours:15Hrs**

Composition of Blood -types of blood cells and function, Blood groups -ABO group and Rh group. Composition of Lymph, Circulatory system, Cardiac system - physiologic anatomy of heart- genesis and spread of cardiac impulses-cardiac cycle, heart sound, cardiac output, ECG.

UNIT - II

DIGESTION **Teaching Hours:15Hrs**

Definition, Digestive system of man, Physical and Chemical process of digestion. structure and function of microvillus, Salivary digestion, gastric digestion-mechanism of HCL formation, intestinal digestion-liver, pancreas, intestinal juice, Role of bile salt in Digestion, Digestion and absorption of carbohydrates, proteins, and lipids**.**

UNIT - III

RESPIRATORY AND EXCRETORY SYSTEM **Teaching Hours:15Hrs**

Respiratory system -Types of respiration, Transport of $O_2$and CO_2, Role of Hemoglobin in of O_2 and CO_2 transport. Oxygen Dissociation curve, Bohr Effect, Chloride shift.Oxygen toxicity& therapy, Artificial respiration.Structure and function of kidney and nephron, Mechanism of urine formation

UNIT - IV

MACRONUTRIENTS **Teaching Hours:15Hrs**

Food- Definition.Balanced diet and its composition.Nutrition and nutrients.Macro and micronutrients. Carbohydrates - Sources, classification, RDA and nutritional significance in the body. Lipids-Sources, RDA and functions Essential fatty acids and their importance.Poly unsaturated fatty acids and their importance.Proteins as a body building food.Major functions of proteins in the body. Rich sources of Protein in diet. RDA for protein. Protein deficiency disorders-Kwashiorkor and marasmus

UNIT - V

MICRONUTRIENTS **Teaching Hours:15Hrs**

Vitamins- Fat soluble - Vitamin A, D, E and K.- Sources, RDA and functions. Water soluble vitamins- Thiamine riboflavin, folic acid and cobalamine - Sources, RDA and function. Minerals - Macro and micro minerals. Sources, RDA and biological functions of Iron, Calcium, Iodine, magnesium, Sodium, potassium and chlorine.

TEXT BOOKS/ REFERENCE BOOKS:

1. Textbook of Medical Physiology 10th Ed by Arthur C. Guyton and John E. Hall, Harcourt Asia Pvt. Ltd, 2016.
2. Principles of Anatomy and Physiology 10th Edition by Gerard J. Tortora and Sandra Grabowski. Publisher: John Wiley and Sons.
3. Animal Physiology and biochemistry -RA Agarval, Anil. K,Srivastav, Kaushal Kumar, S .Chand & CO.,
4. Sathyanarayanan. U (2002), Essentials of Biochemistry Books and allied (p) Ltd.
5. Dr. M. Swaminathan,"Food and Nutrition Vol I&II ", Second edition, Bangalore, Bappco Publishers.
6. B. SrilakshmiDietetics - Multi Colour Edition, New Age International Publishers , 2019
7. B. Srilakshmi. Food Science (Multi Colour Edition) New Age International Publishers 2017

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	M	M	S	S	S	S
CO2	S	M	M	S	M	M	S	S	S	S
CO3	S	M	M	S	M	M	S	S	S	S
CO4	S	M	M	M	M	M	S	S	S	S
CO5	S	M	M	M	M	M	S	S	S	S

PO – Programme Outcome, CO – Course outcome

S – Strong , M – Medium, L – Low (may be avoided)

INTERNAL ELECTIVE
PAPER - 1

MOLECULAR ENDOCRINOLOGY

COURSE OBJECTIVES:

1. To understand the types of hormones
2. To Gain knowledge on the functions of secondary messengers in the body
3. To acquire deep insight on the mechanism of action of peptide hormones
4. To obtain knowledge on the mechanism of action of steroid hormones
5. To gain a clear understanding on Male and Female Reproductive system.

COURSE OUT COMES (five outcomes for each units should be mentioned)

1. After Studying unit-1, the student will be able to Understand the structure of hormones and receptors. Classify hormones based on nature, mechanism of action.
2. After Studying unit-2, the student will be able to Explain the structure, biological action and regulation of hypothalamic and pituitary hormones
3. After Studying unit-3, the student will be able to Illustrate the structure, biological action and regulation of thyroid and pancreatic hormones.
4. After Studying unit-4, the student will be able to Understand about the actions of adrenal hormones
5. After Studying unit-5, the student will be able to Compare the structure and metabolic effects of adrenal hormones

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	Yes	Yes	No
5	Yes	Yes	Yes	Yes	No	No

UNIT - I **Teaching Hours:15Hrs**

Hormones: Definition, Chemical nature and classification. General mechanism of action of Group I and Group II hormones, secondary messengers, G Protein cycle, Signal transduction and Hormonal receptors.

UNIT - II

Teaching Hours: 15Hrs Hypothalamus and hypothalamic releasing factor. Pituitary hormones- Chemistry, Secretion, Functions and Regulation of Anterior Pituitary hormones - GH, Pituitary tropic hormones (LH, FSH and ACTH) and Posterior Pituitary hormones - Vasopressin and Oxytocin.

UNIT - III **Teaching Hours: 15Hrs**

Thyroid and Parathyroid Hormones-Chemistry, Synthesis, Secretion, Functions and Regulations and disorders. Pancreatic Hormones - Chemistry, Secretion, Functions and Regulations of Pancreatic hormones (Insulin and Glucagon)

UNIT - IV **Teaching Hours: 15Hrs**

Adrenal gland hormones - Chemistry, Secretion, Functions Regulations and disorders of Adrenal Cortex hormones (glucocorticoids and mineralocorticoids) and Adrenal Medullary hormones (Epinephrine and Nor-Epinephrine).

UNIT - V **Teaching Hours: 15Hrs**

An introduction to Male and Female Reproductive system.Functions of Gonadal hormones - Testosterone, Estrogen and Progesterone.Ovarian cycle and its regulation.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	M	M	S	S	S	S
CO2	S	M	S	S	M	M	S	S	S	S
CO3	S	M	M	S	M	M	S	S	S	S
CO4	S	M	M	M	M	M	S	S	S	M
CO5	S	M	M	M	M	M	S	S	S	M

TEXT BOOKS/ REFERENCE BOOKS:

1. R.K. Murray, D.K. Granner, P.A. Mayes, D.W. Rodwell (2006), Harper's Biochemistry, twenty fifth edition, Prentice Hall, New Jersey.
2. Guyton (1996) Human Physiology and Mechanisms of Disease. Saunders Publications; 6th edition.
3. Wiiliams Textbook of Endocrinology. (2011), ShilomoMelmed., Elsevier, New Delhi.
4. N.Chatterjee and RanaShinde (2012) Textbook of Medical Biochemistry - eighth edition, Jaypee publication, New Delhi.
5. D.L.Nelson, and M.M. Cox (2008) Lehninger Principles of Biochemistry, 5th Ed, W.H. Freeman and Company, New York
6. D. Voet, and G.Voet (2006), Biochemistry, John Wiley and Sons, New York.
7. G.L Zubay (1999) Biochemistry, 4th Ed, WCB, McGraw-Hill, New York.

SKILLED BASED SUBJECT
PAPER - 3

MEDICAL LABORATORY TECHNOLOGY

COURSE OBJECTIVES:

1. To obtain practical skills to analyse biological samples.
2. To perform collection and preservation of biological samples.
3. To estimate haematological parameters
4. To examine urine and stool sample for normal and abnormal constituents
5. To acquire skills to culture microorganism.

COURSE OUTCOMES

1. After studying unit 1, the student will be able to Follow good laboratory practices and Prepare reagents for experiments
2. After studying unit 2, the student will be able to Examine urine and stool sample for normal and abnormal constituents
3. After studying unit 3, the student will be able to Estimate Hemoglobin and other hematological parameters
4. After studying unit 4, the student will be able to Perform blood grouping
5. After studying unit 5 the student will be able to Acquire knowledge on culturing microorganisms.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	Yes	Yes	No
5	Yes	Yes	Yes	Yes	No	No

UNIT - I

LABORATORY CARE AND INSTRUMENTATION Teaching Hours: 15Hrs

Good laboratory practices, Code of conduct for laboratory personnel - safety measures in the laboratory-chemical and reagents, labeling, storage and usage. First aid in laboratory accidents - precautions and first aid equipment. Reporting laboratory tests and keeping records- documentation. General approach to quality control, quality control of quantitative data.

UNIT - II

URINE ANALYSIS AND STOOL EXAMINATION Teaching Hours: 15Hrs

Composition, collection, preservation, gross examination, interfering factors, chemical examination. Significance of sugar, protein, ketone bodies, bile pigments, blood, uric acid in urine. Specimen collection- inspection of faeces- odour, pH, Interfering substance. Test for occult blood, faecal fat.

UNIT - III

CLINICAL HEMATOLOGY **Teaching Hours: 15Hrs**

Anticoagulant, preservation, Estimation of Hb, PCV, WBC, RBC, Platelets, ESR.Clotting time, bleeding time - normal value, clinical interpretation.

UNIT - IV

BODY FLUIDS AND BLOOD BANKING **Teaching Hours: 15Hrs**

Cerebrospinal fluid and amniotic fluid, semen analysis, sputum examination - Interpretation. Blood grouping- ABO system, Rh typing, Blood transfusion, cross matching, blood transfusion and its complications.

UNIT - V

MEDICAL MICROBIOLOGY **Teaching Hours: 15Hrs**

Culturing of organisms from various specimens.Culture media and antibiotic sensitivity test (pus, urine, Stool, sputum, throat swab, gram staining, Zielh -Neilson staining (TB, Lapra bacilli).Safety procedure in microbiological techniques.

TEXT BOOKS/ REFERENCE BOOKS:

1. Medical Laboratory Technology - Kanai L. Mukherjee, 10th reprint, Tata McGraw Hill Publication and Co. Ltd., Vol, I, II, III. 2002.
2. Medical Laboratory Science- J. Ochei& A. Kolhatkar, Tata McGraw Hill Publication and Co. Ltd., 2002.
3. Practical Clinical Biochemistry - Harold Varley, 5th edition, William Heinemann Medical Books Ltd., London. 1980.
4. Medical lab technology - RamnikSood, Jaypee Brothers, Medical Publishers (P) Ltd, New Delhi.
5. Clinical Chemistry- M.N. Chatterjee& R. Chawla, 2nd edition, Jaypee Brothers Medical Publishers (P) Ltd., 2010.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	M	M	S	M	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	M	S	S	S	S	S
CO4	M	M	S	S	S	S	S	M	S	M
CO5	S	S	S	S	S	M	S	S	S	S

PO – Programme Outcome, CO – Course outcome
S – Strong , M – Medium, L – Low (may be avoided)

SEMESTER VI

CORE PAPER - 8
CLINICAL BIOCHEMISTRY

COURSE OBJECTIVES

1. To acquire fundamental knowledge blood glucose regulation and diabetes mellitus
2. To know about the genetic diseases and fatty liver
3. To obtain a knowledge of liver function tests and its interpretation with pathological diseases
4. To gain insights renal function tests and importance of non protein nitrogenous compounds
5. To understand the importance marker enzymes in diseases and gastric function.

COURSE OUTCOMES

1. After studying unit 1, the students will be able to understand the pathophysiology and molecular basis of Diabetes mellitus and acquire knowledge on the clinical features on Glycosuria, Ketosis, Fructosuria&Galactosemia.
2. After studying unit 2, the students will be able to analyze the genetic diseases like phenyl ketonuria, cystinuria, albinism, hypo and hyperuricemias, obesity and fatty liver
3. After studying unit 3, the students will be able to explain the physiopathological and biochemical markers of the liver function tests.
4. After studying unit 4, the students will be able to understand the methodology to perform renal function tests
5. After studying unit 5, the students will be able to examine the gastric contents and categorize the use of enzymes and Isozymes in assessment of liver damage, bone disorders and myocardial infarction.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

UNIT - I **Teaching hours:15Hrs**

Blood glucose homeostatsis, renal threshold value, regulation of blood glucose - hormonal action. WHO criteria Definitions for hypo &hyperglycemia,.Diabetes Mellitus and its metabolic complications.Oral GTT in normal and diabetic condition, renal glycosuria, Fructosuria&Galactosemia.

UNIT - II **Teaching hours:15Hrs**

Disease related to amino acid metabolism- Clinical manifestation of Phenylketonuria, Cystinuria, Albinism, Fanconi syndrome, Tyrosinemia and alkaptonuria. Types of Lipoproteins - Dyslipoproteinemias, atherosclerosis, obesity & Fatty liver.

UNIT - III **Teaching hours:15Hrs**

Liver function tests: Metabolism of bilirubin - Jaundice, types, causes and differential diagnosis. Liver function test -Icteric index, Vandenberg test, plasma protein changes, Prothrombin Time. Liver disorders - Acute and Chronic Hepatitis, Cirrhosis.

UNIT - IV **Teaching hours:15Hrs**

Renal function tests: Clearance test - urea, creatinine, inulin, PAH test, concentration and dilution test. Renal disorders - glomerulonephritis, Diabetes Insipidus, Nephrotic syndrome, renal failure and UTI.

UNIT - V **Teaching hours:15Hrs**

Gastric function test- collection of gastric contents, examination of gastric residue, FTM stimulation test, tubeless gastric analysis. Gastric disorders.Enzyme patterns in acute pancreatitis, Myocardial infarction and bone disorder.

TEXT BOOKS/ REFERENCE BOOKS:

1. J.L Jain S. (2005), Fundamentals of Biochemistry, Chand Publishing, New Delhi.
2. U. Sathya Narayanan and U. Chakrapani. (2007), Text book of Biochemistry - 3rdedition, Pvt Ltd.
3. A.C. Deb (2001), Fundamentals of Biochemistry, New Central Book Agency Pvt., Ltd., Calcutta.
4. Biochemistry by Zubay, G.L, 4th edition, WMC Brown publishers (1988).
5. Principles of Biochemistry by Garrette and Grisham, Saunders College publishing (1994).
6. Biochemistry by Campbell and Farrell, 4th ed. Brooks/Cole Pub Co. (2002).
7. Lehninger's Principles of Biochemistry by Nelson Cox, 4th ed. McMillan Worth (2004).
8. Harper's Illustrated Biochemistry Thirty-First Edition (A & L LANGE SERIES(2018)
9. U.Chakrapani, U. (2013). Biochemistry (with Clinical Concepts and Case Approach) (7th ed.).

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	S	S	M	S
CO2	M	M	M	S	M	S	S	S	S	M
CO3	M	S	M	M	M	S	S	S	M	S

CO4	S	M	S	S	M	M	S	M	S	M
CO5	S	S	S	M	S	S	S	S	M	M

PO – Programme Outcome, CO – Course outcome
S – Strong , M – Medium, L – Low (may be avoided)

CORE PAPER - 9

BIOTECHNOLOGY

COURSE OBJECTIVES:

1. To acquire knowledge on the recombinant DNA
2. To gain insights on the various vectors
3. To analyse the applications of rDNA in biotechnology

COURSE OUTCOMES: At the end of the Course, the Student will be able to:

1. After studying unit 1, the students will be able to discuss the basic requirements and tools employed in genetic engineering process
2. After studying unit 2, the students will be able to demonstrate the basic and recent techniques applied in the field of Recombinant DNA technology
3. After studying unit 3, the students will be able to apply the basic rDNA technique to produce transgenic animal, discuss gene transfer methods, their application in pharmaceutical industry, cloning and its importance
4. After studying unit 4, the students will be able to understand the transgenic plant technology
5. After studying unit 4, the students will be able to describe the methods employed for DNA amplification, gene therapy and antisense RNA therapy.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

UNIT - I

INTRODUCTION TO RECOMBINANT DNATeaching Hours: 15Hrs

Biotechnology -Definition, Recombinant technology- Restriction endonuclease- Type I, Type II.DNA ligase- DNA joining enzyme, alkaline phosphatase, DNA modifying enzymes.

Linkers, adapters, homopolymers, enzymes used in genetic engineering. Applications of Recombinant DNA. Vectors-Plasmids- pBR322, cosmids, Yeast artificial chromosome

UNIT - II

RECOMBINANT DNA TECHNOLOGY **Teaching Hours: 15Hrs**

Preparation of r-DNA, insertion of r-DNA into vector, methods of transfer, selection of recombinants and screening- genetic methods, immuno chemical methods, South- Western screening, Nucleic acid hybridization methods, radio-active and non-radioactive labelling of probes.

UNIT - III

ANIMAL BIOTECHNOLOGY **Teaching Hours: 15Hrs**

Animal cell culture, tissue culture - gene transfer methods in animals - transfection, microinjection, electroporation, gene gun, use of polycation, transgenic mice - knock out and knock in technology. Embryo transfer and invitro fertilization - applications.

UNIT - IV

PLANT BIOTECHNOLOGY: **Teaching Hours: 15Hrs**

Plant tissue culture -role of Auxins, Cytokinins, Giberellic acid.Somaclonalvariantions - microprojectiles, transgenic plant technology -for pest resistance, herbicide tolerance, delay of fruit ripening and use of plants to produce commercially important proteins -growth promoting bacteria in plants -antisense RNA technology. Gene transfer.

UNIT - V

BASIC TECHNIQUES: **Teaching Hours: 15Hrs**

Maxam and Gilbert method of DNA sequencing.Chemical synthesis of oligonucleotides.Isolation, purification and sequencing of DNA -hybridization methods - southern, northern and western blotting. Amplification of DNA -PCR,- quantitative and qualitative. PCR - types and applications.

TEXT BOOKS / REFERENCE BOOKS

1. U.Sathyanarayana, U Chakrapani, Biotechnology, 12thedition, 2018
2. Brown T.A.Gene cloning and DNA analysis, Wiley Blackwell publishers, 2016.
3. Old and primrose. Principles of gene manipulation. Business service publishers,2003.
4. RC. Dubey, A Textbook of Biotechnology, S. Chand publishers, 2014.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	M	S	M	S	S
CO2	S	S	M	M	M	S	S	S	S	S
CO3	S	S	M	M	M	S	S	S	S	S
CO4	S	S	M	M	M	S	S	M	S	M

CO5	S	S	M	M	M	M	S	S	S	S

PO – Programme Outcome, CO – Course outcome
S – Strong , M – Medium, L – Low (may be avoided)

INTERNAL ELECTIVE
PAPER - 2

IMMUNOLOGY

COURSE OBJECTIVES:

1. To gain a wide knowledge on cells and organs of immune system
2. To study the types of immunity
3. To undertstand the structure and functions of antibodies
4. To acquire skills to perform immunological techniques.
5. To gain deep insight on the mechanisms involved during allergic reactions.

COURSE OUTCOMES:

1. After studying unit 1, the Student will be able to aquire wide knowledge on the immunity, cells and organs of immune system.
2. After studying unit 2, the Student will be able to Illustrate the structure and classification of antibodies
3. After studying unit 3, the Student will be able to understand antigen and antibody interaction during infection
4. After studying unit 4, the Student will gain exposure to mechanisms involved during allergic reactions.
5. After studying unit 4, the Student will acquire knowledge on the principles, methodology involved in immunological techniques.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	No

UNIT - I

IMMUNITY AND IMMUNE CELLS **Teaching Hours: 15Hrs**

History of Immunology - Edward Jenner and Louis Pastuer.Immunity - Innate & Acquired immunity. Immune Response - Antibody & Cell Mediated response. Primary and secondary lymphoid organs.Structure of T, B and NK cell, Structure and functions of Neutrophils, Eosinophils and Basophils, Macrophages - Phagocytosis and inflammation.

UNIT - II

ANTIGEN AND ANTIBODIES **Teaching Hours: 15Hrs**

Antigen - Properties, Specificity, Cross reactivity, Immunogenicity, antigen determinants, Haptens, Adjuvants, Self antigen (MHC). Antibodies - Properties and Structure of classes and subclasses of Immunoglobulin, Monoclonal Antibody production.

UNIT - III

ANTIGEN - ANTIBODY INTERACTIONS **Teaching Hours: 15 Hrs**

Precipitation and Agglutination - Definition and mechanism of formation. Complement pathways, Cytokines and their functions.

UNIT - IV

IMMUNITY TO INFECTION: **Teaching Hours: 15 Hrs**

Hypersensitivity - type I, II, III and IV and their clinical manifestations.Transplantation - types, Mechanism of Allograft rejection, Graft Vs Host reaction, mechanism and prevention of graft rejection,(skin),Immuno suppressive drugs. Basic concepts of plastic surgery.

UNIT - V

IMMUNOLOGICAL TECHNIQUES **Teaching Hours: 15Hrs**

Precipitation in gel.Ouchterlony procedure, Radial immunodiffusion, Immuno electrophoresis, Electroimmmunodiffusion.Principle and applications of RIA and, ELISA .Immunization - Passive and Active, Vaccines - Recombinant vaccines, DNA vaccines, Benefits and adverse effects of vaccination.

TEXT BOOKS / REFERENCE BOOKS

1. Annadurai. B (2008), A textbook of Immunology and Immunotechnology, 1st Edition. S.Chand& Co, Ltd,New York.
2. J. Kuby, R.A.Goldsby, T.J. Kindt and B.A. Osborne, B.A. (2007), Immunology, 4th edition, W.H.Freeman and Company, New York, USA.
3. J. Kuby (2002), Immunology, 5th edition, W.H.Freeman and Company, New York.
4. Ian R. Tizard (2000), Immunology: An Introduction., 4th edition, W.B.SaundersCo.,Philadelphia.
5. Murphy Kenneth (2008), Janeway'sImmunobiology, Garland Science Publishers, New York..
6. Peter J.Delves, Ivan Maurice Roitt,,Seamu J. Martin and Deninis Burton (2006), Roitt's Essential Immunology, 11th edition, Blackwell Scientific Publications, London.
7. I. Roitt, J. Brostoff and DMale (2002), Essential Immunology, 8th edition, English Language Book Society, London..

8. RajasekaranPandian (2007), Immunology and Immunotechnology, Panima Publishers, Chennai.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	S	**S**	**S**	**S**
CO2	M	M	M	M	M	M	S	**S**	**S**	**S**
CO3	M	M	M	M	M	M	S	**S**	**S**	**S**
CO4	M	M	M	M	M	M	S	**S**	**S**	**S**
CO5	M	M	M	M	M	M	S	**S**	**S**	**S**

PO – Programme Outcome, CO – Course outcome
S – Strong , M – Medium, L – Low (may be avoided)

INTERNAL ELECTIVE
PAPER - 3

PHARMACEUTICAL BIOCHEMISTRY

COURSE OBJECTIVES:

1. To understand the chemistry of drug molecules.
2. To Illustrate the mechanism of drug absorption, distribution and metabolism
3. To gain knowledge on the novel drug delivery systems
4. To appraise the uses of Plants in traditional medicine
5. To Highlight the importance of organic phytochemicals in pharmaceuticals

COURSE OUTCOMES: At the end of the Course, the Student will be able to:

1. After studying Unit 1, student will be able to Define a drug and identify the chemistry of drug molecules and Illustrate the mechanism of drug absorption, distribution and metabolism
2. After studying unit 2, student will be able to Explain the routes of drug administration. Appraise on the novel drug delivery systems compared to the conventional routes.
3. After studying unit 3, the students will be able to Justify the use of synthetic drugs for different disease systems.
4. After studying unit 4, the students will be able to Highlight the uses of Plants in traditional medicine

5. After studying unit 5, the students will be able to Highlight the importance of organic phytochemicals in pharmaceuticals

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	Yes	Yes	No
5	Yes	Yes	Yes	Yes	No	No

UNIT - I

DRUG AND ITS METABOLISM **Teaching Hours: 15 Hrs**

Drug -Definition- Structural feature- prodrug concept. Mechanism of Absorption -first -pass effect. Distribution and metabolism of drug.Mechanism of Phase I and Phase II reactions, Action of cytochrome p450.Drug receptor- localization, type and subtypes, models and their drug - receptor interaction, agonist & antagonist.Examples.

UNIT - II

DRUG DELIVERY SYSTEM **Teaching Hours: 15 Hrs**

Definition for IC 50 and LD50 of a drug - Drug tolerance and intolerance, Idiosyneracy (pharmacogenesis), drug allergy- allergic responses to sulphadrugs. Drug abuse.Novel drug delivery systems- role of liposomes and nanoparticles in drug delivery - non conventional routes of administration.

UNIT - III

DRUGS FOR VARIOUS DISORDERS **Teaching Hours: 15 Hrs**

GI tract disorders.Drugs for GI tract disorders.Mechanism of action of drugs used in therapy of GI tract disorder - Ulcer, Irritable bowel syndrome and constipation.Statins as a drug for hyperlipidemia. Antibiotics - sulfonamides,,cotrimoxazole and penicillin. Role of insulin in the treatment of diabetes mellitus. Oral hypoglycemic drugs - sulphonylureas (Gliclazide,glimipride, glibenclamidebiguanides (Metformin).

UNIT - IV

TRADITIONAL MEDICINE **Teaching Hours: 15 Hrs**

Plants and bioactive compounds used in traditional medicine Ayurveda , Siddha and Unani - tulsi, turmeric, neem, ashwagandha, amla, coriander, ginger, Aloe barbadensis. Nilavembukashayam preparation.

UNIT – V

PHYTOCHEMICALS **Teaching Hours: 15 Hrs**

Bioactive components of plant origin: flavonoids, alkaloids, terpenoids, glycosides, saponins, Medicinal plants for the treatment of Diabetes mellitus and Cancer. Chemotherapy - Cytotoxic drug. Biological analysis of active compounds using HPLC, GC- MS(Basic principles only).

TEXT BOOKS/ REFERENCE BOOKS:

1. R.S. Satoskar, S.D. Bhandhakar,Pharmacology and pharmacotheraphy Elsevier, 2017.
2. Bertram. G. Katzung, Basic and clinical Pharmacology, Tata McQrahill publishers, 2015
3. David G. smith, Oxford textbook of clinical pharmacology and drug therapy, Oxford press, 2008, 3rd edition.
4. Ajay Kumar Meena , ParveenBansal, Sanjiv KumarPlants-herbal wealth as a potential source of ayurvedic drugs, Asian Journal of Traditional Medicines, 2009

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	M	M	S	S	S	S
CO2	S	M	S	M	S	S	S	S	S	S
CO3	M	S	S	M	M	S	S	S	S	S
CO4	M	M	S	M	S	S	S	S	S	S
CO5	S	S	S	M	S	M	S	S	S	S

PO – Programme Outcome, CO – Course outcome
S – Strong , M – Medium, L – Low (may be avoided)

SKILL BASED SUBJECT

PAPER - 4

RESEARCH METHODOLOGY

COURSE OBJECTIVES

1. To understand the basics of research
2. To illustrate the importance of research paper
3. To learn the principle of scientific research
4. To understand the importance of collection and analysis of data

5. Acquire knowledge on journals and paper writing

COURSE OUTCOMES

1. After studying Unit1, the students will be able to Gain wide knowledge on the fundamentals of research
2. After studying Unit 2, the students will be able to Identify the research problem and research design
3. After studying Unit 3, the students will be able to Enlighten Importance of Hypothesis, Characteristics of a Good Hypothesis
4. After studying unit4, the students will be able to have Exposure to write thesis
5. After studying unit 5, the students will be able to acquire knowledge on finding scientific articles using PubMed and paper writing

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	Yes	Yes	No
5	Yes	Yes	Yes	Yes	No	No

UNIT - I

RESEARCH-OBJECTIVES AND TYPES **Teaching Hours :15Hrs**

Definition of research - Objectives of research, general characteristics of research, qualities of researcher, criteria for good research, Types of Research, approaches and significance of Research. Problems encountered in research, Motivation in Research.

UNIT - II

RESEARCH DESIGN **Teaching Hours :15Hrs**

Scientific thinking, identification of research problem, defining the problem, evaluation of a Problem. Research design- contents and types of research design, factors affecting research design.

UNIT - III

HYPOTHESIS **Teaching Hours :15Hrs**

Meaning of Hypothesis, Definitions of Hypothesis, Importance of Hypothesis, Characteristics of a Good Hypothesis, Variables in a Hypothesis, formulating a Hypothesis, Testing the Hypothesis

UNIT - IV

THESIS WRITING **Teaching Hours**

:15Hrs Thesis- Components of a thesis -format for writing thesis (Abstract, introduction,

review of literature, materials and methods and discussion), reference styles. Useful search engines.E-resources (e-books/e-journals).

UNIT - V

JOURNALS **Teaching Hours : 15 Hrs**

Journals: Standard of research journals - International and national journals, Scopus indexed journals-explanation. Impact factor - citation index and H index-Definition.Preparation of research manuscript - report writing - format of journals - proof reading - sources of information; journals, reviews, books, and monographs-bibliography. Plagiarism.Search engines - google, pubmed - national informatics center network services. Online data base library.

TEXT BOOKS/ REFERENCE BOOKS:

1. Research methodology, Methods and techniques. C.R.Kothari&GuravGarg. New age publishers, New Delhi.4th edition.2019.
2. Research methodology. P.Saravanavel - Kitlabmahal, 6th edition. 2018.
3. Research methodology: The beginners' manual. 1st edition. Graham Myers. 2017.
4. Research Methodology: Methods and Techniques. Kothari, C.R.New Age International Publishers, New Delhi.2004.
5. Bioinformatics: sequence and genome analysis, by David Mount, second edition.Cold spring harbor lab press. 2004.
6. Bioinformatics: Sequence and Genome Analysis David W Mount, CBS Publishers, Ian Korf, Mark Yandell& Joseph Bedell. 2003.
7. Introduction to Bioinformatics by T.K Atwood and D.J Parry, Smith Publisher: Pearson Education Pvt Ltd. 2002.
8. Robert A. Day. How To Write & Publish a Scientific Paper. Oryx Press; 5 edition.1998.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	M	M	S	S	S	S
CO2	S	M	S	M	S	S	S	S	S	S
CO3	M	S	S	M	M	S	S	S	S	S
CO4	M	M	S	M	S	S	S	S	S	S
CO5	S	S	S	M	S	M	S	S	S	S

PO – Programme Outcome, CO – Course outcome
S – Strong , M – Medium, L – Low (may be avoided)

CORE PRACTICAL-III

ENZYMOLOGY AND BIOMOLECULES

COURSE OUTCOMES: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
CO1	Demonstrate the collection of blood sample List the conditions essential for collection of urine and other clinical samples
CO2	Show the effect of pH,temperature and substrate concentration on the activity of salivary amylase Assay the activity of salivary amylase
CO3	Estimate creatinine by Jaffe's method, urea by DAM-TSC method, DNA by diphenylamine method and RNA by orcinol method
CO4	Identify and enumerate the total count of erythrocytes and leukocytes Differentiate leukocytes and calculate their total count
CO5	Define and determine the erythrocyte sedimentation rate, packed cell volume and mean corpuscular volume and relate their clinical implications Utilize sphygmomanometer to determine the blood pressure

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	Yes	Yes	No
5	Yes	Yes	Yes	Yes	No	No

I. COLORIMETRIC ESTIMATION

a. Estimation of creatinine by Jaffe's method (in serum & urine)

b. Estimation of urea by diacetylmonoxime method (in serum & urine)

c. Estimation of glucose by O- Toludine method

d. Estimation of Protein by Lowry's method

II.CLINICALLY IMPORTANT ENZYMES:

a. Assay of Serum alkaline phosphatase

b. Determination of optimum pH of salivary amylase.

c. Determination of optimum temperature of salivary amylase.

d. Effect of substrate concentration on the activity of salivary amylase.

e. Assay of activity of salivary amylase.

TEXT BOOKS/ REFERENCE BOOKS:

1. J. JayaramanLaboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011
2. S. K. SawhneyRandhir Singh, Introductory Practical Biochemistry, Alpha Science International, Ltd 2 edition, 2005.
3. Alan H GowenlockVarley's Practical Clinical Biochemistry, CBS Publishers and distributors, India Sixth Edition, 1988.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	M	M	S	M	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	M	S	S	S	S	S
CO4	M	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	M	M	S	S	S	S

PO – Programme Outcome, CO – Course outcome
S – Strong , M – Medium, L – Low (may be avoided)

CORE PRACTICAL - IV
HEMATOLOGY, MICROBIOLOGY AND URINALYSIS

COURSE OUTCOMES: At the end of course students will be able to

CO NUMBER	**CO Statement**
CO1	Demonstrate the collection of blood sample List the conditions essential for collection of urine and other clinical samples
CO2	Hands on training to sterilization and gram staining
CO4	Identify and enumerate the total count of erythrocytes and leukocytes Differentiate leukocytes and calculate their total count
CO5	Define and determine the erythrocyte sedimentation rate, packed cell volume and mean corpuscular volume and relate their clinical implications Utilize sphygmomanometer to determine the blood pressure
CO5	Qualitatively analyze the normal and abnormal constituents of urine sample

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No

3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	Yes	Yes	No
5	Yes	Yes	Yes	Yes	No	No

1. HAEMATOLOGY

Hematology - Haemoglobin by Sahli's method, RBC count, PCV, ESR, Total and differential WBC count, Platelet count, Blood grouping, ABO system, Rh System, clotting time, bleeding time.

2. MICROBIOLOGY

Sterilization and disinfection, culture, gram staining, media preparation, antibiotic sensitivity testing

3. URINE ANALYSIS

1. Collection of urine samples
2. Qualitative analysis of urine for normal and pathological conditions.

DEMO EXPERIMENTS.

- Detection of Heart sounds using Stethoscope
- Measurement of Blood pressure using Sphygmomanometer.

TEXT BOOKS/REFERENCE BOOKS

1. J. Jayaraman Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011
2. S. K. SawhneyRandhir Singh, Introductory Practical Biochemistry, Alpha Science International, Ltd 2 edition, 2005.
3. Alan H GowenlockVarley's Practical Clinical Biochemistry, CBS Publishers and distributors, India Sixth Edition, 1988.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	M	M	S	M	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	M	S	S	S	S	S
CO4	M	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	M	M	S	S	S	S

PO – Programme Outcome, CO – Course outcome
S – Strong , M – Medium, L – Low (may be avoided)

INTERNAL ASSESSMENT METHODS

Internal Assessment Methods: (The following items may be brought under test, seminar and assignment framework)

a. Book review and research paper review, syllabus and curriculum review.
b. Data collection and paper writing practices: books level, field study level. Using the course study for society and nature development – exercise
c. Workshops, preparing technical term dictionaries from text books and reference books.
d. Preparing question paper by the candidates: objective type, descriptive type, training can be given by the teacher
e. Forming digital library: collecting text and reference books, course material.
f. Villages, institutions, various people groups may be adopted by the departments of the colleges for practicing their theoretical study. Innovative methods may be implemented in the practices and report can be written for documentation, further discussion and research.
g. Extracurricular and cultural activities may be framed through the syllabus content.
h. Grouping students for self-discussion, self-learning process.
i. Following institution and intellectual and writing reports in the course field.
j. Bloom Taxonomy may be introduced for teaching, learning and evaluation process within the framework of question setting pattern and internal assessment pattern.
k. For application oriented study: Villages, Institutions, various people groups may be adopted by the departments of the colleges for practicing their theoretical study. Innovative methods may be implemented in the practices and report can be written for documentation, further discussion and research.
l. Extracurricular activities may be framed through their syllabus content.
m. Bring the industries to the campus. Bring the students to the industry.
n. Ph.D. Research Methodology is applicable to write project report and any kind of research reports like assignment, seminar papers, case study reports, etc.

ALLIED PAPER - 1

BIOCHEMISTRY I

COURSE OBJECTIVES

1. To acquire knowledge on the structure and functions of carbohydrate
2. To understand the structure and classification of amino acids
3. To acquire knowledge on the classification of proteins and their functions in the body
4. To gain wide knowledge on the various lipids and their importance in the body
5. To understand the basics of DNA and RNA with reference to their functions

COURSE OUTCOMES

1. After studying unit1, the students will be able to explain the structure, biological importance of carbohydrates, from monosaccharides to polysaccharides
2. After studying unit 2, the students will be able to identify the structure and classification of amino acids,

3. After studying unit 3, the students will be able to classify proteins and explain their properties
4. After studying unit 4, the students will be able to classify lipids and describe the structure and biological functions of phospholipids, glycolipids and sterols
5. After studying unit 5, the students will be able to illustrate the structure of nucleotides, distinguish DNA and RNA and describe the structure of DNA, types of RNA and their biological functions

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	No	Yes	No
5	Yes	Yes	Yes	No	Yes	No

UNIT-I: CARBOHYDRATES **Teaching Hours: 15 Hrs**

Definition and Classification of carbohydrate.Monosaccharides – Glucose, Fructose and Arabinose, Linear and ring forms (Haworth formula) for glucose and fructose. Anomer, epimer and enatiomers-Definition with examples. Disaccharides – Definition- Sucrose, maltose and Lactose occurrence, structure and functions. Polysaccharides – Homopolysaccharides -Starch -Structure and functions. Heteropolysacharides-Aminosugars and sugar acids.

UNIT-II: AMINO ACIDS **Teaching Hours:15Hrs**

Definition and classification of amino acids. Reaction of amino acids with ninhydrin, Color reactions of amino acids (Xanthoproteic test, Morners test, Millons test, Sakaguchi test, Lead acetate test and Pauly's test), Amphoteric nature, isoelectric pH and Zwitter ion.

UNIT-III: PROTEINS **Teaching Hours:15Hrs**

Proteins-Definition.Peptide bond formation. Classification of proteins based on solubility, shape and size. Denaturation. Structure of protein: primary, secondary, tertiary and quaternary structure.

UNIT-IV: LIPIDS **Teaching Hours:15Hrs**

Definition, classification and functions of lipids. Occurrence, chemistry and biological functions of simple lipids, compound lipids (e.g. phospholipids) and derived lipids: steroids (e.g. cholesterol). Physical property-emulsification.Chemical property-saponification.Functions of bile acids and bile salts.

UNIT- V: NUCLEIC ACIDS **Teaching Hours:15Hrs**

Nucleic acid- Composition of nucleic acid., Definition - nucleoside, nucleotide and polynucleotide. Double helical model of DNA and its biological functions.Chargaff's rule. RNA-Structure, types and functions of RNA: tRNA, mRNA and rRNA. Differences between DNA and RNA

TEXT BOOKS/REFERENCE BOOKS

1. Ambikashunmugam, "Fundamentals of Biochemistry (8th Edition) 2016, Wolters Kluwer India Pvt Ltd
2. Dr.A.C.Deb, "Fundamentals of Biochemistry" (8th edition), Kolkata, New Central Book Agency
3. Nelson, D. L. & Cox, M. M. Lehninger Principles of Biochemistry. Freeman, 5th edn, 2008.
4. Harper's Illustrated Biochemistry.30th edition -McGraw Hill
5. U.Sathayanarayana,(2006). Biochemistry. 3rd Edition by Books and Allied (P) Ltd., India.
6. Donald Voet and Judith Voet,"Biochemistry",2nd edition,John Wiley & Sons, Inc, NY

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	S	M	S	M
CO2	M	M	M	M	M	M	S	M	S	M
CO3	M	M	M	M	M	M	S	M	S	M
CO4	M	M	M	M	M	M	S	M	S	M
CO5	M	M	M	M	M	M	S	M	S	M

PO – Programme Outcome, CO – Course outcome
S – Strong, M – Medium, L – Low (may be avoided)

ALLIED PAPER - 2

BIOCHEMISTRY II

COURSE OBJECTIVES

1. To understand the basics of metabolic pathways
2. To acquire knowledge on the various metabolic disorders
3. To understand the importance of enzymes in the body
4. To gain knowledge on the sources and functions of vitamins in the body
5. To illustrate the biological significance of minerals in the body

COURSE OUTCOMES:

1. After studying Unit 1, the student will be able to illustrate the reactions of various metabolic pathways

2. After studying Unit 2, the student will be able to acquire knowledge on the various metabolic disorders
3. After studying Unit 3, the student will be able to classify enzymes and explain their functions
4. After studying Unit 4, the student will be able to classify vitamins and their biomedical significance
5. After studying unit 5, the students will be able to analyze the biological importance of Minerals

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	No
2	Yes	Yes	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	No	No	Yes	No
5	Yes	Yes	Yes	No	Yes	No

UNIT-I: METABOLISM **Teaching Hours: 15Hrs**

Metabolism-Catabolism and anabolism-Definition.Reactions of glucose oxidation-Glycolysis, TCA cycle and its energetics, HMP shunt and its significance. Amino acid-transamination and Deamination, reaction, Urea cycle- Formation of urea.

UNIT-II: METABOLIC DISORDERS **Teaching Hours: 15Hrs**

Diabetes mellitus- definition. Types and symptoms., Glycogen storage diseases-Types, Renal Glycosuria-Definition and causes. In born errors of amino acid metabolism- Phenyl ketonuria, Alkaptonuria (Black urine syndrome) and albinism

UNIT-III: ENZYMES **Teaching Hours: 15Hrs**

Enzymes-Definition, IUB system of classification with one example.Mechanism of enzyme action - Lock and key mechanism, Induced Fit theory.Michaleis-Menton equation. Co enzymes- Vitamins as coenzymes (Tabulation of Coenzymes with functions in metabolism)

UNIT-IV: VITAMINS **Teaching Hours: 15Hrs**

Vitamins- fat soluble (Vitamin A, D, E and K) and water soluble vitamins (Vitamin B1, B2, B3 and B12), Vitamin C - sources, RDA, biological function and deficiency of Vitamins of the above mentioned vitamins

UNIT V-MINERALS **Teaching Hours: 15Hrs**

Minerals- sources, RDA, biological functions and deficiency of Calcium, Iron, Phosporus, Sodium and potassium. Examples of minerals as cofactors in metabolism.

TEXT BOOKS/REFERENCE BOOKS

1. Ambikashunmugam, "Fundamentals of Biochemistry (8th Edition) 2016, Wolters Kluwer India Pvt Ltd
2. Harper's Illustrated Biochemistry.30th edition -McGraw Hill
3. U.Sathayanarayana,(2006). Biochemistry. 3rd Edition by Books and Allied (P) Ltd., India.
4. Donald Voet and Judith Voet,"Biochemistry",2nd edition,John Wiley &Sons,Inc,NY

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	S	M	S	M
CO2	M	M	M	M	M	M	S	M	S	M
CO3	M	M	M	M	M	M	S	M	S	M
CO4	M	M	M	M	M	M	S	M	S	M
CO5	M	M	M	M	M	M	S	M	S	M

PO – Programme Outcome, CO – Course outcome
S – Strong, M – Medium, L – Low (may be avoided)

ALLIED PRACTICAL

BIOCHEMISTRY I & II

PRACTICAL I

COURSE OBJECTIVES

1. To obtain skills to qualitatively analyse carbohydrate
2. To acquire skills to qualitatively analyse amino acids
3. To estimate the amount of compounds using volumetric analysis

COURSE OUTCOMES: At the end of the course, students will be able to

1. Quantify glucose in unknown solution by benedict's method
2. Quantify ascorbic acid in lemon by Dichlorophenol indo phenol dye method
3. Quantify glycine by Sorenson's formal titration method
4. Qualitatively analyse the carbohydrates and amino acids and report the type of carbohydrate based on specific tests
5. Differentiate the carbohydrates based microscopic examination of the crystal structure.

Volumetric Estimation

1. Estimation of Glucose by Benedict's method.
2. Estimation of Ascorbic acid by 2, 6 dichlorophenol indophenols dye method.
3. Estimation of Glycine by Sorenson's formal titration.

A) Qualitative analysis of Carbohydrates

- Qualitative analysis of Glucose
- Qualitative analysis of Fructose
- Qualitative analysis of Maltose
- Qualitative analysis of Starch

B) Qualitative analysis of Amino acids

- Qualitative analysis of Arginine,
- Qualitative analysis of Cysteine
- Qualitative analysis of Tryptophan
- Qualitative analysis of Tyrosine

TEXT BOOKS/REFERENCE BOOKS

1. J. Jayaraman, Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011.
2. S. K. SawhneyRandhir Singh, Introductory Practical Biochemistry, Alpha Science International, Ltd 2 edition, 2005.
3. Irwin H.Saegal, Biochemical calculations, Liss, Newyork, 1991