



**MARUDHAR KESARI JAIN COLLEGE FOR WOMEN
(AUTONOMOUS)**

Vaniyambadi – 635 751

PG and Research Department of Biochemistry

for

Undergraduate Programme

Bachelor of Science in Biochemistry

From the Academic Year 2024 - 2025

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1. Preamble

Biochemistry, as a scientific field, delves into the chemical processes within living organisms, focusing on cellular and molecular levels. The Department of Biochemistry at MKJC aims to produce biochemists who can innovate, invent, and share knowledge for the betterment of humanity. It also seeks to provide students with comprehensive training in applying biochemical skills.

The Department of Biochemistry was established in 2004, the department initiated its Post Graduate course in 2007, followed by the M.Phil course in 2012 and the Research Course (Ph.D) in 2021. Biochemistry covers a wide array of scientific disciplines, including Genetics, Microbiology, Forensics, Plant Sciences, Medicine, and Nutrition. It's an ideal choice for students interested in healthcare delivery services and those who want to contribute innovative information to technological advancements in understanding life processes.

Equipped with advanced tools and instruments, the Biochemistry Department's laboratory conducts a variety of biochemical tests on blood and urine to understand health and disease.

The department organizes National and International Conferences, Health Awareness Programs, and Blood Grouping Programs for first-year students every academic year. These events provide valuable information and problem-solving skills to students in biology.

To foster academic and professional advancement, the department has signed Memorandums of Understanding (MoUs) with Microlab, Sacred Heart College, Vanni Tech, Saveetha Institute of Medical & Technical Science, and Xcellogen Biotech. Currently, the department comprises 11 faculty members and has a student strength of 142.

PROGRAMME OUTCOMES (PO)

Programme	B.Sc Biochemistry
Programme Code	US06
Duration	UG (3 Years)
Programme Outcomes	<p>PO1: Acquire knowledge in the field of Biological Sciences and to apply the knowledge in their day-to-day life for the betterment of self and society.</p> <p>PO2: Develop critical, analytical thinking and problem-solving skills.</p> <p>PO3: Develop research related skills in defining the problem, formulate and test the hypothesis, analyse, interpret, and draw conclusion from data.</p> <p>PO4: Address and develop solutions for societal and environmental needs of local, regional and national development.</p> <p>PO5: Work independently and engage in lifelong learning and enduring proficient progress.</p> <p>PO6: Provokes employability and entrepreneurship among students along with ethics and communication skills.</p> <p>PO7: Understand the importance of ethical behavior in business contexts and be able to recognize and address ethical dilemmas they may encounter in their professional careers.</p> <p>PO8: Prepared for lifelong learning and professional development, including the ability to adapt to changes in technology, business practices, and economic conditions throughout their careers.</p>

<p>Programme Specific Outcomes:</p>	<p>PSO1: Students will be able to Understand the principles and methods of various techniques in Biochemistry, Immunology, Microbiology, Enzyme kinetics and Molecular Cell Biology. Based on their understanding, the students may would be able to design and execute experiments during their final semester project, and further research programs.</p> <p>PSO2: Insight on the structure-function relationship of biomolecules, their synthesis and breakdown, the regulation of these pathways, and their importance in terms of clinical correlation. Students will also acquire knowledge of the principles of nutritional biochemistry and also understand diseases and their prevention through Pharmaceutical Biochemistry.</p> <p>PSO3: To understand the concepts of Recombinant DNA Technology, Molecular Endocrinology and Developmental Biology in association with various research methods. Acquire insight into the immune system and its responses, and use this knowledge in the processes of immunization, vaccine development, transplantation and organ rejection.</p>
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Eligibility for Admission:

Candidates for admission to the first year of (B.Sc Biochemistry) shall be required to have passed the Higher Secondary Examination within the science stream in the Physics, Chemistry and Biology subjects with a score of 50%

Methods of Evaluation and Assessment

Methods of Evaluation		
Internal Evaluation		25 Marks
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand / Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or overview	
Application (K3)	Suggest idea/concept with examples, suggest formulae, solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate Between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Semester – I						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA101	Tamil – 1	4	1	0	0	3
24UFEN101	English – 1	4	1	0	0	3
24UBCC101	CC – 1 Biomolecules	3	1	2	0	5
24UBCP102	CC - 2 (Practical) Titrimetric and Qualitative Analysis – I	0	0	4	0	3
24UCHA102	EC - 1 AL Chemistry-I	3	1	0	0	3
24UBCS101	SEC – 1 NM Health and Nutrition	1	0	1	0	2
24UCHP103	SEC – 2 Practical Chemistry-I	0	0	2	0	2
24UBCF101	FC- Medicinal Diet	1	1	0	0	2
					30	23

Semester – II						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA21	Tamil – 2	4	1	0	0	3
24UFEN21	English – 2	4	1	0	0	3
24UBCC21	CC – 3 Cell Biology	3	1	2	0	5
24UBCC22P	CC - 4 (Practical) Qualitative Analysis and Microscopic Analysis	0	0	4	0	2
24UBCA21	EC - 2 AL Chemistry-II	3	1	0	0	4
24UBCA22P	EC - 3 AL Practical Chemistry-II	0	0	2	0	2
24UBCS21	SEC – 3 First Aid	1	0	1	0	2
24UAEC21	AEC – 1 Life Skills Through Yoga	1	1	0	0	2
					30	23

Semester – III						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA31	Tamil – 3	4	1	0	0	3
24UFEN31	English – 3	4	1	0	0	3
24UBCC31	CC – 5 Biophysical and Biochemical Techniques	3	1	2	0	5
24UBCC32P	CC - 6 (Practical) Colourimetric analysis, Biochemical and Buffer Preparations	0	0	4	0	2
24UBCA31 24UBCA32	EC - 4 1. Microbiology – I 1. Nutrition through the lifecycle	3	1	0	0	4
24UBCA33P 24UBCA34P	EC – 5 1. Practical - Microbiology 2. Practical – Nutrition	0	0	2	0	2
24UBCS31	SEC – 4 Biochemical Pharmacology	1	0	1	0	2
24UAEC31	AEC – 2 Human Values and Professional Ethics	1	1	0	0	2
					30	23

Semester – IV						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA41	Tamil – 4	4	1	0	0	3
24UFEN41	English – 4	4	1	0	0	3
24UBCC41	CC - 7 Enzymes	3	1	2	0	5
24UBCC42P	CC - 8 (Practical) Enzyme assays, Renal Functional Test and Liver Functional Test	0	0	4	0	2
24UBCA41/ 24UBCA42	EC - 6 AL Microbiology – II / Botany	3	1	0	0	4
24UBCA41P/ 24UBCA42P	EC - 7 AL (Practical) Microbiology- II/ Practical- Botany	0	0	2	0	2
24UBCS41	SEC - 5 Herbal Medicine	1	0	1	0	2
24UAEC41	AEC – 3 Environmental Studies and Disaster Management	1	1	0	0	2
					30	23

Semester – V						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UBCC51	CC -9 Intermediary Metabolism	4	1	0	0	5
24UBCC52	CC- 10 Human Physiology	4	1	0	0	5
24UBCC53	CC - 12 Clinical Biochemistry	4	1	0	0	4
24UBCC54P	CC – 11 Clinical Biochemistry (Practical)	0	0	3	0	2
24UBCE51 / 24UBCE52	EC – 8 Endocrinology / Evolutionary Biology	3	1	0	0	3
24UBCE53 / 24UBCE54	EC – 9 Research Methodology / Cancer Biology	3	1	0	0	3
24UAEC51	AEC – 4 Gender Equality and Social Inclusion	1	1	0	0	2
24UBCIN51	Internship					2
24UBCIK51	IKS -Introduction to Indian Science and Technology	2				
					30	26

Semester – VI						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UBCC61	CC – 13 Biotechnology	4	1	0	0	4
24UBCC62	CC - 14 Immunology	3	1	1	0	3
24UBCC63P	CC - 15 – Project	0	0	0	5	4
24UBCE63 / 24UBCE64	EC – 11 Medical Lab Technology / Phytochemistry	4	1	0	0	4
24UBCE61P / 24UBCE62P	EC – 10 Haematology Lab / Phytochemistry Lab	0	0	5	0	4
24UBCP61	PEC – 1 Biomedical Instrumentation	1	1	0	0	2
24UBCL61	SLC – 1 Biochemistry in Everyday Life				3	2
					30	23
					141+2*	

Students must complete at least one online course (MOOC) from platforms like SWAYAM, NPTEL, or Nanmulavan within the fifth semester. Additionally, engaging in a specified Self-learning Course is mandatory to qualify for the degree, and successful participation will be acknowledged with an extra credit of 2*.

Part – 1 & 2	Tamil & English	4	SEC	Skill Elective Course	5
CC	Core Course	15	FC	Foundation Course	1
EC-AL	Elective Course – Applied	7	AEC	Ability Enhancement Course	4
EC	Elective Course – Major	4	SLC	Self-Learning Course	1
PEC	Professional Enhancement Course				

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCC11	Core Course -1 Biomolecules	Core	3	1	2	0	5	6	25	75	100
Learning Objectives											
LO1	Students will comprehend the diverse types of saccharides, including monosaccharides, disaccharides, polysaccharides, and their roles in biological systems.										
LO2	Students will investigate the various types of proteins and amino acids, understanding their structures, functions, and characteristics.										
LO3	Students will be able to understand the structure, function, and different forms of DNA, RNA, and nucleic acids, and their significance in genetic processes.										
LO4	Students will explore the characteristics and classifications of lipids, including fatty acids, and understand their roles in cellular structure and energy storage.										
LO5	Students will gain knowledge about the categorization of vitamins and minerals, understanding their importance in metabolism, growth, and overall health.										
Unit	Content										Hours
1	UNIT I: Chemistry of Carbohydrates: Introduction 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), Heteropolysaccharides (hyaluronic acid, heparin).										18 Hours
2	UNIT II: Chemistry of Amino Acids and Proteins: 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. Introduction, classification of proteins based on solubility, size and shape. Structure of proteins - primary, secondary, tertiary and quaternary.										18 Hours
3	UNIT III: Chemistry of Lipids 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.										18 Hours
4	UNIT IV: Chemistry of Nucleic Acids: 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, T _m and hyperchromicity, structure of RNA and its major types -tRNA, mRNA and rRNA.										18 Hours

5	UNIT V: Vitamins and Minerals Dietary Sources, deficiency manifestation and biological functions of fat soluble and water-soluble vitamins. Dietary Sources, deficiency manifestation and biological functions of Calcium, Phosphorus, Magnesium. Iron, Zinc, Iodine, Fluoride, Sodium and Potassium.	15 Hours
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CO	Course Outcomes
CO1	To Understand the structures and functions of carbohydrates
CO2	To Illustrate the classification, structure, properties of amino acids and acquire knowledge about the classification of proteins, levels of structural organization of proteins
CO3	To Gain knowledge on the structure and properties of nucleic acids.
CO4	To study the importance of various lipids
CO5	To Gain knowledge on vitamins and minerals

Textbooks:

1	Dr.A.C.Deb, “Fundamentals of Biochemistry” (8th edition), Kolkata, New Central Book Agency
2	Ambikashunmugam, “Fundamentals of Biochemistry (8th Edition)2016, Wolters Kluwer India Pt Ltd
3	U.Sathayanarayana,(2006). Biochemistry. 3rd Edition by Books and Allied (P) Ltd.,India.
4	Fundamentals of Biochemistry-J.L. Jain, Sunjay Jain, Nitin Jain, S. Chand & Company.
5	Biomolecules-C.Kannan , MJP Publishers,Chennai-5.

Reference Books:

1	Lehninger Principles of Biochemistry-David L. Nelson, Michael M. Cox, Macmillan Worth Publishers.
2	Harper’s Illustrated Biochemistry.30th edition -McGraw Hill
3	Donald Voet and Judith Voet,” Biochemistry”,2nd edition,John Wiley & Sons,Inc,NY
4	Biochemistry-Dr. Amit Krishna De, S. Chand & Co., Ltd.
5	Biochemistry" by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer, 8th edi, published in 2015

Web resources:

1	https://drive.google.com/drive/folders/17teC8hUgF7fkOVFn8bvGTRN28ayoEmXL?usp=drive_link – eBooks google drive
2	https://tvuni.academia.edu/mvinayagam - Educational networks to share research, knowledge, teaching documents, chapters, e-notes, e-books, thesis, materials.
3	https://ncert.nic.in/textbook.php
4	National Digital Library - https://ndl.iitkgp.ac.in/
5	https://cec.nic.in/cec/ - e-Content courseware in UG subjects

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	2	3	3	3	3
CO2	3	2	1	3	2	2	2	3	3	3	3
CO3	3	2	2	3	2	2	2	3	3	3	3
CO4	3	2	2	3	2	2	2	3	3	3	3
CO5	3	2	1	3	2	2	2	3	3	3	3
Total	15	10	8	15	10	10	10	15	15	15	15
Average	3	2	1.6	3	2	2	2	3	3	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCC12P	CC - 2 (Practical) Titrimetric and Qualitative Analysis - I	Core	0	0	4	0	3	4	25	75	100
Learning Objectives											
LO1	Students will be able to identify the presence of various carbohydrates and starch in each sample through qualitative analysis.										
LO2	Students will gain the ability to determine the concentration of biological molecules quantitatively.										
LO3	Students will develop the skills to measure the saponification value of edible oil, providing insights into their quality and composition.										
LO4	Students will develop the skills to measure the acid number of edible oil, providing insights into their quality and composition										
LO5	Student able to qualitatively analyse Carbohydrates										
Unit	Content										Hours
1	<p>EXPERIMENT INVOLVING TITRIMETRIC PROCEDURES</p> <ol style="list-style-type: none"> 1. Estimation of Glycine by Sorenson formal titration. 2. Estimation of ascorbic acid using 2, 6 – dichlorophenol indophenol as link solution, present in an unknown solution 3. Determination of glucose by Benedict’s method. 4. Determination of Acid number of edible oil. 5. Determination of saponification value of edible oil. <p>QUALITATIVE ANALYSIS</p> <p>A) Qualitative analysis of Carbohydrates</p> <ul style="list-style-type: none"> • 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 <p>Qualitative analysis of unknown sugar</p>										60 Hours

CO	Course Outcomes
CO1	Quantify glycine by Sorenson’s formol titration method
CO2	Quantify ascorbic acid in lemon by Dichlorophenol indo phenol dye method
CO3	Quantify glucose by Benedicts method
CO4	Qualitatively analyze the carbohydrates report the type of carbohydrate based on specific tests
CO5	Determine lipid properties of unsaturation and fatty acid content by SAP number and acid number

Textbooks:	
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
4	Quantitative Chemical Analysis" by Daniel C. Harris Publication: W. H. Freeman Edition: 9th Edition (2015)
5	Analytical Chemistry: Principles and Techniques" by Robert A. Day and Michael S. Selvin Publication: CBS Publishers & Distributors Edition: 2nd Edition (2014)
Reference Books:	
1	Fundamentals of Analytical Chemistry" by Douglas A. Skoog, Donald M. West, F. James Holler, and Stanley R. Crouch Publication: Cengage Learning Edition: 9th Edition (2013)
2	Principles of Instrumental Analysis" by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch Publication: Cengage Learning Edition: 7th Edition (2016)
3	Quantitative Analysis for Management" by Barry Render, Ralph M. Stair Jr., and Michael E. Hanna Publication: Pearson, Edition: 13th Edition (2018)
4	Analytical Chemistry" by Gary D. Christian Publication: Wiley Edition: 7th Edition (2013)
5	Practical Analytical Chemistry" by S. M. Khopkar Publication: New Age International Edition: 1st Edition (2003)
Web resources:	
1	https://courseware.cutm.ac.in/wp-content/uploads/2020/06/Practice-6.pdf
2	https://www.iitg.ac.in/biotech/BTechProtocols/Ascorbic.pdf
3	https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/3%20ESTIMATION%20OF%20SUGAR.pdf
4	https://fssai.gov.in/upload/uploadfiles/files/Revised-method-acid-value Oils Fats 20_02_2018.pdf
5	https://egyankosh.ac.in/bitstream/123456789/43428/1/Experiment-24.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	15	15	15	15	15	15	15	15	15	15
Average	3	3	3	3	3	3	3	3	3	3	3

3 – Strong, 2- Medium, 1- Low

1ST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCA11	Allied Biochemistry	SEC-2	3	1	0	0	3	4	25	75	100
Learning Objectives											
LO1	To Students will acquire knowledge on the structure and functions of carbohydrates.										
LO2	To Students will understand the structure and classification of amino acids, essential building blocks of proteins.										
LO3	To Students will acquire knowledge on the classification of proteins and their functions in the body.										
LO4	To understanding their roles in energy storage, membrane structure, and cell signaling..										
LO5	To Students will understand the basics of DNA and RNA with reference to their functions.										
Unit	Content									Hours	
1	UNIT-I Definition and Classification of carbohydrate. Monosaccharides – Glucose, Fructose. Anomer, epimer and enantiomers-Definition with examples. Disaccharides – Definition-Sucrose, maltose and Lactose occurrence, structure and functions. Polysaccharides – Homopolysaccharides -Starch -Structure and functions.									12	
2	UNIT-II 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. Introduction, classification of proteins based on solubility, size and shape. Structure of proteins - primary, secondary, tertiary and quaternary									12	
3	UNIT-III 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).									12	
4	UNIT-IV Nucleic acid- Composition of nucleic acid., Definition - nucleoside, nucleotide and polynucleotide. Double helical model of DNA and its biological functions. Structure ofRNA- types: tRNA, mRNA and rRNA and functions of RNA.									12	
5	UNIT – V Classification, Dietary Sources, deficiency manifestation and biological functions of fat soluble and water-soluble vitamins. Classification, Dietary Sources, deficiency manifestation and biological functions of Calcium, Magnesium. Iron, Sodium and Potassium.									12	

CO	Course Outcomes
CO1	Students will be able to explain the structure, biological importance of carbohydrates, from monosaccharides to polysaccharides
CO2	Students will be able to identify the structure and classification of amino acids,
CO3	Students will be able to classify proteins and explain their properties
CO4	After studying unit 4, the students will be able to classify lipids and describe the structure and biological functions of phospholipids, glycolipids and sterols
CO5	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

Text 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	Fundamentals of Biochemistry-J.L. Jain, Sunjay Jain, Nitin Jain, S. Chand & Company
4	Harper's Illustrated Biochemistry.30th edition -McGraw Hill
5	U.Sathayanarayana,(2006). Biochemistry. 3rd Edition by Books and Allied (P) Ltd., India.
Reference Books:	
1	Biochemistry: Molecular Basis of Cell Structure and 2015by Albert L. Lehninger (Author)
2	Nelson, D. L. & Cox, M. M. Lehninger Principles of Biochemistry. Freeman, 5th edn, 2008.
3	Biochemistry - Voet and Voet
4	Principles and Techniques of Practical Biochemistry- Keith Wilson and John Walker, Cambridge Press.
5	Biochemistry" by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer, 8th edition, published in 2015

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	2	3	3	3
CO2	2	3	3	3	2	3	3	2	3	3	3
CO3	3	3	3	2	3	3	3	2	3	3	3
CO4	3	3	3	3	3	3	3	2	3	3	3
CO5	3	2	3	3	3	3	3	2	3	3	3
Total	14	14	15	14	14	15	15	10	15	15	15
Average	2.8	2.8	3.0	2.8	2.8	3.0	3.0	2.0	3.0	3.0	3.0

3 – Strong, 2- Medium, 1- Low

1ST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCS11	SEC (NME) – 1 Health and Nutrition	SEC – 1 (NME)	1	0	1	0	2	2	25	75	100
Learning Objectives											
LO1	To able to interpret and apply nutrition concepts to evaluate and improve the nutritional health of communities										
LO2	Describe the structure of major human organs and explain their role in the maintenance of healthy individuals										
LO3	To enables the students to learn the importance of Balanced diet, Meal planning at different phases of life.										
LO4	To minimize the growth of microorganisms during the storage period, thus promoting longer shelf life and reduced hazard from eating the food.										
LO5	Guiding healthy individuals to achieve adequate nutrient intake										
Unit	Content										Hours
1	Introduction and definition of food and Nutrition. Basic Food groups-Energy yielding, Body Building, Protective Foods. Basic concepts of Energy Expenditure, Unit of Energy, Calorific values of Proteins, Carbohydrates and Fats. BMR.										6
2	Physiological role and Nutritional significance of Carbohydrates, Proteins, Lipids, Vitamins and Minerals. Biological value of Proteins (Animal and Plant), Single cell Proteins										6
3	Composition of Balanced Diet, RDA for Infants, Children, Adolescent, Adult male, female, Pregnant, Lactating women and Old age.										6
4	Food processing, Food Preservation. Principles of Diet therapy, therapeutic diets for Anaemia, heart diseases, obesity and Diabetes Mellitus.										6
5	Protein Malnutrition (Kwashiorkar), Undernutrition (Marasmus) their preventive and curative measures. Deficiency diseases of Vitamins.										6

CO	Course Outcomes
CO1	To Understand the fundamental concepts of food and nutrition
CO2	To know physiological roles and nutritional significance of carbohydrates, proteins, lipids, vitamins, and minerals in the human body
CO3	To understand nutritional needs during different life stages such as infancy, childhood, adolescence, adulthood, pregnancy, lactation, and old age.
CO4	To know the principles and methods of food processing and preservation, including their effects on nutrient content and food safety.
CO5	To know the causes, symptoms, and risk factors associated with protein-energy malnutrition, including kwashiorkor and marasmus.

Textbooks:

1	Text Book of Physiology and Nutrition-M.Swaminathan.
2	Human Nutrition & Dietetics-Davidson and Passmore.
3	Nutrition and Dietetics-Shubangini Joshi.
4	Biochemistry-Dr. Ambika Shanmugam, Published by Author.
5	Lippincott's Biochemistry - P.C. Champe

Reference Books:

1	Food Science" by Norman N. Potter and Joseph H. Hotchkiss (7th Edi, Springer, 2018)
2	Advanced Nutrition and Human Metabolism" by Sareen S. Gropper, Jack L. Smith, and James L. Groff (7th Edition, Cengage Learning, 2018)
3	Biochemistry - Garrett Grisham. 3rd edition. International student's edition
4	Lehninger Principles of Biochemistry-David L. Nelson, Michael M. Cox, Macmillan Worth Publishers.
5	Nutrition for Health, Fitness & Sport" by Melvin H. Williams, Eric A. Rawson, and David Branch (11th Edition, McGraw-Hill Education, 2019)

Web resources:

1	https://www.jvww.ac.in/documents/83-%20final-Text%20Book%20of%20Food%20and%20Nutrition.pdf
2	https://www.msmanuals.com/en-in/home/disorders-of-nutrition/overview-of-nutrition/carbohydrates,-proteins,-and-fats
3	https://www.nin.res.in/downloads/DietaryGuidelinesforNINwebsite.pdf
4	http://www.jnkvv.org/PDF/02042020124642Modified_diet%20(9%20files%20merged).pdf
5	https://www.msmanuals.com/en-in/professional/nutritional-disorders/undernutrition/protein-energy-undernutrition-peu

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	1	3	2	1	3	1	2	3
CO2	2	3	1	2	3	2	3	2	3	2	2
CO3	2	2	2	1	1	3	3	1	2	3	2
CO4	2	3	1	2	3	2	3	2	3	2	2
CO5	2	3	2	1	1	1	3	1	2	3	2
Total	11	13	09	7	11	10	13	08	11	12	11
Average	2.2	2.6	1.8	1.4	2.2	2.0	2.6	1.6	2.2	2.4	2.2

3 – Strong, 2- Medium, 1- Low

1ST YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCS12P	SEC – 2 Allied Biochemistry Practical	SEC-2	0	0	2	0	2	2	25	75	100
Learning Objectives											
LO1	1. To estimate the number of compounds using volumetric analysis										
LO2	2. To acquire skills to qualitatively analyse carbohydrate										
LO3	3. To obtain skills to qualitatively analyse amino acids										
Unit	Content									Hours	
1	1. Estimation of Glucose by Benedict's method.									2	
2	2. Estimation of Ascorbic acid by 2, 6 dichlorophenol indophenols dye method.									2	
3	3. Estimation of Glycine by Sorenson's formal titration.									2	
4	A) Qualitative analysis of Carbohydrates <ul style="list-style-type: none"> • Qualitative analysis of Glucose • Qualitative analysis of Fructose • Qualitative analysis of Maltose • Qualitative analysis of Starch 									2	
5	B) Qualitative analysis of Amino acids <ul style="list-style-type: none"> • Qualitative analysis of Arginine, • Qualitative analysis of Cysteine • Qualitative analysis of Tryptophan • Qualitative analysis of Tyrosine 									2	

CO	Course Outcomes
CO1	Quantify glycine by Sorenson's formol titration method
CO2	Quantify ascorbic acid in lemon by Dichlorophenol indo phenol dye method
CO3	Quantify glucose by benedicts method
CO4	Qualitatively analyze the carbohydrates report the type of carbohydrate based on specific tests
CO5	Determine lipid properties of unsaturation and fatty acid content by SAP number and acid number

Textbooks:	
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
4	Quantitative Chemical Analysis" by Daniel C. Harris Publication: W. H. Freeman Edition: 9th Edition (2015)
5	Analytical Chemistry: Principles and Techniques" by Robert A. Day and Michael S. Selvin Publication: CBS Publishers & Distributors Edition: 2nd Edition (2014)
Reference Books:	
1	Fundamentals of Analytical Chemistry" by Douglas A. Skoog, Donald M. West, F. James Holler, and Stanley R. Crouch Publication: Cengage Learning Edition: 9th Edition (2013)
2	Principles of Instrumental Analysis" by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch Publication: Cengage Learning Edition: 7th Edition (2016)
3	Quantitative Analysis for Management" by Barry Render, Ralph M. Stair Jr., and Michael E. Hanna Publication: Pearson, Edition: 13th Edition (2018)
4	Analytical Chemistry" by Gary D. Christian Publication: Wiley Edition: 7th Edition (2013)
5	Practical Analytical Chemistry" by S. M. Khopkar Publication: New Age International Edition: 1st Edition (2003)
Web resources:	
1	https://www.youtube.com/watch?v=PAKCgrnKeBA
2	https://www.youtube.com/watch?v=o-ugcmSgtGc
3	https://www.youtube.com/watch?v=KJFt0-q2s9k
4	https://www.youtube.com/watch?v=ojhdTFmkY1c
5	https://www.youtube.com/watch?v=wmhmAESv72E

Mapping with Programme Outcomes and Programme-Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	1	3	3	2	2
CO2	3	3	3	3	3	3	1	3	3	2	2
CO3	3	3	3	3	3	3	1	3	3	2	3
CO4	3	3	3	3	3	3	1	3	3	2	3
CO5	3	3	3	3	3	3	1	3	3	2	3
Total	15	15	15	15	15	15	5	15	15	10	13
Average	3	3	3	3	3	3	1	3	3	2	2.6

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCF11	FC – 1 Medicinal Diet	FC	1	0	1	0	2	2	25	75	100
Learning Objectives											
LO1	Possess basic knowledge about diet										
LO2	Sketch diet plan for GI diseases										
LO3	Sketch diet plan for liver diseases										
LO4	Sketch a diet plan for Infectious diseases										
LO5	Prepare diet chart for Diabetes Renal and Cardiovascular Diseases										
Unit	Content										Hours
1	Principles of Therapeutic Diet: Definitions of Normal diet, Therapeutic diet, Soft Diet and Liquid diet. Objectives of Diet Therapy. Advantages of using normal diet as the basis for Therapeutic diet.										6
2	Diet modification in Gastrointestinal diseases: Peptic ulcer, Diarrhoea, Lactose intolerance, Constipation and Malabsorption syndrome										6
3	Diet Modification in liver and gall bladder in diseases: Etiology, symptoms and dietary treatment in jaundice, hepatitis, Cirrhosis of liver and hepatic coma.										6
4	Diet Modification in Infectious Diseases: Fevers, Typhoid, COVID19 and Viral Hepatitis. Dietary modifications in Tuberculosis.										6
5	Diet Modification in Diabetes, Cardio-vascular diseases, Acute& Chronic glomerulonephritis, nephrosis, renal failure, kidney stone and Hypertension.										6

CO	Course Outcomes
CO1	Possess basic knowledge about diet
CO2	Sketch diet plan for GI diseases
CO3	Sketch diet plan for liver diseases
CO4	Sketch a diet plan for Infectious diseases
CO5	Prepare diet chart for Diabetes Renal and Cardio-vascular diseases
Textbooks:	
1	MA Text Book of Foods, Nutrition and Dietetics, .Raheena Begum, Sterling Publishers Pvt.Ltd.
2	Fundamentals of foods and Nutrition, M.V.Raja Gopal, Sumati. R., Mudambi, Wiley Eastern Limited, Year-1990.
3	Nutrition and Diet Therapy, William S.R 1985, 5th edition, Mosly Co. St. Louis.
4	Nutrition and Dietetics, Author: M. Swaminathan., Publisher: Ramesh Publishers., Edition: 2nd Edition

5	Dietetics: Practice and Future Trends Author: Esther A. Winterfeldt, Jane W. Winterfeldt, Publisher: Jones & Bartlett Learning, Edition: 5th Edition
Reference Books:	
1	Rodwell Williams Nutrition and Diet Therapy, 1985, the C.V Mosly St. Louis
2	M.V. Krause & M.A. Mohan, Food Nutrition and Diet Therapy, 1992 by W.B Saunders Company, Philadelphia, London.
3	Davidson and Passmore, Human Methods and Diabetics, 1976 the English Language Book Society and Churchill.
4	Diet and Nutrition in Critical Care, Author: Rajeev Chawla, Namrata Joshi Publisher: Jaypee Brothers Medical Publishers, Edition: 2nd Edition
5	Modern Nutrition in Health and Disease, A. Catharine Ross, Benjamin Caballero, Robert J. Cousins, et al. Publisher: Lippincott Williams & Wilkins Edition: 11th Edition
Web resources:	
1	https://homescience10.ac.in/storage/pages/ecurriculum/Bsc-Hsc-Sem-4/THERAPEUTIC%20MODIFICATIONS%20OF%20A%20NORMAL%20DIET.pdf
2	https://my.clevelandclinic.org/health/articles/7040-gastrointestinal-diseases
3	https://www.webmd.com/digestive-disorders/understanding-cirrhosis-basic-information
4	https://www.cdc.gov/hepatitis/hav/havfaq.htm
5	https://ugcmoocs.inflibnet.ac.in/assets/uploads/1/264/8373/et/Dietary%20management%20in%20Nephrotic%20syndrome%20and%20renal%20failure200415101004042828.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	1	3	2	1	2	3	2	3	1
CO2	1	3	2	2	3	2	3	2	3	2	3
CO3	2	1	3	2	3	1	2	1	2	2	3
CO4	3	3	1	2	1	3	2	3	1	3	2
CO5	2	3	2	1	3	2	1	3	2	1	2
Total	10	13	09	10	12	09	10	12	10	11	11
Average	2.0	2.6	1.8	2.0	2.4	1.8	2.0	2.4	2.0	2.2	2.2

3-Strong 2 – Medium 1- low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCC21	Core Course -1 Cell Biology	Core	3	1	2	0	5	6	25	75	100
Learning Objectives											
LO1	Cell structure and function: Understanding the structure and function of cells, organelles, and membranes in both prokaryotic and eukaryotic cells										
LO2	The plasma membrane, or the cell membrane, protects a cell. One is to transport nutrients into the cell and also to transport toxic substances out of the cell.										
LO3	The observations suggest that microtubules are partly responsible for the maintenance and functioning of the Golgi complex,										
LO4	Explain the role of ribosomal RNA and proteins in forming ribosomes. Identify the structure and components of mitochondria										
LO5	Understand the Relationship Between the Nucleus and Nucleolus. Identify the components of a chromosome.										
Unit	Content										Hours
1	UNIT I HISTORY OF CELL BIOLOGY An overall view of cells- History of cell Biology - Cell theory. Definition of cell, Classifications of cell - Prokaryotic and Eukaryotic cells. Differences between prokaryotic and eukaryotic cells. Scope of cell biology										15 Hours
2	UNIT II: PLASMA MEMBRANE AND TRANSPORT MECHANISM Plasma membrane- Fluid Mosaic Model- Importance of fluid mosaic model, Structure and function of Plasma membrane. Chemical and Physical properties of the Plasma membrane, Membrane proteins, and their properties. Membrane carbohydrates and their role. Transport mechanism –Different types of membrane transport -Osmosis, facilitated diffusion, active and passive transport, Uniport, Symport, and Antiport. Simple,										15 Hours
3	UNIT III: ENDOPLASMIC RETICULUM, GOLGI COMPLEX, AND MICROTUBULES Endoplasmic reticulum -Endoplasm and Ectoplasm. Types of Rough Endoplasmic reticulum, Smooth Endoplasmic reticulum, Chemical composition of endoplasmic reticulum, Origin of Endoplasmic reticulum, structure and functions. Golgi Complex – structures, chemical composition of Golgi complex and functions of Acrosome, microtubules- structure and function microtubules.										15 Hours
4	UNIT IV: MITOCHONDRIA, RIBOSOMES, LYSOSOMES Mitochondria: the origin of mitochondria, Structure, and function. Ribosomes – Structure of Ribosomes, Chemical composition of ribosomes, types of Ribosomes, and tasks of Ribosomes. Lysosomes- structure and functions. Polymorphic structure of lysosomes and their types. and lysosomal enzymes,										15 Hours

5	UNIT V: CELL DIVISION AND CELL CYCLE Nucleus structure and functions, structure of the interphase nucleus, nuclear pore complex. Nucleolus structure and functions. Chromosome-Chromosome structure and function. Cell divisions are the cell cycles- phases of the cell cycle. Meiotic and mitotic cell division, Difference between Meiotic and mitotic cell division, cell-cell communications, cell recognition, cell adhesion, and cell functions.	15 Hours
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CO	Course Outcomes
CO1	To Explain the structures and functions of basic components of prokaryotic and eukaryotic cells
CO2	To describe the structure, function, and composition of cell membranes and communicate the types and mechanisms of membrane transport
CO3	To discuss the structure and functions of cellular organelles
CO4	To understand the types of microfilaments and mitochondria
CO5	To describe nucleus and nucleolus, Illustrate the phases of cell cycle; in particular mitosis and describe the significance of meiosis in genetic diversity Relate the structure and biological role.

Textbooks:

1	Cell Biology and Molecular Biology Paperback – 1 January 2019 by <u>N. Arumugam</u>
2	Cell Biology, Genetics, Molecular Biology, Evolution and Ecology Dr. P S Verma & Dr. V K Agarwal
3	Cell Biology 4th Edition 2023 By Thomas D Pollard
4	Cell and Molecular Biology PB Paperback – 1 January 2017 by Gupta P.K
5	Principles Of Cell Biology By George Plopper Bygeorge Plopper

Reference Books:

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

Web resources:

1	https://www.youtube.com/watch?v=URUJD5NEXC8
2	https://www.youtube.com/watch?v=t5DvF5OVr1Y
3	https://www.khanacademy.org/science/ap-biology/cell-structure-and-function/cell-structures-and-their-functions/v/introduction-to-the-cell
4	https://www.youtube.com/watch?v=qMOOw0OZZQ8
5	https://www.khanacademy.org/science/ap-biology/cell-structure-and-function/cell-structures-and-their-functions/v/introduction-to-the-cell

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	2	3	3	3	3
CO2	3	2	1	3	2	2	2	3	3	3	3
CO3	3	2	2	3	2	2	2	3	3	3	3
CO4	3	2	2	3	2	2	2	3	3	3	3
CO5	3	2	1	3	2	2	2	3	3	3	3
Total	15	10	8	15	10	10	10	15	15	15	15
Average	3	2	1.6	3	2	2	2	3	3	3	3

3-Strong 2 – Medium 1- low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCC22P	Practical -Titrimetric, Qualitative Analysis, and Microscopic Analysis	Core	0	0	4	0	2	4	25	75	100
Learning Objectives											
LO1	To obtain skills to analyze amino acids qualitatively										
LO2	To learn the parts of a microscope, investigate the cells under a microscope										
LO3	Image the cells using different stains										
LO4	Identify the cells, organelles, and stages of cell division. Identify the spotters										
Unit	Content										Hours
1	A) Qualitative analysis of Amino acids 1. Qualitative analysis of Arginine, 2. Qualitative analysis of Cysteine 3. Qualitative analysis of Tryptophan 4. Qualitative analysis of Proline 5. Qualitative analysis of Methionine 6. Qualitative analysis of Histidine 7. Qualitative analysis of Tyrosine										60
2	B) MICROSCOPY AND STAINING TECHNIQUES 1. Study the parts of Light and Compound microscope 2. Preparation of Slides and Micrometry 3. Examination of prokaryotic and eukaryotic cell										
3	C) GROUP EXPERIMENT 1. Identification of different stages of Mitosis in onion root tip 2. Identification of different stages of Meiosis in onion bulb										
4	D) SPOTTERS 1. Cells: Nerve, Plant and Animal cell 2. Organelles: Mitochondria, Chloroplast, Endoplasmic reticulum, 3. Mitosis stages–Prophase, Anaphase, Metaphase, Telophase										

CO	Course Outcomes
CO1	Identify the parts of microscope.
CO2	Preparation of Slides
CO3	Identify the stages of mitosis & meiosis
CO4	Visualize nucleus and mitochondria by staining methods
CO5	Identify the spotters of cells, organelles and stages of cell division
Textbooks:	
1	Rickwood, D and J.R.Harris Cell Biology: Essential Techniques, John Wiley 1996.
2	Davis, J.M. Basic Cell culture: A practical approach, IRL 1994.

3	Ganesh M.K. and Shivashankara A.R. 2012. Laboratory Manual for Practical Biochemistry Jaypee publications, 2ndEdn
4	Cell and Molecular Biology: A Lab Manual By K. V. Chaitanya
5	Cell Biology Genetics & Molecular Biology V K Aggarwal & Ps Verma
Reference Books:	
1	Essential practical handbook of Cell biology, Genetics and Microbiology -A Practical manual Debarati das Academic publishers, ISBN, 9789383420599, 2 nd Edition 2017
2	Cell biology Practical, Dr. Venu Gupta ISBN8193651219, Prestige publisher, 2 nd Jan 2018.
3	Cell and Molecular biology, De Robertis, 8th edition, 2 nd June, 1987
4	Cell And Molecular Biology : A Lab Manual Kindle Edition By <u>K. V. Chaitanya</u> (Author) Format: Kindle Edition
5	Cell Biology International Edition Author: Thomas D. Pollard, William C. Earnshaw, Jennifer Lippincott-Schwartz Publisher: Elsevier ISBN : 9780323417402
Web resources:	
1	http://amrita.olabs.edu.in/?sub=79&brch=18&sim=237&cnt=1
2	https://www.microscopemaster.com/organelles.html
3	https://www.microscopemaster.com/organelles.html
4	https://www.microscopemaster.com/organelles.html
5	https://www.khanacademy.org/science/ap-biology/heredity/meiosis-andgenetic-diversity/a/phases-of-meiosis

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	3	1	3	3	3	3
CO2	3	2	3	3	3	3	1	3	3	3	3
CO3	3	3	3	3	2	3	1	3	3	3	3
CO4	3	3	2	2	3	3	1	3	3	3	3
CO5	3	3	3	3	2	3	1	3	3	3	3
Total	15	15	15	15	12	15	5	15	15	10	13
Average	3	3	3	3	3	3	1	3	3	2	2.6

3-Strong 2 – Medium 1- low

1ST YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCA21	Allied-Biochemistry-II	Allied	3	1	0	0	4	4	25	75	100
Learning Objectives											
LO1	To understand the basics of metabolic pathways										
LO2	To understand the basics of metabolic pathways of amino acids										
LO3	To acquire knowledge on the various metabolic disorders										
LO4	To understand the importance of enzymes in the body										
LO5	To illustrate the biological significance of Hormones in the body										
Unit	Content									Hours	
1	CARBOHYDRATE METABOLISM -Metabolism-Catabolism and anabolism-Definition. Reactions of glucose oxidation Glycolysis, TCA cycle and its energetics, HMP shunt and its significance.									12	
2	AMINO ACID METABOLISM Amino acid transamination and Deamination, reaction, Urea cycle- Formation of urea, Biosynthesis of creatinine									12	
3	METABOLIC DISORDERS Diabetes mellitus- definition. Types and symptoms., Glycogen storage diseases. Inborn errors of amino acid metabolism- Phenylketonuria, Alkaptonuria (Black urine syndrome), and albinism									12	
4	ENZYMES 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)									12	
5	HORMONES- Definition and classification, mechanism of action, and biological functions of Insulin and glucagon, Sex hormones – testosterone and estrogen, menstrual cycle.									12	

CO	Course Outcomes
CO1	Students will be able to illustrate the reactions of various metabolic pathways in carbohydrates.
CO2	Students will be able to illustrate the reactions of various metabolic pathways in Amino acids
CO3	Student will be able to acquire knowledge on the various metabolic disorders
CO4	Student will be able to classify enzymes and explain their functions
CO5	Gain expertise in giving first aid for insect bites and chemical poisoning

Textbooks:	
1	Lehninger Principles of Biochemistry" by David L. Nelson and Michael M. Cox
2	Harper's Illustrated Biochemistry" by Peter J. Kennelly, Kathleen M. Botham, Owen McGuinness, and Victor W. Rodwell
3	Biochemistry" by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer
4	Textbook of Biochemistry with Clinical Correlations" by Thomas M. Devlin
5	Bioorganic Chemistry: Deoxynucleic Acid (DNA) Directed Synthesis of Polypeptides and Proteins" by Heinz G. Floss, Marvin J. Tsai, and J. Herbert Taylor
Reference Books:	
1	Biochemistry" by Matthew R. Hemming and Michael J. Berridge (Oxford University Press)
2	Clinical Biochemistry: An Illustrated Colour Text" by Michael A. Crook (Elsevier)
3	Textbook of Biochemistry with Clinical Correlations" by Thomas M. Devlin
4	Harper's Illustrated Biochemistry" by Peter J. Kennelly, Kathleen M. Botham, Owen McGuinness, and Victor W. Rodwell
5	Lehninger Principles of Biochemistry" by David L. Nelson and Michael M. Cox
Web resources:	
1	https://youtu.be/5p1inSjJtJQ
2	https://youtu.be/6xQ7uMzWjQw
3	https://youtu.be/G4fN1xL7W0Q
4	https://youtu.be/KlMoM6qNq8o
5	https://youtu.be/H4il5rZL5Xw

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	2	3	3
CO2	3	3	3	3	2	3	2	3	2	3	2
CO3	3	3	3	2	3	3	2	3	3	2	2
CO4	3	2	2	3	2	2	3	3	3	3	3
CO5	3	3	3	2	3	3	3	3	2	3	2
Total	15	14	14	13	13	14	13	15	12	14	13
Average	3.0	2.8	2.8	2.6	2.6	2.8	2.6	3.0	2.4	2.8	2.6

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCA22P	(Practical II) Allied Biochemistry	SEC-2	0	0	4	0	2	2	25	75	100
Learning Objectives											
LO1	Estimate protein quantitatively										
LO2	Prepare biomolecules from its sources										
LO3	Learn the chemical principles behind iodine value in reactions										
LO4	Learn the chemical principles behind saponification numbers in edible oil analysis.										
LO5	Learn the Interpret results in relation to oil quality and stability.										
Unit	Content									Hours	
1	. I Colorimetry a) Estimation of protein by Biuret method (a) b) Estimation of amino acid by Ninhydrin method.									6	
2	II. Biochemical preparations a) Preparation of casein from milk. b) Preparation of starch from potato. c)Preparation of albumin from egg									6	
3	III Group Experiment a) Determination of Iodine of an edible oil b) Determination Saponification number of an edible oil c) Determination of Acid value of an edible oil									6	

CO	Course Outcomes
CO1	Estimate protein by colorimetric method
CO2	Understand the principles of biochemical separation and purification techniques.
CO3	Check the quality of edible oil
CO4	Learn the methods for preparing and isolating biomolecules from natural sources.
CO5	Understand the significance of iodine and saponification numbers in edible oil analysis.
Textbooks:	
1	Laboratory manual in Biochemistry, J. Jayaraman, 2nd edition, New Age International Publishers, 2011,
2	An Introduction to Practical Biochemistry, David T. Plummer, 3 rd edition, Tata McGrawHill Publishing Company Limited, 2001.
3	Biochemical Methods, Sadasivam S and Manickam A, 4h edition, New Age

	International Publishers, 2016
4	Indrani TK. 2003. Nursing Manual of Nutrition and Therapeutic Diet, 1st edition Jaypee Brothers medical publishers.
5	S. Sadasivam A. Manickam Biochemical Methods New Age International Pvt Ltd publisher's third edition 2018
Reference Books:	
1	Biochemical Methods, Sadasivam S and Manickam A, 4h edition, NewAge International Publishers, 2016
2	Essentials of Food and Nutrition, Vol. I & II, M.S. Swaminathan.
3	Analytical Chemistry of Foods" by D. C. Nielsen Edition: 2nd
4	Harold Varley, Practical Clinical Biochemistry, CBS. 6 editions, 2006
5	Biochemical Tests – Principles and Protocols. Anil Kumar, SarikaGarg and NehaGarg. VinodVasishtha Viva Books Pvt Ltd, 2012.
Web resources:	
1	https://www.pdfdrive.com/instant-notes-analytical-chemistry-e912659.html 14
2	https://www.pdfdrive.com/analytical-biochemistry-e46164604.html
3	https://www.pdfdrive.com/biochemistry-books.html
4	https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf
5	https://www.elsevier.com/journals/clinical-biochemistry/0009-9120/guide-for-authors

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	3	1	3	3	3	3
CO2	3	2	3	3	3	3	1	3	3	3	3
CO3	3	3	3	3	2	3	1	3	3	3	3
CO4	3	3	2	2	3	3	1	3	3	3	3
CO5	3	3	3	3	2	3	1	3	3	3	3
Total	15	15	15	15	12	15	5	15	15	10	13
Average	3	3	3	3	3	3	1	3	3	2	2.6

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCS21	SEC – 3 First Aid	SEC	1	0	1	0	2	2	25	75	100
Learning Objectives											
LO1	Provide knowledge on the basics of first aid.										
LO2	Perform first aid during various respiratory issues.										
LO3	Demonstrate the first aid to treat injuries.										
LO4	Learn the first aid techniques to be given during emergency.										
LO5	Familiarize the first aid during poisoning.										
Unit	Content										Hours
1	Aims and important rules of first aid, dealing with emergency, types and content of a first aid kit. First aid technique – Dressing and Bandages, fast evacuation technique, transport techniques.										6 Hours
2	Basics of Respiration – CPR, first aid during difficult breathing, drowning, choking, strangulation and hanging, swelling within the throat.										6 Hours
3	Common medical aid- first aid for wounds, cuts, head, chest, Abdominal injuries, shocks and burns.										6 Hours
4	First aid related to unconsciousness, stroke, fits, convulsions- seizures, epilepsy.										6 Hours
5	First aid in poisonous bites (Insects and snakes), honey bee stings, animal bites, disinfectant, acid and alkali poisoning.										6 Hours

CO	Course Outcomes
CO1	Discuss the rules of first aid, dealing during emergency and first aid techniques
CO2	Understand the first aid techniques to be given during different types of respiratory problems
CO3	Provide first aid for injuries, shocks and bone injury
CO4	Detail on the first aid to be given for unconsciousness, stroke, fits and convulsions
CO5	Gain expertise in giving first aid for insect bites and chemical poisoning

Textbooks:	
1	First Aid and Emergency Care, Dr. R. L. Bijlani, Dr. S. Manjunath: Jaypee Brothers Medical Publishers, 2015
2	First Aid and Emergency Nursing Poonam Malhotra CBS Publishers & Distributors Pvt. Ltd., 2018
3	Handbook of First Aid Dr. R. S. Gokhale, Vora Medical Publications, 2019
4	First Aid Manual for Nurses, P. Jeevanandham, Jaypee Brothers Medical Publishers, 2020
5	The First Aid Handbook, Your one-stop reference guide by Adejobi Adeloye

Reference Books:	
1	First Aid for Medical Emergencies, Dr. P. R. Goyal, CBS Publishers & Distributors Pvt. Ltd. 2021
2	Practical First Aid Dr. K. Srinivas, Paras Medical Publisher, 2016
3	Essentials of First Aid and Emergency Care, Dr. Anil Kumar, Dr. N. Sharma Jaypee Brothers Medical Publishers, 2018
4	Emergency First Aid: A Quick Reference Guide, Dr. R. Gupta, Lotus Publishers 2019
5	Emergency Care and First Aid, Dr. K. S. Venkatesh, AITBS Publishers 2020
Web resources:	
1	https://www.firstaidforfree.com/the-aims-of-first-aid-three-ps/
2	https://www.youtube.com/watch?v=qt94qmBcv-o
3	https://www.youtube.com/watch?v=4e7evinsfm0
4	https://www.youtube.com/watch?v=vSnRdmR6xcE
5	https://www.youtube.com/watch?v=01Po5RTNfhs

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	3	3	3	3	3	2
CO2	3	3	3	2	3	3	3	2	3	2	3
CO3	3	2	3	3	3	2	3	3	3	2	3
CO4	3	3	3	2	2	3	2	3	3	3	2
CO5	3	2	3	2	3	3	3	3	3	2	3
Total	14	13	15	12	13	14	14	14	15	12	13
Average	2.8	2.6	3	2.4	2.6	2.8	2.8	2.8	3	2.4	2.6

3 – Strong, 2- Medium, 1- Low

SCHEME OF VALUATION
CHEMISTRY PRACTICAL FOR PHYSICAL AND
BIOLOGICAL SCIENCES - II
(For Biochemistry and ND (FSM) – I year/II Semester)

Internal assessment	: 25 Marks
External assessment	: 75 Marks
Total	: 100 Marks
Max. Marks	: 75 Marks
Record	: 15 Marks
Organic Analysis	: 60 Marks

Organic Analysis	: 60 Marks
Preliminary Test	: 8 Marks
Aliphatic or Aromatic	: 7 Marks
Saturated or unsaturated	: 7 Marks
Tests for elements	: 9 Marks
Confirmation Tests	: 12 Marks
Functional groups	: 10 Marks
Derivative/Coloured reaction	: 7 Marks

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCC31	CC- Biophysical and Biochemical Techniques	Core	3	1	2	0	5	6	25	75	100
Learning Objectives											
LO1	To introduce the basic principles, types, and applications of electrochemical and centrifugation techniques.										
LO2	To provide an understanding of the underlying principles of chromatographic techniques.										
LO3	To demonstrate experimental skills in various electrophoretic techniques.										
LO4	To appraise the use of colorimetric and spectroscopic techniques in biology.										
LO5	To impart knowledge about the measurement of radioactivity and safety aspects of radioactive isotopes.										
Unit	Content									Hours	
1	Electrochemical and centrifugation technique Measurement of pH, pOH Henderson Hesselbalch equation, Molarity, Molality, and Normality. Examples for preparing solutions (1N, 1 M solutions, etc.) standard Hydrogen electrode, Buffers-Definition, type of Buffers, role of buffers in biological system. Centrifugation - Basic principles, RCF, Sedimentation coefficient, Svedberg constant. Types of rotors. Preparative centrifugation- differential and density gradient centrifugation, types.									18	
2	Chromatography technique Chromatography - adsorption, partition. Principle, instrumentation, and applications of paper chromatography, thin layer chromatography, ion exchange chromatography, gel permeation chromatography and affinity chromatography.									18	
3	Electrophoresis technique Electrophoresis –General principles, factors affecting electrophoretic mobility. Tiselius moving boundary electrophoresis. Electrophoresis with paper, starch, and Iso Electric focusing. Principle, instrumentation and applications of agarose gel electrophoresis and SDS PAGE.									18	
4	Spectroscopy technique: Basics of Electromagnetic radiations- Energy, wavelength, wavenumber, and frequency. Absorption and emission spectra, Lambert-Beer Law, Light absorption and transmittance. Colorimetry-Principle, instrumentation and applications. UV and Visible spectrophotometry, atomic absorption spectroscopy.									18	

5	Radioactivity technique: Radioactivity - Types of Radioactive decay, half-life, units of radioactivity, Detection, and measurement of radioactivity - Geiger Muller Counter. Solid & Liquid scintillation counters. Autoradiography. Biological applications and safety aspects of radioisotopes.	18
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CO	The students will be able to	Course Outcomes
CO1	Demonstrate knowledge of the types of rotors and centrifugation technique for separating biomolecules and electrochemical techniques.	
CO2	Demonstrate the principles, operational procedure, and application of chromatography techniques.	
CO3	Separate DNA and protein using the electrophoretic technique.	
CO4	State Beer's Law and illustrate the instrumentation and uses of colorimeter and spectrophotometer.	
CO5	Enumerate various methods of measurement of radioactivity and safety aspects of radioactive isotopes.	

Textbooks:	
1	Avinash Upadhyay, Kakoli Upadhyay & Nirmalendu Nath 2002, Biophysical Chemistry, Principles and Techniques, 3rd edition, Himalaya Publishing House.
2	L.Veerakumari, 2009, Bioinstrumentation, 1st edition, MJP Publishers.
3	Keith Wilson & John Walker, 2000, Practical Biochemistry-Principles and techniques, Cambridge University Press, 4th edition
4	Biochemistry Laboratory: Modern Theory and Techniques" by Richard I. Gumport and Gary D. Stoner (2015)
5	Biochemical Techniques: Theory and Practice" by C. A. Burtis and E. R. Ashwood (2019)
Reference Books:	
1	Terrance G. Cooper the tools of Biochemistry, 1977, John Wiley & Sons, Singapore.
2	Guru Mani, Research Methodology for Biological Sciences, 2011, 1st edition, MJP Publishers.
3	Saroj Dua, Neera Garg, Biochemical Methods of Analysis, 2010, 1st edition, Narosa Publishing house.
4	Biochemical Techniques: Theory and Practice" by C. A. Burtis and E. R. Ashwood (2019)
5	Biochemical Methods: A Concise Guide" by Andrew F. Rowan (2017)
Web resources:	
1	1. https://www.britannica.com/science/chromatography
2	2. https://www.youtube.com/watch?v=xgxFBQZYXIE
3	3. https://www.youtube.com/watch?v=7onjVBsQwQ
4	https://www.toppr.com/guides/physics/electromagnetism/electromagnetic-radiation/
5	https://decodingbiosphere.com/2371-2/radioactivity-types-measurement/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	3	3	3	3	2
CO2	2	2	2	2	3	3	3	2	3	2	3
CO3	2	2	2	2	2	2	3	3	3	2	3
CO4	2	2	3	3	2	3	2	3	3	3	2
CO5	3	3	3	3	2	3	3	3	3	2	3
Total	12	11	13	13	11	14	14	14	15	12	13
Average	2.8	2.6	3	2.4	2.6	2.8	2.8	2.8	3	2.4	2.6

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCC32P	Core Practical III- Colorimetric analysis Biochemical and Buffer Preparations	Core	0	0	4	0	2	4	25	75	100
Learning Objectives											
LO1	Estimate the amount of Biological Macromolecules.										
LO2	Preparation of biological molecule.										
LO3	Preparation of various buffers.										
I	Colorimetry techniques 1. Estimation of amino acid by Ninhydrin method. 2. Estimation of protein by Biuret method. 3. Estimation of DNA by Diphenylamine method. 4. Estimation of RNA by Orcinol method.									28	
II	Biochemical Preparations 1. Preparation of Starch from Potato. 2. Preparation of Casein from Milk. 3. Preparation of Lactalbumin from Milk.									12	
III	Buffer preparation Citrate buffer Tris Buffer Phosphate buffer									16	
IV	Clinical Preparation Preparation of Normal, Molar and Percentage Solution									4	

Course Outcomes	
CO	The students will be able to
CO1	Estimate the amount of biomolecules by Colorimetric method.
CO2	Estimate the important biochemical constituents in various sample.
CO3	Prepare buffer for Biochemical analysis.

Textbooks:	
1	Harold varley,2005 Practical Clinical Biochemistry,Fourth Edition.
2	S.Sadasivam and A, Manickam,Biochemical Methods, Second Edition
3	Beedu Sashidhar Rao,Vijiay Deshpande,Experimental Biochemistry,2005
Reference Books:	
1	Biochemical Techniques: Theory and Practice" by C. A. Burtis and E. R. Ashwood (2019)
2	Biochemical Methods: A Concise Guide" by Andrew F. Rowan (2017)
3	Practical Biochemistry: Principles and Techniques" – Keith Wilson and John Walker
4	Biochemical Methods" – S. Sadasivam and A. Manickam
Web resources:	
1	https://drive.google.com/drive/folders/17teC8hUgF7fkOVFn8bvGTRN28ayoEmXL?usp=drive_link – eBooks google drive
2	https://tvuni.academia.edu/mvinayagam - Educational networks to share research, knowledge, teaching documents, chapters, e-notes, e-books, thesis, materials.

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	2	3	3	3	3
CO2	3	2	3	3	2	3	2	2	3	2	3
CO3	3	2	3	3	2	3	2	2	3	3	3
CO4	3	3	3	2	2	3	2	2	3	3	3
CO5	3	2	3	2	2	3	2	2	3	3	3
Total	15	11	15	13	10	15	10	11	15	14	15
Average	3.0	2.2	3.0	2.6	2.0	3.0	2.0	2.2	3.0	2.8	3.0

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCA31	Elective Course Microbiology -1	EC	4	0	0	0	4	4	25	75	100
Learning Objectives											
LO1	To learn the History and Evolution of Microbiology.										
LO2	To describe the structural organization, morphology and reproduction of microbes.										
LO3	To explain the methods of cultivation of bacteria.										
LO4	To understand the microscopy and staining techniques.										
LO5	To compare and contrast the different methods of sterilization.										
Unit	Content									Hours	
1	History and Evolution of Microbiology -Classification – Three kingdoms, five kingdoms and eight kingdoms. Spontaneous generation – Biogenesis Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Elie Metchnikoff and Fleming.									12	
2	General Characteristics of Microorganisms - Bacteria, Algae, Fungi, Viruses and Protozoa. Differences between prokaryotic and eukaryotic microorganisms. Anatomy of prokaryotes - cell wall, cytoplasmic membrane, cilia, flagella capsule, cytoplasmic inclusions, sporulation									12	
3	Bacterial Growth -Methods of bacterial growth rate, Generation time, growth curve, Measurement of bacterial growth, Bacterial culture media preparation liquid, solid, semi-solid culture preparation, and pure culture techniques. Anaerobic culture techniques									12	
4	Microscopy –Principle, magnifying power, Resolving Power, Numerical aperture (NA), Instrumentation, Methods, Applications, Advantages, disadvantages of Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM & SEM. Staining methods.									12	
5	Sterilization Techniques - methods of sterilization- Physical, Chemical, and Disinfection. Antimicrobial chemotherapy, Chemotherapeutic agents, antimetabolites, antimicrotubule agents, history of cancer treatment, resistance of antimicrobial chemotherapy tests for sensitivity to antimicrobial agents.									12	

CO	The students will be able to	Course Outcomes
CO1	Appreciate the historical events that led to the discoveries and inventions and understand the Classification of Microorganisms.	
CO2	Demonstrate Knowledge of detailed structure and functions of prokaryotic cell organelles.	
CO3	Examine various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.	
CO4	Demonstrate the principles and working mechanism of different microscopes/Microscope, their function and scope of application.	
CO5	Illustrate the concept of asepsis and modes of sterilization and disinfectants.	

Textbooks:	
1	Pelczar. M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7thEdition., McGraw – Hill, New York.
2	Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott’s Microbiology. 10th Edition., McGraw-Hill International edition.
3	Salle. A.J (1992). Fundamental Principles of Bacteriology. 7thEdition., McGraw Hill Inc. New York.
4	Boyd, R.F. (1998). General Microbiology,2ndEdition., Times Mirror, Mosby College Publishing, St Louis.
5	Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13th Edition Benjamin-Cummings Pub Co
Reference Books:	
1	Jeffrey C. Pommerville., Alcamo’s Fundamentals of Microbiology (9thEdition). Jones & Bartlett learning 2010.
2	Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5thEdition., MacMillan Press Ltd
3	Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11thEdition., Benjamin Cummings.
4	Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5thEdition., McGraw Hill Publications.
5	Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13th Edition Benjamin-Cummings Pub Co
Web resources:	
1	https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology
2	https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp
3	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#
4	https://bio.libretexts.org/@go/page/9188
5	https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-nutrition/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	2	3	3	3	3
CO2	3	2	3	3	2	3	2	2	3	2	3
CO3	3	2	3	3	2	3	2	2	3	3	3
CO4	3	3	3	2	2	3	2	2	3	3	3
CO5	3	2	3	2	2	3	2	2	3	3	3
Total	15	11	15	13	10	15	10	11	15	14	15
Average	3.0	2.2	3.0	2.6	2.0	3.0	2.0	2.2	3.0	2.8	3.0

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCA32	Elective -II Nutrition through life cycle	EC	4	0	0	0	4	4	25	75	100
Learning Objectives											
LO1	To recall the five food groups and their importance in a balanced diet.										
LO2	To understand the role of nutrition in pregnancy and lactation.										
LO3	To gain insight into the principles of effective meal planning for infants and preschool children.										
LO4	To understand the nutritional needs of school children and adolescence.										
LO5	To acquire skills to plan diets for old age.										
Unit	Content										Hours
1	Introduction to Nutrition: - Food groups and balanced diet. Novel Foods. The calorific value of foods: Direct and indirect calorimetry. Empty calories. Basal metabolic rate: Factors affecting BMR. SDA and physical activity. Calculation of the day's energy requirement.										12
2	Nutrition during infancy- Growth and development, growth standards, food and nutritional requirements, breastfeeding, artificial feeding, low birth weight babies, complementary feeds. Nutrition for preschool children- Growth and development, food and nutritional requirements, eating habits food behaviors, nutrition-related problems-PEM, VAD and their dietary interventions										12
3	Nutrition for school children- Growth pattern, Nutritional requirements, the importance of healthy snacks, factors affecting eating habits, and school lunch. Nutrition during adolescence Growth and development, nutritional requirements, food habits. nutritional problems –obesity, underweight, anemia, menstrual problems and eating disorders.										12
4	Nutrition during pregnancy- Physiological demands of pregnancy, nutritional needs, and effect of nutrition on pregnancy outcome, optimal weight gain, nutrition-related problems in pregnancy, complications of pregnancy. Nutrition during lactation- Physiology of lactation, nutritional requirements, concerns of the breastfeeding mother										12
5	Nutrition for old age - Physiological Changes in elderly, food and nutritional requirements, nutritional and health concerns in old age, healthy lifestyle.										12

CO	The students will be able to	Course Outcomes
CO1	Explain the physiological basis for nutritional needs through the human lifecycle	
CO2	Identify nutrition-related concerns and deficiency disorders during pregnancy and lactation.	
CO3	Discuss appropriate dietary guidelines for infants and preschool children.	
CO4	Develop Indigenous, value-added and low cost complementary feeds school children and adolescence.	
CO5	Demonstrate skills to plan and prepare appropriate and sustainable diets Old age.	

Textbooks:	
1	SrilakshmiB. (2011) Dietetics, sixth edition, Newage Publishing Press, New Delhi.
2	Gopalan, C., Ramanathan, P.V. Balasubramanian, S.C. (2001) Nutritive value of Indianfoods, NIN, Hyderabad.
3	Longvah T, Ananthan R, Bhaskar K, Venkaiah K. (2017) Indian Food Composition Tables, National Instituteof Nutrition
4	Abraham S, Nutrition through Lifecycle. (2016)1stedition, New age international publishers, New Delhi.
5	Stacy N, William’s Basic Nutrition and Diet Therapy.(2005)12thedition,Elsevier publications, United Kingdom.
Reference Books:	
1	Whitney EN and Rolfes SR, Understanding Nutrition. (2002) 9 th edition West / Wordsworth, London.
2	Groff JL, Gropper SS, Advanced Nutrition and Human Metabolism. (2000) 3 rd edition, West/ Wadsworth, United Kingdom.
3	Groff JL, Gropper SS, Advanced Nutrition and Human Metabolism. (2000) 3 rd edition, West/ Wadsworth, United Kingdom.
4	Cataldo, DeBruyne and Whitney, Nutrition and Diet therapy–Principles and Practice. (1999) 5 th edition, West/ Wadsworth, London.
5	Stacy N, William’s Basic Nutrition and Diet Therapy. (2005) 12 th edition, Elsevier publication s, United Kingdom.
Web resources:	
1	http://vikaspedia.in/health/nutrition/dietary-guidelines-1/dietary-guideline-1
2	https://www.nhp.gov.in/healthyliving/healthy-diet
3	https://motherchildnutrition.org/india/complementary-feeding-guidelines.html
4	http://vikaspedia.in/health/nutrition/dietary-guidelines-1/diet-for-children-andadolescents
5	https://motherchildnutrition.org/india/complementary-feeding-guidelines.html

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	3	3	3	3	2
CO2	2	2	2	2	3	3	3	2	3	2	3
CO3	2	2	2	2	2	2	3	3	3	2	3
CO4	2	2	3	3	2	3	2	3	3	3	2
CO5	3	3	3	3	2	3	3	3	3	2	3
Total	12	11	13	13	11	14	14	14	15	12	13
Average	2.8	2.6	3	2.4	2.6	2.8	2.8	2.8	3	2.4	2.6

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hour	Marks		
									CIA	External	Total
24UBCA33P	EC-5 1. Practical- Microbiology-I	EC	0	0	2	0	2	2	25	75	100
Learning Objectives											
LO1	To acquire knowledge on cleaning of glass wares and sterilization.										
LO2	To gain knowledge on simple and compound microscope.										
LO3	To learn the pure culture technique, media preparation and staining.										
LO4	To learn the microscopic techniques and staining methods.										
LO5	To acquire knowledge to isolate the microorganisms from the environment										
Unit	Content	Hours									
1	Cleaning of glass wares, Microbiological good laboratory practice and safety. Sterilization of glass wares and media.	30 Hours									
2	Microscope simple and compound microscope										
3	Staining techniques: smear preparation, simple staining and Gram's staining										
4	Fungal identification by Lactophenol cotton blue staining technique.										
5	Isolation of microorganisms from air, soil and sewage. Testing the quality of milk – MBRT										
CO	The students will be able to	Course Outcomes									
CO1	Practice sterilization methods.										
CO2	Understand microscopy methods.										
CO3	Prepare streak plate, pour plate and serial dilution and pigment production of microbes.										
CO4	Apply Microscopy methods, different Staining techniques and motility test.										
CO5	Acquire knowledge to isolate bacteria from the environment.										
Textbooks:											
1	James G Cappucino and N. Sherman MB (1996). A lab manual Benjamin Cummins, New York 1996.										
2	Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.										
3	Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.										
4	Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ltd., Publishers, New Delhi										
5	R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.										

Reference Books:	
1	R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.
2	Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India
3	Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS
4	Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication.
5	Lim D. (1998). Microbiology, 2nd Edition, WCB McGraw Hill Publications
Web resources:	
1	http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403
2	https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635
3	https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf
4	https://microbiologyinfo.com/top-and-best-microbiology-books/
5	https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	2	2	3	3	3
CO2	3	3	3	3	2	3	2	2	3	3	3
CO3	3	3	3	3	2	3	2	2	3	3	3
CO4	3	3	3	3	2	3	2	2	3	3	3
CO5	3	3	3	3	2	3	2	2	3	3	3
Total	15	15	3	14	10	3	10	10	15	15	15
Average	3.0	3.0	3.0	2.8	2.0	3.0	2.0	2.0	3	3	3

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCA34P	2. Practical-Nutrition	Elective	0	0	2	0	2	2	25	75	100
Learning Objectives											
LO1	To assess Nutritional Status.										
LO2	To plan and prepare diets for deficiency diseases.										
LO3	To plan and prepare diets for various stages.										
LO4	To learn ashing of food and preparation of ash solution.										
I	1. Assessment of Nutritional Status a. Body Composition parameters b. Circumference measurements c. Clinical signs d. Dietary assessment									12	
II	Planning and preparation of diets for deficiency diseases a. PEM b. Vitamin A deficiency c. Nutritional anaemia									12	
III	3. Planning and preparation of diets for the following a. Complementary feed b. Pre-school child c. School going children d. Adolescents e. Adult f. Expectant mother g. Nursing mother h. Oldage									12	
IV	4. Ashing of food and preparation of ash solution a. Estimation of moisture content of foods b. Estimation of calcium food									12	

CO	The students will be able to	Course Outcomes
CO1	Assess the nutritional status using various clinical parameters.	
CO2	Calculate nutritional requirements and select appropriate food sources.	
CO3	Select appropriate food sources to meet nutritional needs to create diet plans for various life stages.	
CO4	Analyze data and interpret results from nutrient estimation experiments.	
Textbooks:		
1	Harold varley,2005 Practical Clinical Biochemistry,Fourth Edition.	
2	S.Sadasivam and A, Manickam,Biochemical Methods, Second Edition	
3	Beedu Sashidhar Rao,Vijiay Deshpande,Experimental Biochemistry,2005	
Reference Books:		
1	Biochemical Techniques: Theory and Practice" by C. A. Burtis and E. R. Ashwood (2019)	
2	Biochemical Methods: A Concise Guide" by Andrew F. Rowan (2017)	
3	Practical Biochemistry: Principles and Techniques" – Keith Wilson and John Walker	
4	Biochemical Methods" – S. Sadasivam and A. Manickam	
Web resources:		
1	https://drive.google.com/drive/folders/17teC8hUgF7fkOVFn8bvGTRN28ayoEmXL?usp=drive_link – eBooks google drive	
2	https://tvuni.academia.edu/mvinayagam - Educational networks to share research, knowledge, teaching documents, chapters, e-notes, e-books, thesis, materials.	

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	2	3	3	3	3
CO2	3	2	3	3	2	3	2	2	3	2	3
CO3	3	2	3	3	2	3	2	2	3	3	3
CO4	3	3	3	2	2	3	2	2	3	3	3
Total	12	9	12	11	08	12	8	9	12	11	12
Average	3.0	2.2	3.0	2.7	2.0	3.0	2.0	2.2	3.0	2.7	3.0

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCS31	Skill Enhancement Course: Biochemical Pharmacology	SEC	1	0	1	0	2	2	25	75	100
Learning Objectives											
LO1	To provide the basic concepts of pharmacology.										
LO2	To give the knowledge in metabolism of drugs and factors responsible for metabolism.										
LO3	To acquire the concepts in the adverse response and side effects of drugs.										
LO4	To make the understanding about the action of antibiotics.										
LO5	To provide the importance and values of traditional medicine.										
Unit	Content	Hours									
1	Basics of Drug concepts: Drugs – classification based on sources, routes of drug administration - Oral/Enteral, Parenteral and Local application.	6									
2	Drug Metabolism: Absorption of drugs, factors influencing drug absorption, distribution and excretion of drugs. Drug metabolism - Phase I and Phase II reactions, role of cytochrome P450.	6									
3	Negative impact of Drugs: Drug allergy, Drug tolerance, Drug addiction, Drug abuses and their biological effects. Drug resistance - biochemical mechanism.	6									
4	Antibiotic Drugs: Antibiotics - Definition, Examples and Biochemical mode of action of penicillin, streptomycin	6									
5	Therapeutic Drugs in Traditional Medicine: Therapeutic drugs in Ayurveda, Siddha and Unani for Diabetes mellitus and Obesity, Cancer.	6									

CO	The students will able to	Course Outcomes
CO1	Classify the different routes of drug administration, describe the absorption, distribution, metabolism and excretion of drugs.	
CO2	Illustrate the metabolism of drugs, classify the microsomal and non-microsomal reactions and explain the role of cytochromes.	
CO3	Demonstrate knowledge as the various adverse effects of drugs.	
CO4	Highlight the importance and explain the mode of action of important antibiotics.	
CO5	Justify the use and significance of traditional medicine.	

Textbooks:	
1	N.Muruges, A concise text book of Pharmacology –Sathya Publishers.
2	Jayashree Ghosh, A Textbook of Pharmaceutical chemistry –S. Chand & Company Ltd.
3	S C Mehta, AshutoshKar, Pharmaceutical Pharmacology –New Age International (P) Limited, Publishers.
4	Thieme's Color Atlas of Pharmacology by Heinz Lullmann https://drive.google.com/file/d/17cobo-ZXQU1rdG5uZk4rX1Xc69nUZx7a/view?usp=drive_link
5	VN Sharma, Pharmacology for Health Professionals ANZ Book. By Kathleen Knights. CBSPD (2015)
Reference Books:	
1	Lippincott Illustrated Reviews: Pharmacology: Edited by Karen Whalen, 2 nd South Asian Edition https://drive.google.com/file/d/1azL_Y0awUWdOGtMeSKpfE40hD8i9te-K/view?usp=drive_link
2	David. E. Golan, Principles of Pharmacology, Wolters Kluwer (India) Pvt.Ltd.
3	R.S. Satoskar, S. B. Elsevier Pharmacology and pharmacotherapy. - ISBN-10: 9788131248867 / ISBN-13: 978-8131248867, 2017.
4	Tripathi, K.Essentials of Medical Pharmacology. Jaypee Publishers- ISBN-10: 9350259370 / ISBN-13: 978-9350259375.2018.
5	Essentials of Pharmacology Basic Principles and General Concepts (Fifth Edition)
Web resources:	
1	https://slideplayer.com/slide/3728296/64/video/What+is+bioremediation%3F.mp4
2	https://tvuni.academia.edu/mvinayagam - Educational networks to share research, knowledge, teaching documents, chapters, e-notes, e-books, thesis, materials.
3	https://ncert.nic.in/textbook.php
4	National Digital Library - https://ndl.iitkgp.ac.in/
5	https://efaidnbmnnnibpcajpcgclefindmkaj/https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/health_science_students/pharmacology.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	2	3	3	3	3	1
CO2	3	3	3	3	3	3	2	3	3	3	3
CO3	3	2	1	3	3	2	3	3	3	2	3
CO4	3	2	3	3	3	2	2	3	3	3	2
CO5	3	2	3	3	3	3	3	3	3	3	3
Total	15	11	13	15	15	12	13	15	15	15	12
Average	3	2.2	3	2.6	3	2.4	2.6	3	3	3	2.4

3 – Strong, 2- Medium, 1- Low

II YEAR: IVth SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCC41	CC-7 Enzymes	Core	3	1	2	0	5	6	25	75	100
Learning Objectives											
LO1	Provide fundamental knowledge on enzymes and their properties.										
LO2	Understand the mechanism of action of enzymes and the role of coenzymes in catalysis.										
LO3	Introduce the kinetics of enzymes and determine the Km and Vmax.										
LO4	Explain the effect of inhibitors on enzyme activity										
LO5	Understand the role of enzymes in clinical diagnosis and industries.										
Unit	Content									Hours	
1	Enzymes and Classification Nomenclature and Classification based on IUB with examples, intracellular localization of enzymes, Isolation and purification of enzymes, enzyme as catalyst-Activation energy, Enzyme specificity-absolute, Group, linkage and stereospecificities. Non-protein enzymes – Ribozymes, abzymes. Concept of Active site, Lock and key hypothesis and induced fit theory, Enzyme expression Units-IU, turnover number, katal and specific activity..									18	
2	Enzyme kinetics Enzyme kinetics-Definition of kinetics, Factors affecting enzyme activity - temperature, pH, substrate and enzyme concentration, activators-cofactors, Derivation of Michaelis-Menten equation for uni-substrate reactions, Lineweaver-Burk plot, Eadie-Hofstee plot. Significance of Km and V max and their determination using the plots.									18	
3	Enzyme inhibition Enzyme inhibition - Reversible and irreversible inhibition-types of reversible inhibitors, competitive, non-competitive, and uncompetitive inhibitors. Graphical representation by L-B plot (Kinetic derivations not required), Determination of Km and Vmax in the presence and absence of inhibitors. Allosteric enzymes: Sigmoid curve, positive and negative modulators.									18	
4	Mechanism of enzyme catalysis Acid-base catalysis, covalent catalysis, electrostatic catalysis, metal ion Catalysis, proximity and orientation effect. Coenzymes -Definition, types, coenzymatic forms of vitamins- NAD/NADP, FAD, FMN, Coenzyme A, TPP, PLP. Multienzyme complexes – Pyruvate dehydrogenase complex. Isoenzyme with reference to LDH and CK.									18	

5	Applications of enzymes Immobilized enzymes - methods of immobilization, adsorption, covalent Bonding, cross-linking, encapsulation, entrapment and applications of immobilized enzymes. Biosensors – e.g., Glucose sensors. Industrial applications of enzymes –Food, textile and pharmaceutical Industries.	18
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CO	Course Outcomes The students will be able to
CO1	Identify the major classes of enzymes, differentiate between a Chemical catalysts and biocatalysts and defined the units of enzymes.
CO2	Explain the mechanism of enzyme catalysis and the role of coenzymes in enzyme action.
CO3	Illustrate the steady state kinetics, interpret the MM plot and LB plot based on kinetics data, and determine Km and Vmax.
CO4	Distinguish the types of inhibition along with their importance in Biochemical reactions.
CO5	Comprehend the various methods for the production of immobilized Enzymes and discuss the application of enzymes in clinical diagnosis and various industries.

Text books:

1	U.Sathyannarayana & U.Chakrapani, 2013, Biochemistry, 4th edition, Elsevier India Pvt. Ltd., Books & Allied Pvt. Ltd..
2	Dr. G.R Agarwal, Dr. Kiran Agarwal & O.P. Agarwal, 2015, Textbook of Biochemistry (Physiological chemistry), 18th edition, Goel Publishing House,
3	T.Devasena, 2010, Enzymology, 1st edition, Oxford University Press.
4	R.K. Murray, D.K. Granner, P.A. Mayes, D.W. Rodwell (2006), Harper's Biochemistry, twenty fifth edition, Prentice Hall, New Jersey.
5	A.C. Deb (2001), Fundamentals of Biochemistry, New Central Book Agency Pvt., Ltd., Calcutta.

Reference Books:

1	Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox. W.H. Freeman, 2001
2	Biochemistry, Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, W.H. Freeman Excellent (2001)
3	Harper's Illustrated Biochemistry, Victor W. Rodwell, David Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil, McGraw-Hill Education., (2005)
4	Voet.D, Voet.J.G. and Pratt, C.W, 2004, Principles of Biochemistry, 4th edition John Wiley & Sons, Inc
5	Zubay G.L, et.al. 1995, Principles of Biochemistry, 1st edition, Wm C. Brown Publishers.

Web resources:

1	https://www.google.com/search .
2	https://www.google.com/search
3	https://igntu.ac.in/eContent/BSc-Zoology-04Sem-DrPoonamSharma-Bioenergetics%20and%20metabolism-fatty%20acid.pdf
4	https://www.slideserve.com/mprasadnaidu/amino-acid-metabolism
5	https://bio.libretexts.org/Bookshelves/Biochemistry/Fundamentals_of_Biochemistry_(Jakubowski_and_Flatt) .

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	3	3	3	3	2
CO2	2	2	2	2	3	3	3	2	3	2	3
CO3	2	2	2	2	2	2	3	3	3	2	3
CO4	2	2	3	3	2	3	2	3	3	3	2
CO5	3	3	3	3	2	3	3	3	3	2	3
Total	12	11	13	13	11	14	14	14	15	12	13
Average	2.8	2.6	3	2.4	2.6	2.8	2.8	2.8	3	2.4	2.6

3 – Strong, 2- Medium, 1- Low

II YEAR: IVth SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCC42P	CC - 8 (Practical) Enzyme assays, Renal Functional Test and Liver Functional Test	Core	0	0	4	0	2	4	25	75	100

Learning Outcomes

LO1	To understand the principle and chemistry behind the colorimetric estimation of Biomolecules..										
LO2	To understand the basic principles of enzyme kinetics and the factors influencing enzyme activity.										
I	COLORIMETRIC ESTIMATION 1. Estimation of creatinine by Jaffe's method. 2. Estimation of urea by the Diacetyl monoxime method. 3. Estimation of glucose by the Folin-Wu method 4. Estimation of glucose by the O- O-Toluidine method									28	
II	EXPERIMENTS ON ENZYMES 1. Effect of pH on Amylase Activity 2. Effect of , temperature on Amylase Activity 3. Effect of Substrate Concentration on Amylase Activity 4. Effect of pH on Urease Activity 5. Effect of , temperature on Urease Activity 6. Effect of Substrate Concentration on Urease Activity 7. Assay of activity of alkaline phosphatase in serum. 8. Assay of serum Transaminases (SGOT, SGPT).									32	

CO	The students will be able to	Course Outcomes
CO1	Explain the working principle and applications of colorimetric analysis in biochemical estimations.	
CO2	Explain the kinetic properties and catalytic behavior of enzymes.	

Textbooks:

- 1 | Enzymes: Biochemistry, Biotechnology, Clinical Chemistry Author: Trevor Palmer
- 2 | Fundamentals of Enzymology, Authors: Nicholas C. Price and Lewis Stevens

Reference Books:

- 1 | Biochemical Techniques: Theory and Practice" by C. A. Burtis and E. R. Ashwood (2019)
- 2 | Biochemical Methods: A Concise Guide" by Andrew F. Rowan (2017)
- 3 | Practical Biochemistry: Principles and Techniques" – Keith Wilson and John Walker
- 4 | Biochemical Methods" – S. Sadasivam and A. Manickam

Web resources:

1	https://drive.google.com/drive/folders/17teC8hUgF7fkOVFn8bvGTRN28ayoEmXL?usp=drive_link – eBooks Google Drive
2	https://tvuni.academia.edu/mvinayagam - Educational networks to share research, knowledge, teaching documents, chapters, e-notes, e-books, thesis, and materials.

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	2	3	3	3	3
CO2	3	2	3	3	2	3	2	2	3	2	3
CO3	3	2	3	3	2	3	2	2	3	3	3
CO4	3	3	3	2	2	3	2	2	3	3	3
CO5	3	2	3	2	2	3	2	2	3	3	3
Total	15	11	15	13	10	15	10	11	15	14	15
Average	3.0	2.2	3.0	2.6	2.0	3.0	2.0	2.2	3.0	2.8	3.0

3 – Strong, 2- Medium, 1- Low

II YEAR IVth SEMESTER

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
24UBCA41	EC-6 Microbiology II	Elective Generic /Discipline Specific Elective II	3	1	0	0	4	4	25	75	100
Course Objectives											
CO1	Learn the Bacterial and fungal diseases										
CO2	Understand the viral diseases.										
CO3	Impart knowledge about the Environmental Microbiology.										
CO4	Acquire knowledge about the Food Microbiology										
CO5	Familiarize the biofertilizers and biopesticides										
UNIT	Details										No. of Hours
1	Bacterial diseases – Host microbe interaction, Normal flora, Virulence factors, nosocomial infections. <i>Staphylococcus aureus</i> , <i>Streptococcus pneumoniae</i> , <i>Bacillus anthracis</i> , <i>Clostridium tetani</i> , <i>Corynebacterium diphtheriae</i> – <i>Tuberculosis</i> , <i>Salmonella typhi</i> , <i>Shigella dysenteriae</i> , <i>Vibrio cholera</i> , Fungal diseases – Superficial & cutaneous mycoses, subcutaneous mycoses and opportunistic mycosis										12
2	Viral diseases – Structure and composition of viruses – DNA viral disease – chicken pox, small pox, hepatitis B– RNA viral disease – influenza, measles, mumps, poliovirus, AIDS, dengue.										12
3	Microbiology of Air–Sources of airborne organisms, Airborne diseases. Waterborne diseases; Purification of water. Sewage treatment – Physical, Chemical and Biological methods.										12
4	Sources of contamination and spoilage of foods; Food Preservation; Fermentation products - Bread and Alcoholic beverages (Beer & Wine); Fermented dairy products–Cheese & Yogurt. SCP-Spirulina and Mushroom.										12
5	Biofertilizers – Definition, Types, Importance and Advantages; Nitrogen fixing microorganisms; Phosphate solubilizing bacteria; Biopesticides										12
	Total										60

Course Outcomes	
	The students will be able to Course Outcomes
CO1	Gain Knowledge of common bacterial and fungal diseases.
CO2	Gain Knowledge of common viral diseases.
CO3	Understand the air, water and wastewater microbiology
CO4	Understand the food and dairy microbiology
CO5	Utilize the knowledge of biofertilizers and biopesticides. for sustainable agriculture

Text Books	
1	Kanunga R.(2017).Ananthanarayanan and Panicker’s Textbook of Microbiology.(10 th Edition).Universities Press (India)Pvt.Ltd.
2	Dubey,R.C. and MaheshwariD.K.(2010). A Text Book of Microbiology.S.Chand & Co.
3	RajanS. (2007). Medical Microbiology. MJP publisher.
4	Arora,D.R.and Arora B.B.(2020).Medical Parasitology.(5 th Edition).CBS Publishers & Distributors Pvt.Ltd. NewDelhi.
5	Frazier WC and Westhoff DC(2014).Food Microbiology.Tata McGraw Hill Publishing Company Ltd. New Delhi
6	Subba Rao.N. S. (2017).Soil Microbiology. (5 th Edition). MedTech Publishers.
7	Daniel.C.J.(2006).Environmental Aspects of Microbiology.(2 nd Edition).BrightSun Publications.
ReferencesBooks	
1	Salle A.J.(2007). Fundamental Principles of Bacteriology.(4th Edition). Tata McGraw-Hill Publications.
2	ColleeJ.C.DuguidJ.P.Foraser,A.C, MarimonB.P,(1996). <u>Mackie & McCartney Practical Medical Microbiology</u> 14th edn, Churchill Livingstone.
3	PepperI.L.,GerbaC.P.and GentryT.J.(2014).Environmental Microbiology(1 st Edition).Academic Press, Elsevier.
4	Bitton,G.(2011).Wastewater Microbiology.(4 th Edition).Wiley-Blackwell.
5	Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010).Brock-Biology of Microorganisms, 13th Edition, Benjamin-Cummings Pub Co.
Web Resources	
1	https://www.adelaide.edu.au/mycology/
2	https://en.wikipedia.org/wiki/Virology
3	www.environmentshumail.blogspot.in/
4	http://www.fsis.usda.gov/
5	http://textbookofbacteriology.net/nd

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	2	2	3	3	3	3	3
CO2	3	2	3	3	2	2	2	3	1	3	2
CO3	3	3	3	1	2	2	2	3	3	1	3
CO4	3	3	2	3	2	2	2	2	3	3	2
CO5	3	2	2	3	3	2	3	3	3	3	2
Total	15	13	13	12	11	10	12	14	13	13	12
Average	3	2.6	2.6	2.4	2.2	2.0	2.4	2.8	2.6	2.6	2.4

3–Strong, 2-Medium,1- Low

II YEAR IVth SEMESTER

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
24UBCA42P	EC - 7 AL Practical - Microbiology-II	Elective	0	0	2	0	2	2	25	75	100

Course Objectives

CO1	Acquire knowledge on the cleaning of glassware and sterilization.
CO2	Gain knowledge on media preparation and cultural characteristics.
CO3	Learn the pure culture technique
CO4	Learn the microscopic techniques and staining methods.
CO5	Acquire knowledge to isolate the microorganisms from the environment

UNIT	Details	No. of Hours
1	Media preparation: liquid, solid and semi-solid media.	06
2	Pure culture techniques: Serial dilution – spread plate, pour plate and streak plate.	06
3	Staining techniques: Endospore staining and capsular staining.	06
4	Motility demonstration – Hanging drop technique. Fungal identification by KOH.	06
5	Biochemical test – catalase and oxidase.	06
	Total	30

Course Outcomes

	On completion of this course, students will	Course Outcomes
CO1	Practice sterilization methods	
CO2	Learn to prepare different media and their quality control.	
CO3	Learn streak plate, pour plate and serial dilution and pigment production of microbes.	
CO4	Understand Microscopy methods, different Staining techniques and motility test.	
CO5	Acquire knowledge to isolate bacteria from the environment	

Text Books

1	James GC appucino and N.Sherman MB (1996).Alab manual Benjamin Cummins, NewYork 1996.
2	Kannan.N(1996).Laboratory manual in General Microbiology.Palani Publications.
3	Sundararaj T(2005).Microbiology Lab Manual(1 st edition) publications.
4	Gunasekaran,P.(1996).Laboratory Manual in Microbiology.NewAge International Ld., Publishers, New Delhi.
5	RC Dubey and DK Maheswari(2002).Practical Microbiology.S.Chand Publishing.

References Books	
1	Atlas.R (1997).Principles of Microbiology, 2 nd Edition, WM.C.Brown publishers.
2	Amita J,Jyotsna A and Vimala V (2018). Microbiology Practical Manual.(1 st Edition).ElsevierIndia
3	Talib VH (2019).Handbook Medical Laboratory Technology. (2 nd Edition).CBS
4	Wheelis M,(2010).Principles of Modern Microbiology,1 st Edition. Jonesand Bartlett Publication.
5	Lim D. (1998). Microbiology,2 nd Edition,WCB McGraw Hill Publications.
Web Resources	
1	http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods – and- principles-microbiology /24403 .
2	https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf
3	https://microbiologyinfo.com/top-and-best-microbiology-books/
4	https://www.cliffsnotes.com/study_guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	3	3	3	2	3	2	3	2	3	3
CO2	3	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	2	3	2	3	3
CO4	3	3	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	3	2	3	2	3	3
Total	14	14	14	14	12	15	12	15	12	15	15
Average	2.8	2.8	2.8	2.8	2.4	3	2.4	3	2.4	3	3

3–Strong, 2-Medium,1- Low

IInd YEAR: - IV SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCA42	Allied Course -2 Botany	Core	3	1	0	0	5	4	25	75	100
Learning Objectives											
LO1	To study the morphological characters of the Algae										
LO2	To study the morphological characters of Fungi										
LO3	To understand the morphological diversity of Bryophytes and Pteridophytes.										
LO4	To know the evolution of Bryophytes and Pteridophytes.										
LO5	To access the useful role of gymnosperms and angiosperms										
Unit	Content									Hours	
1	UNIT I Algae General account, habitat, distribution, and economic importance of algae as food, fodder, fertilizer, and their role in fish farming.									12 Hours	
2	UNIT II: Fungi General account, habit and habitat, application of fungi as food, medicine, in agriculture (soil fertility), and industries.									12 Hours	
3	UNIT III: Bryophytes Characteristic features, distribution, and importance of bryophytes in initiating soil formation on barren terrain, in maintaining soil moisture, and in recycling nutrients in forest vegetation.									12 Hours	
4	UNIT IV: . Pteridophytes Characteristic features, distribution, and economic importance of pteridophytes as food, biofertilizer, ornamentals, and medicine.									12 Hours	
5	UNIT V: Gymnosperms Characteristic features, distribution, affinities, and economic importance of gymnosperms as food, timber, and medicines. Angiosperms: General characteristics, origin, and Economic importance of Angiosperms as Cereals (Rice), Legumes (Black gram), Fruit (Citrus), Spices (Black pepper), beverages (Tea), oilseeds (Mustard), and cash crops (Rubber).									12 Hours	

CO	The student will be able to	Course Outcomes
CO1	To identify and describe the morphological characters of algae.	
CO2	To explain the morphological features of fungi.	
CO3	To compare and differentiate the morphological diversity of bryophytes and pteridophytes	
CO4	To explain the evolutionary trends from bryophytes to pteridophytes	
CO5	To assess the useful roles of gymnosperms and angiosperms in ecological balance, medicine, agriculture, industry, and human welfare	

Textbooks:	
1	Bold, H.C. and Wayne, M.J. Introduction to Algae (2nd edition). Prentice Hall, New Jersey
2	Mehrotra R.S. and Aneja K.R. (1990). An Introduction to Mycology, Wiley, Eastern Limited, New Delhi.Press, London
3	Chopra, R. N and Kumar, P. K. (1988). Biology of Bryophytes. New Age International Publishers, New Delhi.
4	Rashid, A. (1999). Introduction to Pteridophyta.
5	Bhatnagar, S.P. & A. Moitra: Gymnosperms.
Reference Books:	
1	Sambamurty, A. A Textbook of Algae. I.K. International Pvt. Ltd., New Delhi.
2	Sethi, I.K. and Walia, S.K. (2011). Textbook of Fungi and Their Allies, Macmillan Publishers India Ltd.
3	Goffinet B and Jonathan Shaw, A. (2009). Bryophyte Biology. Cambridge University Press, New York.
4	Vasishtha, P.C. (2006). Botany for Degree Students: Vol.IV-Pteridophyta
5	Mitra, J.N., Mitra. D., Chowdhuri, S.K. (2018). Studies in Botany (Vol. one) Moulik Library 18-B
Web resources:	
1	http://www.bryoecol.mtu.edu/
2	https://www.amazon.in/Introduction-Bryophytes-Alain-Vanderpoortenebook/dp/B007NWFWQK
3	http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
4	http://www.bsiennis.nic.in/Database/Pteridophytes-in-India_23432.aspx
5	http://www.botany.ubc.ca/bryophyt

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	2	3	3	3	3
CO2	3	2	1	3	2	2	2	3	3	3	3
CO3	3	2	2	3	2	2	2	3	3	3	3
CO4	3	2	2	3	2	2	2	3	3	3	3
CO5	3	2	1	3	2	2	2	3	3	3	3
Total	15	10	8	15	10	10	10	15	15	15	15
Average	3	2	1.6	3	2	2	2	3	3	3	3

3-Strong, 2-Medium,1- Low

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCA43P	Practical - Botany	Core	0	0	2	0	2	2	25	75	100
Learning Objectives											
LO1	To understand the concepts of habit, habitat, and morphology in relation to different groups of plants.										
LO2	To describe the morphological features of Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms, and Angiosperms.										
LO3	To differentiate major plant groups based on body organization, structural complexity, and reproductive features										
LO4	To observe plants in their natural habitats and identify their habit										
LO5	To collect plant specimens scientifically using appropriate tools and ethical methods										
Unit	Content										Hours
1	1. A) Basic concept on habit, habitat, and morphology of the following groups of plants 1. Algae 2. Fungi 3. Bryophytes 4. Pteridophytes 5. Gymnosperms 6. Angiosperms										15
2	B) Field visit to study the habit, habitat, method of collection, and preservation of the following groups of plants: 1. Algae 2. Fungi 3. Bryophytes 4. Pteridophytes 5. Gymnosperms 6. Angiosperms										15

CO	The student will be able to	Course Outcomes
CO1	Explain the concepts of habit, habitat, and morphology with reference to different groups of plants.	
CO2	Describe the morphological features of Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms, and Angiosperms.	
CO3	Differentiate major plant groups based on body organization, level of structural complexity, and reproductive characteristics.	
CO4	Record plant habits through direct observation in natural habitats.	
CO5	Prepare properly labeled specimens suitable for preservation, herbarium preparation, or laboratory study	

Textbooks:

- 1 Bold, H.C. and Wayne, M.J. Introduction to Algae (2nd edition). Prentice Hall, New Jersey
- 2 Mehrotra R.S. and Aneja K.R. (1990). An Introduction to Mycology, Wiley, Eastern Limited, New Delhi.Press, London
- 3 Chopra, R. N and Kumar, P. K. (1988). Biology of Bryophytes. New Age International Publishers, New Delhi.
- 4 Rashid, A. (1999). Introduction to Pteridophyta.
- 5 [Bhatnagar, S.P. & A. Moitra: Gymnosperms.](#)

Reference Books:

- 1 Sambamurty, A. A Textbook of Algae. I.K. International Pvt. Ltd., New Delhi.
- 2 Sethi, I.K. and Walia, S.K. (2011). Textbook of Fungi and Their Allies, Macmillan Publishers India Ltd.
- 3 Goffinet B and Jonathan Shaw, A. (2009). Bryophyte Biology. Cambridge University Press, New York.
- 4 Vasishtha, P.C. (2006). Botany for Degree Students: Vol.IV-Pteridophyta
- 5 Mitra, J.N., Mitra. D., Chowdhuri, S.K. (2018). Studies in Botany (Vol. one) Moulik Library 18-B

Web resources:

- 1 <http://www.bryoecol.mtu.edu/>
- 2 <https://www.amazon.in/Introduction-Bryophytes-Alain-Vanderpoortenebook/dp/B007NFWFQK>
- 3 <http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm>
- 4 http://www.bsiervis.nic.in/Database/Pteridophytes-in-India_23432.aspx
- 5 <http://www.botany.ubc.ca/bryophyt>

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	3	1	3	3	3	3
CO2	3	2	3	3	3	3	1	3	3	3	3
CO3	3	3	3	3	2	3	1	3	3	3	3
CO4	3	3	2	2	3	3	1	3	3	3	3
CO5	3	3	3	3	2	3	1	3	3	3	3
Total	15	15	15	15	12	15	5	15	15	10	13
Average	3	3	3	3	3	3	1	3	3	2	2.6

3 – Strong, 2- Medium, 1- Low

II YEAR IVth SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCS41	SEC-5 Herbal Medicine	SEC	1	0	1	-	2	2	25	75	100
Learning Objectives											
LO1	Provide the importance of traditional systems of medicine and their holistic approaches.										
LO2	Understand plant morphology for identification of medicinal plants.										
LO3	Impart knowledge about pharmacological actions of herbal drugs including anti-inflammatory, antimicrobial, antioxidant, hepatoprotective, antidiabetic, and anticancer properties.										
LO4	To understand extraction, isolation, and purification of phytochemicals like alkaloids, flavonoids, terpenoids, tannins, and glycosides.										
LO5	Acquire knowledge about Herbal Formulations & Quality Control, Good Manufacturing Practices (GMP).										
Unit	Content									Hours	
1	Fundamentals of Herbal Medicine History and origin of herbal medicine (Ayurveda, Siddha, Unani, Chinese, Western), Traditional systems of medicine, Basics of medicinal plant taxonomy, Introduction to medicinal plant parts (leaves, roots, seeds, bark, etc.), Principles of Ayurvedic pharmacology (Rasa, Guna, Veerya, Vipaka, Prabhava)									6	
2	Botany for Herbal Medicine Plant morphology and identification, Plant classification systems, Basics of plant physiology, Herbarium techniques, Plant collection, Preservation and documentation.									6	
3	Herbal Phytochemistry Plant extraction methods (Maceration, Infusion, Percolation, Decoction, Soxhlet). Qualitative and quantitative analysis. Secondary metabolites: Structure, Types, Sources and function of Alkaloids, flavonoids, terpenoids, tannins, glycosides.									6	

4	Pharmacological Actions of Herbal Drugs Anti-inflammatory, antimicrobial, antioxidant, hepatoprotective, antidiabetic, anticancer properties. Mechanism of action of selected herbal drugs. Interaction of herbal drugs With synthetic drugs.	6
5	Herbal Formulations & Quality Control Preparation of herbal formulations: Churna, Asava, Arishta, Ghrita, Taila, Kashaya, Standardization of herbal drugs, WHO guidelines for herbal medicines, Good Manufacturing Practices (GMP), Adulteration and quality control tests.	6

CO	The students will be able to	Course Outcomes
CO1	Understand traditional systems of herbal medicine, including Ayurveda, Siddha, and Unani.	
CO2	Students will understand how to identify and classify medicinal plants.	
CO3	Students will gain a comprehensive understanding of how to describe the pharmacological actions of herbal drugs.	
CO4	Students will gain a comprehensive understanding of analyzing photochemicals using techniques like TLC, HPLC.	
CO5	Students will be able to understand preparation and ensure quality control of herbal formulations following guidelines like the WHO guidelines and GMP.	

Textbooks:	
1	Fundamentals of Pharmacognosy and Phytotherapy" by Heinrich, Barnes, Gibbons, Williamson
2	Textbook of Pharmacognosy and Phytochemistry" by Biren Shah & Avinash Seth
3	Quality Control and Evaluation of Herbal Drugs" by Pulk K. Mukherjee
4	Pharmacological Screening Methods" by Ghosh MN
5	Research Methodology and Biostatistics" for Ayurveda/Pharmacy students
Reference Books:	
1	Textbook of Natural Medicine" – Joseph E. Pizzorno & Michael T. Murray (Western, integrative)
2	World Health Organization: Benchmarks for Training in Ayurveda, Unani, TCM" – WHO Publications
3	The Essential Guide to Herbal Safety – Simon Mills & Kerry Bone
Web Resources	
1	https://www.intechopen.com/chapters/62180
2	https://www.hopkinsmedicine.org/health/wellness-and-prevention/herbal-medicine
3	https://www.philadelphia.edu.jo/academics/s_telfah/uploads/method%20of%20extraction.pdf
4	https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/herbal-medicine
5	https://www.who.int/docs/default-source/medicines/norms-and-standards/guidelines/quality-control/quality-control-methods-for-medicinal-plant-materials.pdf?sfvrsn=b451e7c6_0

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	2	3	3	3	3
CO2	3	2	3	3	2	3	2	2	3	2	3
CO3	3	2	3	3	2	3	2	2	3	3	3
CO4	3	3	3	2	2	3	2	2	3	3	3
CO5	3	2	3	2	2	3	2	2	3	3	3
Total	15	11	15	13	10	15	10	11	15	14	15
Average	3.0	2.2	3.0	2.6	2.0	3.0	2.0	2.2	3.0	2.8	3.0

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCC51	CC – 9 Intermediary Metabolism	CC	4	1	0	0	5	5	25	75	100
Learning Objectives											
LO1	Understand the free energy transformation and biological oxidation.										
LO2	Explain the pathways of carbohydrate metabolism.										
LO3	Describe lipid oxidation and biosynthesis pathways.										
LO4	Analyze amino acid catabolism and specialized product synthesis.										
LO5	Assess nucleic acid metabolism and its regulation.										
Unit	Content									Hours	
1	<p>High-energy compounds: Role of high-energy compounds, free-energy hydrolysis of ATP and other organophosphates, ATP-ADP cycle.</p> <p>Biological Oxidation: Electron Transport Chain, Its Organization and Function. Inhibitors of ETC. Oxidative phosphorylation, P/O ratio, Peter Mitchell's chemiosmosis hypothesis. Mechanism of ATP synthesis, uncoupling of oxidative phosphorylation, substrate-level phosphorylation with examples.</p>									15	
2	<p>Metabolism of carbohydrates: Glycolysis, TCA Cycle, Amphibolic nature, and the integrating role of the TCA cycle. Pentose Phosphate Pathway (HMP shunt), Gluconeogenesis, Glycogenesis, Glycogenolysis and its regulation, glyoxylate cycle, and Cori cycle.</p>									15	
3	<p>Metabolism of lipids Oxidation of fatty acids α, β, and ω oxidation of saturated fatty acids, Oxidation of fatty acids with odd number of carbon atoms and unsaturated fatty acids, Ketogenesis, Biosynthesis of saturated fatty acids and Unsaturated fatty acids, Biosynthesis and degradation of triglycerides, phospholipids and cholesterol.</p>									15	
4	<p>Metabolism of amino acid Biosynthesis of Nutritionally Non-essential Amino Acids-Glycine, Serine and Proline. Catabolism of amino acid - Oxidative deamination, non – oxidative deamination, transamination and decarboxylation. Biogenic amines, the Urea cycle, and its regulation</p>									15	
5	<p>Metabolism of Nucleic Acid Biosynthesis of purines and pyrimidines, de novo synthesis and salvage pathways, Degradation of purines and pyrimidines, Conversion of ribonucleotide to deoxyribonucleotide</p>									15	

CO	Course Outcomes
	The student will be able to
CO1	Understand the principles of free energy transformation and biological oxidation in cellular metabolism.
CO2	Explain and analyze the pathways of carbohydrate metabolism.
CO3	Describe the oxidation and biosynthesis pathways of lipids.
CO4	Analyze the Metabolism of amino acids and the formation of specialized products derived from them.
CO5	Evaluate the metabolism of nucleic acids and their regulatory mechanisms.

Textbooks:	
1	Sathyanarayana, U., and Chakrapani, U., Biochemistry, Elsevier India Pvt. Ltd., 2015, 4th Edition.
2	A.C. Deb — New Central Book Agency — 10th Edition — 2018
3	Pankaja Naik — Jaypee Brothers Medical Publishers — 5th Edition — 2021
4	Debajyoti Das — Academic Publishers — 14th Edition — 2020
5	M.N. Chatterjea & Rana Shinde — Jaypee Brothers Medical Publishers — 9th Edition — 2019.
Reference Books:	
1	Nelson, David L. and Cox, Michael M., Lehninger Principles of Biochemistry, W.H. Freeman and Company, 2008, 5th Edition.
2	Voet, Donald, Voet, Judith G., and Pratt, Charlotte W., Principles of Biochemistry, John Wiley & Sons, Inc., 2010, 4th Edition.
3	Zubay, Geoffrey L., Parson, William, and Vance, Dennis E., Principles of Biochemistry, Wm. C. Brown Publishers, 1995, 2nd Edition.
4	Murray, Robert K., Granner, Daryl K., and Rodwell, Victor W., Harper's Illustrated Biochemistry, McGraw Hill Publishers, 2006, 27th Edition.
5	Garrett, Reginald H., and Grisham, Charles M., Biochemistry, Thomson Learning Inc., 2005, 3rd Edition.
Web resources:	
1	https://nptel.ac.in/courses/104/105/104105102/
2	http://www.nptelvideos.in/2012/11/biochemistry-
3	https://pmc.ncbi.nlm.nih.gov/articles/PMC8411952/
4	https://nptel.ac.in/courses/104/105/104105102/
5	http://www.nptelvideos.in/2012/11/biochemistry-

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1	2	3	2	2	1	3	1	3
CO2	3	3	2	2	1	2	1	2	3	1	1
CO3	3	2	1	1	1	1	1	2	3	2	2
CO4	3	2	1	2	1	2	2	1	3	2	3
CO5	3	2	2	2	2	2	2	2	3	2	2
Total	15	11	7	9	9	9	7	8	15	8	9
Average	3	2.2	1.4	1.8	1.8	1.8	1.4	1.6	3	1.6	1.8

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCC52	CC-10 Human Physiology	CC	4	1	0	0	5	5	25	75	100
Learning Objectives											
LO1	To understand the composition and functions of blood and its components.										
LO2	To explain the digestion and absorption of carbohydrates, proteins, and lipids.										
LO3	To describe the structure and functions of the respiratory and nervous systems.										
LO4	To apply the mechanism of synaptic transmission and neurotransmission.										
LO5	To evaluate the major muscle proteins and their role in muscle contraction.										
Unit	Content										Hours
1	Circulatory System Composition of Blood - types of blood cells and their functions, Blood groups - ABO group and Rh group. Circulatory system, Circulatory System: Structure and functions of the Heart. Cardiac cycle, Pacemaker, Blood pressure, and Factors affecting blood pressure.										15
2	Digestive system Definition: Digestive system, Physical and Chemical processes of digestion. structure and function of microvilli, Salivary digestion, gastric digestion, mechanism of HCL formation, intestinal digestion, liver, pancreas, intestinal juice, Role of bile salt in Digestion.										15
3	Respiratory system Respiratory System-Overview of respiratory system, Types of respiration, Transport of respiratory gases, Exchange of respiratory gases in lungs and tissues – Chloride Shift & Bohr's effect, Lung surfactant.										15
4	Nervous system Nervous system- Structure of neuron, synaptic transmission, reflex action, neurotransmission- Resting membrane and Action potential. Neurotransmitters- acetyl choline, Noradrenaline, Dopamine, Serotonin, Histamine, GABA.										15
5	Muscular system & Reproductive system Muscular system-structure and types of muscles - skeletal, smooth, and cardiac muscles, muscle proteins- types and functions, mechanism of muscle contraction. Reproductive system -Oogenesis, spermatogenesis, fertilization - early development, implantation, placentation, and Parturition.										15

Course Outcomes	
CO	The students will be able to
CO1	Understand the blood components and their functions.
CO2	Explain the structure and functions of the digestive and excretory systems.
CO3	Describe respiratory processes, transport and exchange of gases, and the physiological principles involved.
CO4	Apply the structure and functional organization of the nervous system and the neuron.
CO5	Analyze the events involved in fertilization, implantation, placentation, and parturition.

Textbooks:	
1	K. Sembulingam & Prema Sembulingam, Essentials of Medical Physiology, 8th Edition, Jaypee Brothers Medical Publishers, 2022.
2	A.K. Jain Textbook of Physiology, Volume I, 8th Edition- Avichal Publishing Company, 2022
3	Dr. C. Shanmugam, Human Physiology - Revised Edition, Saras Publication -2021.
4	C.C. Chatterjee — Human Physiology, Volume I -12th Edition CBS Publishers & Distributors, 2019.
5	Arthur C. Guyton & John E. Hall, Textbook of Medical Physiology — 14th Edition — Elsevier — 2020
Reference Books:	
1	Vander, Sherman & Luciano — Vander’s Human Physiology: The Mechanisms of Body Function — McGraw-Hill Education — 15th Edition — 2018
2	Vander, A.J. et al., 1981. Human Physiology: Tata McGraw-Hill Publishing Co., New Delhi
3	Guyton, A. C. and Hall, J. E. Textbook of Medical Physiology. 11th Edition. Saunders, Philadelphia. USA, 2006.
4	Martini, F.H. and Nath, J. L. Fundamentals of Anatomy & Physiology. Pearson Benjamin Cummings. USA. 2009.
5	Bipin Kumar. Human Physiology. Campus Book International, New Delhi. 2001.
Web resources:	
1	https://courses.lumenlearning.com/pgcc-ap2/chapter/cardiac-cycle/?utm_source=chatgpt.com
2	https://www.classcentral.com/course/youtube-cardiac-system-from-stimuli-to-rhythmic-muscle-contraction-part-3-437488?utm_source=chatgpt.com
3	https://igntu.ac.in/eContent/BSc-Zoology-04Sem-DrPoonamSharma-Bioenergetics%20and%20metabolism-fatty%20acid.pdf
4	https://www.slideserve.com/mprasadnaidu/amino-acid-metabolism
5	https://bio.libretexts.org/Bookshelves/Biochemistry/Fundamentals_of_Biochemistry_(Jakubowski_and_Flatt) .

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	3	3	3	3	2
CO2	2	2	2	2	3	3	3	2	3	2	3
CO3	2	2	2	2	2	2	3	3	3	2	3
CO4	2	2	3	3	2	3	2	3	3	3	2
CO5	3	3	3	3	2	3	3	3	3	2	3
Total	12	11	13	13	11	14	14	14	15	12	13
Average	2.8	2.6	3	2.4	2.6	2.8	2.8	2.8	3	2.4	2.6

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCC53	CC- 12 Clinical Biochemistry	Core	4	1	0	0	4	5	25	75	100

Learning Objectives

LO1	To understand the basic concepts and diseases of carbohydrate metabolism.
LO2	To explain the diseases of lipid metabolism.
LO3	To elucidate the liver function test and the kidney function test.
LO4	To describe the principles, types, and clinical significance of gastric function tests.
LO5	To analyze the diagnostic significance of enzymes in various diseases and their estimation in clinical practice.

Unit	Content	Hours
1	Diseases Related to Carbohydrate Metabolism Maintenance of blood glucose by hormones with special reference to insulin and glucagon. Diabetes mellitus – types, causes, biochemical manifestations, diagnosis and treatment. Random/Fasting/PP glucose testing, Diagnosis-by GTT. Inborn errors of carbohydrate metabolism (Glycosuria, Galactosemia) and Glycogen storage diseases (Von Grierk’s disease and Pompe’s disease).	15
2	Diseases related to Lipid Metabolism Lipid Profile. Lipid Disorders - Atherosclerosis, Fatty liver and hyperlipidemia. Hypercholesterolemia, Tay-Sach’s disease, Niemann-Pick disease, Gaucher disease. Lipoprotein Disorders of dyslipidemia (familial hypercholesterolemia).Diagnosis & Treatment - Lipotropic agents and Clinical Manifestations.	15
3	Liver & Renal Function Tests: Liver Function Test: Bilirubin metabolism and Jaundice. Estimation of conjugated and total bilirubin in serum (Diazo method). Detection of bilirubin and bile salts in urine (Fouchet’s test and Hay’s sulphur test). Serum enzymes in liver disease: serum transaminases (SGPT & SGOT) and lactate dehydrogenase (LDH). Renal Function Tests: Clearance Tests – Creatinine Clearance Test, Urea Clearance test, Inulin Clearance test, Blood Urea Nitrogen.	15
4	Gastric Function Test: Collection of gastric contents, examination of gastric residuum, fractional test meal (FTM), Gastric Stimulation Tests - Pentagastrin Test, Histamine / Histalog Test. Tubeless gastric analysis(Diagnex Blue (Resin) Test). Gastric disorders. Enzyme patterns in Acute Pancreatitis and Myocardial Infarction.	15
5	Clinical Enzymology Clinically Important Enzymes and Isoenzymes as diagnostic markers - Clinical significance of AST, ALT, ALP, ACP, CK and their pattern in. Myocardial infarction, Liver disease, Bone disease, GI tract (pancreatitis).	15

Course Outcomes	
CO	The students will be able to
CO1	Explain the concepts of hormones and their importance in maintaining glucose and types of Diabetes, diagnosis and treatment.
CO2	Analyze the lipid profile and different deficiency states.
CO3	Describe the liver and kidney functions and specific diagnostic methods used for biological samples.
CO4	Interpret gastric function test results and correlate them with gastric disorders.
CO5	Interpret enzyme levels and correlate them with specific pathological conditions for diagnosis.
Textbooks:	
1	MN Chatterjee and Rana Shinde, Textbook of Medical Biochemistry, Jaypee Brothers Medical Publishers (P) LTD, New Delhi, 8th Edition, 2012
2	Ambika Shanmugam's Biochemistry for Medical Students, 8 th edition, published by Wolters Kluwer India Pvt. Ltd.
3	D.M. Vasudevan, Textbook of Biochemistry for Medical Students.
4	Bhagavan & Ha, Essentials of Medical Biochemistry.
5	Satyanarayana, Textbook of Biochemistry.
Reference Books:	
1	Thomas M. Devlin, Textbook of Biochemistry with Clinical Correlations.
2	W.J. Marshall & S.K. Bangert, Clinical Biochemistry: Metabolic and Clinical Aspects.
3	Alan H. Gowenlock et al., Varley's Practical Clinical Biochemistry.
4	R.K. Kanai L. Mukherjee, Practical Clinical Biochemistry.
5	Dinesh Puri, Textbook of Medical Biochemistry.
Web resources:	
1	http://pmc.ncbi.nlm.nih.gov/articles/PMC1532522/
2	http://www.journals.elsevier.com/clinical-biochemistry/
3	https://www.researchgate.net/publication/351783125_Textbook_of_Clinical_Biochemistry
4	https://www.perlego.com/book/996521/clinical-biochemistry-pdf
5	https://pdfroom.com/books/clinical-biochemistry-an-illustrated-colour-text-5e/v0K2lGPZgap

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	3	3	3	3	2
CO2	2	2	2	2	3	3	3	2	3	2	3
CO3	2	2	2	2	2	2	3	3	3	2	3
CO4	2	2	3	3	2	3	2	3	3	3	2
CO5	3	3	3	3	2	3	3	3	3	2	3
Total	12	11	13	13	11	14	14	14	15	12	13
Average	2.8	2.6	3	2.4	2.6	2.8	2.8	2.8	3	2.4	2.6

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCC54P	CC 11-Clinical Biochemistry (Practical)	CC	0	0	3	0	2	3	25	75	100
Learning Objectives											
LO1	To understand the principles and perform the estimation of clinically important enzymes										
LO2	To assess the physical characteristics of urine										
LO3	To analyse urine for normal constituents using standard qualitative biochemical tests.										
LO4	To quantitatively determine the concentration of urea and uric acid in the given urine sample										
Unit	Content	Hours									
I	<p>A. Clinical Enzymology</p> <p>1. Estimation of Alkaline Phosphatase (ALP) activity</p> <p>2. Estimation of Acid Phosphatase Activity</p> <p>3. Estimation of Lactate Dehydrogenase (LDH) activity</p> <p>4. Estimation of Serum Creatine Kinase (CK)</p> <p>B. Qualitative analysis of normal constituents of urine (Urea, Creatinine, Calcium, Phosphate, Uric acid, Choline and Sulphate)</p> <p>C. Qualitative analysis of Abnormal constituents of urine (Glucose, Protein, Ketone bodies, Bile salts, Bile pigments and Blood)</p> <p>D. Quantitative analysis of urine Sample</p> <p>1. Estimation of Urea in urine</p> <p>2. Estimation of Uric acid in urine</p>	45									

CO	Students will be able to	Course Outcomes
CO1	Understand the principles of clinical enzymology to accurately estimate the activity of important diagnostic enzymes	
CO2	Explain the urine samples to identify the normal constituents using qualitative biochemical methods.	
CO3	Analyze abnormal constituents in urine using qualitative biochemical methods.	
CO4	Determine the concentration of urea and uric acid in the given urine sample	

Textbooks:	
1	Basic Concepts in Clinical Biochemistry: A Practical Guide — Vijay Kumar & Kiran Dip Gill
2	Clinical Biochemistry: A Laboratory Guide — Rooma Devi, Aman Chauhan, Simmi Kharb & Chandra Shekhar Pundir
Reference Books:	
1	Fundamentals of the Study of Urine and Body Fluids – John W. Ridley
2	A Laboratory Handbook of Urine Analysis and Physiological Chemistry – Charles G. L. Wolf
Web resources:	
1	https://personales.upv.es/thinkmind/dl/conferences/achi/achi_2018/achi_2018_10_30_20157.pdf
2	https://uomustansiriyah.edu.iq/media/lectures/6/6_2019_12_01!05_06_08_PM.pdf
3	https://www.zmchdahod.org/pdf/college/Abnormal_Urine_Analysis-01-12-2018.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	2	2	2	3	2	1
CO2	3	3	2	2	2	2	1	2	3	3	2
CO3	3	2	2	2	3	3	2	3	3	3	3
CO4	3	2	3	2	2	2	2	3	2	2	2
Total	12	9	8	8	9	9	7	10	11	10	8
Average	3.0	2.2	2.0	2.0	2.2	2.2	1.7	2.5	2.7	2.5	2.0

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCE51	EC – 8 Endocrinology	EC	3	1	0	0	3	4	25	75	100

Learning Objectives

LO1	To introduce the basic concepts of hormones, their classification, chemical nature, and mechanism of action.
LO2	To explain the structure, secretion, functions, and regulation of hypothalamic and pituitary hormones.
LO3	To provide knowledge about thyroid and pancreatic hormones and their role in maintaining normal body functions.
LO4	To analyze the functions, regulation, and disorders of adrenal gland hormones.
LO5	To explain reproductive hormones, Secretion. Functions and regulation

Unit	Content	Hours
1	Hormones- Introduction, 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 (c AMP, c GMP)	12
2	Pituitary Hormones- Chemistry, Secretion, Functions and Regulation of Anterior Pituitary hormones – Growth Hormone, Pituitary tropic hormones (Luteinizing hormone, Follicle-stimulating hormone and Adrenocorticotrophic hormone) and Posterior Pituitary hormones - Vasopressin and Oxytocin.	12
3	Thyroid & Pancreatic Hormones- Chemistry, Secretion, Functions, Regulations and Disorders. Pancreatic Hormones - Chemistry, Secretion, Functions, and Regulations of Pancreatic Hormones (Insulin and Glucagon)	12
4	Adrenal gland hormones - Chemistry, Secretion, Functions, Regulations, and disorders of Adrenal Cortex hormones (glucocorticoids and mineralocorticoids) and Adrenal Medullary hormones (Epinephrine and Nor-Epinephrine).	12
5	Reproductive Hormones- Chemistry, Secretion, Functions, Regulations, and Disorders of Gonadal Hormones (Testosterone, Estrogen, and Progesterone) Menstrual Cycle	12

CO	Course Outcomes
	The student will be able to
CO1	Understand the types of hormones, their chemical nature, mechanism of action, and hormone receptors.
CO2	Explain the structure, secretion, functions, and regulation of hypothalamic and pituitary hormones.
CO3	Illustrate the structure, functions, regulation, and disorders of thyroid and pancreatic hormones.
CO4	Examine the functions, regulation, and disorders of adrenal gland hormones.
CO5	Analyze and compare the functions of reproductive hormones.

Textbooks:	
1	Harper's Biochemistry – R.K. Murray, D.K. Granner, P.A. Mayes and D.W. Rodwell, 25th edition, Prentice Hall, New Jersey, 2006.
2	Biochemistry – G.L. Zubay, Biochemistry, 4th edition, WCB McGraw-Hill, New York, 1999.
3	Williams Textbook of Endocrinology – Shlomo Melmed, Williams Textbook of Endocrinology, Elsevier, New Delhi, 2011.
4	Textbook of Medical Biochemistry – N. Chatterjee and Rana Shinde, Textbook of Medical Biochemistry, 8th edition, Jaypee Publications, New Delhi, 2012.
5	Textbook of Endocrinology – I. Niyas Ahamed, Textbook of Endocrinology, 1st edition, Association of Indian Biologists Publications, 2012.
Reference Books:	
1	Guyton, Human Physiology and Mechanisms of Disease, 6th edition, Saunders Publications, 1996.
2	Lehninger Principles of Biochemistry – D.L. Nelson and M.M. Cox, Lehninger Principles of Biochemistry, 5th edition, W.H. Freeman and Company, New York, 2008.
3	Biochemistry – D. Voet and G. Voet, Biochemistry, John Wiley and Sons, New York, 2006.
4	DeGroot's Endocrinology: Basic Science and Clinical Practice – K.R. Feingold, B. Anawalt, A. Boyce et al., DeGroot's Endocrinology: Basic Science and Clinical Practice, 8th edition, Elsevier Publications, 2022.
5	Williams Textbook of Endocrinology – S. Melmed, R.J. Auchus, A.B. Goldfine, R.J. Koenig and C.J. Rosen, Williams Textbook of Endocrinology, 15th edition, Elsevier Publications, 2024.
Web resources:	
1	https://biologynotesonline.com/hormones-structure-types-functions-examples/
2	https://courses.lumenlearning.com/suny-ap2/chapter/the-pituitary-gland-and-hypothalamus/
3	https://www.endotext.org/wp-content/uploads/pdfs/chapter-2-thyroid-hormone-synthesis-and-secretion.pdf
4	https://www.geeksforgEEKS.org/biology/protein-energy-malnutrition-pem/
5	https://open.lib.umn.edu/humanbiology/chapter/5-3-hormonal-control-of-human-reproduction/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1	2	3	2	2	1	3	1	3
CO2	3	3	2	2	1	2	1	2	3	1	1
CO3	3	2	1	1	1	1	1	2	3	2	2
CO4	3	2	1	2	1	2	2	1	3	2	3
CO5	3	2	2	2	2	2	2	2	3	2	2
Total	15	11	7	9	9	9	7	8	15	8	9
Average	3	2.2	1.4	1.8	1.8	1.8	1.4	1.6	3	1.6	1.8

3 – Strong, 2- Medium, 1- Low

III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UBCE52	EC-8 Evolutionary Biology	EC	3	1	0	0	3	4	25	75	100

Learning Objectives

LO1	To understand the historical development of evolutionary thought and Darwin's theories.
LO2	To understand the origin and evolution of life through chemogeny and biogeny concepts.
LO3	To evaluate the different evidence supporting evolution, including fossil, molecular, and phylogenetic evidence.
LO4	To explain the evolutionary trends in plants and fungi, including the origin of land plants, vascular systems, and angiosperm phylogeny.
LO5	To analyse the evolutionary origin of humans through primate phylogeny, hominin evolution, and molecular evidence.

Unit	Content	Hours
1	Historical Review of Evolutionary Concept Pre-Darwinian ideas – List of contributors influencing Darwin indicated as a timeline. Lamarckism – Merits and demerits. Darwinism – Merits and demerits, Post-Darwinian era – Modern synthetic theory; biomathematics and the theory of population genetics leading to Neo-Darwinism.	12
2	Life's Beginnings Chemogeny – An overview of pre-biotic conditions and events; experimental proofs to abiotic origin of micro- and macro-molecules. Current concept of chemogeny – RNA first hypothesis. Biogeny – Cellular evolution based on proto-cell models (coacervates and proteinoid micro-spheres). Origin of photosynthesis – Evolution of oxygen and ozone buildup. Endosymbiotic theory – Evolution of Eukaryotes from Prokaryotes	12
3	Evidences of Evolution Fossils as direct evidence, Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse as an example, Molecular evidence (Globin gene families as an example), Molecular clock concept.	12
4	Evolution of Plants and Fungi Origin of land plants – Terrestrial algae and Bryophytes; alternation of generations. Early vascular plants – Steelar evolution; Sporangium evolution. Angiosperms – Phylogeny of major groups. Fungi	12
5	Human Ancestry and Phylogeny Primate characteristics and unique Hominin characteristics. Primate phylogeny leading to Hominin line. Human migration – Theories. Brief reference to molecular analysis of human origin – Mitochondrial DNA and Y-chromosome studies	12

Course Outcomes	
The student will be able to	
CO1	Explain the historical development and major theories of evolution leading to Neo-Darwinism.
CO2	Describe the origin and evolution of life and the emergence of cellular forms
CO3	Analyse fossil, molecular, and phylogenetic evidence supporting evolution.

CO4	Explain the evolutionary trends in plants and fungi from primitive to advanced forms.
CO5	Analyse human evolution and ancestry using phylogenetic and molecular evidence.

Textbooks:	
1	Ruppert, Fox, and Barnes (2006). Invertebrate Zoology.
2	Edition, Thomson Books/Cole
3	Campbell & Recce(2005). Biology, Pearson Education, (Singapore) Pvt.Ltd.
4	Smith, T.M., and Smith, R.C. (2006). Elements of Ecology I st edition Pearson Publications
5	Miller, G.T (2006). Environmental Science, 11 th edition, Brooks/Cole
Reference Books:	
1	Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
2	Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H., (2007).
3	Evolution. Cold Spring, Harbour Laboratory Press.
4	Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers.
5	Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
Web resources:	
1	https://plato.stanford.edu/entries/evolution-before-darwin/
2	https://en.wikipedia.org/wiki/Lamarckism
3	http://www.preservearticles.com/education/what-are-the-merits-and-demerits-of-darwanism/28368
4	http://www.yourarticlelibrary.com/biology/origin-of-life-chemical-evolution-formation-of-primitive-life-and-its-evolution-theories/27304
5	http://www.yourarticlelibrary.com/biology/origin-of-life-chemical-evolution-

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1	2	3	2	2	1	3	1	3
CO2	3	3	2	2	1	2	1	2	3	1	1
CO3	3	2	1	1	1	1	1	2	3	2	2
CO4	3	2	1	2	1	2	2	1	3	2	3
CO5	3	2	2	2	2	2	2	2	3	2	2
Total	15	11	7	9	9	9	7	8	15	8	9
Average	3	2.2	1.4	1.8	1.8	1.8	1.4	1.6	3	1.6	1.8

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCE53	EC – 9 Research Methodology	EC	3	1	0	0	3	4	25	75	100
Learning Objectives											
LO1	To explain research concepts and formulate research problems and plans in biochemistry.										
LO2	To describe data collection methods and apply appropriate sampling techniques with ethical considerations.										
LO3	To interpret statistical methods for analyzing biological data.										
LO4	To demonstrate the use of computer tools for data analysis and scientific presentation.										
LO5	To develop scientific writing skills and explain research ethics and IPR.										
Unit	Content										Hours
1	Research Fundamentals Basics of Research, types and Characteristics, Research Methods versus Methodology, Research designs in Biochemistry: in vitro, in vivo, in situ, clinical trials. Identification and criteria of selecting a research problem (Hypothesis); Formulation of objectives; Research plan and its components										12
2	Collection of Data Introduction to data collection and its importance in research; types of data: primary and secondary, qualitative and quantitative. Sources of data: surveys, observation, interviews, questionnaires, and experiments. Sampling methods: Probability Sampling (Random Sampling) and Non-Probability Sampling (Non-Random Sampling). Ethical aspects of data collection: informed consent, confidentiality, and honesty. Introduction to secondary data sources such as books, journals, and online databases. Common errors in data collection and simple methods to reduce bias.										12
3	Statistical Analysis: Measures of variation - standard deviation, Non-linear regression, Standard error. Analysis of variance for one-way and two-way classified data and multiple comparison procedures. Significance - students' t-test, chi-square test. Dunnett's test										12
4	Computer and its role in research: Overview of Computer and its role in research: Basics of MS Word, MS Excel: tabulation, calculation and data analysis, preparation of graphs, histograms and charts. Use of statistical software SPSS. PowerPoint: preparation of presentations and scientific poster designing										12
5	Scientific Writing and Research Ethics Introduction to Scientific Writing: Principles and importance of scientific writing; Academic writing style and presentation. Dissertation/Thesis Writing: Standard format and structure, Chapterization (Introduction, Review of Literature, Materials and Methods (Methodology), Results, Discussion, Conclusion and Future Perspectives, Bibliography / References, Appendices). Referencing styles: Harvard system, Vancouver system. Research Ethics and Integrity: Ethical issues in research, Intellectual Property Rights (IPR), Overview of plagiarism and its identification using tools such as Turnitin and Grammarly.										12

CO	Course Outcomes
CO1	Students will be able to identify research problems and design suitable methodologies.
CO2	Students will be able to collect and organize data using appropriate methods and ethics.
CO3	Students will be able to analyze and evaluate data using statistical tools.
CO4	Students will be able to apply computer tools to prepare and present scientific data.
CO5	Students will be able to prepare scientific documents and adhere to ethical standards.

Textbooks:	
1	Garg, B. L., et al. (2018). An introduction to research methodology. RBSA Publishers.
2	Kothari, C. R. (2004). Research methodology: Methods and techniques (2nd ed.). New Age International Publishers.
3	Sinha, S. C., & Dhiman, A. K. (2002). Research methodology. Ess Ess Publications.
4	Gurumani, N. (2006). Research methodology for biological sciences. MJP Publishers.
5	Zar, J. H. (1984). Biostatistical methods (2nd ed.). Prentice Hall.
Reference Books:	
1	Pandey, P., & Pandey, M. M. (2015). Research methodology: Tools and techniques. Bridge Center.
2	Coley, S. M. (1990). Proposal writing. Sage Publications.
3	Day, R. A., & Gastel, B. (2012). How to write and publish a scientific paper (7th ed.). Cambridge University Press.
4	Fink, A. (2019). Conducting research literature reviews: From the internet to paper (5th ed.). Sage Publications.
5	Scientific thesis writing and paper presentation. (2010). MJP Publishers
Web resources:	
1	Research Methodology (IIT Madras) <ul style="list-style-type: none"> Covers fundamentals of research, data analysis, ethics, and technical writing
2	Research Methodology (NPTEL Course Page) <ul style="list-style-type: none"> Introductory course explaining core research concepts and methodology basics
3	Research Methodology in Natural Sciences (IISER Kolkata) <ul style="list-style-type: none"> Focus on hypothesis testing, scientific communication, and research ethics
4	Research Methodology in Humanities and Social Sciences <ul style="list-style-type: none"> Focus on research design concepts
5	Basic Course in Biomedical Research <ul style="list-style-type: none"> Health research methodology including experimental design and data interpretation

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	2	3
CO2	3	3	3	3	3	3	3	3	2	3	3
CO3	3	3	3	3	3	3	3	3	3	3	2
CO4	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	2	2
Total	15	13	15	15	15	15	15	15	13	13	13
Average	3	2.6	3	3	3	3	3	3	2.6	2.6	2.6

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCE54	EC – 9 Cancer Biology	EC	3	1	0	0	3	4	25	75	100
Learning Objectives											
LO1	Explain the basic concepts, origin, and molecular mechanisms involved in cancer development.										
LO2	Describe the genetic and epigenetic alterations associated with cancer progression and hereditary cancers.										
LO3	Differentiate normal cells from cancer cells based on structural, functional, and biochemical characteristics.										
LO4	Discuss the major types of cancers, tumour suppressor genes, and modern methods used for cancer detection and treatment.										
LO5	Evaluate the role of environmental, lifestyle, and carcinogenic factors in cancer prevention and public health awareness.										
Unit	Content									Hours	
1	Cancer: Introduction; Origin of Cancer- The Mutation Concept, The Epigenetic Concept, Viral Concept, Unified genetic concept of cancer; Difference between Normal and Cancer cells; Signs and symptoms.									15	
2	Cancer as a genetic disease; Genetic Alterations in Cancer cells, Point mutation, splice mutation, alternate splicing; Mutation in regulatory sequences, deletions, Insertion, Chromosome abnormalities, Genetic defects and the time course of hereditary cancer.									15	
3	Types of Cancer: - Blood & Lymph – Leukaemia, Malignant lymphoma, Bone- Soft tissue Sarcoma, Thorax- Breast cancer, Male genitalia- Prostate cancer, Female genitalia- Cervical cancer; Tumour suppressor genes.									15	
4	Detection and Treatment: - Early detection, Molecular detection of Carcinomas, Cancer warning signals; Therapies- Chemotherapy, Gene therapy, Radiotherapy, Biological therapy (Immuno therapy).									15	
5	Prevention:- Tobacco smoking, sunlight, diet, ionising radiation, alcohol and drugs, promiscuity, lifestyle and cancer prevention, Environmental factors and cancer, potentially carcinogenic substances for humans.									15	
									75		

CO	Course Outcomes
CO1	Demonstrate understanding of cancer biology, mutation theories, viral concepts, and unified genetic concepts of cancer.
CO2	Analyze various genetic abnormalities such as point mutations, splice mutations, insertions, deletions, and chromosomal abnormalities involved in carcinogenesis.
CO3	Classify different cancers including leukemia, lymphoma, sarcoma, breast, prostate, and cervical cancers with their pathological significance.
CO4	Explain principles and applications of cancer diagnosis and treatment methods including chemotherapy, radiotherapy, gene therapy, and immunotherapy.
CO5	Assess cancer risk factors and recommend preventive strategies related to lifestyle, environmental exposure, tobacco, alcohol, radiation, and diet.

Textbooks:	
1	A. Sarkar, 2011, Biology of Cancer, Discovery Publishing House, New Delhi.
2	Ranjit Sen, 2004, Principles and Management of Cancer, B.I. Publications Pvt Ltd, New Delhi.
3	Dr M.R.Ahuja, 1997, Cancer- Causes and Prevention, UBS Publishers Distributors Pvt. Ltd.
4	A. Sarkar, 2011, Biology of Cancer, Discovery Publishing House, New Delhi.
5	Robert A. Weinberg, The Biology of Cancer, Published by, Garland Science / Taylor & Francis Group, 2014
Reference Books:	
1	Francesco Pezzella, Mahvash Tavassoli, David J. Kerr, 2019, Oxford Textbook of Cancer Biology, Oxford University Press
2	Albert DeNittis, MD, Joel W. Goldwein, MD, and Thomas J. Dilling, MD, 2002, The Biology of Cancer.
3	Robin Hesketh, 2012, Introduction to Cancer Biology, Cambridge University Press
4	Vincent T. DeVita Jr., Theodore S. Lawrence, Steven A. Rosenberg, Cancer: Principles and Practice of Oncology, Published by Wolters Kluwer, 2019
5	John E. Niederhuber, James O. Armitage, James H. Doroshow, Michael B. Kastan, Joel E. Tepper Abeloff's Clinical Oncology, Published by Elsevier, 2020
Web resources:	
1	http://csbl.bmb.uga.edu/mirrors/JLU/DragonStar2017/download/introduction-to-cancer biology.pdf
2	http://webserver1.oneonta.edu/faculty/bachman/cancer/207lectures.htm
3	National Cancer Institute (NCI) – Types of Cancer Detailed information on the classification, pathology, and genetics of different cancers
4	PubMed – Cancer Immunotherapy Articles Research articles on biological therapy and immunotherapy.
5	Centres for Disease Control and Prevention (CDC) – Cancer Prevention Public health strategies for cancer prevention and awareness.

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	1	3	3	3	3	2
CO2	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	2	2	3	3	3	2
CO4	3	3	3	3	3	2	2	3	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	3	3	2
Total	15	15	15	15	15	14	8	14	15	15	15	12
Average	3	3	3	3	3	2.8	1.6	2.8	3	3	3	2.4

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UAEC51	AEC – 4 Gender Equality and Social Inclusion	AEC	1	1	0	0	2	2	25	75	100
Learning Objectives											
LO1	To understand the introduction to Gender and Social Inclusion										
LO2	To acquire knowledge on Gender inequality in society										
LO3	To equip the Social Exclusion and Marginalized Groups										
LO4	To understand Legal Frameworks and Policies										
LO5	To assimilate knowledge about Strategies for Promoting Equality and Inclusion										
Unit	Content	Hours									
1	Introduction to Gender and Social Inclusion: Concepts: Gender-Gender roles, stereotypes, and socialization - Meaning and importance of social inclusion- Intersectionality (gender, caste, class, disability, etc.) - Historical perspectives on gender inequality.	6									
2	Gender Inequality in Society: Forms of gender discrimination (education, health, employment) - Gender-based violence and its types - Wage gap and economic inequality - Representation of gender in media and culture - Case studies on gender inequality (local and global).	6									
3	Social Exclusion and Marginalized Groups: Understanding social exclusion - Marginalized communities (women, LGBTQ+ individuals, persons with disabilities, minorities) - Barriers to inclusion (social, economic, political) - Role of culture, tradition, and norms in exclusion - Impact of exclusion on development.	6									
4	Legal Frameworks and Policies: National and international laws promoting gender equality - Human rights perspective on inclusion - Government policies and welfare programs - Role of institutions (NGOs, UN, civil society).	6									
5	Strategies for Promoting Equality and Inclusion: Gender mainstreaming and inclusive development - Education and awareness programs - Role of media and technology - Empowerment approaches (economic, social, political) - Community participation and leadership - Measuring progress (indicators like SDGs)	6									

CO	Course Outcomes
CO1	Understand the introduction to Gender and Social Inclusion
CO2	Acquire knowledge on Gender inequality in society
CO3	Equip the knowledge on Social Exclusion and Marginalized Group
CO4	Understand Legal Frameworks and Policies towards gender Equality
CO5	Gain knowledge about Strategies for Promoting Equality and Inclusion

Textbooks:	
1	Development as Freedom, Amartya Sen, Publisher: Oxford University Press (1999).
Reference Books:	
1	Gender Trouble: Feminism and the Subversion of Identity, 2 nd Edition (1999 revised edition) Publisher: Routledge, London & New York.
2	David E. Newton, Gender Inequality: A Reference Handbook, Bloomsbury Academic, 2019.
3	Gender Inequality: A Reference Handbook, by David E. Newton ABC-CLIO, 2019.
Web resources:	
1	GESI-Traning-Module.pdf
2	Gender Equality and Social Inclusion WV.pdf
3	integrity-action-gesi-strategy-version-2.pdf
4	Major Marginalized Groups: A Closer Look - Urban Studies
5	UNOPS GESI Mainstreaming in Projects Strategy (Final)

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	3	2	3	2	3	3	2	2	2
CO2	2	2	2	2	2	2	2	2	2	2	2
CO3	2	3	3	2	3	2	3	3	2	2	2
CO4	2	2	2	2	2	2	2	2	3	2	2
CO5	3	3	3	2	3	2	3	3	3	2	2
Total	11	12	13	10	13	10	13	13	12	10	10
Average	2.2	2.4	2.6	2	2.6	2	2.6	2.6	2.4	2	2

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCIK51	Introduction to Indian Science and Technology	IKS	1	1	0	0	2	2	25	75	100
Learning Objectives											
LO1	To understand Indian scientific philosophy: the unity of science, spirituality, types of knowledge, and epistemology.										
LO2	To understand the key contributions of Indian astronomy, metallurgy, and medicine.										
LO3	To understand traditional Indian practices in agriculture, water management, and textile science.										
LO4	To knowledge transmission, daily-life science, colonial impact, and NEP 2020 revival.										
LO5	To understand the integration of Ayurveda, Vastu Shastra, and Jyotisha with modern fields, and related digitisation, standardisation, and global challenges.										
Unit	Content									Hours	
1	Philosophical Foundations of Indian Science-Unity of science and spirituality - Śāstra, Kalā, Vidyā: categories of knowledge - Epistemology: Pratyakṣa (perception), Anumāna (inference), Śabda (testimony).									6	
2	Astronomy: Jyotiṣa, planetary motion, eclipse theory, Aryabhaṭa, Varāhamihira. Metallurgy: Iron pillar, zinc distillation, wootz steel. Medicine: Āyurveda (Caraka, Suśruta), health systems, surgery.									6	
3	Agriculture and irrigation: canal systems, crop rotation, organic methods. Water management: stepwells, tanks, and dams. Textile science: dyeing, spinning, weaving, cotton technology									6	
4	Role of guilds, hereditary knowledge, community transmission - Science in rituals, festivals, and daily life - Colonial disruption and documentation - NEP 2020 and revival of traditional knowledge systems.									6	
5	Integrative models: Ayurveda + modern medicine, Vastu + architecture, Jyotiṣa + data science - Challenges and possibilities in digitisation, standardization, and global relevance.									6	

CO	Course Outcomes
CO1	Understand Indian scientific philosophy, its knowledge systems, and core epistemological methods.
CO2	Explain the key contributions of Indian science in astronomy, metallurgy, and medicine.
CO3	Describe the traditional Indian practices in agriculture, irrigation, water management, and textile science.
CO4	Apply the knowledge transmission, daily-life science, colonial impacts, and revival of traditional systems under NEP 2020.
CO5	Evaluate the integration of Ayurveda, Vāstu, and Jyotiṣa with modern fields and related challenges.

Textbooks:	
1	Dharampal. Indian Science and Technology in the Eighteenth Century.
2	Rajaram, N.S., and Frawley, D. Vedic Aryans and the Origins of Civilization.
3	Balasubramanian, R. (Ed.). History of Science, Philosophy and Culture in Indian Civilization (PHISPC Series).
4	Kak, S. The Astronomical Code of the Ṛgveda.
5	Pingree, D. The Logic of Science in Indian Mathematics and Astronomy.
Reference Books:	
1	Salomon, R. Indian Epigraphy and Scientific Inscriptions.
2	Sharma, R.S. Irrigation and State in Ancient India.
Web resources:	
1	https://philosophy.institute/epistemology/pramanas-indian-philosophy-foundations/?utm_
2	Pramanas: The Foundations of Knowledge in Indian Philosophy • Philosophy Institute

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	2	1	3	3	3	3
CO2	3	3	3	2	1	3	1	3	3	3	3
CO3	3	3	3	3	2	2	1	3	3	3	3
CO4	3	3	2	1	3	2	1	3	3	3	2
CO5	3	3	3	2	3	3	1	3	3	3	3
Total	15	15	14	9	10	12	5	15	15	15	14
Average	3	3	2.8	1.8	2	2.4	1	15	3	3	2.8

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCC61	CC - 13 Biotechnology	Core	4	1	0	0	4	5	25	75	100
Learning Objectives											
LO1	Explain the principles and tools of recombinant DNA technology and gene cloning.										
LO2	Demonstrate plant tissue culture techniques and genetic transformation in plants.										
LO3	Apply animal cell culture methods, gene transfer techniques, and transgenic technologies.										
LO4	Analyze the potential of marine bioresources in biotechnology applications.										
LO5	Evaluate microbial processes and fermentation technology for industrial and environmental applications.										
Unit	Content									Hours	
1	Recombinant DNA Technology Introduction and scope of biotechnology. Recombinant DNA technology – definition and general principles. Restriction endonucleases (types and functions), DNA ligase, DNA Polymerases, Reverse Transcriptase, Alkaline Phosphatase, Polynucleotide Kinase (PNK), Terminal Deoxynucleotidyl Transferase (TdT), Exonucleases, Endonucleases, DNA Methyl transferases, and RNA Polymerase in DNA manipulation. Gene cloning techniques. Cloning vectors – plasmids (pBR322, pUC), bacteriophages (λ phage), cosmids – salient features and applications. Selection and screening of recombinants (colony hybridization, antibody-based screening). Applications of recombinant DNA technology: production of therapeutic proteins (e.g., insulin), vaccine development, gene therapy, and genetically modified organisms (GMOs) in agriculture.									15	
2	Plant Biotechnology Plant tissue culture – basic requirements, MS medium, callus and protoplast culture. Micropropagation, somaclonal variation and somatic hybridization. Plant gene transfer systems – Agrobacterium-mediated transfer. Vectors – Ti plasmid (cointegration, binary vectors), plant viral vectors (TMV, CaMV). Selectable markers, reporter genes and promoters. Transgenic plants – pest resistance, herbicide resistance, stress tolerance and edible vaccines.									15	
3	Animal Biotechnology Animal cell culture – primary culture, cell lines, organ culture, methods and applications. Gene transfer methods – viral vectors, yeast vectors, microinjection, electroporation, particle bombardment. Transgenic animals (transgenic mice) – production and applications. Human genome mapping and gene therapy. Stem cell technology – types, culture and applications. Ethical considerations.									15	
4	Marine Biotechnology Introduction to marine biotechnology: scope and significance of marine bioresources. Marine organisms such as microorganisms, algae, and invertebrates as sources of bioactive compounds. Isolation and screening of marine-derived products, including enzymes, antibiotics, and secondary metabolites. Applications in pharmaceuticals, nutraceuticals and									15	

	aquaculture. Recent advances, challenges, and sustainable utilization of marine resources.	
5	Fermentation, Microbial and Environmental Biotechnology Microbial growth kinetics. Fermentation technology: types, fermentor design, and operation. Upstream and downstream processing. Industrial production and applications: ethanol, antibiotics (streptomycin), and enzymes (amylase, proteases). Environmental biotechnology: biodegradation, bioremediation, wastewater treatment, oil spill cleanup, bioleaching, and biodegradable plastics.	15

CO	Course Outcomes
CO1	Analyze the use of enzymes, vectors, and screening methods in recombinant DNA and cloning techniques.
CO2	Apply methods for plant regeneration and development of transgenic plants with desired traits.
CO3	Evaluate applications of animal biotechnology in gene therapy, transgenics, and stem cell research.
CO4	Analyze the applications of marine organisms in pharmaceutical, industrial, and environmental fields.
CO5	Explain the role of fermentation and microbes in industrial production and environmental management.

Textbooks:

1	Dubey, R. C. (2014). A textbook of biotechnology (5th ed.). S. Chand Publishing.
2	Singh, B. D. (2023). Biotechnology: Expanding horizons (5th ed.). Kalyani Publishers / MedTech Science Press.
3	Sathyanarayana, U., & Chakrapani, U. (2020). Biotechnology (latest revised ed.). Books and Allied (P) Ltd.
4	Brown, T. A. (2020). Gene cloning and DNA analysis: An introduction (8th ed.). Wiley-Blackwell. ✓ (Latest edition upgraded from 7th ed.)
5	Stanbury, P. F., Whitaker, A., & Hall, S. J. (2017). Principles of fermentation technology (3rd ed.). Butterworth-Heinemann.

Reference Books:

1	Primrose, S. B., & Twyman, R. M. (2013). Principles of gene manipulation and genomics (7th ed.). Wiley-Blackwell.
2	Glick, B. R., Pasternak, J. J., & Patten, C. L. (2017). Molecular biotechnology: Principles and applications of recombinant DNA (5th ed.). ASM Press.
3	Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2014). Molecular biology of the gene (7th ed.). Pearson.
4	Kim, S. K. (Ed.). (2015). Handbook of marine biotechnology. Springer.
5	Scragg, A. H. (2005). Environmental biotechnology (2nd ed.). Oxford University Press.

Web resources:

1	Molecular Biology (IIT Guwahati) <ul style="list-style-type: none"> Covers recombinant DNA technology, cloning, gene expression, and molecular tool
2	https://onlinecourses.nptel.ac.in/noc25_bt53/preview Course: Genetic Engineering: Theory and Application <ul style="list-style-type: none"> Includes gene cloning, vectors, recombinant DNA, screening methods
3	https://nptel.ac.in/courses/102103045 Course: Fundamentals of Biotechnology <ul style="list-style-type: none"> Covers plant biotechnology, transgenics, tissue culture basics
4	Industrial Biotechnology (IIT Kharagpur) <ul style="list-style-type: none"> Covers fermentation technology, bioreactors, microbial production, environmental applications
5	https://onlinecourses.nptel.ac.in/noc22_bt35/preview Course: Genome Editing and Engineering <ul style="list-style-type: none"> Covers gene transfer, transgenics, CRISPR, animal biotechnology applications

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	2	3
CO2	3	3	3	3	3	3	3	3	2	3	3
CO3	3	3	3	3	3	3	3	3	3	3	2
CO4	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	2	2
Total	15	13	15	15	15	15	15	15	13	13	13
Average	3	2.6	3	3	3	3	3	3	2.6	2.6	2.6

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCC62	CC-14 Immunology	Core	3	1	1	0	3	5	25	75	100
Learning Objectives											
LO1	Learn haemopoiesis, lymphocyte differentiation, and immunoglobulin biology.										
LO2	Gain knowledge of immunological techniques and immune response regulation.										
LO3	Explain humoral and cell-mediated immune responses.										
LO4	Study transplantation, infectious diseases, and immunodeficiency conditions.										
LO5	Understand applications of antibodies in diagnosis and therapy.										
Unit	Content									Hours	
1	Cells of The Immune System: Cells of the immune System - Macrophages, B and T lymphocytes, Dendritic cells, Natural killer and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells. Organs of the immune system: Thymus, Bone marrow, Spleen, lymph nodes, MALT, GALT. Haemopoiesis and differentiation, lymphocyte trafficking. Structure and functions of different classes of Immunoglobulin. Biology of antigen and Superantigens.									15	
2	Antigen-Antibody Reactions: Antigen antibody reactions, Applications of Immunological techniques- ELISA, RIA, Immunofluorescence, immunoblotting and immunoelectrophoresis, immunocytochemistry, genetic control of immune response, effector mechanisms, MHC, antigen recognition and presentation, activation of B and T lymphocytes.									15	
3	Humoral and Cell Mediated Immunity: Humoral and cell-mediated immunity. Cell-mediated Cytotoxicity: Mechanism of T cell and NK Cell-mediated lysis, Antibody-dependent cell-mediated Cytotoxicity and macrophage-mediated Cytotoxicity. Interleukins and Cytokines - their role in immune regulation, Biology of the Complement System, and Complement Fixation Test. Immune suppression and immune tolerance.									15	
4	Immunity Versus Diseases: Hypersensitivity – Immediate (Type 1) and Delayed (Type IV), Autoimmune disorders, Transplantation immunology- MLR, HLA Typing, Bone marrow transplantation, Organ transplants. Immunity to Infectious agents - Bacteria, Viruses, Malaria, and Helminthes. Tumor immunology and immunotherapy. AIDS and other immune deficiencies, Structure of HIV, envelope glycoproteins, destruction of T cells: immunologic symptoms of AIDS, AIDS vaccine.									15	
5	Applications of Antibody Vaccine technology and recombinant vaccines, Identification of B and T epitopes for vaccine development. In situ characterization of cells from tissues, Immuno screening of Recombinant library, Hybridoma – Monoclonal Antibody production and applications; MAbs in diagnosis and therapy.									15	

CO	The student will be able to	Course Outcomes
CO1	Understand the structure and functions of immune cells, organs, and immunoglobulins, including haemopoiesis and antigen biology.	
CO2	Explain antigen–antibody interactions and apply various immunological techniques in analysis and diagnosis.	
CO3	Describe the humoral and cell-mediated immune responses, including cytokine action and complement system mechanisms.	
CO4	Analyse immune responses in diseases such as hypersensitivity, autoimmunity, infections, and immunodeficiency disorders.	
CO5	Evaluate knowledge of antibody-based techniques, monoclonal antibody production, and vaccine development in biomedical applications.	

Textbooks:	
1	J. Kuby – Immunology (8th Edition) – W.H. Freeman and Company, New York – 2018
2	C. V. Rao – An Introduction to Immunology – Narosa Publishing House, Chennai – 2005
3	Barker & Taylor – Applied Immunology and Biochemistry – Scientific e-Resources – 2019
4	I. R. Tizard – Immunology: An Introduction (4th Edition) – Saunders College Publishers, New York – 1995
5	Ananthanarayan & Paniker — Textbook of Microbiology (Immunology section) — Universities Press — 11th Edition — 2021.
Reference Books:	
1	E. Benjamini – Immunology: A Short Course (IV Edition) – Wiley-Liss Publication – 2008
2	P. J. Delves – Roitt’s Essential Immunology (11th Edition) – Blackwell Publishing – 2006
3	A. K. Chakravarty – Immunology and Immunotechnology – (Publication not specified) – (Year not specified)
4	K. Murphy – Janeway’s Immunobiology – Garland Science Publishers – 2008
5	I. R. Tizard – Immunology: An Introduction (4th Edition) – W.B. Saunders Co., Philadelphia – 2000

Web resources:	
1	https://ebooks.inflibnet.ac.in/biocp16/chapter/types-of-immunity-innate-and-acquired/
2	https://microbiologynotes.org/immunoglobulin-introduction-structure-and-function/
3	https://www.biologydiscussion.com/biochemistry/immunochemical-techniques/top-7-types-of-immunochemical-techniques-used-in-biochemistry/12525#google_vignette
4	https://microbenotes.com/hypersensitivity-introduction-causes-mechanism-and-types/
5	https://byjus.com/biology/vaccine-definition/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	2	2	2	2	2
CO2	3	2	2	1	2	2	2	2	3	2	2
CO3	3	2	2	2	2	2	2	3	3	2	2
CO4	3	2	3	2	2	2	2	3	3	2	2
CO5	3	2	2	3	2	3	2	2	3	3	2
Total	15	10	11	10	11	11	10	12	14	11	10
Average	3.0	2	2.2	2	2.2	2.2	2	2.4	2.8	2.2	2

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCE63	EC -11 Medical Lab Technology	EC	4	1	0	0	4	5	25	75	100
Learning Objectives											
LO1	To obtain practical skills and follow good laboratory practices to analyse biological samples.										
LO2	To perform the collection and preservation of biological samples.										
LO3	To estimate haematological parameters										
LO4	To examine the urine and stool samples for normal and abnormal constituents										
LO5	To acquire skills to culture microorganisms and in-depth knowledge on Bacteriology.										
Unit	Content									Hours	
1	Laboratory Care and Instrumentation Good laboratory practices, Code of conduct for laboratory personnel, safety measures in the laboratory, chemicals and reagents, labelling, storage and use. First aid for laboratory accidents: precautions and first-aid equipment. Reporting laboratory tests and keeping records and documentation. General approach to quality control, quality control of quantitative data.									15	
2	Urine Analysis and Stool Examination Composition, collection, preservation, gross examination, interfering factors, and chemical examination. Significance of sugar, protein, ketone bodies, bile pigments, blood, and uric acid in urine. Specimen collection- inspection of faeces- odour, pH, interfering substance. Test for occult blood, faecal fat.									15	
3	Clinical Hematology Haemostasis, Mechanism of blood coagulation, Fibrinolysis, Anticoagulant, preservation, Estimation of Hb, PCV, WBC, RBC, Platelets, ESR. Clotting time, bleeding time - normal value, clinical interpretation.									15	
4	Body Fluids and Blood Banking Cerebrospinal fluid and amniotic fluid, semen analysis, sputum examination - Interpretation. Blood grouping- ABO system, Rh typing, Blood transfusion, cross-matching, and its complications.									15	
5	Practical Microbiology Techniques Collection and culturing of microorganisms from various clinical specimens (pus, urine, stool, sputum, and throat swabs), Preparation and use of different types of culture media. Antibiotic sensitivity testing. Microscopic examination techniques (Gram staining, Ziehl–Neelsen staining for detection of acid-fast bacilli (e.g., Mycobacterium tuberculosis and Mycobacterium leprae)									15	

CO	Course Outcomes
	The student will be able to
CO1	Understand the good laboratory practices, safety measures, and proper documentation.
CO2	Explain and interpret urine and stool analysis.
CO3	Describe the hematological tests and understand coagulation mechanisms.
CO4	Analyze body fluids and perform blood grouping and transfusion procedures.
CO5	Apply microbiological techniques, including culturing and staining methods.

Textbooks:	
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	Laboratory Directions for Beginners In Bacteriology, Veranus A. Moore, Adlard Coles Nautical Books, 2007.
Reference Books:	
1	Lippincott's illustrated reviews immunology, Doan T., 2nd edition, LWW, 2012.
2	Clinical Chemistry- M.N. Chatterjee& R. Chawla, 2nd edition, Jaypee Brothers Medical Publishers (P) Ltd., 2010.
3	Textbook of Medical Laboratory Technology – by Praful B. Godkar
4	District Laboratory Practice in Tropical Countries – by Monica Cheesbrough
5	Ananthanarayan and Paniker’s Textbook of Microbiology – by R. Ananthanarayan and C. K. Jayaram Paniker
Web resources:	
1	https://buat.edu.in/wp-content/uploads/2025/08/E-Manual-Content-Introduction-to-Good-Laboratory-Practices.pdf
2	https://www.scribd.com/document/790580973/URINE-AND-STOOL-EXAMINATION
3	https://www.scribd.com/presentation/482546016/hemostasis-PPT
4	https://www.scribd.com/document/746451821/Analysis-of-Body-Fluids
5	https://cec.nic.in/cec/ - e-Content courseware in UG subjects

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	3	2	3	2	1
CO2	3	3	2	2	2	2	1	2	3	2	1
CO3	3	3	3	2	2	2	1	2	3	3	2
CO4	3	3	3	3	2	2	2	2	3	3	3
CO5	3	3	3	2	3	3	2	3	3	3	2
Total	15	14	13	12	11	11	9	11	15	13	9
Average	3	2.8	2.6	2.4	2.2	2.2	1.8	2.2	3	2.6	1.8

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCE64	EC -11 Phytochemistry	EC	4	1	0	0	4	5	25	75	100
Learning Objectives											
LO1	To learn various quality control parameters to test quality of crude drugs from natural origin.										
LO2	Identify and quantify adulterations in herbal crude drugs,										
LO3	To impart insight on WHO guidelines required for cultivation, collection and quality control of herbal drugs.										
LO4	To make students understand pharmacopoeial standards and monographs given in various herbal pharmacopoeias, pharmacovigilance study and its importance										
LO5	To learn various quality control parameters to test quality of crude drugs from natural origin.										
Unit	Content									Hours	
1	<p>Introduction to Pharmacognosy Adulteration and methods to encounter adulteration of plant drugs. Evaluation of plant drugs. Organoleptic evaluation of drugs including gross morphology, sampling, preliminary examination and foreign matter. Physical evaluation of plant drugs: Determination of moisture content, foreign organic matter, ash values, extractive values and swelling index. Refractive index, optical rotation and their applications in standardization of plant drugs.</p>									15	
2	<p>Cultivation and Extraction of Plant drugs Selection, identification and authentication of herbal materials, drying and processing of herbal raw material Cultivation technology, post harvest care and processing of medicinal and aromatic plants: Profile of some high trade value plants: Chirata, Giloe, Gudmar, Isapgol, Jatamansi, Kalmegh, Kesar, Mulethi, Sarpagandha and Tulsi, Ashwagandha, Belladonna, Ginger, Turmeric, Aloes, Digitalis, Vinca, Ephedra, Senna, etc</p>									15	
3	<p>Isolation of Phytoconstituents chemical properties, characterization (excluding synthesis) and therapeutic uses of some medicinally important class of Plant Phenolics (Tannins & flavonoids), Alkaloids (Quinine,, Atropine, Solasodine Vincristine, Vinblastine, Strychnine),Glycosides (Sennoside, Digoxin, Diosgenin,), Terpenoides, Steroids and Resinous substances (Podophyllotoxin), Fixed oils, Volatile oils, Carbohydrates, taxol.</p>									15	
4	<p>Herbal Remedies: Toxicity & Regulations: Importance of Herbal Therapies, Herbal versus Conventional drugs, Efficacy of herbal therapies, safety in herbal drugs, toxicity in Herbals and their interaction, Herbal drug regulations in India</p>									15	

5	Edible Dyes: Edible dyes sweeteners, perfumery and cosmetic agents from plants Enzymes from plant origin. Marine plants: Introduction, chemistry and biology of marine products of plant origin.	15
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CO	Course Outcomes
	The student will be able to
CO1	Applying standardized quality control parameters to test the quality of crude drugs from natural origin.
CO2	Determining the adulterations found in herbal crude drugs,
CO3	To follow pharmacopoeial standards and monographs using various herbal pharmacopoeias.
CO4	An understanding of WHO guidelines required for cultivation, collection and quality control of herbal drugs.
CO5	Analyze edible dyes from plant origin

Textbooks:

1	W.C. Evans, 2002. "Trease & Evan's Pharmacognosy". WB.Saunders & co., London.
2	T. Swain, 1963. "Chemical plant Taxonomy". Academic Press, London.
3	C.A Stace, 1985. "Plant Taxonomy and Biosystematics". Edward Arnold, London.
4	C.K. Atal, "Cultivation and Utilization of Medicinal plants". R.R.L. Jammu
5	H.E. Street, 1997. "Plant Cell and Tissue Culture". Blackwell Scientific, London.

Reference Books:

1	J.B. Harborne, 1998. "Phytochemical methods", Chapman and Hall.
2	K. Paech, 1956. "Modern methods of plant analysis"., Springer-Verlag
3	Guidelines for the Assessment of herbal medicines, 1991, WHO Report, Geneva.
4	Quality Control Methods for Medicinal Plant material, 1992, WHO Guidelines.
5	Indian Pharmacopoeia, 1996, Govt. of India, Ministry of Health and Family Welfare, Delhi.

Web resources:

1	Health Organization – WHO Guidelines on Herbal Medicines World Useful for herbal drug standardization, safety, toxicity, and regulations.
2	National Center for Complementary and Integrative Health (NCCIH) Information on herbal medicines, efficacy, safety, and herb-drug interactions.
3	Pharmacognosy Reviews Journal Review articles on medicinal plants, phytoconstituents, and herbal drug research.
4	American Herbal Pharmacopoeia Standards for medicinal plant identification and quality control.
5	AYUSH Research Portal Research articles and traditional medicine information from India.

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	3	2	3	2	1
CO2	3	3	2	2	2	2	1	2	3	2	1
CO3	2	2	3	3	2	2	1	2	3	3	2
CO4	3	3	3	3	2	2	2	2	3	3	3
CO5	3	3	3	2	3	3	2	3	3	3	2
Total	14	13	13	13	11	11	9	11	15	13	9
Average	2.8	2.6	2.6	2.6	2.2	2.2	1.8	2.2	3	2.6	1.8

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCE61P	EC-10 Hematology Lab	EC	0	0	5	0	4	5	25	75	100
Learning Objectives											
LO1	To perform estimation of haemoglobin, bleeding time, clotting time, RBC count, WBC count, PCV, ESR, and peripheral smear examination.										
LO2	To acquire practical knowledge of blood grouping, Rh typing, cross-matching, and Coombs tests in blood banking.										
LO3	To identify common laboratory materials and explain their applications in haematology and blood banking.										
Unit	Content									Hours	
	<p>I Haematological Investigations</p> <p>a. Haemoglobin by Sahli's method</p> <p>b. RBC Counting</p> <p>c. Total and differential count of white blood cells</p> <p>d. Blood clotting time</p> <p>e. Bleeding time</p> <p>f. Packed cell volume</p> <p>g. Erythrocyte sedimentation rate</p> <p>h. Preparation & examination of blood smear (Peripheral smear).</p> <p>i. HCG kit test</p> <p>II. BLOOD BANKING</p> <p>a. Blood grouping & Rh typing</p> <p>b. Cross-matching</p> <p>c. Direct Coombs test</p> <p>d. Indirect Coombs test</p> <p>III.SPOTTERS:</p> <p>Lab materials – Name & application of each:</p> <p>a. Vacutainer - Lavender / Blue / Green / Grey topped</p> <p>b. ESR tube</p> <p>c. Cuvette</p> <p>d. PCV tube</p> <p>e. Pasteur pipette</p> <p>f. Micropipette</p> <p>g. RBC pipette</p> <p>h. WBC pipette</p> <p>i. Neubauer chamber</p> <p>j. Lancet</p>									75	

CO	Course Outcomes
	The student will be able to
CO1	Perform routine haematological investigations and interpret the results accurately.
CO2	Analyse blood samples for haemoglobin estimation, cell counting, ESR, PCV, and peripheral smear examination.
CO3	Demonstrate blood grouping, Rh typing, cross-matching, and Coombs tests used in blood banking.

Textbooks:	
1	Manickam, S.S. (2018). Biochemical Methods (3 rd ed.). New Age International Pvt Ltd publishers - ISBN 10: 8122421407 / ISBN 13: 9788122421408
2	Plummer, D.T. (n.d.). An Introduction to Practical Biochemistry. Tata McGraw-Hill ISBN: 97800708416
3	B. Godkar. 2020. Textbook of Medical Laboratory Technology Vol 1 & 2, Paperback, 3rd edition, Bhalani Publishers.
4	Alan H Gowenlock. 1998. Varley's Practical Clinical Biochemistry, 6th edition, CBS Publishers, India
5	Kanai L Mukerjee. 1996. Medical Lab Technology, Vol I& II, 1st edition, Tata McGraw-Hill, Pennsylvania.
Reference Books:	
1	Singh, S.K. (2005). Introductory Practical Biochemistry (2nd ed. SSSSSSSS). Alpha Science International, Ltd- ISBN 10: 8173193029 / ISBN 13: 9788173193026
2	Ashwood, B. a. (2001). Tietz Fundamentals of Clinical Chemistry. WB Saunders Company, Oxford Science Publications USA - ISBN 10: 0721686346 / ISBN 13: 978072168634
Web resources:	
1	https://asset.ejaypee.com/TOC-new/9789350252024.pdf?utm_source=chatgpt.com
2	https://pharmacyinfo.com/stimation-of-hemoglobin/?utm_source=chatgpt.com
3	https://studylib.net/doc/7873181/hb--esr--pcv-assessment-and-osmotic-fragility-test?utm_source=chatgpt.com
4	https://pubmed.ncbi.nlm.nih.gov/34886658/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	2	2	2	3	2	1
CO2	3	3	2	2	2	2	1	2	3	3	2
CO3	3	2	2	2	3	3	2	3	3	3	3
Total	9	7	5	6	7	7	5	7	9	8	6
Average	3	2.3	1.6	2	2.3	2.3	1.6	2.3	3	2.6	2

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCE62P	EC-10 Phytochemistry Lab	EC	0	0	5	0	4	5	25	75	100
Learning Objectives											
LO1	To learn various quality control parameters to test quality of crude drugs from natural origin.										
LO2	Identify and quantify adulterations in herbal crude drugs,										
LO3	To learn to handle various conventional and Novel extraction techniques										
Unit	Content									Hours	
I	<ol style="list-style-type: none"> 1. Microscopical evaluation of plant drugs (at least five) listed in theory- Vein islet number, vein termination number, stomatal index, stomatal number, palisade ratio, trichomes, starch grains, calcium oxalate crystals) 2. Determination of moisture content, foreign organic matter, ash values, extractive values, swelling index of plant drug. 3. Extraction by different methods - Conventional (Soxhlet, Maceration, Reflux, Percolation, Stirring etc.) & Novel (Microwave Assisted, Ultrasonic method, Supercritical fluid extraction etc) 4. Physico-chemical, phytochemical evaluation of some plant drugs containing alkaloids, terpenoids, glycosides phenolics, steroids. 5. Estimation of total solid content and alcohol content in Asava/Arista 6. Pharmacopoeial evaluation of natural products Determination of vitamin C in some crude drugs 									75	

	Course Outcomes The student will be able to
CO1	Identification of medicinal plants using various macroscopic and microscopic parameters.
CO2	Knowledge of different conventional and novel methods of extraction of crude drugs.
CO3	Application of pharmacovigilance study for herbal drugs.

Textbooks:	
1	W.C. Evans, Trease and Evans Pharmacognosy, 15th edition 2002, W.B. Saunders & Co., London.
2	S.S. Handa and M.L. Kaul, Supplement to cultivation and utilization of medicinal plants, 1996, R.R.L Jammu, India.
3	Ram P Rastogi, Compendium of Indian Medicinal Plants, 1998, Vol. I-V, CSIR, Lucknow, New Delhi.
4	T. Fleming, PDR for Herbal Medicine, 2nd edition, 2000, Medical Economics compant, Montvale, New Jersey.
Reference Books:	
1	Dr.P.Mukherjee, Quality control herbal drugs, 2005, Business Horizons, New Delhi.
2	S.S. Handa, S.P.S. Khanuja, G. Longo & D.D. Rakesh — Extraction Technologies for Medicinal and Aromatic Plants — United Nations Industrial Development Organization — 1st Edition — 2008
Web resources:	
1	Quality Control Methods for Herbal Materials – WHO
2	Evaluation of Crude Drugs – PharmaTutor
3	Determination Ash Value and Extractive Value
4	Swelling Index and Moisture Content Practical

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	2	2	2	3	2	1
CO2	2	3	2	2	2	2	1	2	3	3	2
CO3	3	2	2	1	3	3	2	3	2	3	3
Total	8	7	5	6	7	7	5	7	9	8	6
Average	2.8	2.3	1.6	1.8	2.3	2.3	1.6	2.3	1.8	2.6	2

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCP61	PEC – 1 Biomedical Instrumentation	PEC	1	1	0	0	2	2	25	75	100
Learning Objectives											
LO1	To provide insights into the blood pressure and its measurement.										
LO2	To elaborate on the mechanism of instruments related to respiration.										
LO3	To highlight the importance of imaging techniques.										
LO4	To acquaint students with the basics of medical assisting devices.										
LO5	To familiarize with the life-saving and therapeutic equipment.										
Unit	Content									Hours	
1	Measurement of Physiological Parameters Measurement of blood pressure–sphygmomanometer. Cardiac output –Cardiac rate – Heart sound – Stethoscope, ECG – EEG – EMG – ERG									6	
2	Monitoring and Respiratory Equipment Monitoring of inspired/expired anaesthetic gases, capnograph, inhalators, nebulisers, aspirators, infant respirator, Plethysmography									6	
3	Medical Imaging Techniques Medical imaging: X-ray machine, radiographic and fluoroscopic techniques– Computed tomography–MRI–PET, Ultrasonography–Endoscopy–Thermography									6	
4	Assisting Medical Equipment Assisting equipment: Pacemakers –Defibrillators–Ventilators									6	
5	Therapeutic Equipment Therapeutic equipment: Nerve and muscle stimulators –Diathermy–Heart – Lung machine – Audio meters – Dialysers.									6	

CO	Course Outcomes
CO1	Explain the physiological basis of blood pressure and demonstrate the principles involved in its measurement.
CO2	Describe the construction and working mechanism of instruments used for measuring and supporting respiration.
CO3	Discuss the importance of medical imaging techniques in diagnosis and patient care.
CO4	Apply the basic principles and applications of medical assisting devices used in healthcare.
CO5	Evaluate the operation and clinical significance of life-saving therapeutic equipment used in emergency and critical care.

Textbooks:	
1	M. Arumugam, Bio-Medical Instrumentation, Anuradha Agencies, Chennai, 2002.
2	L. A. Geddes and L. E. Baker, Principles of Applied Biomedical Instrumentation, John Wiley & Sons, New York, 3rd Edition, 1989.
3	Jen-Shih Lee, Biomedical Engineering Entrepreneurship, Springer, 2010.
4	Sudip Paul, Introduction to Biomedical Instrumentation and Its Applications, PHI Learning Pvt. Ltd., New Delhi, 2014.
5	Mandeep Singh, Introduction to Biomedical Instrumentation, PHI Learning Pvt. Ltd., New Delhi, 2012.
Reference Books:	
1	R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2nd Edition, 2003.
2	C. Rajarao and S. K. Guha, Principles of Medical Electronics and Biomedical Instrumentation, Universities Press (India) Ltd., Hyderabad, 2001.
3	John G. Webster, Medical Instrumentation: Application and Design, John Wiley & Sons, New York, 4th Edition, 2009.
4	Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson Education, 4th Edition, 2001.
5	P. V. Kumar, Biomedical Instrumentation and Measurements, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2007.
Web resources:	
1	Measurements of microbial growth - Microbiology Notes
2	Mosby's Respiratory Care Equipment
3	Medical Imaging Techniques Geeky Medics
4	A Unit 4: Equipment for Critical Care - Pacemakers, Defibrillators & More - Studocu
5	SBM1403.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	3	2	3
CO4	3	2	3	2	3	2	3	2	3	3	3	3
CO5	3	2	3	2	2	3	3	3	3	3	3	3
Total	15	13	15	13	13	14	14	14	15	15	15	15
Average	3.0	2.6	3.0	2.6	2.6	2.8	2.8	2.8	3.0	3.0	3.0	3.0

3 – Strong, 2- Medium, 1- Low

IIIrd YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBCL61	SLC – 1 Biochemistry in Everyday Life	SLC	0	0	0	3	2	3	25	75	100
Learning Objectives											
LO1	Understand the fundamentals of life with Biochemistry										
LO2	Explain the health benefits of common household remedies and basic medicines.										
LO3	Describe the difference between biodegradable and non-biodegradable waste										
LO4	Analyse the biochemical processes involved in food preparation and preservation.										
LO5	Interpret basic blood test reports and common health indicators.										
Unit	Content									Hours	
1	The Molecular Logic of Life & Wellness -Definition and scope of biochemistry, The biological importance of water, hydration, and pH balance in the human body, pH and buffers (simple understanding with examples like lemon, soap), Acidic foods and basic foods and its important. Balanced diet and nutritional components. Importance of sleeping. Antioxidants in fruits and vegetables.									9	
2	Biochemistry of Traditional & modern Wisdom: Indian knowledge system of using turmeric, ginger, and garlic in daily life. Maintaining a basic emergency medical kit - Aspirin (300mg), Sorbitrate 5 mg, Cetirizine, Paracetamol, Ibuprofen, Antacids. Painkillers, antibiotics (basic use and misuse), ORS preparation and importance. First-Aid for Burns and Stings.									9	
3	Environmental Biochemistry & Waste Management- Biochemical differentiation between Biodegradable and Non-Biodegradable. Waste decomposition and recycling of kitchen waste into manure. Greywater recycling. Home-scale Biogas Plants and biofertilizers production. The role of microbes in decomposing waste.									9	
4	Household Science & Food Technology- Biochemistry behind making curd, idli/dosa, butter, and bread. Composition of milk, pasteurisation, and the process of making ghee and paneer. Common household methods include pickling, salting, and drying. Water purification methods (boiling, filtration, chlorination). Hygiene and sanitation. Knowledge of Food Adulterants.									9	
5	Clinical Biochemistry & Family Health- Understanding basic blood reports of Haemoglobin levels, Blood Glucose (Diabetes), and Lipid Profile (Cholesterol), thyroid profile. Age-Specific Biochemical Health Indicators for lactose intolerance and common milk allergies in infants, dehydration, Anemia, PCOD, mental health of children, Blood pressure, memory loss and age-related vision changes.									9	

CO	Course Outcomes
CO1	Understand the balanced diet, hydration, and healthy lifestyle practices in daily life.
CO2	Demonstrate safe use of first-aid, ORS preparation, and basic medications in emergencies.
CO3	Implement simple waste management practices like composting and recycling at home.
CO4	Practice safe food handling, water purification, and identification of food adulteration.
CO5	Assess family health conditions using simple biochemical parameters and take preventive measures.

Textbooks:	
1	U. Satyanarayana & U. Chakrapani, Book Title: Biochemistry, Publisher: Elsevier India, Year: 2025 (7th Edition)
2	U. Chakrapani, Book Title: Biochemistry, Publisher: Elsevier India., Year: 2020 (5th Edition)
3	Sankhavaram R. Panini, Book Title: Medical Biochemistry: An Essential Textbook, Publisher: Thieme, Year: 2021
4	L. Matsyagiri et al Book Title: A Textbook of Biochemistry Publisher: Shashwat Publication, Year: 2023
5	Harbans Lal & Ashuma Sachdeva, Book Title: Textbook of Biochemistry, Publisher: CBS Publishers & Distributors, Year: 2024
Reference Books:	
1	Darshan Malik et al. Textbook of Nutritional Biochemistry, Publisher: Springer Singapore, Year: 2023
2	Manvesh Kumar Sihag, Ankit Goyal, Karuna Meghwal, Beenu Tanwar, Biochemistry and Human Nutrition, Publisher: New India Publishing Agency (NIPA), Year: 2019
3	Martha H. Stipanuk et al. Biochemical, Physiological, and Molecular Aspects of Human Nutrition Publisher: Elsevier Year: 2026 (5th Edition)
4	Gerald Litwack Human Biochemistry (2nd Edition), Publisher: Elsevier, Year: 2021
5	I. Clement, Applied Nutrition, Dietetics and Biochemistry for Basic BSc Nursing, Publisher: Jaypee Brothers Medical Publishers, Year: 2025
Web resources:	
1	https://drive.google.com/drive/folders/17teC8hUgF7fkOVFn8bvGTRN28ayoEmXL?usp=drive_link – eBooks Google Drive
2	https://tvuni.academia.edu/mvinayagam - Educational networks to share research, knowledge, teaching documents, chapters, e-notes, e-books, thesis, and materials.
3	https://ncert.nic.in/textbook.php
4	ICAR e-Courses, https://ecourses.icar.gov.in
5	Khan Academy, https://www.khanacademy.org

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	2	1	2	2	2	1	3	3
CO2	3	2	2	3	2	1	3	2	2	2	3	3
CO3	2	2	1	3	2	2	3	2	1	1	2	2
CO4	3	3	2	3	2	2	3	2	3	1	3	3
CO5	3	3	3	2	2	2	2	3	3	3	3	3
Total	14	12	9	13	10	8	13	11	11	8	14	14
Average	2.8	2.4	1.8	2.6	2.0	1.6	2.6	2.2	2.2	1.6	2.8	2.8

3 – Strong, 2- Medium, 1- Low