



# **SACRED HEART COLLEGE (AUTONOMOUS)**

**Tirupattur – 635 601, Tamil Nadu, S.India**

**Resi : (04179) 220103**

**College : (04179) 220553**

**Fax : (04179) 226423**

*Ready for  
Every Good Work*

*A Don Bosco Institution of Higher Education, Founded in 1951 \* Affiliated to Thiruvalluvar University, Vellore \* Autonomous since 1987*

*Accredited by NAAC (4<sup>th</sup> Cycle – under RAF) with CGPA of 3.31 / 4 at 'A+' Grade*

**DEPARTMENT OF BIOCHEMISTRY**

**SACRED HEART COLLEGE**

**(AUTONOMOUS)**

**Tirupattur-635 601, Tirupattur District**

**(Affiliated to Thiruvalluvar University, Vellore)**

**Accredited by NAAC (4<sup>th</sup> Cycle–under RAF) with CGPA of 3.31/4**

**at 'A+' Grade**

**B.Sc. BIOCHEMISTRY SYLLABUS**

**2021–2022**

## **PROGRAMME OUTCOMES AT SHC**

### **PROGRAMME OUTCOMES AT UNDERGRADUATE LEVEL**

#### **Undergraduates will be able to:**

- PO1: Discuss their new knowledge and understanding; apply new ideas in order to acquire employability/self-employment
- PO2: Pursue higher learning programmes and become entrepreneurs
- PO3: Recognize moral and ethical values and be socially responsible citizens in the society
- PO4: Apply analytical, technical, problem solving, critical thinking skills, and decision-making skills in solving real life problems in one's life and in the society.
- PO5: Direct their own self-learning through MOOC courses, co-curricular activities, industrial exposures and field trainings
- PO6: Develop their own broad conceptual background in Biological sciences, Computing sciences, Languages and culture, Management studies, Physical sciences, etc.
- PO7: Demonstrate communication skills both oral and written in personal and academic pursuits.

**B.Sc. BIOCHEMISTRY**  
**PROGRAMME SPECIFIC OUTCOMES [PSO]**

- PS01:** Disciplinary knowledge and understanding of Biochemistry, structure and function of biological molecules and explain biological mechanisms, such as the processes and control of bioenergetics and metabolism, as chemical reactions.
- PS02:** Explain the biochemical processes that underlie the relationship between genotype and phenotype and demonstrate an experiential learning and critical thinking of the structure and function of both prokaryotic and eukaryotic cells (including the molecular basis and role of sub-cellular compartmentalization).
- PS03:** Demonstrate an understanding of the principles, and have practical experience of a wide range of biochemical techniques (e.g. basic molecular biology, cell biology and microbiology methods, spectrophotometry, the use of standards for quantification, enzyme kinetics; macromolecular purification, chromatography electrophoresis, etc.).
- PS03:** Analyze biochemical data (e.g. in enzyme kinetics, molecular structure analysis and biological databases and carry out laboratory-orientated numerical calculations (e.g. inter-conversion of masses, moles, and molarity, preparation of solutions and accurate dilutions), be capable in data visualization and analysis, including the application of data transformations (e.g. logarithmic, exponential).
- PS04:** Basic professional skills pertaining to biochemical analysis, carrying out clinical diagnostic tests and ability to use skills in specific areas related to Biochemistry such as industrial production, technology development, clinical, health, agriculture, community development, etc.
- PS05:** Curiosity and ability to formulate Biochemistry related problems and using appropriate concepts and methods to solve them and ability to use various e-resources in order to solve challenges related to Biochemistry.
- PS06:** Articulation of ideas, scientific writing and authentic reporting, effective presentation skills and having conversational competence including communication and effective interaction with others, listening, speaking, and observational skills.
- PS07:** Collaboration, cooperation and realizing the power of groups and community, ability to work in a group, community and ability to grasp ideas and to turn ideas into action related to biochemical mechanisms and processes related to industries, industrial production, health, agriculture, etc.

**B.Sc. BIOCHEMISTRY SYLLABUS**  
**UNDER CBCS (With effect from 2021-2022)**  
**PROGRAMME STRUCTURE**

SEM	Sub Code	Title of the Subject	Hours	Credit	E-Hrs	CA	SE	Total
I SEMESTER	LT114	Tamil-I	5	3	3	50	50	100
	LE115AT	English-I	5	2	3	50	50	100
	LE115AP	English Lab-I	-	1	-	-	-	-
	BC106	Cell Biology	3	3	3	50	50	100
	BC107	Biomolecules	4	4	3	50	50	100
	PBC102	Main practical- I	3	3	3	50	50	100
	ACH110	Allied Chemistry-I	4	3	3	50	50	100
	PACH209	Allied Chemistry Lab Work	2	-	-	50	50	100
	SK104	Communication Skills	2	1	-	-	-	-
	VE105A/B	Religion/Value Education-I	2	1	-	-	-	-
	CE103	Communicative English-I	-	1	-	-	-	-
<b>TOTAL</b>			<b>30</b>	<b>22</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
II SEMESTER	LT214	Tamil-II	5	3	3	50	50	100
	LE215AT	English-II	5	2	3	50	50	100
	BC206	Plant Biochemistry	3	3	3	50	50	100
	BC207	Human physiology	4	4	3	50	50	100
	PBC205	Main practical-II	3	3	3	50	50	100
	ACH210	Allied Chemistry-II	4	3	3	50	50	100
	PACH209	Allied Chemistry Lab Work	2	2	3	50	50	100
	SK204	Leadership skills	2	1	-	-	-	-
	VE205A/B	Religion/Value Education-II	2	1	-	-	-	-
	CE203	Communicative English-II	-	1	-	-	-	-
<b>TOTAL</b>			<b>30</b>	<b>23</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
III SEMESTER	LT312	Tamil-III	5	3	3	50	50	100
	LE309T	English-III	5	2	3	50	50	100
	BC306	Microbiology	3	3	3	50	50	100
	BC307	Biophysical chemistry	4	4	3	50	50	100
	PBC302	Main practical-III	3	3	3	50	50	100
	AM310C	Allied Biostatistics-I	6	5	3	50	50	100
	SK304	Technical Skills-I	2	1	-	-	-	-
	VE306	Human Rights	2	1	3	50	50	100
	LE309P	English Lab-III	-	1	-	-	-	-
		OUTREACH	-	-	-	-	-	-
		SHELTERS	-	-	-	-	-	-
<b>TOTAL</b>			<b>30</b>	<b>23</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
IV SEMESTER	LT411	Tamil-IV	5	3	3	50	50	100
	LE409T	English-IV	5	2	3	50	50	100
	BC407	Microbial Biochemistry	3	3	3	50	50	100
	BC408	Analytical Biochemistry	4	4	3	50	50	100
	PBC405	Main practical-IV	3	3	3	50	50	100
	AM409C	Allied Biostatistics-II	6	5	3	50	50	100

	SK404	Employability Skills	2	1	-	-	-	-
	VE406	Environmental Science	2	1	3	50	50	100
	LE409P	English Lab-IV	-	1	-	-	-	-
		OUTREACH	-	2	-	-	-	-
		SHELTERS	-	2	-	-	-	-
		<b>Internship</b>		<b>1*</b>	-	-	-	-
	<b>TOTAL</b>		<b>30</b>	<b>27+1*</b>	-	-	-	-
<b>V SEMESTER</b>	BC522	Enzymology	4	4	3	50	50	100
	BC523	Intermediary metabolism	5	5	3	50	50	100
	BC524	Endocrinology	4	4	3	50	50	100
	BC525	Genetics	4	4	3	50	50	100
	PBC502	Main practical-V	5	4	6	50	50	100
	BC526A/B/C	<ul style="list-style-type: none"> <li>Biomedical Instrumentation</li> <li>Medical laboratory technology</li> <li>Pharmacology</li> </ul> (one out of three)	6	4	3	50	50	100
	SSP-I	<b>Health Management</b>	-	<b>1*</b>	-	-	-	-
NBC504	NME –Energy Builders	2	1	3	50	50	100	
	<b>TOTAL</b>		<b>30</b>	<b>26 + 1*</b>	-	-	-	-
<b>VI SEMESTER</b>	BC620	Molecular Biology	5	5	3	50	50	100
	BC621	Immunology	4	4	3	50	50	100
	BC622	Medical Biochemistry	4	4	3	50	50	100
	PBC606	Main practical-VI	5	4	6	50	50	100
	BC623A	Subject Skill-I Biotechnology	5	5	3	50	50	100
	BC623B	Subject Skill-II Bioethics	5	5	3	50	50	100
	SSP-II	<b>Nutritional Biochemistry</b>	-	<b>1*</b>	-	-	-	-
	NBC604	NME – Health care and Disease management	2	1	3	50	50	100
	Certificate Courses NPTEL/MOOCs	-	<b>1*</b>	-	-	-	-	
	<b>Project</b>	-	<b>2*</b>	-	-	-	-	
	<b>TOTAL</b>		<b>30</b>	<b>28 + 4*</b>	-	-	-	-

**TOTAL HOURS = 180 Hours**

**TOTAL CREDITS = 148 + 2\* (SSP) + 1\* (Internship) + 1\* from other Department Certificate Courses/NPTEL/MOOCs online courses + 2\* from Project.**

### Regulation for Theory

#### 1. Evaluation Scheme for Continuous Assessment (50)

Written tests (CA) (2)	:	30 marks
Attendance	:	05 marks
Other Components	:	15 marks

#### Other Components

MCQ	:	10 marks
Assignment	:	5 marks

#### 2. Question Paper Pattern for CA

The question paper shall have three sections with the maximum of 50 marks with the following break-up:

#### Section-A

Section A shall contain 6 short answer questions without choice drawn from two units Each question shall carry 2 marks.

(6 x 2 = 12 marks)

#### **Section-B**

Section B shall contain 3 either or questions drawn from two units.

Each question shall carry 6 marks.

(3 x 6 = 18 marks)

#### **Section-C**

Section C shall contain 3 questions from two units.

Two questions out of the three are to be answered each carrying 10 marks.

(2 x 10 = 20 marks)

### **3. Question Paper Pattern for Semester Examinations**

The question paper shall have three sections with the maximum of 100 marks with the following break-up:

#### **Section - A**

Section A shall contain 10 short answer questions drawn from all the units on the basis of minimum two from units. All ten are to be answered each carrying 2 marks.

(10 x 2 = 20 marks)

#### **Section - B**

Section B shall contain 5 either or questions drawn from all the five units.

Each question shall carry 7 marks.

(5 x 7 = 35 marks)

#### **Section – C**

Section C shall contain 5 questions drawn one each from the five units.

Three questions out of the five are to be answered each carrying 15 marks.

(3 x 15 = 45 marks)

### **Regulation for Practical Examinations**

#### **Question paper pattern for Core Practical Examination**

Total: 100 Marks

The practical papers consist of the internal assessment (50 marks) and semester examination (50 marks)

Internal Assessment (50)

Lab Work - 25 marks

Model exam - 25 marks

Semester Examination (50)

#### **Evaluation Pattern for SSP (Health Management/Nutritional Biochemistry)**

- Submission of Assignment
- One MCQ test covering the syllabus

#### **Evaluation Pattern for Internship**

Submission of Internship report with certificate of attending 15 days training before IV Semester from the concerned lab – 1\* credit.

#### **Evaluation Pattern for Project**

Submission of project report with Viva-2\* credits.

**Course Objectives:**

- To understand the structure of prokaryotic and eukaryotic cellular organization and to know the fluid mosaic model and membrane transport mechanism.
- To learn about the chemical composition and functions of endoplasmic reticulum, golgi apparatus and lysosomes.
- To have in-depth understanding of the Structure, Chemical composition and functions of Mitochondria and Ribosomes.
- To learn the functions of peroxisomes and glyoxysomes and composition of cytoskeleton and extracellular matrix.
- To acquire knowledge on nucleus–structure, composition and functions of chromosomes cell cycle, cell division and cell death mechanisms.

**Course Outcomes:**

S.No.	Description	Cognitive Level (K-level)
CO-1	Develop an understanding of the structure of cell and its difference between prokaryotes and eukaryotes	K6,K2
CO-2	Define and understand the fluid mosaic model and membrane transport	K1, K2
CO-3	Categorize the chemical composition and functions of endoplasmic reticulum, golgi apparatus and lysosomes.	K4
CO-4	Broad knowledge on the structure, chemical composition and functions of mitochondria, ribosomes, peroxisomes and glyoxysomes.	K3, K6
CO-5	Demonstrate a clear understanding of the composition of cytoskeleton and extracellular matrix.	K2
CO-6	Evaluate the mechanism of cell division with reference to mitosis and meiosis	K5

**UNIT-I:** Cell and its Theory, Structure of Plant and Animal cell. Cells-Prokaryotes and Eukaryotes, Difference between Prokaryotes and Eukaryotes.

**UNIT-II:** Membrane structure-Fluid Mosaic model, chemical composition and physical properties. Membrane Transport-Diffusion, Active and Passive.

**UNIT-III:** Structure, Chemical composition and functions of Endoplasmic Reticulum, Golgi apparatus and Lysosomes.

**UNIT-IV:** Structure, Chemical composition and functions of Mitochondria and Ribosomes. Functions of Peroxisomes and Glyoxysomes.Cytoskeletons.

**UNIT-V:** Nucleus-Structure, composition and functions of Chromosomes. Cell cycle and Cell divisions-Mitosis and Meiosis.

**Text Books:**

1. P.S Verma and V.K.Agarval (2016) Cytology (Cell Biology, Biomolecules and Molecular Biology), S.Chand Publishing, New Delhi.

2. Geoffrey M. Cooper and Robert E. Hausma (2015) *The Cell: A Molecular Approach*, Seventh Edition, Sinauer Associates, Inc.

**References:**

1. J.M. Bery, J.L. Tymoezko and L. Stryer (2008) *Biochemistry*, 6<sup>th</sup> Ed., W.H. Freeman and Company, New York.
2. D.L.Nelson, and M.M. Cox (2008) *Lehninger Principles of Biochemistry*, 5<sup>th</sup> Ed., W.H. Freeman and Company, New York.
3. T.D.Pollard and W.C. Earnshaw (2002), *Cell Biology*, Saunders Publishing and Co, New York.
4. C.B. Powar (1994), *Cell Biology*, Second edition, Himalayan publishing house, Mumbai.



**Course Objectives:**

- To study the structure and functions of large biological macromolecules.
- To understand the organic chemical principles in life processes.
- To introduce the knowledge of lipid and their importance.
- To provide in-depth understanding of Nucleic acids and its structure.
- To categorize the source, applications of vitamins and minerals.

**Course outcomes:**

S.No.	Description	Cognitive Level (K-level)
CO-1	Understand the knowledge of carbohydrates and their classifications in detail	K2, K3
CO-2	Acquire the basic knowledge on the classification and structure of amino acids and classify proteins based on its physical and chemical properties	K3
CO-3	Discuss the importance, classification and functions of lipids	K2
CO-4	Enumerate the structure and properties of nucleic acids and its types	K1
CO-5	Explore and recommend the source, applications of vitamins and minerals	K4, K5
CO-6	Compile the basic information on the sources, mechanism and applications of macro and micro elements	K6

**UNIT-I:** Classification of Carbohydrates. Isomers, Anomers, epimers, enantiomers and mutarotation. Ring and linear structure (Haworth projection formula). Structure, Properties and Functions of Monosaccharides, Structure and Functions of Oligo (Di-Maltose, Lactose and Sucrose) and Polysaccharide (Homo-Starch, Glycogen & Cellulose; Hetero-Proteoglycan).

**UNIT-II:** Classification and structure of Amino acids. Essential and Non-essential amino acids. Properties of amino acids—Physical and Chemical, Zwitter ion. Classifications of Proteins based on solubility, shape, composition and biological function. Structure of Proteins. Denaturation and Renaturation of Proteins.

**UNIT-III:** Classification of Lipids, Essential fatty acids, Structure, Types and Functions of Phospholipids. Structure and functions of Glycolipids and Cholesterol.

**UNIT-IV:** Structure of purine and pyrimidine nucleotides. Structure and Properties of DNA—T<sub>m</sub>, Denaturation and Renaturation, Hypo & Hyperchromicity and Types of RNA.

**UNIT-V:** Vitamins—Fat and Water Soluble Vitamins, Chemical name, Sources, Daily requirements, Functions and Deficiency disorders. Minerals—Micro (Fe, Zn, Cu, I, F, Mn, Mo) and Macro elements (Na, Mg, Cl, Ca, P, K, S)—source, biological importance and Deficiency disorders.

**Text Books:**

1. A.C. Deb (2001), Fundamentals of Biochemistry, New Central Book Agency Pvt., Ltd., Calcutta.
2. Murray, R. K., D. K. Granner, P. A. Mayes and D. W. Rodwell. 2006. Harper's Biochemistry, 25<sup>th</sup> edition, Prentice Hall, New Jersey.
3. J.L Jain., (2005). Fundamentals of Biochemistry. S.Chand Publishing, New Delhi.
4. D.L.Nelson, and M.M. Cox (2008) Lehninger Principles of Biochemistry, 5th Ed, W.H. Freeman and Company, New York.

**References:**

1. R.K. Murray, D.K. Granner, P.A. Mayes, D.W. Rodwell (2006), Harper's Biochemistry, twentyfifth edition, Prentice Hall, New Jersey.
2. D. Voet, and G.Voet (2006), Biochemistry, John Wiley and Sons, New York.
3. G.L Zubay (1999) Biochemistry, 4th Ed, WCB, McGraw-Hill, New York.
4. AmbikaShanmugam (1998). Fundamentals of Biochemistry for Medical Students.
5. U. Satyanarayana., (2006) A textbook of Biochemistry, Books & Allied, Kolkata.

**Semester-I****Sub. Code: PBC102****MAIN PRACTICAL-I****3 Hours/3 Credits****I. Qualitative analysis of carbohydrate**

Arabinose, Glucose, Fructose, Maltose, Lactose, Sucrose and Starch.

**II. Qualitative analysis of Amino acid**

Arginine, Cysteine, Tyrosine, Tryptophan, Histidine and Methionine.

**Semester-II****Sub. Code: BC206****PLANT BIOCHEMISTRY****3 Hours/3 Credits****Course Objectives:**

- To provide the basic knowledge of plant cell and water absorption mechanism.
- To get familiar with photosynthetic mechanism and starch production cycle.
- To acquire knowledge about NPK cycle and its biological significance.
- To give detail idea about seed germination, primary and secondary metabolites.
- To explore the information about plant hormones and their physiological effects.

**Course Outcomes:**

S.No.	Description	Cognitive Level (K-level)
CO-1	Understand the basic knowledge of plant cell and water absorption mechanism.	K2, K3
CO-2	Acquire knowledge on photosynthetic mechanism and starch production cycle.	K3
CO-3	Discuss about NPK cycle and its biological significance.	K2
CO-4	Describe about seed germination, primary and secondary metabolites.	K1
CO-5	Explore the information about plant hormones and their physiological effects.	K4
CO-6	Assess the in-depth principle and speculate the mechanism of plant life cycle	K5, K6

**UNIT-I:** Plant cell-Structure and Functions, Plant cell wall, Transpiration-Types, Mechanism and Factors affecting transpiration, Mechanism of Water Absorption–Passive and Active.

**UNIT-II:** Photosynthesis–photosynthetic pigments and chloroplast. Light reaction– Photosystems, Cyclic and non-cyclic photophosphorylation, Calvin cycle, Hatch-Slack cycle.

**UNIT-III:** Cycles of Elements-N<sub>2</sub> cycle, Biochemistry of symbiotic and non-symbiotic N<sub>2</sub> fixation, Sulphur cycle and Phosphorous cycle.

**UNIT-IV:** Biochemistry of seed dormancy, seed germination, fruit ripening and Senescence, Primary and Secondary metabolites in Plants–Definition and Function.

**UNIT-V:** Plant growth regulators-Physiological effects of Auxins, Gibberellins, Cytokinins, ABA and Ethylene.

**Text Books:**

1. H.S. Srivastava (2006), Plant Physiology, Biochemistry and Biotechnology, Rastogi Publications, Merut.
2. V. Verma, Plant Physiology, (2001) 7th revised edition. Emkay publications.
3. V.K. Jain, (2000) Fundamentals of Plant Physiology, S.Chand Publishing, New Delhi.

**References:**

1. N.C. Gautam (2006), Plant Biotechnology, Shree Publishers.
2. Heldt HW (2005), 3rd Edition, Plant Biochemistry, Elsevier Academic Press Publication, USA.
3. A.J. Lack (2001).Plant Biology. Viva Books, New Delhi.
4. P.J. Lea and R.C. Leegood (1999), 2nd Edition, Plant Biochemistry and Molecular Biology, Wiley and Sons, New York.
5. Andrew Lack (2001) Plant Biology, Taylor & Francis, New York.

**Course Objectives:**

- To understand the anatomy and physiology, various levels of organizations basic homeostatic mechanism.
- To elucidate and describe the composition, function of various body fluids like blood and lymph, their significance and related disorders
- To explain the morphology, physiology of circulatory, respiratory and digestive system and classify the structure of lungs, transport of gases between lungs and tissues. Explain the morphology, functions of kidney and nephron and their role in urine formation.
- To categorize the Structure and functions of nerve cells, conduction of nerve impulses, the role of neurotransmitters and reflex action.
- To speculate the physiology of muscle contraction in co-ordination with the joints, their articulation and skin.

**Course Outcomes:**

S.No.	Description	Cognitive Level (K-Level)
CO-1	Define and explain the anatomy and physiology, various levels of organizations basic homeostatic mechanism.	K1, K2
CO-2	Explain and determine the composition, function of various body fluids like blood and lymph, their significance and related disorders	K2, K3
CO-3	Explain and sketch the morphology, physiology of circulatory, respiratory and digestive system.	K2, K4
CO-4	Categorize the structure of lungs, transport of gases between lungs and tissues. Explain the morphology, functions of kidney and nephron and their role in urine formation.	K2, K4
CO-5	Evaluate the structure and functions of nerve cells, conduction of nerve impulses, the role of neurotransmitters and reflex action.	K5
CO-6	Speculate the physiology of muscle contraction in co-ordination with the joints, their articulation and skin.	K6

**UNIT-I:** Components of Blood, Morphology and functions of blood cells. Blood groups and Rh factor. Lymphatic system and Composition of lymph. Circulatory system - Heart anatomy, Pace maker, Cardiac cycle and ECG.

**UNIT-II:** Structure of Lungs, Transport of gases between lungs and tissues. Structure and functions of Kidney and Nephron. Mechanism of urine formation.

**UNIT-III:** Structure and functions of digestive system. Digestion and Assimilation of Carbohydrate, lipids, proteins and nucleic acid. Mechanism of HCl secretion in stomach. Role of hormones involved in digestion.

**UNIT-IV:** Structure and functions of nerve cells, Conduction of nerve impulse in myelinated and non-myelinated sheath. Neurotransmitters, Reflex action, Sleep and awake.

**UNIT-V:** Muscles- Types, structure and functions. Ultra structure of skeletal muscle- light band, dark band, Sarcomere, Filaments- Thick (myosin) and Thin (actin, tropomyosin and troponin). Contraction and relaxation of skeletal muscle via  $Ca^{2+}$  pump.

**Text Books:**

1. N. Arumugam (2001) Animal Physiology, Saras publication.
2. Sembulingam K and Sembulingam P (2010). Essentials of medical physiology. 5<sup>th</sup> ed. Jaypee Brothers Medical Limited. pp. 85-89.
3. R.A. Agarwal, Anil. K, Srivastava, KaushalKumar (1986), Animal physiology and Biochemistry- 3rd edition. S.Chand Publishing, New Delhi.

**References:**

1. J. Brachet and A. E. Mirsky (1963), The Cell-Biochemistry, physiology and morphology, Academic Press.
2. William. F. Ganong. (2005), Review of Medical Physiology McGraw-Hill Medical; 22 edition.
3. Guyton (1996) Human Physiology and Mechanisms of Disease. Saunders Publications; 6th edition.
4. A.C. Guyton and J.E. Hall (2000), Text Book of Medical Physiology. Harcourt Asia.
5. Anne Waugh and Allison Grant (2018). Ross & Wilson anatomy and physiology in health and illness. Edinburgh: Elsevier, 2018.

**I. Titrimetric methods**

1. Estimation of Ascorbic Acid
2. Estimation of Glucose by Benedict's Method
3. Estimation of Glycine by Sorensen's Formal Titration method
4. Estimation of Calcium from Milk

**II. Preparations**

1. Preparation of Starch from potato
2. Preparation of Casein from Milk
3. Preparation of Albumin from Egg
4. Mitosis and Meiosis of Onion root tip.

**Course Objectives:**

- To learn and impart the basic knowledge on Microbiology.
- To understand the various types of microscopes and its applications.
- To understand the overview of bacteria, fungi, Algae and protozoa.
- To create awareness on viruses and bacteriophages.
- To know the various methods in microbial techniques.

**Course outcomes:**

S.No.	Description	Cognitive Level (K-level)
CO-1	Acquire broad knowledge of history, importance and scope of microbiology.	K3
CO-2	Describe and identify the various types of microscopes and its applications.	K1
CO-3	Assess the various types of microorganisms based on their ultrastructure.	K5
CO-4	Classify on viruses, Lytic and Lysogenic cycle and bacteriophage.	K2
CO-5	Examine the theory and practice of sterilization and staining techniques.	K4
CO-6	Compose the information on microorganisms and its techniques.	K6

**UNIT-I:** Microbiology–History, Branches and Scope. Spontaneous generation–Abiogenesis and Biogenesis; Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, and Alexander Fleming.

**UNIT-II:** Microscopy–Principles and applications of Bright field; Dark field; Phase contrast microscope and Fluorescence microscope; Principles and Applications of Electron Microscopy–SEM and TEM.

**UNIT-III:** Bacteria–Ultra structure; Classification (Gram positive and Gram negative); Shape and arrangement; Cell wall polysaccharides; Growth curve and Factors affecting microbial growth. Fungi (Mold and Yeast), Algae and Protozoa - Ultra structure, Characteristics and Economic importance.

**UNIT-IV:** Virus - General properties, Structure and Classification; Plant (TMV & CMV) and Animal viruses (Dengue & Corona); Viroids and Prions; Bacteriophage–Structure, Lytic and Lysogenic cycle.

**UNIT-V:** Sterilization–Dry heat, Moist heat, Filtration and Radiation; Disinfection and Disinfectants; Culture medium, Staining techniques–Gram staining and Acid fast staining; Antibiotic sensitivity test.

**Text Books:**

1. M.J. Pelczar Jr, E.C.S. Chan and N.R. Kreig (2006). “Microbiology”- 5<sup>th</sup> Edition McGraw Hill Inc. New York.
2. Park William Halock (2001) Pathogenic Microorganisms, Leafebiger, Philadelphia.



**References:**

1. R. Ananthanarayan and C.K. JayaramPaniker (2000). Text book of Microbiology. 6th Edition, Orient Longman Limited, Chennai.
2. P. Chakraborty (2003). A Text book of Microbiology. 2nd Edition, Published by New Central Book Agency (P) Ltd., Kolkata.
3. R.C. Dubey and D.K. Maheswari, (2010). A Text book of Microbiology. 3<sup>rd</sup> Edition, S. Chand Publishing, New Delhi.
4. H.Frobisher, R.D.Hinsdil, K.T.Crabtree and D.R.Goodhert (2005). Fundamentals of Microbiology, Saunder and Compa
5. C.B. Powar and H.F. Daginawala, (2008). General Microbiology. Volume: II. Himalaya Publishing House.

**Course Objectives:**

- To understand about the measurement of solutes in solution and learn the basic concepts in biophysical chemistry.
- To learn the regulation of pH the various buffer systems.
- To acquire in-depth understanding on the principles of electrochemical techniques, instrumentation and applications of reference electrodes.
- To learn the laws of thermodynamics, reversible and irreversible process and their applications.
- To acquire knowledge on viscosity coefficient, surface tension and their applications.

**Course outcomes:**

S.No.	Description	Cognitive Level (K-level)
CO-1	Develop an understanding on the measurement of solutes in solutions namely normality, molality and molarity.	K6
CO-2	Define and understand osmosis, diffusion and its various applications	K1
CO-3	Categorize acids with bases and functions of various buffer systems.	K4
CO-4	Determine the principles of electrochemical techniques, instrumentation and applications of reference electrodes.	K3
CO-5	Demonstrate a clear understanding of thermodynamics, reversible and irreversible processes.	K2
CO-6	Evaluate the mechanism of surface tension and their applications.	K5

**UNIT-I:** Units of measurement of solutes in solution, normality, molality, molarity, and milliosmol, Percentage solution examples for this concept. Ionic strength, Isotonic, hypertonic and hypotonic solution. Diffusion, Osmosis and its applications.

**UNIT-II:** Acid and bases, Arrhenius, Lowry & Bronsted concept, Lewis concept–conjugated pairs. pH, pOH, buffer, buffering capacity, common ion effect. Henderson–Hasselbalch equation. Buffer systems–Bicarbonate, Phosphate, Protein & Haemoglobin buffers.

**UNIT-III:** Principles of electrochemical techniques, Reference electrodes – Silver and Calomel electrode. Determination of pH using pH indicator, Universal indicators, pH paper & pH meter- Instrumentation and applications, Hydrogen electrode and glass electrodes.

**UNIT-IV:** First law of thermodynamics, Work, heat, free energy, enthalpy and entropy, exothermic and endothermic reactions, Reversible & irreversible process, isothermal and adiabatic process, Hess's law and its applications, Kirchoff's equation, relations between Cp & Cv.

**UNIT-V:** Definition and determination of viscosity coefficient. Poiseuille's equation, Stoke's law and terminal velocity. Surface tension: Definition, determination of surface tension, temperature effect. Equilibrium constant, Le-Chatelier's principle and applications.

**Text Books:**

1. B.R. Puri, L.R. Sharma, M.S. Pathania (2016), Principles of Physical Chemistry. 47<sup>th</sup> Ed., Vishal Publishing Co.
2. K. Wilson and J. Walker (2006), Practical Biochemistry – Principles and techniques of Biochemistry and Molecular Biology, sixth Edition, Cambridge University Press, New York, USA.

**References:**

1. Upadhyay, K. Upadhyay and N. Nath (2007), Biophysical chemistry, Third revised edition, Himalaya publishing House, Mumbai.
2. VasanthaPattabhi and Gautham, (2002), Biophysics, second reprint 2005. Narosa Publishing House PVT Ltd, New Delhi.
3. R. Gurdeep, Chatwal and Sham K. Aanand. (2006). Instrumental Methods of Chemical Analysis, Himalaya publishing House, New Delhi.
4. David Freifelder(1976).,Physical biochemistry, applications to biochemistry and molecular biology, second edition.W.H.Freeman& Co Ltd.
5. M.L Srivastava (2008).,Bioanalytical Techniques., Narosa, Chennai.

**I. Preparation**

a).Preparation of Buffer

1. Phosphate buffer
2. Tris buffer
3. Citrate buffer.

b).Solution preparation

1. Normality and Molarity solution
2. Saturated solution, Percentage solution, Sucrose gradient solution and dilute solution.

**II. Techniques**

a).Colorimetry

1. Estimation of Amino acids by Ninhydrin method.
2. Estimation of Protein by Biuret method.
3. Estimation of Protein by Lowry's method.
4. Estimation of Phosphorus by Fiske and Subbarow method.

**Course Objectives:**

- To learn the principle involved in food preservation and its application.
- To study the various diseases caused by pathogenic microorganisms.
- To know the processes of microbial fermentation and fermenters.
- To understand the role of microbes in solid and liquid waste management.
- To learn the use of microorganisms in biofertilizers and vermicomposting.

**Course outcomes:**

S.No.	Description	Cognitive Level (K-level)
CO-1	Apply the microbial metabolism for the benefit of mankind	K3
CO-2	Evaluate the various infectious diseases, their diagnosis and treatment	K5
CO-3	Compare the differences between microbial fermentation and Industrial fermentation.	K2
CO-4	Correlate the use of microorganisms in waste management	K4
CO-5	Denote the implications of microbes in the environment.	K1
CO-6	Validate the use of nutrients for mankind, vermicomposting and organic farming.	K6

**UNIT-I:** Food preservation-Principles and Preservatives; Dairy products–Cheese and Yoghurt; Baker’s yeast (Bread making) and Alcoholic beverages (Beer & Wine production). SCP-Cultivation and Applications.

**UNIT-II:** Bacterial diseases – Typhoid, Anthrax, Tuberculosis and Leprosy; Fungal diseases-Candidiasis, Aspergillosis and Dermatophytes; Viral diseases-AIDS, Covid-19, Dengue, Rabies and Hepatitis.

**UNIT-III:** Microbial fermentation and Fermentor; Industrial fermentation–Penicillin, Streptomycin, Ethanol, Vitamin B<sub>12</sub>, Glutamic acid, Protease, Amylase and Lipase.

**UNIT-IV:** Solid and Liquid Wastes, Solid waste management–Saccharification, Gasification and Composting; Liquid waste management–Aerobic and Anaerobic methods; Bioremediation and *Biodeterioration* of wastes.

**UNIT-V:** Biofertilizers-Characteristic features of bacterial biofertilizers, types and uses. Biopesticides–Scope, Classification and Importance. Composting and Vermicomposting and Organic farming.

**Text Books:**

1. M.J. Pelczar Jr, E.C.S. Chan and N.R. Kreig (2006). “Microbiology”- 5<sup>th</sup> Edition McGraw Hill Inc. New York.
2. M.J. Waites (2007). Industrial Microbiology. Blackwell Publishing Company. UK.

**References:**

1. R. Ananthanarayan and C.K. JayaramPaniker (2000). Text book of Microbiology. 6th Edition, Orient Longman Limited, Chennai.
2. R.M. Atlas and R. Bartha (1992). Microbial ecology. Fundamentals and applications. 3rd Edition. Red Wood City. C.A. Benjamin
3. W.C. Frazies and D.C. Westhoff (1988). Food microbiology. 4th Edition. McGraw Hill NY.
4. U. Satyanarayana (2005). Biotechnology. 1st Edition, Books and Allied (P) Ltd., Kolkata.
5. N.S. SubbaRao (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt. Ltd. NewDelhi.

**Course Objectives:**

- To learn the basic knowledge of centrifugation and its applications.
- To study the working principle of chromatography.
- To understand the principle and instrumentation of electromagnetic radiation.
- To learn the principle, instrumentation and applications of colorimeter.
- To understand the basic mechanism and applications of radioisotopes.

**Course outcomes:**

S.No.	Description	Cognitive Level (K-level)
CO-1	Understand the basic knowledge on centrifugation and its applications	K2
CO-2	Acquire the basic knowledge on different types of centrifuges	K3
CO-3	Summarize the principle and application of chromatography	K5
CO-4	Discriminate the Principles, instrumentation and applications of Spectroscopy	K4
CO-5	List out the types and applications of electrophoresis	K1
CO-6	Integrate the basic mechanism and applications of radioisotopes and radioactivity	K6

**UNIT-I:** Basic principles-Sedimentation rate, Svedberg unit, different types of rotors. Types of centrifuges, Different types of centrifugation –Analytical and preparative, Differential, density gradient, isopycnic and equilibrium centrifugation and its applications.

**UNIT-II:** General principles (partition and adsorption), instrumentation and Applications of chromatography–Paper Chromatography, Thin layer chromatography, Affinity Chromatography, Ion Exchange Chromatography, Gel filtration chromatography, Gas Liquid chromatography and HPLC.

**UNIT-III:** General principles, factors affecting the migration rate-sample, electric field, buffer and supporting medium. Paper electrophoresis, Tiselius moving boundary electrophoresis, Agarose gel electrophoresis, SDS-PAGE and Immunoelectrophoresis.

**UNIT-IV:** Basic principles of electromagnetic radiation. Energy, wavelength, wave number and frequency. Absorption and emission spectra. Beer–Lambert’s law, light absorption and its transmittance. Principles, instrumentation and applications–Colorimeter, UV-visible, Flame Emission and Atomic Absorption Spectrophotometer.

**UNIT-V:** Atomic structure, radiation, types of radioactive decay, half-life, and units of radioactivity (Roentgen, Rad, Rem, Let). Detection and measurement of radioactivity–methods based upon ionization (GM counter), methods based upon excitation (Liquid and solid scintillation counter), Autoradiography, Applications of radioisotopes, Radiation hazards and safety measures.

**Text Books:**

1. P. Asokan (2001), Analytical Biochemistry. Chinnaa Publications.
2. M K. Wilson and J. Walker (2006), Practical Biochemistry–Principles and techniques of Biochemistry and Molecular Biology, sixth Edition, Cambridge University Press, New York, USA.

**References:**

1. A. Upadhyay, K. Upadhyay and N. Nath (2007), Biophysical chemistry, Third revised edition, Himalaya publishing House, Mumbai.
2. VasanthaPattabhi and Gautham, (2002), Biophysics, second reprint 2005. Narosa Publishing House PVT Ltd, New Delhi.
3. R. Gurdeep, Chatwal and Sham K. Aanand. (2006). Instrumental Methods of Chemical Analysis, Himalaya publishing House, New Delhi.
4. David Freifelder., (1976), Physical biochemistry, applications to biochemistry and molecular biology, second edition. W.H. Freeman & Co Ltd.



**I. Electrophoresis**

1. Separation of serum protein by SDS-PAGE
2. Separation of DNA by Agarose gel electrophoresis.

**II. Chromatography**

1. Paper chromatographic separation and detection of amino acids
2. Separation of carbohydrates and amino acids by TLC

**III. Microbiology**

1. Preparation of liquid and solid media.
2. Isolation of bacteria from Air, soil and water.
3. Isolation and maintenance of organisms by plating and streaking methods.  
Slants and swab culture.
4. Gram's staining method.
5. Antibiotic sensitivity test

**Course Objectives:**

- To gain a broad knowledge about the classification of enzymes.
- To acquire knowledge about the mechanism of enzyme action.
- To learn the structure and functions of cofactors and coenzymes.
- To study the different enzyme inhibitory mechanism.
- To gain skill and knowledge about the purification and commercial applications of enzymes.

**Course outcomes:**

S.No.	Description	Cognitive Level (K-level)
CO-1	Describe the classification of enzymes and its nomenclature.	K1
CO-2	Determine the mechanism action of enzymes.	K3
CO-3	Compile the structure and functions of cofactors and coenzymes	K6
CO-4	Explain in-depth insights about various enzyme inhibition mechanisms.	K2
CO-5	Outline the mechanism involved in the regulation of Allosteric enzymes	K4
CO-6	Perceive the enzyme purification methods in industrial applications	K5

**UNIT-I:** Enzymes-Definition, Nomenclature and IUBMB classification, and enzyme units (IU, Katal, turnover number and specific activity). Metalloenzymes and metal activated enzymes. Multi-enzyme systems–PDH and FAS.Non-protein enzymes, Cofactor, Coenzymes, prosthetic group, apoenzyme and holoenzyme.

**UNIT-II:** Active site–General characteristics; Mechanism of action of enzyme – Lock and Key theory and induced fit theory. Structure and functions of coenzyme reaction involving nucleotides-NAD/NADP, FMN/FAD and Coenzyme-A, Biotin, Folate, Lipoate.Isoenzymes (LDH and CK).

**UNIT-III:** Enzyme Kinetics–Reaction rate, energy of activation, enzyme catalysis and factors affecting enzymatic reactions. Michaelis-Menton equation, Line-Weaver Burk plot, Eadie–Hofstee plot and Hanes-Woolf plot.

**UNIT-IV:** Enzyme inhibition–Reversible: Competitive, Non-competitive and uncompetitive and irreversible inhibitions (kinetics and derivations not required). Feedback inhibition, Allosteric enzymes and its regulation.

**UNIT-V:** Isolation and purification of enzymes: Salting in and out, Dialysis, Chromatography and electrophoretic techniques. Criteria of purity of enzymes.Enzyme immobilization- Methods and applications.

**Text Books:**

1. Trevor Palmer (2004). Enzymes-Biochemistry, Biotechnology, Clinical Chemistry. First Edition, East West Press, New Delhi.
2. J.M. Bery, J.L. Tymoezko and L. Stryer (2008) Biochemistry, 6<sup>th</sup> Ed, W.H. Freeman and Company, New York.

**References:**

1. U. Sathyanarayanan (2002), Essentials of Biochemistry Books and allied (p) Ltd.

2. D.L.Nelson, and M.M. Cox (2008) Lehninger Principles of Biochemistry, 5<sup>th</sup> Ed, W.H. Freeman and Company, New York
3. D. Voet, and G.Voet (2006), Biochemistry, John Wiley and Sons, New York.
4. G.L Zubay (1999) Biochemistry, 4<sup>th</sup> Ed, WCB, McGraw-Hill, New York.
5. R.K. Murray, D.K. Granner, P.A. Mayes, D.W. Rodwell (2006), Harper's Biochemistry, twenty fifth edition, Prentice Hall, New Jersey.
6. T.M. Devlin (2002), Textbook of Biochemistry with Clinical correlations, 5th edition, John Wiley & Sons Inc, Publications.
7. A.C. Deb (2001), Fundamentals of Biochemistry, New Central Book Agency Pvt., Ltd., Calcutta.
8. S.M. Bhatt (2011), Enzymology and Enzyme Technology. (2011), S. Chand Publishing, New Delhi.

**Course Objectives:**

1. To gain knowledge about the major pathways of carbohydrate metabolism.
2. To gain insights about the various components and metabolic steps involved in ETC.
3. To acquire knowledge about the various pathways involved in lipid metabolism.
4. To understand the catabolic pathway of amino acid metabolism.
5. To understand the different biosynthetic and biodegradable pathway of nucleotides.

**Course outcomes:**

S.No.	Description	Cognitive Level (K-level)
CO1	Determine the major pathways of carbohydrate metabolism	K3
CO2	Outline the various components and metabolic steps involved in ETC	K4
CO3	Compare the various pathways of lipid metabolism	K2
CO4	Describe the different catabolic pathway of amino acid metabolism	K1
CO5	Perceive the different biosynthetic and biodegradable pathway of nucleotides	K5
CO6	Integrate the various metabolic pathways of Biomolecules	K6

**UNIT-I:** The basic metabolic pathways-anabolic, catabolic and amphibolic pathways. Aerobic and Anaerobic glycolysis and its energetics. Citric acid cycle-Pyruvate Dehydrogenase Complex and its energetics. Gluconeogenesis. Glycogenesis, Glycogenolysis and Pentose phosphate pathway.

**UNIT-II:** Electron Transport Chain-Components of ETC. Role of ETC-Oxidative Phosphorylation-Chemiosmotic Hypothesis, Uncouplers and High Energy Compounds (ATP and GTP).

**UNIT-III:** Biosynthesis and  $\beta$ -Oxidation of Fatty Acids, Biosynthesis of Triacyl Glycerol and Phospholipids and Cholesterol.

**UNIT-IV:** Catabolism of Amino acids-Transamination, Oxidative Deamination and Non-Oxidative Deamination, and Urea Cycle. Formation of Creatine Phosphate and Creatinine, Methylation and Decarboxylation.

**UNIT-V:** Nucleic Acid Metabolism-Biosynthesis and Degradation of Purine and Pyrimidine Nucleotides-Denovo Synthesis and Salvage Pathway.

**Text Books:**

1. Fundamentals of Biochemistry. (2005)., J.L Jain S. Chand Publishing, New Delhi.
2. R.K. Murray, D.K. Granner, P.A. Mayes, D.W. Rodwell (2012), Harper's Biochemistry, twenty eighth edition, Prentice Hall, New Jersey.

**References:**

1. D.L.Nelson, and M.M. Cox (2008) Lehninger Principles of Biochemistry, 5<sup>th</sup> Ed, W.H. Freeman and Company, New York
2. J.M. Bery, J.L. Tymoezko and L. Stryer (2008), Biochemistry, 6<sup>th</sup> Ed, W.H. Freeman and Company, New York.
3. Trevor Palmer (2004). Enzymes-Biochemistry, Biotechnology, Clinical Chemistry. First Edition, East West Press, New Delhi.
4. A.C. Deb (2001), Fundamentals of Biochemistry, New Central Book Agency Pvt., Ltd., Calcutta.
5. D. Voet, and G.Voet (2006), Biochemistry, John Wiley and Sons, New York.
6. U. Sathya Narayanan and U. Chakrapani. (2007), Text book of Biochemistry, 3<sup>rd</sup> edition, Pvt Ltd.
7. Fundamentals of Biochemistry for Medical Students,(1998) AmbikaShanmugam.

**Course Objectives:**

- To learn the basic aspects of hormones and endocrine glands.
- To provide in depth knowledge about the pituitary hormones.
- To study about the thyroid hormones and their regulation.
- To know about adrenal glands and its biological functions
- To learn about gonadal hormones and their regulation.

**Course outcomes:**

S.No.	Description	Cognitive Level
CO-1	Demonstrate the basic aspects of hormones, classification and functions.	K2
CO-2	Examine the role of pituitary hormones and their regulation	K1
CO-3	Acquire knowledge on the thyroid hormones and their regulation	K3
CO-4	Correlate between adrenal hormones and their homeostasis.	K4
CO-5	Perceive the role of gonadal hormones and their regulation	K5
CO-6	Compile the chemistry, secretion, functions and regulations of various hormones	K6

**UNIT-I:** Hormones–Definition, Chemical nature and classification. Mechanism of action of Group I and Group II hormones, Signal transduction and introduction to Hormonal receptors (Tyrosine receptors). Positive and negative feedback regulation of endocrine system.

**UNIT-II:** Hypothalamus and hypothalamic releasing factor. Pituitary hormones- Chemistry, Secretion, Functions and Regulation. Anterior Pituitary hormones–GH, Pituitary tropic hormones (LH, FSH, TSH, ACTH and Prolactin) and Posterior Pituitary hormones (Vasopressin and Oxytocin).

**UNIT-III:** Thyroid and Parathyroid Hormones–Chemistry, Synthesis, Secretion, Functions and Regulations. Pancreatic Hormones-Chemistry, Secretion, Functions and Regulations (Insulin and Glucagon).

**UNIT-IV:** Adrenal gland hormones-Chemistry, Secretion, Functions and Regulations of Adrenal Cortex hormones (glucocorticoids and mineralocorticoids) and Adrenal Medullary hormones (Epinephrine and Nor-Epinephrine). Renin-angiotensin system.

**UNIT-V:** Chemistry, Secretion, Functions and Regulations of Gonadal hormones– Testosterone, Estrogen and Progesterone. Ovarian cycle and its regulation.

**Text 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.

**References:**

1. Williams Textbook of Endocrinology. (2011), Shilomo Melmed., Elsevier, New Delhi.
2. K.V. Krishnadas (1996), Textbook of Medicine, Jaypee publication, New Delhi.
3. N.Chatterjee and Rana Shinde (2012) Textbook of Medical Biochemistry - eighth edition, Jaypee publication, New Delhi.
4. D.L.Nelson, and M.M. Cox (2008) Lehninger Principles of Biochemistry, 5<sup>th</sup> Ed, W.H. Freeman and Company, New York
5. D. Voet, and G.Voet (2006), Biochemistry, John Wiley and Sons, New York.
6. G.L Zubay (1999) Biochemistry, 4<sup>th</sup> Ed, WCB, McGraw-Hill, New York.

**Course Objectives:**

- To learn the Premendelian concepts of heredity in genetics.
- To understand the Mendelian inheritance and laws of probability.
- To know about linkage, crossing over and Morgan's law.
- To understand the Chromosomal Mutations, Ploidy and its types.
- To explain the Population Genetics and Hardy Weinberg Law.

**Course Outcomes:**

S.No.	Description	Cognitive Level (K-level)
CO-1	Define the features of Premendelian concepts of heredity and genetic maps	K1
CO-2	Explain the Mendelian inheritance and laws of probability with examples	K2
CO-3	Construct the knowledge on different types of linkage and its Significance	K3
CO-4	Connect the basic concepts of crossing over, types and its significance.	K4
CO-5	Perceive the key concepts on chromosomal mutations with specific examples.	K5
CO-6	Develop a thorough understanding of the population genetics and gene frequency.	K6

**UNIT-I:** Genetics-Introduction; Premendelian concepts of heredity– Fluid theory, Reproductive blood theory, Preformation, Epigenesis, Inheritance of acquired characters, Theory of Pangenesis and Germplasm theory; Rediscovery of Mendel's original work, Genotype and Phenotype; Heredity; Gene, Genome, Trait, Genetic material and Genetic maps.

**UNIT-II:** Mendelian Inheritance and laws; Laws of Probability–Rule of addition and rule of multiplication; chi-square analysis, Pedigree analysis; Incomplete and Co-dominance; Multiple alleles; Lethal alleles; Epistasis; Pleiotropy; Sex linked inheritance.

**UNIT-III:** Linkage and Crossing over; Morgan's Law; complete and incomplete linkage; Back and Test cross; Types of linkage; gene mapping–cross over, gene mapping for two point and three point crosses; Interference and Coefficient of Coincidence.

**UNIT-IV:** Chromosomal Mutations–Deletion, Duplication, Inversion and Translocation; Ploidy–Euploidy, Aneuploidy and Polyploidy. Down Syndrome, Turner syndrome and Klinefelter syndrome.

**UNIT-V:** Population Genetics, Hardy Weinberg Law–Gene Frequency, Factors affecting gene frequency, Eugenics, Euphenics and Euthenics.

**Text Books:**

1. A.V.S.S Sambamurty, (2007), Molecular Genetics, Narosa, Chennai.
2. P.J. Russell (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.

**References:**

1. E.J. Gardner, M.J. Simmons and D.P. Snustad (2008). VIII ed. Principles of Genetics. Wiley India.
2. D.P. Snustad M.J. Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. W.S. Klug, M.R. Cummings, C.A, Spencer, C.A. (2009). Concepts of Genetics. XI Edition. Benjamin Cummings.
4. B.R. Glick, J.J Pasternak (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
5. Gurbachan S Miglani (2006), Developmental Genetics, IK. International, New Delhi.



**I. Colorimetric Estimation**

1. Estimation of Creatinine by Jaffe's Method.
2. Estimation of Urea by DiacetylMonoxime Method.
3. Estimation of DNA by Di Phenyl Amine method.
4. Estimation of RNA by Orcinol method.
5. Estimation of glucose by O-Toluidine method.
6. Estimation of Cholesterol by Zak's method.

**II. Urine Analysis**

Qualitative analysis of Normal and pathological (abnormal) urine.

**Course Objectives:**

- To learn the basic concepts in biomedical equipment.
- To understand the mechanism of bioelectrodes.
- To understand the biosensor-mechanism and types.
- To study the trouble shooting and maintenance of biomedical instruments.
- To understand the therapeutic instruments and patient monitoring system.

**Course Outcomes:**

S.No	Description	Cognitive Level (K-Level)
CO-1	Describe the basic concepts in biomedical equipment.	K1
CO-2	Explain the mechanism of bioelectrodes and their uses.	K2
CO-3	Determine the biosensor-mechanism and its types.	K3
CO-4	Analyze the trouble shooting and maintenance of biomedical instruments.	K4
CO-5	Perceive the information on therapeutic instruments	K5
CO-6	Speculate the various patients monitoring system.	K6

**UNIT-I:** Classification of Biomedical Equipment–Diagnostic, therapeutic and clinical laboratory equipment. Applications of endoscope, laparoscope and cardioscope. Transducers for biomedical application.

**UNIT-II:** Bioelectric signals, recording and their characteristics, Bioelectrodes–types, electrodes for ECG, EMG, EOG and ERG, electrodes tissue interface, contact impedance and effects of high contact impedance.

**UNIT-III:** Biosensor-mechanism and types. Autoanalyzer-Types and application. Automatic tissue processing and application of microtome. Pulse oximetry. Magnetic resonance imaging system, NMR components and its biological applications.

**UNIT-IV:** Measurement of Heart rate, pulse rate, respiration rate and blood pressure. X- Ray Machine–Basic components, types, dental image intensifier system, trouble shooting and maintenance.

**UNIT-V:** Therapeutic instruments–Introduction, types, classification, power source and electrodes of cardiac pacemaker. Computer application in medicine-computerized catheterization laboratory, computerized patient monitoring system.

**Text Books:**

1. Arumugam, (2002) Biomedical Instrumentation, Anuratha Agencies Publishers, 2<sup>nd</sup> edition.
2. Mandeepsingh, (2014) Introduction to biomedical instrumentation, Paperback publishers.

**References:**

1. Edward J. Bukstein, (2001) Introduction to Biomedical electronics, Sane and Co. Inc. USA.
2. Goddes and Baker, (2002) Principles of applied biomedical instrumentation, John Wiley.
3. R.S. Khandpur, (2003) Hand book of Medical instruments, TMH, New Delhi, 644pp.
4. Cromwell, (2007) Biomedical instrumentation, Prentice Hall of India, New Delhi.
5. John G. Webster (2007) Medical instrumentation, John Wiley.
6. Carr and Brown (2009) Biomedical instrumentation and measurement, Pearson.
7. R.S Khandpur (2014) Handbooks biomedical instrumentation, 3<sup>rd</sup> edition McGraw Hill Education (India) Private Limited.

**Course Objectives:**

- To understand the basic knowledge on the collection and preservation of samples
- To acquire a broad knowledge on haematological parameters
- To know the normal and abnormal constituents of urine and feces
- To learn the different histopathological techniques and its uses.
- To know the types of culturing organisms from various specimens

**Course Outcomes:**

S.No.	Description	Cognitive Level (K-level)
CO-1	Understand the basic knowledge on the collection and preservation of samples	K2
CO-2	Acquire a broad knowledge on haematological parameters	K3
CO-3	Outline the normal and abnormal constituents of urine and feces	K4
CO-4	Enumerate the different histopathological techniques	K1
CO-5	Justify the types of culturing organisms for different specimens	K5
CO-6	Compile the normal and abnormal values of biochemical parameters.	K6

**UNIT-I:** Specimens–Collection and preservation of Blood, Urine, Feces, Sputum, Semen, Throat swab, Amniotic fluid and CSF. Smears–types, preparation and maintenance. Good laboratory practices.

**UNIT-II:** Blood–Blood pressure, Clotting time, Bleeding time, Hemoglobin Estimation, RBC count and WBC count, Differential count, Erythrocyte Sedimentation Rate, Packed cell volume and platelet counting.

**UNIT-III:** Urine–Composition, Preservation, Microscopic and Macroscopic Examination (Physical and Chemical examination). Feces–Composition, Macroscopic and Microscopic Examination, Chemical examination–Occult blood and Steatorrhea.

**UNIT-IV:** Histopathology–Tissue cutting, fixation, embedding, tissue slicing by microtome, slide mounting and staining.

**UNIT-V:** Culturing of organism from various specimens (Pus, Urine, Blood, Sputum and Throat Swab). Gram's staining and Acid-fast staining. Antibiotic sensitivity test.

**Text Books:**

1. D.Sahu (1997), Critical approach to clinical medicine, Vikas Publishing, Noida.
2. Devlin, T.M. (2002), Textbook of Biochemistry with Clinical correlations, 5th edition, John Wiley & Sons Inc, Publications.
3. Ramnik Sood (2009), Medical Laboratory Technology: Methods and Interpretation. JPB; Sixth edition.
4. Kanai L. Mukherjee and Anuradha Chakravarthy (2017), Medical Laboratory Technology, Procedure Manual for Routine Diagnostic Tests - Vol. 1. McGraw Hill Education; Third edition.

**References:**

1. P.D. Mayne (1994), Clinical chemistry in diagnosis and treatment. A Hodder Arnold Publication; 6<sup>th</sup> Revised edition.
2. W.J. Marshall and S.K. Bangeit, (1995), Clinical biochemistry - Metabolic concepts and clinical aspects, Churchill Livingstone.
3. K.V. Krishna Das, Text Book of Medicine, (1996), Jaypee publication, New Delhi.
4. A.C. Guyton and J.E. Hall, (2000), Text Book of Medical Physiology Harcourt Asia.
5. Guyton (1996) Human Physiology and Mechanisms of Disease. Saunders Publications; 6<sup>th</sup> edition.
6. N.Chatterjee and RanaShinde (2012) Textbook of Medical Biochemistry - eighth edition, Jaypee publication, New Delhi.
7. K. Sampath (1999), Hospital and Clinical Pharmacy, Vikas Publishing. Noida.

**Course Objectives:**

- To learn the basic information on history and classification of drugs.
- To study on the basic information on drug and drug receptor mechanisms.
- To learn about the phase I and phase II drug metabolisms.
- To understand the mode of action of anti-cancer drugs and other agents.
- To gain knowledge about adverse drug reactions and intolerance.

**Course Outcomes:**

S.No.	Description	Cognitive Level (K- level)
CO-1	Acquire knowledge on the basic information on history and classification of drugs.	K3
CO-2	Gain thorough knowledge about the different drug receptors and their actions.	K1
CO-3	Understand the basic mechanism of drug and drug receptors	K2
CO-4	Focus in-depth insights about the mode of action of drugs used in different diseases	K4
CO-5	Adapt knowledge about the study of different chemotherapeutic value of anti-cancer drugs.	K6
CO-6	Assess the insight knowledge about the adverse effects of drugs	K5

**UNIT-I:** Drugs-Sources, routes of drug administration, dosage and dosage forms. Classification, Absorption, Distribution, Metabolism and Elimination of drug.

**UNIT-II:** Drug-Receptor interactions involvements of binding forces in drug receptor interaction, Receptor mediated and non-mediated interactions.

**UNIT-III:** Drug metabolism-Phase I and II enzyme reactions and biochemical importance of xenobiotic metabolism.

**UNIT-IV:** Cancer-Definition and types, Chemotherapy-anticancer drugs, antimetabolites, antibiotics and alkylating agents. Radiation therapy.

**UNIT-V:** Vaccination against infection. Adverse drug reactions, biological effects of drug abuse and drug dependence, drug tolerance and intolerance. Assay of drug potency-Bioassay and Immunoassay.

**Text Books:**

1. Chatwal G R (1996) Pharmaceutical Chemistry-Inorganic., Himalaya, Bombay
2. Bentley (1969) Bentley and Driver's Text Book of Pharmaceutical Chemistry Oxford and IBH, New Delhi.

**References:**

1. Burger, D. J. Abraham (2003) Oxford textbook, of Clinical pharmacology and drug therapy. D.G. Burger's medicinal Chemistry & Drug Discovery.
2. K. D .Tripathi (2004) Essentials of Medical Pharmacology. 5<sup>th</sup> edition, Jaypee, NewDelhi.
3. Richard A. Harvey, Pamela C. Champe, Richard Finkel, Luigi Cubeddu, Michelle A. Clarke (2008) Pharmacology (Lippincott Illustrated Reviews Series), 4<sup>th</sup> edition, Wolterskluwer.
4. William, O. and Foge, B.I. (2008) Principles of medicinal chemistry, WaverksPvt Ltd., New Delhi.
5. Bhandarkar (2010) Pharmacology and Pharmacotherapeutics, 10<sup>th</sup> edition Elsevier.
6. Satoskar (2015) Pharmacology and Pharmacotherapeutics, 24<sup>th</sup> edition, Elsevier.
7. R.S.Satoskar. S.D. Bhandhakar and S.S. Anilapure (2015) Pharmacology and Pharmacotherapeutics, Elsevier.

**Course Objectives:**

- To learn the basic information about genetic material and central dogma.
- To understand the process of DNA replication involving the roles of various DNA polymerases in prokaryotes and eukaryotes.
- To study the types of RNA and its synthesis.
- To acquire knowledge on various steps in protein synthesis and its modification.
- To recognize knowledge related to mutation, DNA repair and operon hypothesis.

**Course Outcomes:**

S.No.	Description	Cognitive Level (K-Level)
CO-1	Observe the basic information on molecular genetics, genetic material and central dogma	K2
CO-2	Analyze the processes involved in replication and various DNA polymerases involved in DNA synthesis.	K4
CO-3	Determine the transcription mechanism, post-transcriptional modifications and reverse transcription	K3
CO-4	Justify the role of peptides and protein molecules during translation process	K5
CO-5	Recognize the role of proteins during gene expression, and its regulations.	K1
CO-6	Integrate the gene regulation mechanism in molecular biology.	K6

**UNIT-I:** Organization of Genes, Chromosome Structure, Types and Functions. DNA as Genetic Material - Evidence and Central Dogma, Satellite DNA.

**UNIT-II:** Replication-Types, Evidence for Semi-Conservative Replication. Replication in Prokaryotes and Eukaryotes. Inhibitors of Replication.

**UNIT-III:** Transcription: RNA Polymerases in Prokaryotes, Role of Sigma Factor, Steps- Initiation, Elongation and Termination (Rho-dependant and independent). Inhibitors. Post-Transcriptional Modifications and Reverse Transcription.

**UNIT-IV:** Translation: Genetic code-Codon Dictionary and Salient Features of Genetic Code. Composition of Prokaryotic and Eukaryotic Ribosomes, Structure of RNA, Role of signal peptide. Steps-Activation of Amino Acids, Initiation, Elongation and Termination of protein synthesis in prokaryotes. Post-Translational Modifications. Inhibitors of Protein Synthesis.

**UNIT-V:** Gene Mutation: Types-Point Mutation (transition and transversion), Frame Shift Mutation-Insertion and Deletion, Suppressor Mutation-Nonsense and Missense suppression. Mutagens-Physical and Chemical Mutagens. DNA Repair Mechanism-Base Excision, UV repair, Recombination repair and SOS. Gene Regulation-operon concept (Lac operon).

**Text Books:**

1. P.S Verma and V.K. Agarval (2016) Cytology (Cell Biology, Biomolecules and Molecular Biology), S. Chand Publishing. New Delhi.
2. D.L. Nelson, and M.M. Cox (2008) Lehninger Principles of Biochemistry, 5<sup>th</sup> Ed, W.H. Freeman and Company, New York.

**References:**

1. Rastogi, S.C. (2003), Cell and Molecular Biology, 2<sup>nd</sup> edition, New Age International Publishers.
2. Benjamin Lewin (2004) Genes VII, Pearson Education Limited, New York.
3. G.Karp.John (2002), Cell and Molecular biology – 3<sup>rd</sup> edition Wiley and Sons N.Y.
4. David Freifelder (1976), Physical biochemistry, applications to biochemistry and molecular biology, second edition. W.H. Freeman & Co Ltd.
5. R.K. Murray, D.K. Granner, P.A. Mayes, D.W. Rodwell (2006), Harper's Biochemistry, twenty fifth edition, Prentice Hall, New Jersey.



**Course Objectives:**

- To understand the basic concept of immune system and gain insight knowledge about T & B cell mediated immune response.
- To acquire sufficient knowledge about antigen and its properties apart from structure of antibody and its sub-classes.
- To understand and gain insight about antigen-antibody reactions and complement system.
- To acquire in-depth knowledge about the hypersensitivity and Transplantation-types.
- To gain appropriate knowledge about Immunization and Immunological techniques.

**Course Outcomes:**

S.No.	Description	Cognitive Level (K-level)
CO-1	Establish the basic concept of immune system; T & B cell mediated immune response.	K3
CO-2	Differentiate antigens, antibodies and sub-classes of Immunoglobulins	K2
CO-3	Denote the antigen-antibody reactions and complement system.	K1
CO-4	Evaluate the different types of hypersensitivity reactions.	K5
CO-5	Compile the different types of Transplantation and concepts of plastic surgery	K6
CO-6	Outline the information on various immunological techniques.	K4

**UNIT-I:** History of Immunology-Edward Jenner and Louis Pasteur with their experiments. Immunity-Innate and Acquired immunity.Immune Response-Antibody and Cell Mediated response.Cells of the immune system, Organs of the immune system–primary and secondary lymphoid organs.

**UNIT-II:** Antigen-Properties, Cross reactivity, Antigenicity, Immunogenicity, antigen determinants, Haptens, Adjuvants, Self-antigen (MHC) an outline only. Antibodies - Properties and Structure of classes and subclasses of Immunoglobulins.

**UNIT-III:** Antigen–Antibody interaction–Precipitation and Agglutination, Complements and their activation pathway, Cytokines and their functions.

**UNIT-IV:** Hypersensitivity–type I, II, III and IV and their clinical manifestations. Transplantation-types, Mechanism of Allograft rejection, Immuno suppressor agents, Tissue and organ transplantation.Basic concepts of plastic surgery.

**UNIT-V:** Immunization-Passive and Active, Vaccines-Recombinant vaccines, DNA vaccines, Benefits and adverse effects of vaccination. Principle and applications of RIA, ELISA, Immunofluorescence and Complement fixation test. Monoclonal Antibody production and its applications.

**Text Books:**

1. Annadurai. B (2008), A textbook of Immunology and Immunotechnology, 1<sup>st</sup> Edition, S.Chand& Co, Ltd, New York.
2. J. Kuby, R.A.Goldsby, T.J. Kindt and B.A. Osborne, B.A. (2007), Immunology, 4<sup>th</sup> edition, W.H.Freeman and Company, New York, USA.

**References:**

1. J. Kuby (2002), Immunology, 5th edition, W.H.Freeman and Company, New York.
2. Ian R. Tizard (2000), Immunology: An Introduction., 4th edition, W.B. Saunders Co., Philadelphia.
3. Murphy Kenneth (2008), Janeway's Immunobiology, Garland Science Publishers, New York.
4. Peter J. Delves, Ivan Maurice Roitt, Seamu J. Martin and Dennis Burton (2006), Roitt's Essential Immunology, 11th edition, Blackwell Scientific Publications, London.
5. Rajasekaran Pandian (2007), Immunology and Immunotechnology, Panima Publishers, Chennai.
6. I. Roitt, J. Brostoff and D Male (2002), Essential Immunology, 8th edition, English Language Book Society, London.

**Course Objectives:**

- To learn the information on diseases of carbohydrate metabolism.
- To analyze the role of diseases of amino acid metabolism
- To learn liver functions tests and its interpretation.
- To acquire knowledge on kidney function tests.
- To know the basic information on gastric and pancreatic function tests.

**Course Outcomes:**

S.No.	CO Statement	Cognitive Level
CO-1	Observe the basic concepts on diseases of carbohydrate metabolism	K2
CO-2	Analyze the role of diseases associated with amino acid metabolism	K4
CO-3	Determine the role of liver functions tests	K3
CO-4	Outline kidney function tests and its interpretation	K5
CO-5	List out the role of gastric and pancreatic function tests	K1
CO-6	Integrate various diseases and their pathophysiology	K6

**UNIT-I:** Blood sugar level–Definition, Types and Normal Values, Renal threshold of Glucose, Regulation of blood glucose- Hormonal action. Hypo and Hyperglycemia–Causes, Diagnosis and Treatment. Diabetes mellitus, Glycosuria, Fructosuria, Galactosemia, HbA<sub>1C</sub>, ketoacidosis, Glycogen Storage Disease, GTT.

**UNIT-II:** Diseases related to amino acid-Clinical manifestation of Phenylketonuria, Cystinuria, Albinism, Fanconi syndrome, Tyrosinemia and Alkaptonuria. Lipoproteins-Hyperlipoproteinemia, Hypolipoproteinemia, Atherosclerosis, Myocardial infarction, Ischemic Heart Disease and Obesity.

**UNIT-III:** Liver–Functions, Liver function test, Metabolism of Bilirubin, Jaundice–classification, causes and differential diagnosis. Liver disorders–Causes, Symptoms, Diagnosis and Treatment for Acute and Chronic Hepatitis, Cirrhosis, Fatty Liver, Gall Stones.

**UNIT-IV:** Kidney–Functions, Renal function test, Clearance test–Urea, Creatinine, Inulin, PAH test, Concentration and Dilution test. Renal disorders: Causes, symptoms, Diagnosis and Treatment–Glomerulonephritis, Diabetes Insipidus, Nephrotic syndrome, Renal failure and UTI.

**UNIT-V:** Gastric function test- Collection of gastric content, Examination of gastric residium, FTM, Alcohol Stimulation test, Tubeless gastric analysis. GI tract disorders-Peptic ulcer, Gastric carcinoma, Zollinger-Ellison syndrome. Pancreatic function test- Composition of pancreatic juice. Disorders-Acute and Chronic pancreatitis and Steatorrhoea. Intestinal function test.

**Text Books:**

- 1.N.Chatterjee and RanaShinde (2012) Textbook of Medical Biochemistry- eighth edition, Jaypee publication, New Delhi.
- 2.T.M. Devlin (2002), Textbook of Biochemistry with Clinical correlations, 5th edition, John Wiley & Sons Inc, Publications.

**References:**

1. Carl A. Burtis, Edward.R. Ashwood, David E Bruns, Tietz Text book of clinical chemistry and molecular diagnostics, (5<sup>th</sup> edition). Elsevier, St. Louis, USA, [2012].
2. Harrison, T.R. Fauci, Branunwalad and Isselbaeher, Principles of Internal Medicine [1998] McGraw Hills.[Vol-I & II]
3. Joan F. ZilvaA, PR Pannall, Clinical Chemistry in Diagnosis and Treatment, Liyods–Luke [Medical Books] Ltd., London [1975].
4. K.V. Krishnadas, Textbooks of Medicine [1996], Jaypee Brothers.
5. W.J. Marshall and S.K. Bangert, Clinical Chemistry [1995]

**I. Experiments on Enzymes by Colorimetry**

1. Effect of pH, temperature and substrate concentration on salivary amylase
2. Effect of pH, temperature and substrate concentration for urease
3. Assay of Serum Transaminases (SGOT) & (SGPT)

**II. Haematology**

1. Collection of Blood and Blood grouping
2. Measurement of BP
3. Enumeration of Total RBC count
4. Enumeration of Total WBC Count
5. Estimation of Haemoglobin content by Sahli's method
6. Determination of ESR
7. Differential Counting
8. Bleeding and Clotting time
9. PCR (demonstration)

**Semester-VI****Sub. Code: BC623A****SS1: BIOTECHNOLOGY****5 Hours/5 Credits****Course Objectives:**

- To learn the basic concepts in Recombinant DNA technology and its tools.
- To know the methods of gene transformation, recombinant selection and screening methods.
- To understand the molecular techniques namely southern, northern, western, PCR and DNA sequencing.
- To understand the plant tissue culture and applications of transgenic plants.
- To gain knowledge on animal tissue culture and applications of transgenic animals.

**Course Outcomes:**

S.No.	Description	Cognitive Level (K-level)
CO-1	Discuss the basic tools in Recombinant DNA technology.	K2
CO-2	Acquire knowledge of gene transformation, Recombinant selection and screening methods.	K3
CO-3	Develop a clear understanding of blotting techniques.	K6
CO-4	Analyze a thorough knowledge about PCR and DNA Sequencing.	K4
CO-5	Recognize and gain insight into Plant tissue culture techniques.	K1
CO-6	Justify the knowledge of animal tissue culture and applications of transgenic animals	K5

**UNIT-I:** Recombinant DNA technology and its tools-Isolation of gene, Cloning vectors: plasmid, cosmid, phage, YAC, BAC, HAC, binary vector, shuttle vector and expression vectors, rDNA formation. Ligation, Use of linkers and adapters.

**UNIT-II:** Methods of gene transformation. Recombinant selection and screening methods- Insertional inactivation, Hybridization and Immunological methods.

**UNIT-III:** Molecular techniques–Southern, Northern and Western blotting and its applications. PCR – Types and its applications, DNA sequencing methods–Maxam-Gilbert.

**UNIT-IV:** Plant tissue culture–Media composition, nutrients, growth regulators, initiation and differentiation. Callus and suspension culture, Micro propagation, Somatic embryogenesis and Somoclonal variation. Applications of Transgenic plants.

**UNIT-V:** Animal tissue culture–substrate, culture media and culture procedures, Primary culture and cell lines, tissue culture- slide, flask and test tube culture. Applications of transgenic animals.

**Text Books:**

1. R.C. Dubey (1993) A textbook of Biotechnology, S. Chand Publishing, New Delhi.
2. A.K. Srivastava, R.K. Singh and M.P. Yadav (2005), Animal Biotechnology, Oxford and IBH.

**References:**

1. N Channarayappa, (2006), Molecular biotechnology University Press, Hyderabad
2. R.C.Dubey (2014) Advanced Biotechnology, S. Chand Publishing, New Delhi.
3. H.D. Kumar (1997), Molecular Biology & Biotechnology Vivas publishing house Pvt. Ltd.
4. Bernard, R. Glick Jack.J. Pasternak, (2003) Molecular biotechnology–Principle and application of recombinant DNA, 3<sup>rd</sup>edition Library of Congress.
5. S. B. Primrose (1994), Molecular Biotechnology, 2nd Ed. Blackwell Scientific publishers, Oxford.
6. V. Kumaresan and N. Arumugam (2016) Fundamentals of Biotechnology-Saras Publications.