Marudhar Kesari Jain College for Women (Autonomous)

Vaniyambadi – 635 751

PG & Research Department of Biochemistry

Syllabus

Undergraduate Programme

Bachelor of Science in Biochemistry

From the Academic Year 2025-2026

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE AND POSTGRADUATE EDUCATION

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. Our department received DST-FIST fund in the year 2023.

The undergraduate department of Biochemistry was established in 2004, the department initiated its Post Graduate programme in 2007, followed by the M.Phil programme 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.

The Biochemistry Department's laboratory conducts a variety of biochemical tests on blood and urine to understand health and disease. This department equipped with advanced tools and instruments to conduct research.

The department organizes National and International Conferences, Health Awareness Programs, and Blood Grouping Programs for the benefit of 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 160.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION	
Programme	**B.Sc., Biochemistry**
Programme Code	**US04**
Duration	**3 Years [UG]**
Programme Outcomes	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study. **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. **PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation. **PO7: Cooperation / Teamwork:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team. **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence, and experiences from an open-minded and reasoned perspective.

	PO9: Reflective thinking: Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO 11 Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO 13: Moral and ethical awareness/reasoning**: Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work. **PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
Programme Specific Outcomes:	**PSO1 – Placement:** To prepare the students who will demonstrate respectful engagementwith others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO2 - Entrepreneur:** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skills that will facilitate startups and high potential organizations. **PSO3 – Research and Development:** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards Growth and development. **PSO4 – Contribution to Business World:** To produce employable, ethical, and innovative professionals to sustain inthe dynamic business world. **PSO 5 – Contribution to the Society:** To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

PROGRAM OUTCOMES

PO1	Acquire knowledge in the field of Biological Sciences and to apply the knowledge in their day-to-day life for betterment of self and society.
PO2	Develop critical, analytical thinking and problem-solving skills.
PO3	Develop research related skills in defining the problem, formulate and test the hypothesis, analyse, interpret, and draw conclusion from data.
PO4	Address and develop solutions for societal and environmental needs of local, regional and national development.
PO5	Work independently and engage in lifelong learning and enduring proficient progress.
PO6	Provoke employability and entrepreneurship among students along with ethics and communication skills.
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.
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.

PROGRAM SPECIFIC OUTCOMES

PSO1	Students will be able to Competent in the principles, methods and applications of various techniques in Biochemistry, Immunology, Microbiology, Enzyme kinetics and Molecular Cell Biology for Placement and Entrepreneurial initiatives in relevant fields.
PSO2	Students will be capable of designing and executing experiments with relevant competencies for further research and development.
PSO3	Students will be able to acquire insight into the immune system and its responses, and use this knowledge in the processes of immunization, vaccine development, transplantation and organ rejection as required for a healthy society.

Eligibility for Admission:

Candidate for admission to the first year of M.Sc., Biochemistry shall be required to passed the UG with any one of the followings-Biochemistry / Chemistry / Microbiology / Biotechnology / Life Sciences.

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

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
24UBC32P	CC - 6 (Practical) Colorimetric analysis, Biochemical and Buffer Preparations	0	0	4	0	2
24UBCA31 24UBCA32	EC - 4 1. Microbiology – I 1. Nutrition through lifecycle	3	1	0	0	4
24UBCA33P 24UBCA34P	EC – 5 1. Practical - Microbiology-I 2. Practical - Nutrition	0	0	2	0	2
24UBCS31	SEC – 4 Biochemical Pharmacology	1	0	1	0	2
24UAEC31	AEC – 2 Human Values and Ethics	1	1	0	0	2
					30	**23**

Semester – IV

	Tamil – 4	4	1	0	0	3
	English – 4	4	1	0	0	3
	CC - 7 Molecular Biology	3	1	2	0	5
	CC - 8 (Practical) Colorimetric analysis, Electrophoretic and Chromatographic Techniques – I	0	0	4	0	2
	EC - 6 AL Microbiology – II	3	1	0	0	4
	EC - 7 AL (Practical) Microbiology-II	0	0	2	0	2
	SEC - 5 Herbal Medicine	1	0	1	0	2
	AEC – 3 Environmental Studies	1	1	0	0	2
					30	**23**

Semester – V

	CC -9 Enzymology and Intermediary Metabolism	4	1	0	0	4
	CC- 10 (Practical) Colorimetric analysis, Electrophoretic and Chromatographic Techniques - II	0	0	4	0	4
	CC - 11 Biotechnology	2	1	1	0	4
	CC - 12 (Practical) Enzyme Assays	0	0	3	0	2
	EC – 8 Clinical Biochemistry	4	1	0	0	4
	EC – 9 Research Methodology	4	1	0	0	4
	AEC – 4 Social Responsibilities and Upliftment	1	1	0	0	2
	Internship				2	2
					30	**26**

Semester - VI

	CC – 13 Human Physiology and Endocrinology	4	1	0	0	4
	CC - 14 Practical Haematology, Microbiology and Urine Analysis	0	0	5	0	3
	CC - 15 - Project	0	0	0	5	4
	EC – 10 Immunology	4	1	0	0	4
	EC – 11 Medical lab technology	4	1	0	0	4
	PEC – 1 Personality Development	1	1	0	0	2
	SLC – 1 Computer Applications				3	2
					30	**23**
					141+2*	

Students must complete at least one online course (MOOC) from platforms like SWAYAM, NPTEL, or Nanmudalvan 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				

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

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, 1stedition, MJP Publishers.
3	Keith Wilson & John Walker, 2000, Practical Biochemistry-Principles and techniques, Cambridge University Press, 4thedition
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, 1stedition, MJP Publishers.
3	Saroj Dua, Neera Garg, Biochemical Methods of Analysis, 2010, 1stedition, 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=xgxFBQZYXlE
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
24UBC32P	**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

CO	**Course Outcomes** **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, antimetabolities, 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 Changs 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,Elseivier publications, United Kingdom.
Reference Books:	
1	Whitney EN and Rolfes SR, Understanding Nutrition. (2002) 9th edition West / Wordsworth, London.
2	Groff JL, Gropper SS, Advanced Nutrition and Human Metabolism. (2000) 3rd edition, West/ Wadsworth, United Kingdom.
3	Groff JL, Gropper SS, Advanced Nutrition and Human Metabolism. (2000) 3rd edition, West/ Wadsworth, United Kingdom.
4	Cataldo, DeBruyne and Whitney, Nutrition and Diet therapy–Principles and Practice. (1999) 5th edition, West/ Wadsworth, London.
5	Stacy N, William's Basic Nutrition and Diet Therapy. (2005) 12th edition, Elseivier publication s, United Kingdom.
Web resources:	
1	http://vikaspedia.in/health/nutrition/dietary-guidelines-1/dietary-guideline-1
2	https://www.nhp.gov.in/healthlyliving/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

Cour se Code	Course Name	Category	L	T	P	S	Cred its	Hour	Marks		
									CIA	Externa l	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 Ld., 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, 2ndEdition, 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

Cour se Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	Externa l	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.Murugesh, 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, 2nd South Asian Editionhttps://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://efaidnbmnnnibpcajpcglclefindmkaj/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: THIRD SEMESTER

Course Code	CourseName	Category	L	T	P	S	Credit	Hours	Marks	
									CIA	Total
	Internship		0	0	3	0	2	3	**25**	**100**

Learning Objectives	
LO1	To understand the workflow of diagnostic laboratories, including sample collection, processing, analysis, reporting, and quality control.
LO2	To gain insight into research methodologies used in biochemistry, including hypothesis formation, data collection, and analysis.
LO3	To enhance problem-solving skills in experimental biochemistry and clinical diagnostics.
LO4	To develop professional ethics and discipline needed for laboratory and research work.
LO5	To strengthen communication skills required for documenting experiments, preparing reports, and collaborating in laboratory teams.

S.No	REGULATIONS	Hour
I	1. Biochemistry students must complete a 15 - day's internship in any approved Hospital, Diagnostic Lab, Research Institute, Pharma/Biotech Company, or Food Industry during the Semester II vacation. 2. The candidates must demonstrate the ability to perform routine biochemical analyses, document laboratory procedures accurately, maintain an internship logbook, and monitor the outcomes or interpretations of the biochemical tests performed. 3. The candidates must develop skills in biochemical screening and assessment, including sample handling, preliminary diagnostic evaluation, and interpretation of laboratory results for patient or clinical samples. 4. During the Third Semester, candidates are required to refine the work completed during the internship by incorporating constructive feedback received from the Hospital/industry during reviews, and by further developing the project to meet Hospital/industry standards. 5. The Candidates have to prepare and submit the manuscript of the Internship experience as a Report as per the requirements of the Department for Evaluation. 6. The submission of the Internship Report will be done at the end of the Third Semester for Presentation and Viva-Voce during the Practical Examinations of the Semester. The Passing Minimum for Internship is 50%. 7. If the Candidate fails to score 50% in the Internship, the Candidate has to improve it during the next attempt. 8. A Faculty Member from the Department will act as a Guide to supervise/monitor the progress of the Candidates. 9. The Faculty Member will act as the Internal Examiner during the course of the Internship as well as at the time of conducting the Viva-Voce Examination. 10. The Internal Marks for the Internship will be awarded by the concerned Guide /Internal Examiner. 11. The Internal and External Examiners shall both evaluate the Internship Report, Presentation and conduct the Viva-Voce Examination.	30

CO	Course Outcomes **Students will be able to**
CO1	Understand and describe the complete workflow of diagnostic laboratories, including sample collection, processing, biochemical analysis, reporting, and quality control procedures.
CO2	Apply basic research methodologies in biochemistry, including collecting experimental data and performing scientific analysis.
CO3	Enhance problem-solving skills in experimental biochemistry and clinical diagnostic situations.
CO4	Develop professional ethics, responsibility, and discipline required for laboratory and research environments.
CO5	Improve communication skills essential for documenting experiments, preparing scientific reports, and effectively collaborating with laboratory teams.

INTERNAL MARKS AWARDED FOR THE INTERNSHIP -25Marks
✓ Internship Review1 (During the beginning of the Semester)-5 Marks ✓ Internship Review2 (At the end of the Semester)-5 Marks ✓ Progress of the Internship by the Candidate's active Participation-15 Marks
EXTERNAL MARKS AWARDED FOR THE INTERNSHIP-75Marks
✓ Evaluation of the Internship Report -50 Marks ✓ Presentation & Viva-Voce Examination-25 Marks

Marudhar Kesari Jain College for Women (Autonomous)

Vaniyambadi – 635 751

PG & Research Department of Biochemistry

Syllabus

Undergraduate Programme

Bachelor of Science in Biochemistry

From the Academic Year 2025-2026 (Even)

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE AND POSTGRADUATE EDUCATION

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. Our department received DST-FIST fund in the year 2023.

The undergraduate department of Biochemistry was established in 2004, the department initiated its Post Graduate programme in 2007, followed by the M.Phil programme 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.

The Biochemistry Department's laboratory conducts a variety of biochemical tests on blood and urine to understand health and disease. This department equipped with advanced tools and instruments to conduct research.

The department organizes National and International Conferences, Health Awareness Programs, and Blood Grouping Programs for the benefit of 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,Xcellogen Biotech and Bioinnov Solutions LLP. Currently, the department comprises 11 faculty members and has student strength of 160.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION	
Programme	**B.Sc., Biochemistry**
Programme Code	**US04**
Duration	**3 Years [UG]**
Programme Outcomes	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study. **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. **PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesizing and articulating; Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation. **PO7: Cooperation / Teamwork:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team. **PO8: Scientific reasoning**: Ability to analyze, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence, and experiences from an open-minded and reasoned

	PO9: Reflective thinking: Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO 11 Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO 13: Moral and ethical awareness/reasoning**: Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work. **PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

Programme Specific Outcomes:	**PSO1 – Placement:** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, and beliefs and apply diverse frames of reference to decisions and actions. **PSO2 - Entrepreneur:** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skills that will facilitate startups and high potential organizations. **PSO3 – Research and Development:** Design and implement HR systems and practices grounded in research that complies with employment laws, leading the organization towards Growth and development. **PSO4 – Contribution to Business World:** To produce employable, ethical, and innovative professionals to sustain inthe dynamic business world. **PSO 5 – Contribution to the Society:** To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

PROGRAM OUTCOMES

PO1	Acquire knowledge in the field of Biological Sciences and to apply the knowledge in their day-to-day life for betterment of self and society.
PO2	Develop critical, analytical thinking and problem-solving skills.
PO3	Develop research related skills in defining the problem, formulate and test the hypothesis, analyze, interpret, and draw conclusion from data.
PO4	Address and develop solutions for societal and environmental needs of local, regional and national development.
PO5	Work independently and engage in lifelong learning and enduring proficient progress.
PO6	Provoke employability and entrepreneurship among students along with ethics and communication skills.
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.
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.

PROGRAM SPECIFIC OUTCOMES

PSO1	Students will be able to Competent in the principles, methods and applications of various techniques in Biochemistry, Immunology, Microbiology, Enzyme kinetics and Molecular Cell Biology for Placement and Entrepreneurial initiatives in relevant fields.
PSO2	Students will be capable of designing and executing experiments with relevant competencies for further research and development.
PSO3	Students will be able to acquire insight into the immune system and its responses, and use this knowledge in the processes of immunization, vaccine development, transplantation and organ rejection as required for a healthy society.

Eligibility for Admission:

Candidate for admission to the first year of M.Sc., Biochemistry shall be required to passed the UG with any one of the followings-Biochemistry / Chemistry / Microbiology / Biotechnology / Life Sciences.

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

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) Colorimetric analysis, Biochemical and Buffer Preparations	0	0	4	0	2
24UBCA31 24UBCA32	EC - 4 1. Microbiology – I 2. Nutrition through lifecycle	3	1	0	0	4
24UBCA33P 24UBCA34P	EC – 5 1. Practical - Microbiology-I 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

	Tamil – 4	4	1	0	0	3
	English – 4	4	1	0	0	3
	CC - 7 Enzymes	3	1	2	0	5
	CC - 8 (Practical) Enzyme assays,Renal Functional Test and Liver Functional Test	0	0	4	0	2
	EC - 6 AL Microbiology – II	3	1	0	0	4
	EC - 7 AL (Practical) Microbiology-II	0	0	2	0	2
	SEC - 5 Herbal Medicine	1	0	1	0	2
	AEC – 3 Environmental Studies	1	1	0	0	2
					30	**23**

Semester – V

	CC -9 Intermediary Metabolism	4	1	0	0	4
	CC- 10 (Practical) Colorimetric analysis, Electrophoretic and Chromatographic Techniques - II	0	0	4	0	4
	CC - 11 Biotechnology	2	1	1	0	4
	CC - 12 Nutritional Biochemistry	0	0	3	0	2
	EC – 8 Clinical Biochemistry	4	1	0	0	4
	EC – 9 Human Physiology and Endocrinology	4	1	0	0	4
	AEC – 4 Social Responsibilities and Upliftment	1	1	0	0	2
	Internship				2	2
					30	**26**

Semester - VI

	CC – 13 Research Methodology	4	1	0	0	4
	CC - 14 Practical Haematology, Microbiology and Urine Analysis	0	0	5	0	3
	CC - 15 - Project	0	0	0	5	4
	EC – 10 Immunology	4	1	0	0	4
	EC – 11 Medical lab Technology	4	1	0	0	4
	PEC – 1 Personality Development	1	1	0	0	2
	SLC – 1 Computer Applications				3	2
					30	**23**
					141+2*	

Students must complete at least one online course (MOOC) from platforms like SWAYAM, NPTEL, or Nanmudalvan 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				

II YEAR: IVth **SEMESTER**

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
	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 Stereo specificities. 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- Menton equation for uni-substrate reactions , Line weaver - 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, un-competitive 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, co enzymatic 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

CO	Course Outcomes The students will be able to
CO1	Identify the major classes of enzymes, differentiate between a Chemical catalyst and a biocatalyst and define 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 MM plot and LB plot based on kinetics data, and determine Km and Vmax.
CO4	Distinguish the types of inhibition along with its importance in Biochemical reactions.
CO5	Comprehend the various methods for production of immobilized Enzymes and discuss the application of enzymes in clinical diagnosis and various industries.

Text books:	
1	U.Sathyanarayana &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),18thedition, Goel Publishing House,
3	T.Devasena, 2010, Enzymology, 1stedition, 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, 4theditionJohnWiley& Sons,Inc
5	Zubay G.L, et.al.1995, Principles of Biochemistry, 1stedition, WmC.BrownPublishers.
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
	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 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 Diacetyl monoxine method. 3. Estimation of glucose by Folin Wu method 4. Estimation of glucose by O- Toludine 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, 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
	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	Bacteria diseases – Host microbe interaction, Normal flora, Virulence factors, nosocomial infections.Staphylococcus aureus, Streptococcus pneumoniae, Bacillus anthracis, Clostridium tetani, Corynebacterium diphtheriae– Tuberculosis, Salmonella typhi, Shigella dysenteriae, Vibrio cholera, 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	
Course Outcomes	On completion of this course, students will;
CO1	Gain Knowledge of common bacterial and fungal diseases.
CO2	Gain Knowledge of common viral diseases.
CO3	Understand the air,water and waste water 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.(10th 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.(5thEdition).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. (5thEdition). MedTech Publishers.
7	Daniel.C.J.(2006).Environmental Aspects of Microbiology.(2ndEdition).BrightSun Publications.
ReferencesBooks	
1	Salle A.J.(2007). Fundamental Principles of Bacteriology.(4thEdition). Tata McGraw-Hill Publications.
2	ColleeJ.C.DuguidJ.P.Foraser,A.C, MarimonB.P,(1996). Mackie & Mc Cartney Practical Medical Microbiology.14thedn,ChurchillL ivingston.
3	PepperI.L.,GerbaC.P.and GentryT.J.(2014).Environmental Microbiology(1st Edition).Academic Press,Elsevier.
4	Bitton,G.(2011).Wastewater Microbiology.(4thEdition).Wiley-Blackwell.
5	Madigan M.T., Martinko J.M.,Stahl D.A, and Clark D. P. (2010).Brock-Biology of Microorganisms,13thEdition 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

Mappingwith 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
	EC - 7 AL (Practical) Microbiology-II	**Elective**	**0**	**0**	**2**	**0**	**2**	**2**	**25**	**75**	**100**

Course Objectives	
CO1	Acquire knowledge on cleaning of glass wares 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	
Course Outcomes	On completion of this course, students will;
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 manualin General Microbiology.Palani Publications.
3	Sundararaj T(2005).Microbiology Lab Manual(1st edition) publications.
4	Gunasekaran,P.(1996).Laboratory manualin Microbiology.NewAge International Ld.,Publishers, NewDelhi.
5	RC Dubey and DK Maheswari(2002).Practical Microbiology.S.Chand Publishing.

References Books	
1	Atlas.R (1997).Principles of Microbiology, 2nd Edition, WM.C.Brown publishers.
2	Amita J,Jyotsna A and Vimala V (2018). Microbiology Practical Manual.(1st Edition).ElsevierIndia
3	Talib VH (2019).Handbook Medical Laboratory Technology. (2nd Edition).CBS
4	Wheelis M,(2010).Principles of Modern Microbiology,1st Edition. Jonesand Bartlett Publication.
5	Lim D. (1998). Microbiology,2nd Edition,WCB McGraw Hill Publications.
Web Resources	
1	http://www.biology discussion.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://microbiology info.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

II YEAR IVth SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
	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 medic 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, ant diabetic, 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	Course Outcomes
CO1	After studying unit 1, Understand traditional systems of herbal medicine including Ayurveda, Siddha, Unani.
CO2	After studying unit 2, students will understand how to Identify and classify medicinal plants.
CO3	After studying unit 3, students will be comprehensive understanding ofhow to Describe pharmacological actions of herbal drugs.
CO4	After studying unit 4, students will be comprehensive understanding of Analyze photochemical using techniques like TLC, HPLC.
CO5	After studying unit 5, students will be able to UnderstandPreparation and ensure quality control of herbal formulations following guidelines like 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 Pulok 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.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