

SENGUNTHAR ARTS AND SCIENCE COLLEGE

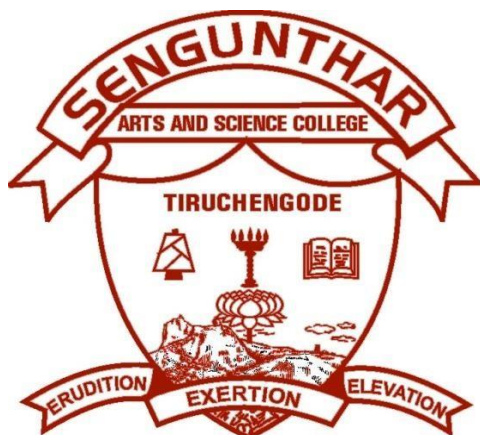
(Autonomous)

(Affiliated to Periyar University, Salem and Approved by AICTE, New Delhi)

An ISO 9001:2015 Certified Institution. Recognized under section 2(f) and 12 (B) of the UGC Act, 1956 and Accredited by NAAC with A⁺

TIRUCHENGODE-637205, NAMAKKAL DT., TAMILNADU

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SYLLABUS

B.Sc., MICROBIOLOGY

(CBCS –LOCF)

(With effect from the Academic Year 2024-2025)

CHAIRMAN

CDC

PRINCIPAL

CORRESPONDENT

INTRODUCTION

Microbiology is a wide discipline of biology which encompasses five groups of microorganisms i.e. bacteria, protozoa, algae, fungi, and viruses. It studies their interaction with their environments as well as how these organisms are harnessed in human endeavor and their impact on society. The study has its extensions in various other conventional and advanced fields of biology by employing microbes as study models. Since the inception of microbiology as a branch of science, it has remained an ever-expanding field of active research, broadly categorized as pure and applied science. Knowledge of different aspects of Microbiology has become crucial and indispensable to the society. Study of microbes has become an integral part of education and human progress. There is a continuous demand for microbiologists as work force in education, industry and research. Hence Microbiological tools and techniques are used in almost all fields which are indispensable for people working in fields like Agriculture, Food Industry, Medical Sciences, Environmental Science and Pharmaceutical Science etc...The syllabi for the three-year B.Sc. degree course in Microbiology are framed in such a way that the students at the end of the course, can be adept at Microbiological techniques for pursuing higher studies and can also apply Microbiological methods judiciously to a variety of industrial needs.

AIM

The syllabus of this program is aimed at preparing the students with the latest developments and put them on the right track to fulfil the present requirements.

ELIGIBILITY FOR ADMISSION:

Candidates for admission to the first year of the Degree of Bachelor of Science in Microbiology ((UG) Course shall be required to have passed the Higher Secondary Examination in any one of the biological sciences(Botany, Zoology, Biology). (Academic/Vocational stream - Agri, Home Science, Poultry) under higher secondary board of examination, Tamil Nadu or as per norms set by the Government of Tamil Nadu or other examinations accepted as equivalent thereto by the Guidelines of Periyar University.

PROGRAMME OUTCOMES

REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAME WORK (CBCS) FOR UNDER GRADUATE	
Programme	B.Sc., MICROBIOLOGY
Programme Code	24UMB
Duration	UG - Three Years
Programme Outcomes (POs)	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, synthesizing 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/Team work: 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.
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	Pos										PSOs				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	PS01	PS02	PS03	PS04	PS05
CLO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CLO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CLO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CLO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Level of Correlation between POs and PSOs (*Suggested by UGC as per Six Sigma Tool – Cause and Effect Matrix*);

1 – Low, 2 – Medium, 3 – High, 0 – No Correlation YEAR

**I YEAR
SEMESTER-I**

S. No	Course Category	Course code	Title of the course	Hrs/Week			Credit Points	Max Marks		
				L	T	P		CIA	ESE	Total
1	Part-I Tamil Language-I	24S1UFTA01	Podhu Tamil-I	6		-	3	25	75	100
2	Part-II English Language-I	24S1UFEN01	General English-I	6		-	3	25	75	100
3	Part-III Core-I	24S1UMB01	Microbiological Concepts and Microbial Diversity	5		-	5	25	75	100
4	Part-III Core Practical-I	24S1UMBP01	Practical-I Microbiological Concepts and Microbial Diversity	-		5	-	-	-	-
5	Part-III Elective -I	24S1UMBE01	Biochemistry and Clinical Applications	4		-	3	25	75	100
6	Part-IV NME-I	24S1UMBN01	Public Health and Preventive Medicine	2		-	2	25	75	100
		24S1UMBN02	Mushroom farming business							
7	Part-IV Foundation course-I	24S1UMBF01	FC- Microbes: Attributes and Valuable Resources	2		-	2	25	75	100
Total				25		05	18			600

SEMESTER-II

1	Part-I Tamil Language-II	24S2UFTA02	Podhu Tamil-II	6		-	3	25	75	100
2	Part-II English Language-II	24S2UFEN02	General English-II	6		-	3	25	75	100
3	Part-III Core-II	24S2UMB02	Microbial physiology And Metabolism	5		-	5	25	75	100
4	Part-III Core Practical-1I	24S2UMBP02	Practical-II Microbial physiology and Metabolism	-		5	5	40	60	100
5	Part-III Elective-II	24S2UMBE02	Bio-instrumentation	4		-	3	25	75	100
6	Part-IV NME-II	24S2UMBN03	Nutrition and health hygiene	2		-	2	25	75	100
		24S2UMBN04	Bio-fertilizer Technology							
7	Part-IV Skill Based Elective-I	24S2UMBS01	Sericulture	2			2	25	75	100
		24S2UMBS02	Mushroom technology							
8	Part-III Core Practical-I	24S1UMBP01	Practical-I Microbiological Concepts and Microbial Diversity	-		-	5	40	60	100
Total				25		5	28			800

**II YEAR
SEMESTER –III**

S. No	Course Category	Course code	Title of the course	Hrs/ Week			Credit Points	Max Marks		
				L	T	P		CIA	ESE	Total
1	Part –I Tamil Language–III	24S3UFTA03	Podhu Tamil-III	6		-	3	25	75	100
2	Part -II English Language–III	24S3UFEN03	General English-III	6		-	3	25	75	100
3	Part - III Core –III	24S3UMB03	Molecular Biology and microbial genetics	5		-	5	25	75	100
4	Part - III Core Practical –III	24S3UMBP03	Practical-III Molecular Biology and microbial genetics			5	-	-	-	-
5	Part - III Elective - III	24S3UMBE03	Molecular biology in Diagnosis	4		-	3	25	75	100
6	Part - IV SEC - II	24S3UMBS03	Basics of Forensic Science	1		-	1	25	75	100
7	Part - IV SEC - III	24S3UMBS04	Algal Technology	2		-	2	25	75	100
8	Part - IV EVS		Environmental Studies	1		-	-	-	-	-
Total				25		05	17			600
SEMESTER –IV										
1	Part – I Tamil Language– IV	24S4UFTA04	Podhu Tamil-IV	6	-	-	3	25	75	100
2	Part - II English Language– IV	24S4UFEN04	General English-IV	6	-	-	3	25	75	100
3	Part - III Core –IV	24S4UMB04	Immunology and Immunotechnology	5	-	-	5	25	75	100
4	Part – III Core Practical -IV	24S4UMBP04	Practical-IV Immunology and Immunotechnology	-	-	5	5	40	60	100
5	Part – III Elective – IV	24S4UMBE04	Clinical Laboratory technology	4	-	-	3	25	75	100
6	Part -IV SEC - IV	24S4UMBS05	Vaccine Technology	2	-	-	2	25	75	100
7	Part -IV SEC - V	24S4UMBS06	Basics of Medical coding and Disease management	2	-	-	2	25	75	100
8	Part - IV EVS	24S4UES01	Environmental Studies	1	-	-	2	25	75	100
9	Part – III Core Practical –III	24S3UMBP02	Practical-III Molecular Biology and microbial genetics	-	-	-	5	40	60	100
Total				25		05	30			900

**III YEAR
SEMESTER –V**

S. No	Course Category	Course code	Title of the course	Hrs/ Week			Credit Points	Max Marks		
				L	T	P		CIA	ESE	Total
1	Part - III Core	24S5UMB05	Bacteriology And Mycology	5		-	4	25	75	100
2	Part -III Core	24S5UMB06	Virology And Parasitology	5		-	4	25	75	100
3	Part - III Core Practical –V	24S5UMBP05	Practical -V	-		5	-	-	-	-
4	Part - III Core Practical –III	23S5UMBPR01	Project viva voce	-		5	4	40	60	100
5	Part - III Elective - V	24S5UMBE05	Recombinant DNA Technology	4		-	3	25	75	100
6	Part - IV Elective - VI	24S5UMBE06	Biosafety and Bioethics	4		-	3	25	75	100
7	Part - IV	24S5UMBVE01	Value education	2		-	2	25	75	100
8	Part - IV	24S5UIT01	Internship/ industrial visit / Field visit	15 days		-	2	-	-	-
Total				20	-	10	22			600

SEMESTER –VI

1	Part - III Core	24S6UMB07	Environmental And Agriculture Microbiology	6			4	25	75	100
2	Part - III Core	24S6UMB08	Food, Dairy And Probiotic Microbiology	6			4	25	75	100
3	Part - III Core –VI	24S6UMBP06	Practical- VI			6	4	40	60	100
4	Part - III Elective- VII	24S6UMBE07	Pharmaceutical Microbiology	5	-	-	3	25	75	100
5	Part - III Elective – VIII	24S6UMBE08	Entrepreneurship And Bio-Business	5	-		3	25	75	100
6	Part -IV SEC - IV	24S6UMBPC01	Microbial Quality Control And Testing	2	-		2	25	75	100
7	Part -IV SEC - V	24S6UEX01	Extension Activity	-	-	-	1	-	-	-
8	Part - III Core Practical –V	24S5UMBP05	Practical -V	-	-	-	4	60	40	100
Total				24		6	25			700
CUMULATIVE TOTAL				144		36	140			4200

SEMESTER – I

FIRST YEAR - SEMESTER I**CORE I - MICROBIOLOGICAL CONCEPTS AND MICROBIAL DIVERSITY**

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S1UMB01	Core-I	Theory	Y	Y	-	5	5

Learning Objectives

- ❖ To learn the fundamental principles about different aspects of Microbiology including recent developments in the area.
- ❖ To describe the structural organization, morphology and reproduction of microbes.
- ❖ To explain the methods of cultivation of microbes and measurement of growth.
- ❖ To understand the microscopy and other basic laboratory techniques like culturing, disinfection and sterilization in Microbiology.
- ❖ To compare and contrast the different methods of sterilization.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Study the historical events that led to the discoveries and inventions and understand the Classification of Microorganisms.	PO5, PO6, PO10
CO2	Gain Knowledge of detailed structure and functions of prokaryotic cell organelles.	PO10
CO3	Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.	PO10
CO4	Explain the principles and working mechanism of different microscopes/Microscope, their function and application.	PO4, PO9
CO5	Understand the concept of asepsis and modes of sterilization and disinfectants.	PO4, PO9

CORE I – MICROBIOLOGICAL CONCEPTS AND MICROBIAL DIVERSITY

Unit	Details	No. of Hours
I	Emergence of Microbiology as vital discipline. Spontaneous generation, biogenesis–Contributions of Anton von Leeuwenhock, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Paul Ehrlich, Elie Metchnikoff, Edward Jenner. Classification –five kingdoms system. Basic concepts of Eubacteria, Archaeobacteria and Eucarya.	15
II	General features Cellular and acellular microorganisms - difference between prokaryotic and eukaryotic microorganisms. Bacteria – Structure- Cell wall - Flagella – Fimbriae – Pili- Cell membrane- Cytoplasm- Nucleoid, gas vesicles and Spore. Structure of fungi (Mold and Yeast), Structure of microalgae – Chlamydomonas. Model Preparation -(Bacteria, Virus, Mold and Chlamydomonas)	15
III	Pure culture methods and Media for Cultivation - Streak plate, Spread plate and pour plate method, Types of Media, Quantitative measurement of growth. Anaerobic culture Techniques.	15
IV	Types of Microscopy and Handling Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM & SEM, Preparation of Electron microscopic slide Confocal microscopy, and Atomic Force Microscopy. Stains and staining methods. Field Visit to HEI and Report Submission	15
V	Control of Microorganisms Definition for sterilization–Moist Heat - Autoclaving, Dry Heat – Hot air oven, – Quality control for Autoclave and Hot Air oven Radiation – UV, Ionization, filtration – membrane filter and disinfection, antiseptic; Antimicrobial agents.	15
	Total	75
● Model Preparation & Field Visit – related to the above topic are to be considered for Internal Exam only		

Text books

- ❖ Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. (2010). General Microbiology, 5th Edition., MacMillan Press Ltd
- ❖ Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9th Edition). Jones & Bartlett learning 2010.
- ❖ Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th Edition, McGraw-Hill International edition.
- ❖ Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11th Edition, Benjamin Cummings.
- ❖ 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

- ❖ Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition., McGraw Hill, New York.
- ❖ Tortora, G.J., Funke, B.R., Case, C.L. (2013). Microbiology. An Introduction 11th Edition., A La Carte Pearson.
- ❖ Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5th Edition, McGraw Hill Publications.
- ❖ Salle. A.J (1992). Fundamental Principles of Bacteriology. 7th Edition., McGraw Hill Inc. New York.

Web Resources

- ❖ <https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology>.
- ❖ <https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp>.
- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#>.
- ❖ <https://bio.libretexts.org/@go/page/9188>.
- ❖ <https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-nutrition/>.

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	0	0	0	3	3	0	0	0	3
CO2	0	0	0	0	0	0	0	0	0	3
CO3	0	0	0	0	0	0	0	0	0	0
CO4	0	0	0	3	0	0	0	0	3	0
CO5	0	0	0	3	0	0	0	0	3	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution toPos	3.0	3.0	3.0	3.0	3.0

Course Coordinator

BOS Chairman

CORE I - PRACTICAL I - MICROBIOLOGICAL CONCEPTS AND MICROBIAL DIVERSITY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S1UMBP01	Core Practical -I	Practical	-	-	Y	5	5

Learning Objectives

To acquire knowledge on Cleaning of glass wares, GLP and sterilization.

To gain knowledge on media preparation and cultural characteristics.

To learn the pure culture technique.

To learn the microscopic techniques and staining methods.

To acquire knowledge on stain and staining methods.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Practice sterilization methods; learn to prepare media and their quality control.	PO4, PO7, PO8, PO9, PO10
CO2	Learn streak plate, pour plate and serial dilution and pigment production of microbes.	PO4, PO7, PO8, PO9
CO3	Understand Microscopy methods, different Staining techniques and motility test.	PO4, PO7, PO8, PO9, PO10
CO4	Observe culture characteristics of microorganisms.	PO4, PO7, PO8, PO9
CO5	Study on Microbial Diversity using Hay Infusion Broth-Wet mount.	PO4, PO7, PO8, PO9

CORE I – PRACTICAL I - MICROBIOLOGICAL CONCEPTS AND MICROBIAL DIVERSITY

Unit	Details	No. of Hours
I	Cleaning of glass wares, Microbiological good laboratory practice and safety. Sterilization and assessment of sterility–Autoclave, hot air oven, and membrane filtration. Microscopy: light microscopy and bright field microscopy.	15
II	Media preparation: liquid media, solid media, semi-solid media, agar slants, agar deeps, agar plates.	15
III	Preparation of basal, differential, enriched, enrichment, transport, and selective media preparation- sterility check of media. Pure culture techniques: streak plate, pour plate, decimal dilution.	15
IV	Culture characteristics of microorganisms: growth on different media, growth characteristics, and description. Demonstration of pigment production.	15
V	Staining techniques: smear preparation, simple staining, Gram's staining and Endospore staining. Hay Infusion Broth-Wet mounts to show different types of microbes, hanging drop. Wet mount preparation of Spirulina, Nostoc, Chlorella	15
	Total	75

Text books

- ❖ Dubey R.C. and Maheshwari D. K. (2023). Practical Microbiology. S. Chand. (4th Edition).
- ❖ Cappuccino, J. and Sherman, N. (2014). Microbiology: A Laboratory Manual, (10th Edition). Pearson Education, Publication, New Delhi.
- ❖ Cullimore D. R. (2010). Practical Atlas for Bacterial Identification. (2nd Edition). -Taylor & Francis.
- ❖ R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.
- ❖ Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS.

Reference books

- ❖ Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm. C. Brown publishers.
- ❖ Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
- ❖ Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ltd., Publishers, New Delhi.
- ❖ Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
- ❖ Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India.
- ❖ Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication.
- ❖ Lim D. (1998). Microbiology, 2nd Edition, WCB McGraw Hill Publications.

Web Resources

- ❖ <http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection- methods-and-principles-microbiology/24403>.
- ❖ <https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635>
- ❖ https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf
- ❖ <https://microbiologyinfo.com/top-and-best-microbiology-books/>
- ❖ <https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	0	0	2	0	0	2	3	2	2
CO2	0	0	0	3	0	0	2	2	2	0
CO3	0	0	0	3	0	0	3	3	2	2
CO4	0	0	0	3	0	0	3	2	2	0
CO5	0	0	0	3	0	0	3	2	2	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution toPOs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

ELECTIVE I - BIOCHEMISTRY AND CLINICAL APPLICATIONS

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S1UMBE01	Elective	Theory	Y	Y	-	4	3

Learning Objectives

- ❖ To acquire knowledge of carbohydrates and lipids, their characteristic properties and organization in carrying out all the living functions which constitute the life.
- ❖ To explain the biological activity of amino acids and proteins.
- ❖ To identify the metabolic errors in enzymes of carbohydrates and lipids.
- ❖ To describe the disorders in amino acid metabolism.
- ❖ To interpret the consequences, biochemical, clinical features, diagnosis and treatment of metabolic diseases of day today life.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Explain the structure, classification , biochemical functions and significance of carbohydrates and lipids	PO1
CO2	Differentiate essential and non-essential amino acids, biologically important modified amino acids and their functions, Illustrate the role, classification of Proteins and recognize the structural levelorganization of proteins, its functions and denaturation.	PO1
CO3	Assess defective enzymes and Inborn errors. Recognize diseases related to carbohydrate and lipid metabolism.	PO4, PO5, PO6
CO4	Discuss and evaluate the pathology of aminoacid metabolic Disorders.	PO4, PO5, PO6
CO5	Appraise the imbalances of enzymes in organ function and relate the role of Clinical Biochemistry in screening and diagnosis.	PO5, PO6,PO9

ELECTIVE I - BIOCHEMISTRY AND CLINICAL APPLICATIONS

Unit	Details	No. of Hours
I	Basic concepts of Clinical Biochemistry A brief review of units and abbreviations used in expressing concentrations and standard solutions. Specimen collection and processing (Blood, urine, faeces). Anti-coagulant preservatives for blood and urine. Transport of specimens.	12
II	Carbohydrate General properties, function, structure, classification of monosaccharides (Glucose, Fructose, Galactose), Oligoaccharides (Sucrose, Maltose, Lactose) and polysaccharide (Starch, Glycogen,) and biological significance. Disorders of carbohydrate metabolism: diabetes mellitus, ketoacidosis, hypoglycemia, glycogen storage diseases, galactosemia and lactose intolerance. Model Preparation: Structures of carbohydrates	12
III	Lipids – General properties, functions, structure, classification (Simple, Derived and Complex), Cholesterol, LDL, HDL – biological significance. Disorders of lipid metabolism: hyper lipidemia, hyper lipoproteinemia, hypercholesterolemia, hyper triglyceridemia, sphingolipidosis.	12
IV	Amino acids & Proteins General properties, functions, structure, classification and biological significance of amino acids and. Proteins, Disorders of amino acid metabolism: alkaptonuria, phenylketonuria, phenylalaninemia, homocystineuria, tyrosinemia, aminoacidurias.	12
V	Organ function test Liver function test: Metabolism of bilirubin, jaundice – types, Icteric index, Renal function test : Clearance test – Urea, Creatinine, Gastric function test Collection of gastric contents, examination of gastric residuum, FTM, stimulation test, tubeless gastric analysis. Clinical enzymology Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase. Field Visit: Clinical Laboratory and Report Submission	12
	Total	60
● Model Preparation & Field Visit – related to the above topic are to be considered for Internal Exam only		

Text books

- ❖ Satyanarayana, U. and Chakrapani, U (2014). Biochemistry, 4th Edition, Made Simple Publisher.
- ❖ Jain J L, Sunjay Jain and Nitin Jain (2016). Fundamentals of Biochemistry, 7th Edition, S Chand Company
- ❖ Ambika Shanmugam's (2016). Fundamentals of Biochemistry for Medical Students, 8th Edition. Wolters Kluwer India Pvt Ltd.
- ❖ Vasudevan. D.M. Sreekumari. S, Kannan Vaidyanathan (2019). Textbook of Biochemistry for Medical Students. Kindle edition, Jaypee Brothers Medical Publishers
- ❖ Jeremy M. Berg, Lubert Stryer, John L. Tymoczko, Gregory J. Gatto (2015). Biochemistry, 8th edition. WH Freeman publisher.

Reference books

- ❖ Amit Kessel & Nir Ben-Tal (2018). Introduction to Proteins: structure, function and motion. 2nd Edition, Chapman and Hall.
- ❖ David L. Nelson and Michael M. Cox (2017). Lehninger Principles of Biochemistry, 7th Edition W.H. Freeman and Co., NY.
- ❖ Lupert Stryer, Jeremy M. Berg, John L. Tymoczko, Gatto Jr., Gregory J (2019). Biochemistry. 9th Edition, W.H. Freeman & Co. New York.
- ❖ Donald Voet, Judith Voet, Charlotte Pratt (2016). Fundamentals of Biochemistry: Life at the Molecular Level, 5th Edition, Wiley.
- ❖ Joy PP, Surya S. and Aswathy C (2015). Laboratory Manual of Biochemistry, Edition 1., Publisher: Kerala agricultural university.

Web Resources

- ❖ <https://www.abebooks.com> › plp
- ❖ <https://kau.in/document/laboratory-manual-biochemistry>
- ❖ <https://metacyc.org>
- ❖ <https://www.medicalnewstoday.com>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	0	0	0	0	0	0	0	0	0
CO2	2	0	0	0	0	0	0	0	0	0
CO3	0	0	0	3	3	3	0	0	0	0
CO4	0	0	0	3	3	3	0	0	0	0
CO5	0	0	0	0	3	3	0	0	3	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

NME -I - PUBLIC HEALTH AND PREVENTIVE MEDICINE

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S1UMBN01	NME -1	Theory	Y	Y	-	2	2

Learning Objectives

- ❖ To describe the concepts of health and disease and their social determinants.
- ❖ To summarize the health management system.
- ❖ To know about the various health care services.
- ❖ To outline the goals of preventive medicine.
- ❖ To gain knowledge about alternate medicine.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Identify the health information system.	PO1,PO5, PO6
CO2	Associate various factors with health management system.	PO1,PO2, PO3,PO5, PO6, PO9
CO3	Choose the appropriate health care services.	PO1,PO5, PO6
CO4	Appraise the role of preventive medicine in community setting.	PO4,PO5, PO6
CO5	Recommend the usage of alternate medicine during out breaks.	PO1,PO5, PO6

NME -I - PUBLIC HEALTH AND PREVENTIVE MEDICINE

Unit	Details	No. of Hours
I	Introduction to Public Health: Definition of health and its determinants, social determinants of health, Introduction to public health and its goals, Role of public health in disease prevention and health promotion and health policies.	6
II	Basic of Public Health Nutrition: Concepts of nutrition and dietetics; nutrition epidemiology; essential nutrients, nutrition-related diseases, and food systems and sustainability; national nutrition programs and policies. Model Preparation Nutrition-related diseases	6
III	Health management & Health care services: Applications of behavioral sciences and psychology in health management-water and sanitation in human health-national programs for communicable and non-communicable diseases, Health care of the community-information, education, communication and training in health-maternal & child health-school health services.	6
IV	Role of preventive medicine in Public Health Promotion: levels of prevention-Risk assessment in communities and vulnerable population –surveillance, monitoring and reporting of disease outbreaks - forecasting and control measures in community setting – early detection methods. Field Visit: PHC and Report Submission	6
V	Public Health Systems: Public health system in India, Primary healthcare infrastructure and delivery mechanisms; Challenges and opportunities in strengthening the public health system; Prevention through alternate medicine: Unani, Ayurveda, Homeopathy, Naturopathy systems in epidemic and pandemic outbreaks- SARS and MERS Corona virus, and Ebola. Overview of global public health initiatives.	6
	Total	30
● Model Preparation & Field Visit – related to the above topic are to be considered for Internal Exam only		

Text Books

- ❖ Park.K (2021). Textbook of preventive and social medicine, 26th edition.
- ❖ Mahajan& Gupta (2013). Text book of preventive and social medicine, 4th edition.
- ❖ Chun-Su Yuan, Eric J. Bieber, Brent Bauer (2006). Textbook of Complementary and Alternative Medicine. Second Edition. Routledge publishers.
- ❖ Vivek Jain (2020). Review of Preventive and Social Medicine: Including Biostatistics.12th edition, Jaypee Brothers Medical Publishers.
- ❖ Lal Adarsh Pankaj Sunder (2011). Textbook of Community Medicine: Preventive and Social Medicine, CBS publisher.

Reference books

- ❖ Howard Waitzkin, Alina Pérez, Matt Anderson (2021). Social Medicine and the coming Transformation. First Edition. Routledge publishers.
- ❖ GN Prabhakara (2010). Short Textbook of Preventive and Social Medicine. Second Edition. Jaypee publishers.
- ❖ Jerry M. Suls, Karina W. Davidson, Robert M. Kaplan (2010).Handbook of Health Psychology and Behavioral Medicine. Guilford Press.
- ❖ Marie Eloïse Muller, Marie Muller, Marthie Bezuidenhout, Karien Jooste (2006). Health Care Service Management. Juta and Company Ltd.
- ❖ Geoffrey Rose (2008).Rose's Strategy of Preventive Medicine: The Complete. OUP Oxford.

Web Resources

- ❖ <https://www.omicsonline.org/scholarly/social--preventive-medicine-journals-articles-ppts-list.php>.
- ❖ <https://www.healthcare-management-degree.net>.
- ❖ <https://www.conestogac.on.health-care-administration-and-service-management>.

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	0	0	0	3	3	0	0	0	0
CO2	3	3	0	2	3	3	0	0	3	0
CO3	0	0	0	2	3	3	0	0	0	0
CO4	3	0	0	3	3	2	0	0	0	0
CO5	3	0	0	0	3	3	0	0	0	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

NME- I - MUSHROOM FARMING BUSINESS

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S1UMBN02	NME	Theory	Y	Y	-	2	2

Learning Objectives

- ❖ To facilitate self-employment.
- ❖ To know the nutrient value of mushroom.
- ❖ To study the morphology and types of Mushrooms.
- ❖ To know the spawn production technique.
- ❖ To aware the identification of edible and poisonous Mushrooms.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Students can start small scale industry of Mushroom cultivation.	PO1,PO5,PO7
CO2	Students study the morphology and types of Mushrooms.	PO1, PO2
CO3	They are aware of the identification of edible and poisonous Mushrooms.	PO1, PO5
CO4	Students will be able produce spawn on their own.	PO7, PO8, PO10
CO5	Learned the prospects and scope of mushroom cultivation in small scale industry.	PO5, PO7, PO8

NME- I - MUSHROOM FARMING BUSINESS

Unit	Details	No. of Hours
I	Introduction: History of mushroom cultivation; Classification and distribution of mushroom; life cycle of mushroom. Identification of poisonous mushrooms	6
II	Spawn preparation: Isolation of pure culture; Nutrient media for pure culture; layout of spawn preparation room; raw material of spawn; sterilization; preparation of mother spawn and multiplication Poster Preparation-Spawn Production.	6
III	Cultivation of mushroom: Layout of mushroom shed - small scale and large scale production unit. Types of raw material – preparation and sterilization; Mushroom bed preparation – maintenance of mushroom shed; harvesting method and preservation of mushrooms. Hands on Skill Training- Mushroom bed preparation & Cultivation	6
IV	Nutrient values of mushroom: Protein, carbohydrate, fat, fibre, vitamins and amino acids contents; short and long term storage of mushroom; preparation of various dishes from mushroom.	6
V	Types of mushroom: Milky mushroom; oyster, button mushroom and any one medically valuable mushroom.	6
	Total	30

Text Books

- ❖ Paul Stamets, J.S. and Chilton, J.S. 2004. Mushroom cultivation a practical guide to growing mushrooms at home, Agarikon Press.
- ❖ Shu Fing Chang, Philip G. Miles and Chang, S.T. 2004. Mushrooms Cultivation, nutritional value, medicinal effect and environmental impact. 2nd ed., CRC press.

Web Resources

- ❖ Tewari and Pankaj Kapoor S.C. 1993. Mushroom cultivation. Mittal Publication. Delhi.
- ❖ Marimuth et al., 1991. Oyster Mushrooms. Dept. of Plant pathology, TNAU, Coimbatore.
- ❖ Nita Bahl. 1988. Hand book of Mushrooms, 2nd Edition, Vol I & II
- ❖ <https://www.indiamart.com/proddetail/mushroom-cultivation-processing-preservation-book-7903478688.html>
- ❖ <https://www.saraspublication.com/books/mushroom-cultivation>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	0	0	0	3	0	3	0	0	0
CO2	3	3	0	0	0	0	0	0	0	0
CO3	3	0	0	0	3	0	0	0	0	0
CO4	0	0	0	0	0	0	3	3	0	3
CO5	0	0	0	0	3	0	3	3	0	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

**CORE I - FOUNDATION COURSE–MICROBES: ATTRIBUTES AND VALUABLE
RESOURCES**

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S1UMBF01	Foundation Course	Theory	Y	Y	-	2	2

Learning Objectives

- ❖ To emphasize economic importance of bacteria.
- ❖ To gain knowledge on beneficial and harmful aspects of fungi.
- ❖ To explore the role of algae in various sectors.
- ❖ To acquire basic insight on significance of viruses.
- ❖ To impart importance of protozoa in day-to-day life.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Study the historical events that led to the discoveries and inventions and understand the classification of Microorganisms.	PO2, PO6, PO10
CO2	Gain Knowledge of detailed structure and functions of prokaryotic cell organelles.	PO4,PO10
CO3	Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.	PO6,PO9
CO4	Explain the principles and working mechanism of different microscopes / Microscope, their function and scope of application.	PO4, PO8
CO5	Understand the concept of asepsis and modes of sterilization and disinfectants.	PO3, PO10

CORE I - FOUNDATION COURSE–MICROBES: ATTRIBUTES AND VALUABLE RESOURCES

Unit	Details	No. of Hours
I	Common traits and Commercial significance of bacteria- Antibiotic production (<i>Streptomyces</i>), Biofertilizer (<i>Rhizobium</i>), Superbugs (<i>Pseudomonas</i>), fermentation and Medicinal products (<i>Lactobacillus</i>). Harmful aspects such as food spoilage (<i>Clostridium</i>) and diseases (<i>Xanthomonas</i>, <i>Salmonella</i>, <i>Vibrio</i>). Medicinal Values of Lactobacillus-Sample products and report.	6
II	Common traits and Commercial significance of fungi- Biopesticide (<i>Beauveria</i>), Industry (<i>Saccharomyces</i>), medicine (<i>Penicillium</i>). Harmful aspects-food spoilage (mold), diseases in crops (<i>Fusarium</i>), humans (<i>Aspergillus</i>), allergic reactions (<i>Mucor</i>). Model Preparation	6
III	Common traits and Commercial significance of algae- single cell protein (<i>Spirulina</i>), soil fertility (<i>Anabaena</i>), environment (Phytoplanktons). Harmful aspects- Eutrophication and phycotoxins.	6
IV	Common traits and Commercial significance of virus- Vaccine production (Rabies virus), gene therapy (Adenovirus), biopesticides (Cauliflower mosaic virus). Harmful aspects - diseases (plant-TMV, human-Influenza virus). Field Visit to TNAU and Report Submission	6
V	Common traits and Commercial significance of protozoa- Biocontrol (<i>Haemogregarina</i>), sanitation (<i>Amoeba</i>), oil exploration (<i>Radiolaria</i>). Harmful aspects –diseases (<i>Entamoeba</i>, <i>Giardia</i>).	6
	Total	30
● Model Preparation & Field Visit – related to the above topic are to be considered for Internal Exam only		

Text Books

- ❖ Pelczar, M.J., Chan, E. C. S. and Kreig, N. R. (2006). Microbiology. 5th edition, TataMc Grow Hill Inc, New York.
- ❖ Dubey, R.C. and Maheswari, D.K. (2005). A Text book of Microbiology. S.Chand & Company Ltd, New Delhi.
- ❖ Subba Rao, N.S. (1995). Soil microorganisms and plant growth, Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.
- ❖ Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.
- ❖ S. Ram Reddy, S.M. Reddy (2008). Microbial Physiology. Anmol Publications Pvt Ltd.

Reference books

- ❖ Hurst, C.J., Crawford, R.L., Garland, J.L., Lipson, D.A. and Mills, A.L. (2002). Manual of Environmental Microbiology, 2nd Edition. A. SM Press, New Delhi.
- ❖ Atlas, R.A. (1995). Principles of Microbiology. Mosby Publications, USA.
- ❖ Madigan, M.T. and Martinko, J.M. (2014). Brock Biology of Microorganisms. 14th Edition. Prentice Hall International Inc., USA.
- ❖ Moat, A.G and J.W Foaster (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.
- ❖ BhanuShrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.

Web Resources

- ❖ <https://microbiologyinfo.com/category/basic-microbiology/>
- ❖ <https://microbiologyinfo.com/category/basic-microbiology/>
- ❖ <https://www.britannica.com/science/microbiology>
- ❖ <https://www.healthcare-management-degree.net>
- ❖ <https://www.conestogac.on.health-care-administration-and-service-management>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	3	0	0	0	3	0	0	0	3
CO2	0	0	0	2	0	0	0	0	0	3
CO3	0	0	0	0	0	3	0	0	2	0
CO4	0	0	0	3	0	0	0	2	0	0
CO5	0	0	2	0	0	0	0	0	0	2

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

SEMESTER – II

SEMESTER – II
CORE II – MICROBIAL PHYSIOLOGY AND METABOLISM

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S2UMB02	Core – II	Theory	Y	Y	-	5	5

Learning Objectives

- ❖ To study the basic principles of microbial growth.
- ❖ To understand the basic concepts of aerobic and anaerobic metabolic pathways.
- ❖ To analyze the role of individual components in overall cell function.
- ❖ To provide the information on sources of energy and its utilization by microorganisms.
- ❖ To study the different types of metabolic strategies.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Describe microorganisms based on nutrition.	PO6, PO9
CO2	Know the concept of microbial growth and identify the factors affecting bacterial growth.	PO6, PO7, PO9
CO3	Explain the methods of nutrient uptake.	PO6, PO9
CO4	Describe anaerobic and aerobic energy production.	PO6, PO9
CO5	Elaborate the process of bacterial photosynthesis and reproduction.	PO6, PO9

CORE II – MICROBIAL PHYSIOLOGY AND METABOLISM

Unit	Details	No. of Hours
I	Growth and regulation: Nutritional requirements – macro and micronutrients – growth factors. Transport the nutrients across the membrane – diffusion, active and passive transport, group translocation. Growth curve – growth determinations – batch, continuous and synchronous culture.	15
II	Cell differentiation: Morphogenesis – development of dormant and resting structures. Sporulation in <i>Bacillus</i> . –formation and stages of Endospore, germination and regulation. Poster Preparation- Sporulation	15
III	Respiratory metabolism: Carbohydrate metabolism – Embden Meyerhoff pathway – the HMP pathway – The Tricarboxylic acid cycle. Aerobic respiration – Substrate level phosphorylation – Oxidative level phosphorylation – lipid catabolism – beta oxidation.	15
IV	Biosynthesis of molecules: Synthesis of fatty acids. Biosynthesis of nucleotides – purines and pyrimidines. Biosynthesis of amino acids – glutamate family, Biosynthesis of bacterial cell wall.	15
V	Photosynthesis: Oxygenic and Anoxygenic photosynthesis and Calvin Benson cycle – Methanogenesis pathways. Fermentation – alcoholic, propionic, lactic and mixed acid fermentation and solvent producing fermentations. Power point presentation- Fermented food Products	15
	Total	75
• Poster Preparation & Power presentation – related to the above topic are to be considered for internal exam only		

Text Books

- ❖ BhanuShrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.
- ❖ Rajapandian K.(2010). Microbial Physiology, Chennai: PBS Book Enterprises India.
- ❖ MeenaKumari. S. Microbial Physiology, Chennai 1st Edition MJP Publishers 2006.
- ❖ Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S.Chand & Co.
- ❖ S. Ram Reddy, S.M. Reddy (2008). Microbial Physiology. Anmol Publications Pvt Ltd.

Reference books

- ❖ Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
- ❖ Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
- ❖ Moat, A.G and J.W Foaster (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.
- ❖ Schlegel, H.G. (1993). General Microbiology., 7th Edition, Press syndicate of the University of Cambridge.

Web Resources

- ❖ <https://sites.google.com/site/microbialphysiologyoddsem/teaching-contents>.
- ❖ <https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition>.
- ❖ https://onlinecourses.swayam2.ac.in/cec20_bt14/preview.

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	0	0	0	0	3	0	0	3	0
CO2	0	0	0	0	0	3	2	0	3	0
CO3	0	0	0	0	0	3	0	0	3	0
CO4	0	0	0	0	0	3	0	0	3	0
CO5	0	0	0	0	0	3	0	0	3	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

CORE PRACTICAL -II - MICROBIAL PHYSIOLOGY AND METABOLISM

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S2UMBP02	Core Practical - II	Theory	-	-	Y	5	5

Learning Objectives

- ❖ To understand the principles of motility test.
- ❖ To understand the basic concepts of staining methods.
- ❖ To learn the bacterial count using different methods and anaerobic culture.
- ❖ To study the morphological demonstration of microorganisms and identification.
- ❖ To study the biochemical identification of the bacteria.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Describe hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method.	PO6, PO7, PO8, PO9,
CO2	Demonstrate Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining.	PO6, PO7, PO8, PO9,
CO3	Explain antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains.	PO6, PO7, PO8, PO9,
CO4	Describe demonstration of the size of yeast, fungal filaments and protozoa.	PO6, PO7, PO8, PO9,
CO5	Elaborate on the bacterial identification- morphological, physiological, and biochemical methods.	PO6, PO7, PO8, PO9

CORE PRACTICAL -II - MICROBIAL PHYSIOLOGY AND METABOLISM

Unit	Details	No. of Hours
I	Motility demonstration: hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method. Staining techniques: Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining.	15
II	Direct counts – Direct cell count (Petroff-Hausser counting chamber), Turbidometry. Effect on pH and Temperature. Bacterial growth curve.	15
III	Anaerobic culture methods. Antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains.	15
IV	Morphological variations in algae, fungi and protozoa.	15
V	Methods of bacterial identification- morphological, physiological, and biochemical methods - IMViC test, H ₂ S, TSI, Oxidase, catalase, urease test, and Carbohydrate fermentation test. Maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture.	15
	Total	75

Text Books

- ❖ James G Cappucino and N. Sherman MB (2014). A lab manual Benjamin Cummins, New York.
- ❖ Kannan. N (2002). Laboratory manual in General Microbiology. Palani Publications.
- ❖ Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
- ❖ Gunasekaran. P (2007). Laboratory manual in Microbiology. New age international publisher.

Reference books

- ❖ David White., James Drummond., Clay Fuqua (2012) Physiology and Biochemistry of Prokaryotes. 4th Ed. Oxford University Press, New York.
- ❖ Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
- ❖ Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
- ❖ Dawes, I.W and Sutherland L.W (1992). Microbial Physiology (2nd edition), Oxford Blackwell Scientific Publications.

Web Resources

- ❖ [https://sites.google.com/site/microbial physiology odd sem/teaching-content](https://sites.google.com/site/microbial%20physiology%20odd%20sem/teaching-content)
- ❖ <https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition>
- ❖ https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
- ❖ <https://www.studocu.com/microbial-physiology-practicals>
- ❖ <https://www.agr.hokudai.ac.jp/microbial-physiology>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	0	0	0	0	3	2	3	2	0
CO2	0	0	0	0	0	3	3	2	3	0
CO3	0	0	0	0	0	2	3	3	2	0
CO4	0	0	0	0	0	3	3	3	3	0
CO5	0	0	0	0	0	3	3	3	3	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution toPOs	3.0	3.0	3.0	3.0	3.0

Course Coordinator

BOS Chairman

ELECTIVE – II - BIOINSTRUMENTATION

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S2UMBE02	Elective - II	Theory	Y	-	-	4	3

Learning Objectives

- ❖ To understand the analytical instruments and study the basic principles in the field of sciences.
- ❖ To gain knowledge about principles of spectroscopy
- ❖ To understand the analytical techniques of Chromatography and electrophoresis
- ❖ To understand the principle of different types of scans used in medical diagnosis
- ❖ To gain information about the principles of radioactivity and its measurements

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Gain knowledge about the basics of instrumentation.	PO1,PO4
CO2	Exemplify the structure of atoms and molecules by using the principles of spectroscopy.	PO4,PO10
CO3	Evaluate by separating and purifying the components.	PO4,PO7
CO4	Understand the need and applications of imaging techniques.	PO7,PO8
CO5	Categorize the working principle and applications of fluorescence and radiation.	PO10

ELECTIVE -II - BIOINSTRUMENTATION

Unit	Details	No. of Hours
I	Basic laboratory Units & Instruments: Biochemical calculations- preparations of Molar, Normality, PPM solutions - Buffers- (Phosphate, Acetate, TE, TAE) - Ammonium sulphate precipitation. Principle and working of pH meter, Laminar-air flow. Centrifugation: Types of centrifuge methods and their applications.	12
II	Chromatographic techniques: Theory, principles and applications of paper, thin layer, gel filtration, ion exchange, affinity, hydrophobic, gas liquid, high pressure/ performance liquid chromatography (HPLC)., MSGC-Mass Spectroscopy And Gas Chromatography. Power point Presentation on Chromatographic techniques	12
III	Electrophoretic techniques: Basic principles of electrophoresis, theory and application of paper, starch gel, agarose, native and denaturing PAGE, isoelectric focusing.	12
IV	Spectroscopy: Spectroscopic techniques, theory and applications of Uv, Visible, IR, NMR, Fluorescence, Atomic Absorption, CD, ORD, Mass, Raman Spectroscopy. Field Visit and Report Submission	12
V	Radioisotopic techniques: Use of radioisotopes in life sciences, radioactive labelling, Geiger- Muller and Scintillation counters, autoradiography and its applications. Dosimeter.	12
	Total	60
● Power point Presentation & Field Visit – related to the above topic are to be considered for Internal Exam only		

Text Books

- ❖ Jayaraman J (2011). Laboratory Manual in Biochemistry, 2nd Edition. Wiley Eastern Ltd., New Delhi.
- ❖ Ponmurugan. P and Gangathara PB (2012). Biotechniques. 1st Edition. MJP publishers.
- ❖ Veerakumari, L (2009). Bioinstrumentation- 5th Edition -.MJP publishers.
- ❖ Upadhyay, Upadhyay and Nath (2002). Biophysical chemistry – Principles and techniques 3rd Edition. Himalaya publishing home.
- ❖ Skoog A., West M (2014). Principles of Instrumental Analysis – 14th Edition W.B. Saunders Co., Philadelphia.

Reference books

- ❖ Rodney F. Boyer (2000). Modern Experimental Biochemistry, 3rd Edition. Pearson Publication.
- ❖ N. Gurumani. (2006). Research Methodology for biological sciences- 1st Edition – MJ Publishers.
- ❖ Wilson K and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Edition. Cambridge University Press.
- ❖ Webster, J.G. (2004). Bioinstrumentation- 4th Edition - John Wiley & Sons (Asia) Pvt. Ltd, Singapore.
- ❖ Chatwal G and Anand (1989). Instrumental Methods of Chemical Analysis. S. Himalay Publishing

Web Resources

- ❖ <http://www.biologydiscussion.com/biochemistry/centrifugation/centrifuge-introduction-types-uses-and-other-details-with-diagram/12489>.
- ❖ <https://www.watelectrical.com/biosensors-types-its-working-and-applications/>.
- ❖ <http://www.wikiscales.com/articles/electronic-analytical-balance/>.
- ❖ <https://study.com/academy/lesson/what-is-chromatography-definition-types-uses.html>.

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	0	0	3	0	0	0	0	0	0
CO2	0	0	0	2	0	0	0	0	0	3
CO3	0	0	0	2	0	0	0	0	0	0
CO4	0	0	0	0	0	0	3	0	0	0
CO5	0	0	0	0	0	0	3	3	0	3

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution toPOs	3.0	3.0	3.0	3.0	3.0

Course Coordinator

BOS Chairman

NME II – NUTRITION AND HEALTH HYGIENE

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S2UMBN03	NME - II	Theory	Y	-	-	2	2

Learning Objectives

- ❖ To learn about nutrition and their importance.
- ❖ To make student understand the nutritional facts flora better life.
- ❖ To learn information to optimize our diet.
- ❖ To impart knowledge on different health care programs taken up by India.
- ❖ To learn knowledge on different health indicators and types of hygiene methods.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Learn the importance of nutrition for a healthy life.	PO5, PO6, PO7, PO8, PO10
CO2	Study the nutrition for life cycle.	PO5, PO6, PO7, PO8, PO10
CO3	Know the health care programmes of India.	PO5, PO6, PO7, PO8, PO10
CO4	Learn the importance of community and personal health & hygiene measures.	PO5, PO6, PO7, PO10
CO5	Create awareness on community health and hygiene.	PO5, PO6, PO7, PO10

ME II – NUTRITION AND HEALTH HYGIENE

Unit	Details	No. of Hours
I	Importance of Nutrition: Basics of Meal Planning. Carbohydrates, Lipids, Proteins, Vitamins, Macro and micro minerals –functions, dietary sources, effects of deficiency, Importance of water– functions, sources, requirements ,and effects of deficiency.	6
II	Nutrition for Life Cycle: Balanced diet - Normal, Pregnant, lactating women, Infancy, young children Adolescents, Adults, and the Elderly; Diet Chart; Nutritive value of Indian foods. Poster Preparation: Food Adulteration	6
III	Improper diets and their effects: Definition, Identification, Signs and Symptoms - malnutrition, under-nutrition, over-nutrition, Protein Energy Malnutrition, obesity; Nutritional Disease and Disorder - hypertension, diabetes, anemia, osteomalacia, Cardio-vascular disease.	6
IV	Health Policy: Determinants of health, Key Health Indicators, Environment health & Public health; Health-Education: Principles and Strategies. National Health Policy of Govt. of India; Functioning of various nutrition and health organizations in India.	6
V	Hygiene: Definition; Personal, Community, Medical and Culinary hygiene; WASH (Water, Sanitation and Hygiene) programme. Rural Community Health: Village health sanitation & Nutritional committee. Community & Personal Hygiene: Environmental Sanitation and Sanitation in Public places. Poster Preparation Personal Hygiene and Sanitation in Public places.	6
	Total	30
● Poster Preparation – related to the above topic are to be considered for Internal Exam only		

Text Books

- ❖ Bamji, M.S., K. Krishnaswamy & G.N.V. Brahman (2009) Textbook of Human Nutrition (3rd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- ❖ Acharya, Sankar Kr, Rama Das, Minati Sen (2021). Health Hygiene and Nutrition Perception and Practices. Satish Serial Publishing House.
- ❖ SK. Halder (2022). Occupational Health and Hygiene in Industry. CBS Publishers.
- ❖ Satish Serial Publishing House Doss (2021). Public Health and Hygiene, Notion Press.

Reference books

- ❖ Bamji, M.S., K. Krishnaswamy & G.N.V. Brahman (2009) Textbook of Human Nutrition (3rd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- ❖ Swaminathan (1995) Food & Nutrition (Vol I, Second Edition) The Bangalore Printing & Publishing Co Ltd., , Bangalore.
- ❖ SK. Halder (2022). Occupational Health and Hygiene in Industry. CBS Publishers.
- ❖ Swaminathan (1995) Food & Nutrition (Vol I, Second Edition) The Bangalore Printing & Publishing Co Ltd., , Bangalore.

Web Resources

- ❖ National Rural Health Scheme:
<https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=969&lid=9>.
- National Urban Health Scheme:
- ❖ <https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=970&lid=17>
- ❖ Village health sanitation & Nutritional committee
- ❖ <https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=149&lid=25>
- ❖ Health Impact Assessment - <https://www.who.int/hia/about/faq/en/>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	0	0	0	3	2	2	3	0	3
CO2	0	0	0	0	3	2	2	3	0	3
CO3	0	0	0	0	3	3	2	3	0	3
CO4	0	0	0	0	3	3	3	0	0	3
CO5	0	0	0	0	3	3	3	0	0	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution toPOs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

NME- II – BIO-FERTILIZER TECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S2UMBN04	NME-II	Theory	Y	-	-	2	2

Learning Objectives

- ❖ To facilitate self-employment.
- ❖ To know the nutrient value of Bio-fertilizer.
- ❖ To acquire enterprise management capabilities
- ❖ To know the mass production technique.
- ❖ To build confidence through end to end approach in product development.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Students can start small scale industry of Biofertilizer production	PO1,PO5,PO7
CO2	Describe the different methods of composting. .	PO1, PO2
CO3	Assess quality of compost and its role in soil nutrition. .	PO1, PO5
CO4	Apply methods of bio-control	PO7,PO8, PO10
CO5	Develop a composting unit for production of biofertilizers (generateemployment)	PO5, PO7, PO8

NME- II – BIO-FERTILIZER TECHNOLOGY

Unit	Details	No. of Hours
I	Introduction: Biofertilizers and biocontrol agents (Bacterial, Fungal, Algal, Protozoa and Virus), Merits and demerits and agronomic importance.	6
II	Bacterial bio fertilizer: <i>Rhizobium</i> , <i>Azotobacter</i> , <i>Azospirillum</i> and <i>Frankia</i> . <i>Acetobacteria</i> biofertilizer, Phosphate solubilizing microbes – phosphobacteria Poster Presentation & Biofertilizer Preparation Training	6
III	Algal biofertilizer - Blue green algae- <i>Azolla</i> – Importance.	6
IV	Fungal biofertilizers - Mycorrhizae – ecto and endomycorrhiza Field visit and Report Submission	6
V	Biopesticides – <i>Bacillus thuringiensis</i> and <i>Trichoderma viride</i> ; <i>Trichogramma</i> sp and Biosafety.	6
	Total	30
● Poster Preparation – related to the above topic are to be considered for Internal Exam only		

Text Books

- ❖ Subba Rao N.S. 1995, Soil microorganisms and plant growth, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
- ❖ Mahendra K. Rai. 2005, Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
- ❖ Kannaiyan S. 2003, Bioethnology of Biofertilizers, CHIPS, Texas.

Reference books

- ❖ Masanobu Fukuoka, Frances Moore Lappe Wendell Berry (2009). The One-Straw Revolution: An Introduction to Natural Farming, 1st edition, YRB Classics.
- ❖ Sujit Chakrabarty (2018). Organic Home Gardening Made Easy, 1st Edition,
- ❖ Singh and Purohit (2008). Biofertilizer technology. Agrobios, India.
- ❖ Bansal M (2019). Basics of Organic Farming CBS Publisher
- ❖ Hurst, C.J., Crawford R.L., Garland J.L., Lipson D.A., Mills A.L. and Stetzenbach L.D. (2007). Manual of Environmental Microbiology. (3rd Edition). American Society for Microbiology.

Web Resources

- ❖ <http://www.marketsandmarkets.com/PressReleases/compound-biofertilizers-customized-fertilizers.asp>
- ❖ <http://www.transparencymarketresearch.com/pressrelease/global-biofertilizers-market.htm>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	0	0	0	3	0	3	0	0	0
CO2	3	3	0	0	0	0	0	0	0	0
CO3	3	0	0	0	3	0	0	0	0	0
CO4	0	0	0	0	0	0	3	3	0	3
CO5	0	0	0	0	3	0	3	3	0	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Course Coordinator

BOS Chairman

SEC - I - SERICULTURE TECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S2UMBS01	SEC – I	Theory	Y	-	-	2	2

Learning Objectives

- ❖ To acquire knowledge on the concepts of origin, growth and study of Sericulture as science and scientific approach of mulberry plant
- ❖ To describe the morphology and physiology of silkworm.
- ❖ To discuss effective management of silkworm diseases.
- ❖ To demonstrate field skills in mulberry cultivation and silkworm rearing with an emphasis on technological aspects.
- ❖ To demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Discuss the overall aspects of Sericulture and the biology and varieties of mulberry plant. Creates awareness among students about the economic importance and suitability of Sericulture in Indian conditions.	PO1, PO5, PO7
CO2	Familiarize with the lifecycle of silk worm.	PO1, PO2
CO3	Explain common diseases of silkworm encountered during rearing, sources of infection, disease symptoms, pre-disposing factors and their management practices.	PO1, PO5
CO4	Attain thorough knowledge about the cultivation of mulberry, maintenance of the farm, seed technology, silkworm rearing, post cocoon techniques like stifling, reeling, and utilization of by-products.	PO7, PO8, PO10
CO5	Plan the facilities required for establishment of in sectary. Competent to transfer the knowledge and technical skills to the Seri-farmers. Analyze the importance of sericulture in entrepreneurship development and emerge as potential entrepreneur.	PO5, PO7, PO8

SEC - I - SERICULTURE TECHNOLOGY

Unit	Details	No. of Hours
I	Introduction to Sericulture: Its distribution in India. Cultivation of food plants-Mulberry crop cultivation and protection. Bio-ecology of mulberry silkworms.	6
II	Biology of Silkworm: Morphology of silkworm. Life cycle of silkworm- egg, larva, pupa, and moth. Poster Presentation	6
III	Rearing of silkworms & Harvesting: Rearing of silkworms. Insectary facilities and rearing equipments- favourable climatic conditions for rearing. Harvesting and processing of cocoons. Stifling and reeling of cocoons, Value added products of mulberry and silkworms.	6
IV	Silkworm pathology: Mulberry Silkworm Diseases: Pebrine, Grasserie, Muscardine, Flacherie, Symptoms and Pathogens, Mode of Infection, Prevention and Control. Brief Account of Pests and Predators of Silkworms, Nature of damage and control measures. Field Visit- Report Submission	6
V	Entrepreneurship and rural development in sericulture: Planning for EDP, Project formulation, Government Subsidies and Schemes for Sericulture farming and Reeling appliances.	6
	Total	30
● Poster Presentation & Field Visit – related to the above topic are to be considered for Internal Exam only		

Text Books

- ❖ Ganga, G. and Sulochana Chetty (2010). Introduction to Sericulture,,J., Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
- ❖ Dandin S B, Jayant Jayaswal and Giridhar K (2010). Handbook of Sericulture technologies, Central Silk Board, Bangalore.
- ❖ M. C. Devaiah, K. C. Narayanaswamy and V. G. Maribashetty(2010). Advances in Mulberry Sericulture,,CVG Publications, Bangalore
- ❖ T.V.Sathe and Jadhav.A.D.(2021). Sericulture and Pest Management, Daya Publishing House.
- ❖ M.Johnson, M.Kesary (2019). Sericulture, 5th. Edition. Saras Publications. Manisha Bhattacharyya (2019). Economics of Sericulture, Rajesh Publications.
- ❖ Muzafar Ahmad Bhat, Suraksha Chanotra, Zafar Iqbal Buhroo, Abdul Aziz and Mohd. Azam (2020). A Textbook on Entrepreneurship Development Programme in Sericulture, IP Innovative Publication.

Reference books

- ❖ S. Morohoshi (2001). Development Physiology of Silkworms 2nd Edition, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi
- ❖ Hamamura, Y (2001). Silkworm rearing on Artificial Diet. Oxford & IBH publishing Co., Pvt. Ltd. New Delhi.
- ❖ Dr. R. K. Rajan & Dr. M. T. Himantharaj (2005). Silkworm Rearing Technology, Central Silk Board, Bangalore.

Web Resources

- ❖ <https://egyankosh.ac.in> › bitstream
- ❖ <https://archive.org> › details › Sericulture Handbook
- ❖ <https://www.academic.oup.com>
- ❖ <https://www.sericulture.karnataka.gov.in>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	0	0	0	3	0	3	0	0	0
CO2	3	0	0	0	3	0	0	0	0	0
CO3	3	0	0	0	3	0	0	0	0	0
CO4	0	0	0	0	0	0	3	3	0	3
CO5	0	0	0	0	3	0	3	3	0	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution toPOs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

SEC- I – MUSHROOM TECHNOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S2UMBS02	SEC-I	Theory	Y	-	-	2	2

Learning Objectives

- ❖ To facilitates self-employment.
- ❖ To knows the nutrient value of mushroom.
- ❖ To study the morphology and types of Mushrooms.
- ❖ To know the spawn production technique.
- ❖ To aware the identification of edible and poisonous Mushrooms.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Students can start small scale industry of Mushroom cultivation	PO1,PO5, PO7
CO2	Students study the morphology and types of Mushrooms.	PO1, PO2
CO3	They are aware of the identification of edible and poisonous Mushrooms.	PO1, PO5
CO4	Students will be able produce spawn on their own.	PO7, PO8, PO10
CO5	Learned the prospects and scope of mushroom cultivation in small scaleindustry	PO5, PO7, PO8

SEC- I – MUSHROOM TECHNOLOGY

Unit	Details	No. of Hours
I	Introduction: History of mushroom cultivation; Classification and distribution of mushroom; life cycle of mushroom. Identification of poisonous mushrooms.	6
II	Spawn preparation: Isolation of pure culture; Nutrient media for pure culture; layout of spawn preparation room; raw material of spawn; sterilization; preparation of mother spawn and multiplication Poster Preparation-Spawn Production.	6
III	Cultivation of mushroom: Layout of mushroom shed - small scale and large scale production unit. Types of raw material – preparation and sterilization; Mushroom bed preparation – maintenance of mushroom shed; harvesting method and preservation of mushrooms. Poster Preparation- Mushroom bed preparation & Cultivation.	6
IV	Nutrient values of mushroom: Protein, carbohydrate, fat, fibre, vitamins and amino acids contents; short and long term storage of mushroom; preparation of various dishes from mushroom.	6
V	Types of mushroom: Milky mushroom; oyster, button mushroom and any one medically valuable mushroom.	6
	Total	30
• Poster Preparation & Hands on Skill Training – related to the above topic are to be considered for Internal Exam only		

Text Books

- ❖ Paul Stamets, J.S. and Chilton, J.S. 2004. Mushroom cultivation A practical guide to growing mushrooms at home, Agarikon Press.
- ❖ Shu Fing Chang, Philip G. Miles and Chang, S.T. 2004. Mushrooms Cultivation, nutritional value, medicinal effect and environmental impact. 2nd ed., CRC press.

Web Resources

- ❖ Tewari and Pankaj Kapoor S.C. 1993. Mushroom cultivation. Mittal Publication. Delhi.
- ❖ Marimuth et al., 1991. Oyster Mushrooms. Dept. of Plant pathology, TNAU, Coimbatore.
- ❖ Nita Bahl. 1988. Hand book of Mushrooms, 2nd Edition, Vol I & II.
- ❖ <https://www.indiamart.com/proddetail/mushroom-cultivation-processing-preservation- book-7903478688.html>.

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	0	0	0	3	0	3	0	0	0
CO2	3	3	0	0	0	0	0	0	0	0
CO3	3	0	0	0	3	0	0	0	0	0
CO4	0	0	0	0	0	0	3	3	0	3
CO5	0	0	0	0	3	0	3	3	0	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution toPOs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

SEMESTER – III

SECOND YEAR - SEMESTER III

CORE –III MOLECULAR BIOLOGY AND MICROBIAL GENETICS

Subject Code	Major	Category	L	T	P	Hours	Credit
24S3UMB03	Core-III	Theory	Y	Y	-	5	5

Learning Objectives

- ❖ Illustrate the significance and functions of RNA in protein synthesis.
- ❖ Explain the causes and types of DNA mutation and DNA repair mechanisms.
- ❖ Outline the role of plasmids and phages in genetics.
- ❖ Examine the mechanisms of gene transfer and recombination.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Analyze the significance of DNA and elucidate the replication mechanism.	PO4, PO5, PO7,PO9
CO2	Illustrate the types of RNA and protein synthesis machinery.	PO4, PO7,PO9
CO3	Infer the causes and types of DNA mutation and summarize the DNA repair mechanisms.	PO5, PO7,PO9
CO4	Evaluate the importance of plasmids and phages in genetics.	PO7,PO9
CO5	Analyze gene transfer and recombination methods.	PO5, PO6, PO7,PO9

CORE –III MOLECULAR BIOLOGY AND MICROBIAL GENETICS

Unit	Details	No. of Hours
I	Primary structure of DNA: Chemical and structural qualities of 3', 5'-Phosphodiester bond. Secondary Structure of DNA: Watson & Crick model, Chargaff's rule- Salient features of double helix, forms of DNA. Denaturation and renaturation. DNA organization in prokaryotes, viruses, eukaryotes. Replication of DNA in prokaryotes and eukaryotes - DNA Replication, Types and mechanism of Enzymes involved in replication.	15
II	Structure and function of mRNA, rRNA and tRNA. Characteristics of promoter and enhancer sequences. RNA synthesis: Concept of transcription. Transcription in Prokaryotes. Distinction between transcription processes in prokaryotes versus eukaryotes. Genetic code: Codon degeneracy, Wobble hypothesis and its importance, Translation in prokaryotes and eukaryotes - Translational machinery - Ribosome structure in prokaryotes and eukaryotes, tRNA structure and processing. Inhibitors of protein synthesis. Overview of regulation of gene expression - lac, trp and ara operons as examples.	15
III	Mutation - Definition and types - base substitutions, frame shifts, deletions, insertions, duplications, inversions. Silent, conditional and lethal mutations. Mutagenesis-Spontaneous and Induced mutation. Physical and chemical mutagens. Reversion and suppression. Repair Mechanisms - Photo-reactivation, Nucleotide Repair, Base Excision Repair, Methyl Directed Mismatch Repair and SOS Repair. Uses of mutations, Selection of Mutants, Ames test.	15
IV	Plasmid replication and partitioning, host range, plasmid incompatibility, plasmid amplification, regulation of plasmid copy number, curing of plasmids. Types of plasmids – R Plasmids, F plasmids, colicinogenic plasmids, metal resistance plasmids, Ti plasmid, linear plasmids, yeast 2μ plasmid. Bacteriophage- T4, Phage – Lambda phage- Structure. Applications of Phages in Microbial Genetics. Model Preparation -(plasmid, bacteriophage)	15
V	Gene Transfer Mechanisms- Conjugation and its uses. Transduction - Generalized and Specialized, Transformation - Natural Competence and Transformation. Transposition and Types of Transposition reactions. Mechanism of transposition: Replicative and non- replicative transposition. Transposable elements - Prokaryotic transposable elements – insertion sequences, composite, and non-composite transposons. Uses of transposons. Power point Presentation-Gene transfer in Strain Improvement	15
	Total	75
Model Preparation & Power point Presentation related to the above topic are to be considered for internal exam only		

Text Books

- ❖ Malacinski G.M. (2008). Freifelder's Essentials of Molecular Biology. 4th Edition. Narosa Publishing House, New Delhi.
- ❖ Gardner E. J. Simmons M. J. and Snusted D.P.(2006). Principles of Genetics. 8th Edition. Wiley India Pvt. Ltd.
- ❖ Trun N. and Trempey J. (2009). Fundamental Bacterial Genetics. 1st Edition. Blackwell Science Ltd.
- ❖ Brown T. A. (2016). Gene Cloning and DNA Analysis- An Introduction. (7th Edition). John Wiley and Sons, Ltd.
- ❖ Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd.

References Books

- ❖ Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press.
- ❖ Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition., Pearson New International edn.
- ❖ Nelson, D.L. and Cox, M.M. Lehninger(2017). Principles of Biochemistry. 7th Edition, W.H. Freeman.
- ❖ Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4th Edition, ASM Press Washington-D.C. ASM Press.
- ❖ Primrose S.B. and Twyman R. M. (2006). Principles of Gene Manipulation and Genomics. (7th Edition). Blackwell Publishing

Web Resources

- ❖ [PDF] Lehninger Principles of Biochemistry (8th Edition) By David L. Nelson and Michael M. Cox Book Free Download – Study Materialz.in
- ❖ <https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/>
- ❖ <https://courses.lumenlearning.com/boundless-biology/chapter/dna-replication/>
- ❖ Molecular Biology Notes - Microbe Notes
- ❖ Molecular Biology Lecture Notes & Study Materials | Easy Biology Class

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	2	3	2	1	2	3
CO2	3	2	2	3	3	3	3	2	3	3
CO3	3	2	2	3	2	3	3	2	3	3
CO4	3	2	2	3	3	3	3	2	3	3
CO5	3	2	2	3	3	3	2	2	3	3

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	1
CO2	3	2	2	2	1
CO3	3	1	2	3	1
CO4	3	1	2	2	2
CO5	3	2	3	2	2
Weightage	15	8	11	11	7
Weighted percentage of Course Contribution to Pos	3	1.6	2.2	2.2	1.4

Course Coordinator**BOS Chairman**

CORE PRACTICAL – III MOLECULAR BIOLOGY AND MICROBIAL GENETICS

Subject Code	Major	Category	L	T	P	Hours	Credit
24S3UMBP03	Core Practical-III	Practical	-	-	Y	5	5

Learning Objectives

- ❖ Provide knowledge on structure and replication of DNA
- ❖ Illustrate the significance and functions of RNA in protein synthesis.
- ❖ Explain the causes and types of DNA mutation and DNA repair mechanisms.
- ❖ Outline the role of plasmids and phages in genetics.
- ❖ Examine the mechanisms of gene transfer and recombination.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Illustrate different types of DNA and RNA.	PO4, PO7, PO9, PO10
CO2	Utilize hands-on training in isolation of genomic and	PO4, PO7, PO9, PO10
CO3	Analyze importance of experimental microbial genetics.	PO4, PO7, PO9, PO10
CO4	Apply the knowledge of molecular techniques in various	PO4, PO7, PO9, PO10
CO5	Investigate the significance of Phages.	PO4, PO7, PO9, PO10

CORE PRACTICAL – III MOLECULAR BIOLOGY AND MICROBIAL GENETICS

Unit	Details	No. of Hours
I	Study of different types of DNA and RNA using micrographs and model / schematic representations.	15
II	Isolation of Genomic and Plasmid DNA from <i>E. coli</i> and Analysis by Agarose gel electrophoresis. Estimation of DNA using colorimeter (diphenylamine reagent), UV spectrophotometer (A260 measurement).	15
III	Resolution and visualization of proteins by polyacrylamide gel electrophoresis (SDS-PAGE) – UV induced auxotrophic mutant production and isolation of mutants by replica plating technique.	15
IV	Perform artificial Transformation in <i>E. coli</i> . Isolation of antibiotic resistant mutants by gradient plate method.	15
V	Screening and isolation of phages from sewage. Perform RNA isolation. Estimate RNA.	15
	Total	75

Text Books

- ❖ Crichton. M. (2014). Essentials of Biotechnology. Scientific International Pv Ltd. New Delhi.
- ❖ Sambrook J. and Russell D.W. (2001). Molecular Cloning - A Laboratory Manual – 7th Edition. Cold Spring Harbor, N.Y: Cold Spring Harbor Laboratory Press.
- ❖ Dale J. W., Schantz M. V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd.
- ❖ Gunasekaran P. (2007). Laboratory Manual in Microbiology. New Age International.
- ❖ James G Cappucino and Natalie Sherman. (2016). Microbiology – A laboratory manual. (5th Edition), The Benjamin publishing company. New York.

References Books

- ❖ Glick B. R. and Patten C.L. Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press. 2018.
- ❖ Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition., Pearson New International edn.
- ❖ Nelson, D.L. and Cox, M.M. Lehninger (2017). Principles of Biochemistry. 7th Edition, W.H. Freeman.
- ❖ Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4th edition, ASM Press Washington-D.C. ASM Press.
- ❖ Brown T.A. (2016). Gene Cloning and DNA Analysis. (7th Edition). John Wiley and Jones, Ltd.

Web Resources

- ❖ <https://www.molbiotools.com/usefullinks.html>
- ❖ (PDF) Molecular Biology Laboratory manual (researchgate.net)
- ❖ <https://www.molbiotools.com/usefullinks.html>
- ❖ <https://geneticgenie.org3>.
- ❖ <https://currentprotocols.onlinelibrary.wiley.com/doi/pdf/10.1002/cpet.5>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	2	3	2	1	2	3
CO2	3	2	2	3	3	3	3	2	3	3
CO3	3	2	2	3	2	3	3	2	3	3
CO4	3	2	2	3	3	3	3	2	3	3
CO5	3	2	2	3	3	3	2	2	3	3

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	0
CO2	3	3	2	1	1
CO3	3	2	3	2	1
CO4	3	2	3	2	2
CO5	2	1	3	2	1
Weightage	14	10	13	8	5
Weighted percentage of Course Contribution to POs	2.8	2	2.6	1.6	1

Course Coordinator

BOS Chairman

ELECTIVE - III MOLECULAR BIOLOGY IN DIAGNOSIS

Subject Code	Major	Category	L	T	P	Hours	Credit
24S3UMBE03	Elective - III	Theory	Y	Y	-	4	3

Learning Objectives

- ❖ Understand the role of molecular biology in the diagnosis of infectious diseases, cancer and other genetic disorders.
- ❖ Understand the basic molecular Biology techniques such as DNA tractions, PCR in diagnosis that is important in molecular research labs.
- ❖ Understand the molecular Biology and its role in diseases, forensic and focus on the Laboratory techniques.
- ❖ Be able to handling with laboratory wares and instruments used in molecular biology Laboratory.
- ❖ Establish quality assurance principles and practices to ensure the accuracy and reliability of Laboratory information.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Able to identify the role and importance of molecular diagnostics such as real-time PCR, epidemiological genotyping, microfluidics, bio-imaging, sequencing technologies and immuno-diagnostics.	PO4, PO5, PO7, PO9
CO2	Describe application of molecular biology in forensic medicine, genetic fingerprinting, genetic engineering and diagnosis of various diseases.	PO4, PO7, PO9
CO3	Able to incorporate both in silico and lab-based techniques as part of a combined molecular diagnostics strategy.	PO5, PO7, PO9
CO4	Explain the importance of molecular diagnostic techniques in diagnosing genetic disorders, human cancer and infectious diseases.	PO7, PO9
CO5	Establish quality assurance principles and practices to ensure the accuracy and reliability of laboratory information.	PO5, PO6, PO7, PO9

ECTIVE - III MOLECULAR BIOLOGY IN DIAGNOSIS

Unit	Details	No. of Hours
I	Enzyme Immunoassays: Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting. Enzyme immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology.	12
II	Molecular methods in clinical microbiology: Applications of PCR, RFLP, RAPD, RFCP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology.	11
III	Laboratory tests in chemotherapy: Susceptibility tests: micro-dilution and macro-dilution broth procedures. Susceptibility tests: Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests.	12
IV	Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Anti-idiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno florescence. Radioimmunoassay. Model Preparation- (Epitope design)	13
V	Application of Molecular Diagnosis in Oncology, Forensic, Paternity, Transplantation and infectious diseases. Regulatory and ethical issues in Molecular testing, Performance of basic techniques used in molecular techniques. Field Visit and Presentation of Report	12
	Total	60
Model Preparation & Field Visit – related to the above topic are to be considered for internal exam only		

Text / Reference Books:

- ❖ Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
Bioinstrumentation, Webster.
- ❖ Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic.
- ❖ Ananthanarayan R and Paniker CKJ. (2005). Textbook of microbiology. 7th edition
(edited by Paniker CKJ). University Press Publication.
- ❖ Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's
medical microbiology. 4th edition. McGraw Hill Publication.
- ❖ Goering R, Dockrell H, Zuckerman m and Wakelin D. (2007). Mims' medical microbiology.
4th edition. Elsevier.
- ❖ Willey Jm, Sherwood Lm, and Woolverton CJ. (2008). Prescott, Harley and Klein's
microbiology
7th edition. Mc Graw Hill Higher Education.
- ❖ Microscopic Techniques in Biotechnology, Michael Hoppert

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	3	3	3	2	2	3
CO2	3	2	2	3	3	3	3	2	3	3
CO3	3	2	2	3	3	3	3	2	3	3
CO4	3	2	2	3	3	3	3	2	3	3
CO5	3	2	3	3	3	3	3	2	3	3

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	1
CO2	3	2	3	2	1
CO3	3	2	3	3	2
CO4	3	1	3	2	2
CO5	2	1	2	2	3
Weightage	14	8	14	11	9
Weighted percentage of Course Contribution to Pos	2.8	1.6	2.8	2.2	1.5

Course Coordinator**BOS Chairman**

SKILL ENHANCEMENT COURSE - II BASICS OF FORENSIC SCIENCE

Subject Code	Major	Category	L	T	P	Hours	Credit
24S3UMBS03	SEC - II	Theory	Y	Y	-	1	1

Learning Objectives

- ❖ To provide in depth knowledge of forensic science, it's disciplines and importance and working in forensic science laboratory.
- ❖ The basic principle of DNA analysis and forensic significance of DNA typing.
- ❖ The importance of short tandem repeats and restriction fragment length polymorphism in DNA technique.
- ❖ Role of DNA typing in parentage testing.
- ❖ Significance of forensic documentation.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Able to understand about the basics and different target areas for forensic studies	PO4, PO5, PO7, PO9
CO2	Able to understand about the working and functioning of Forensic science laboratories	PO4, PO7, PO9
CO3	Able to incorporate both in silico and lab-based techniques as part of a combined molecular diagnostics strategy	PO5, PO7, PO9
CO4	Explain the importance of molecular diagnostic techniques in diagnosing genetic disorders, human cancer and infectious diseases.	PO7, PO9
CO5	Establish quality assurance principles and practices to ensure the accuracy and reliability of laboratory information.	PO5, PO6, PO7, PO9

SKILL ENHANCEMENT COURSE - II BASICS OF FORENSIC SCIENCE

Unit	Details	No. of Hours
I	Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, Classification of injuries and their medico-legal aspects, method of assessing various types of deaths-natural, artificial, murder, suicide and drowning- determining.	3
II	Basic Principles - DNA as biological blueprint of life - Extraction of DNA for analysis. Quantisation of DNA – yield gel quantisation and slot blot quantisation. Mitochondrial DNA – sequence analysis.	3
III	Forensic DNA Typing - Collection of specimens. Polymerase chain reaction – historical perspective, sequence polymorphisms, individualization of evidence. Short tandem repeats (STR) – role of fluorescent dyes, nature of STR loci - Restriction fragment length polymorphism (RFLP) – genetic markers used in RFLP, typing procedure and interpretation of results - Touch DNA. Model Preparation -Trace DNA Sources.	3
IV	Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification.	3
V	Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security. Power point Presentation-AI in forensic science	3
	Total	15
Model Preparation &Power point Presentation – related to the above topic are to be considered for internal exam only		

Text / Reference Books:

- ❖ Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
- ❖ B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).
- ❖ M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
- ❖ S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
- ❖ W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
- ❖ R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
- ❖ W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene - Investigation, CRC Press, Boca Raton (2013).

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	0	2	3	2	0	1	2	1	0
CO2	3	0	2	2	3	2	0	2	1	1
CO3	3	0	2	2	3	2	0	2	0	2
CO4	3	0	3	2	3	1	0	2	2	1
CO5	3	2	1	1	3	0	1	1	1	2

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	1
CO2	3	3	2	2	1
CO3	3	2	3	3	2
CO4	3	1	3	2	2
CO5	2	1	2	2	3
Weightage	14	9	12	11	9
Weighted percentage of Course Contribution to Pos	2.8	1.8	2.4	2.2	1.8

Course Coordinator**BOS Chairman**

SEC - III ALGAL TECHNOLOGY

Subject Code	Major	Category	L	T	P	Hours	Credit
24S3UMBS04	SEC - III	Theory	Y	-	-	2	2

Learning Objectives

- ❖ To impart sufficient information about the economic value of algae
- ❖ To study the multiple technique on algae cultivation.
- ❖ To know about the seaweed liquid fertilizers.
- ❖ Understand the techniques involved in the algal production system
- ❖ To study about the genetics of algae

Course Outcomes		
Course Outcomes	On completion of this course, students will	
CO1	Obtain an in-depth knowledge on economic importance of algae.	PO1, PO2, PO3, PO4, PO5, PO7, PO9
CO2	Understand the applied facet of botany and acquire a complete knowledge about the cultivation methods in algae.	PO4, PO7, PO9
CO3	Understand the preparation of seaweed liquid fertilizers and their applications in agriculture and horticulture.	PO5, PO7, PO9, PO10
CO4	Realization of the commercial potential of algal products.	PO7, PO9, PO8, PO10
CO5	Gain more information about algal genetics.	PO5, PO6, PO7, PO9

SEC - III ALGAL TECHNOLOGY

Unit	Details	No. of Hours
I	Scope of algal technology – Commercial potential and utility of algae. Classification and Types of Algae. Algae as sources for food, feed, pigments, Pharmaceuticals and nutraceuticals, fine chemicals, fuel, Biofertilizer and hormones. Economic importance of algae in India.	6
II	Algal production systems; Strain selection; Algal growth curve; Culture media; cultivation methods – small scale and Large-scale cultivation of algae. Harvesting and packing.	6
III	Industrial application of algae - fuel, algal lipids - transesterification to ester fuel - substitutes for petroleum derived fuel. Algal products - Spirulina mass cultivation and its applications. Mass cultivation of micro-algae as source of protein and as feed. Biofertilizers - method of preparation, applications and its advantages over inorganic fertilizers. Model Preparation- Spirulina.	6
IV	Algal immobilization and its applications - culturing for metabolite production and natural compounds. Methods of immobilization - alginate beads-extraction of compounds. Recombinant DNA technology in algae	6
V	Role of algae in environmental health - Sewage treatment, treating industrial effluent, Phycoremediation- heavy metal removal, algae as indicators in assessing water quality and pollution; Saprobic index; Algal culture collection centers in India. Power point Presentation- Role of algae Carbon sequestration.	6
	Total	30

Text Book(s)

- ❖ Sharma, O.P, 2011. Algae. McGraw Hill Education (India) Private Limited. ISBN: 0070681945.
- ❖ Suganya, T. and Renganathan, S. 2015. Biodiesel production using algal technology. Academic Press. ISBN: 0128009713.
- ❖ Trivedi, P.C. 2001. Algal Biotechnology. Pointer publishers, Jaipur, India.
- ❖ Venkataraman, L.V. and Becker, E.W. 1985. Biotechnology and Utilization of Algae – The Indian Experience. Dept. Science and Technology, New Delhi and Central Food Research Institute, Mysore, India.

Reference Books

- ❖ Faizal, B. and Yusuf, C. 2016. Algal biotechnology: Products and processes. Springer. ISBN: 3319123335.
- ❖ Bajpai, Rakesh K., Prokop, Ales, Zappi, Mark E. 2014. Algal Biorefineries Volume 1: Cultivation of Cells and Products. Springer. ISBN: 9400774931.
- ❖ Barsanti, Laura. and Paolo, Gualtieri. 2005. Algae-Anatomy, Biochemistry and Biotechnology. Taylor & Francis, London, New York.
- ❖ Becker, E.W. 1994. Microalgae-Biotechnology and microbiology. Cambridge University Press

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	3	3	3	2	2	3
CO2	3	2	2	3	3	3	3	2	3	3
CO3	3	2	2	3	3	3	3	3	2	3
CO4	3	2	2	2	3	3	3	3	2	3
CO5	3	2	2	3	2	3	2	2	3	3

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	1
CO2	3	2	3	2	1
CO3	2	2	3	2	1
CO4	3	1	2	3	2
CO5	3	2	2	2	1
Weightage	14	9	12	11	6
Weighted percentage of Course Contribution to Pos	2.8	1.8	2.4	2.2	1.2

Course Coordinator

BOS Chairman

SEMESTER IV

CORE –IV IMMUNOLOGY AND IMMUNOTECHNOLOGY

Subject Code	Major	Category	L	T	P	Hours	Credit
24S4UMB04	CORE –IV	Theory	Y	-	-	5	5

Learning Objectives

- ❖ To gain knowledge about immune system, organs of immunity and cells involved.
- ❖ To distinguish the types of antigens and antibodies; their properties.
- ❖ To provide in-depth knowledge on immuno-techniques.
- ❖ To discuss the role of MHC system in transplantation; functions of Tumor specific antigens.
- ❖ To impart knowledge on immunological disorders.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Assess the fundamental concepts of immunity, contributions of the organs and cells in immune responses.	PO1, PO4, PO6, PO9
CO2	Investigate the structures of Ag and Ab; Immunization.	PO1, PO4, PO5, PO7
CO3	Justify the Immunoassay and Immuno techniques.	PO1, PO4, PO5, PO6 PO4,
CO4	Explain about the immunologic processes governing graft rejection and therapeutic modalities for immuno suppression in Transplantation	PO7,PO9
CO5	Analyze the overreaction by our immune system leading to hypersensitive conditions and its consequences.	PO5, PO6, PO7,PO9

CORE –IV IMMUNOLOGY AND IMMUNOTECHNOLOGY

Unit	Details	No. of Hours
I	Organs and Cells in Immune System and Immune Response: Primary lymphoid organs, secondary lymphoid organs, and lymphoid tissues; T – cell and B –cell membrane bound receptors – apoptosis; T - cell processing, presentation and regulation; T –cell subpopulation, properties, functions and T – cell suppression; Physiology of immune response- innate, humoral and cell mediated immunity; Immunohematology.	15
II	Antigen and Antibody: Antigens - Properties of haptens, epitopes, adjuvants, and cross reactivity; Antibodies- structure, properties, classes; Antigen and Antibody Reactions: precipitation, agglutination, complement fixation, opsonization, neutralization; Vaccines – active and passive immunization; Classification of vaccines; Other approaches to new vaccines; Types of vaccine - antibacterial, antiviral; Vaccination schedule.	15
III	Immunoassay and Immunotechniques - Preparation and standardization of bacterial antigens; Raising of monoclonal and polyclonal antibodies; Purification of antibodies. Immunotechniques - WIDAL,RIA, RAST, ELISA, Immuno fluorescence techniques and Flow cytometry.	15
IV	Transplantation and Tumor Immunology - MHC Antigens - structure and function; HLA system - Regulation and response to immune system; Transplantation immunology - tissue transplantation and grafting; Mechanism of graft acceptance and rejection; HLA typing; Tumor specific antigens; Immune response to tumors; Immune diagnosis; cancer immune therapy. Model Preparation -(Tumour Cell).	15
V	Immunological disorders and diseases - Hypersensitivity reactions (Type I, II, III and IV); acquired immunodeficiency syndrome; Auto immune disorders and diseases: organ specific and non- organ specific. Power point Presentation - Gene therapy for Auto immune diseases	15
	Total	75
Model Preparation &Power point Presentation – related to the above topic are to be considered for internal exam only		

Text Books

- ❖ Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5th Edition., Wiley-Blackwell, New York.
- ❖ Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7th Edition. W. H. Freeman and Company, New York.
- ❖ Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. (2021). Cellular and Molecular Immunology, 10th Edition. Elsevier.
- ❖ Robert R. Rich, Thomas A. Fleisher, William T. Shearer, Harry Schroeder, Anthony J. Frew, Cornelia M. Weyand. (2018). Clinical Immunology: Principles and Practice, 5th Edition. Elsevier.
- ❖ Pravash Sen. Gupta. (2003). Clinical Immunology. Oxford University Press.

References Books

- ❖ Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
- ❖ Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11th Edition. Wiley-Blackwell.
- ❖ William R Clark. (1991). the Experimental Foundations of Modern Immunology. 3rd Edition. John Wiley and Sons Inc. New York.
- ❖ Frank C. Hay, Olwyn M. R. Westwood. (2002). Practical Immunology, 4th Edition, Wiley-Blackwell.
- ❖ Noel R. Rose, Herman Friedman, John L. Fahey. (1986). Manual of Clinical Laboratory Immunology. ASM. 3rd Edition.

Web Resources

- ❖ https://www.researchgate.net/publication/275045725_Practical_Immunology-_A_Laboratory_Manual.
- ❖ <https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf>.
- ❖ https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC106J-lab-manual.pdf.
- ❖ Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov).
- ❖ Immunology - an overview | Science Direct Topics.

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	3	2	3	2	1	2	2
CO2	3	2	2	3	2	3	2	1	2	2
CO3	3	2	2	3	2	3	3	2	3	2
CO4	3	2	3	3	3	3	2	1	2	2
CO5	3	2	3	3	3	3	2	1	2	2

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	0
CO2	3	2	2	1	1
CO3	2	1	3	2	1
CO4	2	1	2	3	2
CO5	2	1	2	2	2
Weightage	12	7	11	9	4
Weighted percentage of Course Contribution to Pos	2.4	1.4	2.2	1.8	1.2

Course Coordinator**BOS Chairman**

CORE PRACTICAL –IV IMMUNOLOGY AND IMMUNOTECHNOLOGY

Subject Code	Major	Category	L	T	P	Hours	Credit
24S4UMBP04	CORE –IV	Practical	-	-	Y	5	5

Learning Objectives

- ❖ To gain hands-on knowledge to identify Blood group and typing.
- ❖ To acquire adequate skill to perform latex agglutination reactions.
- ❖ To analyze precipitation reactions in gels.
- ❖ To investigate the antigen & antibody reactions in electrophoresis.
- ❖ To familiarize with Separation of Lymphocytes.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Assess the blood groups and types	PO1,PO5, PO6, PO7, PO8
CO2	Competently perform serological diagnostic tests such as RF, ASO, CRP	PO4, PO5, PO6, PO7, PO8
CO3	Illustrate the antigen antibody reactions in gel.	PO5, PO6, PO7, PO8, PO9
CO4	Compare & contrast antigens and antibodies in Electrophoresis	PO5, PO6, PO7, PO8, PO9
CO5	Examine the concept of ELISA.	PO5, PO6, PO7, PO8, PO9

CORE –IV IMMUNOLOGY AND IMMUNOTECHNOLOGY

Unit	Details	No .of Hours
I	Identification of blood group and typing. Coomb's test. TPHA	15
II	T cell identification Latex Agglutination reactions- RF, ASO, CRP,WIDAL Slide.	15
III	Ouchterlony's Double Diffusion Method (antigen pattern). Single Radial Immuno Diffusion Method.	15
IV	Electrophoresis - Serum, Counter and Immuno.	15
V	Separation of Lymphocytes by gradient centrifugation method. ELISA: Hepatitis/ HIV .	15
Total		75

Text Books

- Talwar. (2006). Hand Book of Practical and Clinical Immunology, Vol. I, 2nd edition, CBS.
- ❖ Asim Kumar Roy. (2019). Immunology Theory and Practical, Kalyani Publications.
 - ❖ Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5th Edition., Wiley-Blackwell, New York.
 - ❖ Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7th Edition., W. H. Freeman and Company, New York.
 - ❖ Pravash Sen. Gupta. (2003). Clinical Immunology. Oxford University Press.

References Books

- ❖ Frank C. Hay, Olwyn M. R. Westwood. (2008). Practical Immunology, 4th Edition, Wiley-Blackwell.
- ❖ Wilmore Webley. (2016). Immunology Lab Manual, LAD Custom Publishing.
- ❖ Rose. (1992). Manual of Clinical Lab Immunology, ASM.
- ❖ Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
- ❖ Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11th Edition., Wiley-Blackwell.

Web Resources

- ❖ https://www.researchgate.net/publication/275045725_Practical_Immunology-_A_Laboratory_Manual
- ❖ <https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf>
- ❖ https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC106J-lab-manual.pdf
- ❖ Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)
- ❖ Immunology - an overview | Science Direct Topics

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	3	3	3	2	1	2	2
CO2	3	2	2	3	3	3	3	1	3	2
CO3	3	2	2	3	2	3	3	1	3	2
CO4	3	2	2	3	2	3	3	1	3	2
CO5	3	2	2	3	3	3	3	2	3	2

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	0
CO2	3	3	3	2	1
CO3	3	2	3	2	1
CO4	3	2	2	2	1
CO5	3	1	3	2	1
Weightage	15	10	13	9	4
Weighted percentage of Course Contribution to Pos	3.0	2.0	2.6	1.8	0.8

Course Coordinator**BOS Chairman**

ELECTIVE –IV CLINICAL LABORATORY TECHNOLOGY

Subject Code	Major	Category	L	T	P	Hours	Credit
24S4UMBE04	ELECTIVE –IV	Theory	Y	-	-	4	3

Learning Objectives

- ❖ Demonstrate ethical and professional conduct with patients, laboratory personnel, health-care professionals, and the public.
- ❖ To acquire adequate skill to perform latex agglutination reactions.
- ❖ Explain how accurate and reliable information might be obtained about proper procurement, storage and handling of laboratory specimens.
- ❖ Develop a sound scientific knowledge foundation and perform a full range of laboratory tests with accuracy and precision.
- ❖ Establish quality assurance principles and practices to ensure the accuracy and reliability of laboratory information.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Describe characteristics of laboratory organizations and demonstrate professionalism by displaying professional conduct, model ethical behavior and operate as a vital member of the medical lab team.	PO3,PO5, PO10
CO2	Accurately collect specimens for various purposes. Determine appropriate tests based on test request, Maintain standard and CO2 transmission-based precautions,	PO5, PO6, PO10
CO3	Identify the basic structure of cells, tissues and organs and describe their contribution to normal function.	PO6, PO8, PO9, PO10
CO4	Recognize the pathologies behind benign and malignant disorders of erythrocytes, leucocytes, thrombocytes and familiar with the diagnosis, evaluation, and management of hematologic malignancies.	PO5, PO6, PO9,PO10
CO5	Interpret, implement, and complying with laws, regulations and accrediting standards and guidelines of relevant governmental and non-governmental agencies.	PO1, PO7, PO10

ELECTIVE –IV CLINICAL LABORATORY TECHNOLOGY

Unit	Details	No. of Hours
I	Introduction to Clinical Laboratory Science: Basic laboratory principles - Code of conduct for medical laboratory personnel -Organization of clinical laboratory and role of medical laboratory technician - Safety measures. Assessment of a patient and brief history of collection.	12
II	Specimen collection and processing - Blood, urine, stool, sputum, CSF, amniotic fluid and bile. Separation of serum and plasma, Handling of specimens for testing, preservation of specimens, transport of specimens and factors affecting the clinical results.	12
III	Introduction to histopathology-Methods of examination of tissues and cells, Fixation of tissues: Classification and properties of fixatives. Tissue processing - Collection of specimens, Labeling and fixation, Dehydration, Clearing, Impregnation, Embedding – Paraffin block making, Section Cutting, Microtomes – types and mounting of sections. Model Preparation -Types of Tissues	12
IV	Introduction to Haematology- Laboratory methods used in the investigation of coagulation disorders - coagulation tests, Routine IV coagulation tests, Laboratory diagnosis of bleeding disorders. Estimation of fibrinogen, Assay of coagulation factors.	12
V	Quality Standards in Healthcare Laboratories – Development and Quality Standards in Healthcare Laboratories – Development and implementation of standards, Accreditation Boards –NABL, ISO, CAP, COLA, Performing quality assessment - pre-analytical, and post-analytical phases of testing. Power point Presentation - Quality Standards in Health Laboratories	12
Total		60
Model Preparation &Power point Presentation – related to the above topic are to be considered for internal exam only		

Text Books

- ❖ Mukharji,K.L. (2000).Medical Laboratory Techniques, Vol - I, II & III, 5 th Edition. Tata McGrawHill, Delhi.
- ❖ Ochei,A., Kolhatkar.A. (2000).Medical Laboratory Science: Theory and Practice, McGraw Hill Education.
- ❖ RamnikSood (2015).Concise Book of Medical Laboratory Technology:Methods and Interpretation, 2 nd Edition, Jaypee Brothers Medical Publishers, NewDelhi.
- ❖ 4. vS. Ramakrishnan, KN Sulochana (2012). Manual of Medical Laboratory .Techniques, Jaypee Brothers Medical Publishers Pvt. Ltd.
- ❖ Talib V.H. (2019).Handbook Medical Laboratory Technology,2 nd Edition, Directorate of health services, Government of India.

References Books

- ❖ Rutherford, B.H. Gradwohl , A.C. Sonnenwirth L. Jarett. Gradwohls. (2000). Clinical Laboratory Methods and Diagnosis, Vol-I, 8th edition, Mosby.
- ❖ Baker, F.J., Silverton, R.E., and Pallister,.J. (1998). An Introduction to Medical Laboratory Technology, 7 th Edition, CBS Publishers and Distributors Pvt. Ltd.
- ❖ Godkar (2021).Textbook of Medical Laboratory Technology, 3 rd Edition, Bhalani Publishing House.
- ❖ M.N.Chatterjee and RanaShinde.(2008). Textbook of Medical Biochemistry, 7 th Edition, Jaypee Brothers Medical Publishers Pvt. Limited
- ❖ James G Cappucino. and Natalie Sherman. (2016). Microbiology – A laboratory manual. (5 th Edition). The Benjamin publishing company. New York.

Web Resources

- ❖ 1 <https://www.jaypeedigital.com> › book
- ❖ 2 <https://www.pdfdrive.com> › wintrobcs-clinical-hematology
- ❖ 3 <https://currentprotocols.onlinelibrary.wiley.com/doi/pdf/10.1002/cpet.5>
- ❖ 4 <https://vlab.amrita.edu/index.php?sub=3&brch=272>
- ❖ 5 <https://nptel.ac.in/courses/102105087>

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	2	3	1	2	2
CO2	3	2	3	3	3	3	3	1	2	2
CO3	3	2	2	3	2	3	2	1	2	2
CO4	3	2	2	3	3	3	3	1	3	2
CO5	3	2	3	3	3	3	3	2	2	3

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	2	3
CO2	3	3	2	2	2
CO3	3	3	2	1	1
CO4	3	2	3	2	1
CO5	2	1	1	2	3
Weightage	14	11	9	9	10
Weighted percentage of Course Contribution to Pos	2.8	2.2	1.8	1.8	2

Course Coordinator**BOS Chairman**

SEC –IV VACCINE TECHNOLOGY

Subject Code	Major	Category	L	T	P	Hours	Credit
24S4UMBS05	Skill Enhancement Course SEC -IV	Theory	Y	-	-	2	2

Learning Objectives

- ❖ To provide knowledge on the basics of immunization and induction of immunity.
- ❖ To learn the types of vaccines, its immunological effects and regulatory guidelines
- ❖ To learn the role of rDNA in vaccine technology.
- ❖ To provide the knowledge on conventional to recent technology of vaccine production
- ❖ To learn about ethical issues and regulations in vaccine production and clinical trials

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Explain the significance of critical antigens, immunogens and adjuvants in developing effective vaccines.	PO1,PO10
CO2	Understand the types of vaccines.	PO5
CO3	Construct vaccine applying rDNA technology.	PO7,PO10
CO4	Formulate the strategies for developing an innovative vaccine.	PO9,PO10
CO5	Evaluate the regulatory issues and guidelines for the management.	PO3,PO5

SEC –IV VACCINE TECHNOLOGY

Unit	Details	No.of Hours
I	History of vaccination, Active and passive immunization; requirements for induction of immunity, Epitopes, linear and conformational epitopes, characterization and location of APC,MHC and immunogenicity.	6
II	Vaccine technology- Role and properties of adjuvants, recombinant Vaccine, rDNA and protein-based vaccines production, plant-based vaccines, reverse vaccinology ; Peptide vaccines, conjugate vaccines. Recent advances in Malaria, Tuberculosis, HIV. Model Preparation-HIV	6
III	Fundamental research to rational vaccine design. Antigen identification and delivery, T-Cell expression cloning for identification of Vaccine targets for intracellular pathogens, Rationale vaccine design based on clinical requirements: Scope of future vaccine strategies.	6
IV	Vaccine additives and manufacturing residuals, Regulation and testing of vaccines, Regulation of vaccines in developing countries, Quality control and regulations in vaccine research.	6
V	Animal testing, Rational design to clinical trials, Large scale production- Bacterial and animal cell lines.Commercialization. Vaccine safety ethics and Legal issues. Power point Presentation-Rabies Vaccine manufacturing	6
Total		30
Model Preparation &Power point Presentation – related to the above topic are to be considered for internal exam only		

Text Books

- ❖ Ronald W. Ellis.(2001). New Vaccine Technologies Landes Bioscience.
- ❖ Cheryl Barton. (2009). Advances in Vaccine Technology and Delivery. Espicom Business Intelligence.
- ❖ Male, David. Ed. (2007). Immunology. 7th Edition. Mosby Publication.
- ❖ Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne. (2002). Immunology. 6th Edition, Freeman.
- ❖ Brostoff J, Seaddin JK, Male D, Roitt IM. (2002). Clinical Immunology. 6th Edition, Gower Medical Publishing.

References Books

- ❖ Stanley A. Plotkin, Walter Orenstein & Paul A. Offit. (2013). Vaccines, 6th Edition. BMA Medical Book Awards Highly Commended in Public Health. Elsevier Publication.
- ❖ Coico, R. et al. (2003). Immunology: A Short Course. 5th Edition, Wiley – Liss.
- ❖ Parham, Peter. (2005). The Immune System. 2nd Edition, Garland Science.
- ❖ Abbas, A.K. et al. (2007). The Cellular and Molecular Immunology. 6th Edition, Sanders / Elsevier.
- ❖ Weir, D.M. and Stewart, John (2000). Immunology. 8th Edition, Churchill Pvt. Ltd.

Web Resources

- ❖ <https://www.slideshare.net/adammmbbs/pathogenesis-3-rd-internal-updated-43458567>
- ❖ <https://www.bio.fiocruz.br/en/images/stories/pdfs/mpti/2013/selecao/vaccine-processtechnology.pdf>
- ❖ https://www.dcvmn.org/IMG/pdf/ge_healthcare_dcvmn_introduction_to_pd_for_vaccine_production_29256323aa_10mar2017.pdf
- ❖ https://www.researchgate.net/publication/313470959_Vaccine_Scaleup_and_Manufacturing

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	3	3	3	2	1	3	2
CO2	3	2	2	3	3	3	2	1	2	2
CO3	3	2	2	3	3	3	3	2	3	2
CO4	3	3	2	3	3	3	3	3	3	2
CO5	3	2	3	3	3	3	2	2	2	3

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	1
CO2	3	2	2	1	1
CO3	3	1	3	2	2
CO4	3	1	3	3	2
CO5	2	1	2	2	3
Weightage	14	7	12	10	9
Weighted percentage of Course Contribution to Pos	2.8	1.4	2.4	2	1.8

Course Coordinator

BOS Chairman

SEC –V BASICS OF MEDICAL CODING AND DISEASE MANAGEMENT

Subject Code	Major	Category	L	T	P	Hours	Credit
24S4UMBS06	Skill Enhancement Course SEC -5	Theory	Y	-	-	2	2

Learning Objectives

- ❖ To understand the language of healthcare, including anatomy, physiology, and common medical conditions.
- ❖ To learn how to apply ICD-10, CPT, and HCPCS codes.
- ❖ To understand the Health Insurance Portability and Accountability Act (HIPAA).
- ❖ To understand the molecular mechanisms involved in different microbial diseases.
- ❖ To gain the knowledge in different sources of human diseases and the strategies used to treat/control these diseases.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understanding the language of healthcare, including anatomy, physiology, and common medical conditions. .	PO1,PO10
CO2	Learning how to apply ICD-10, CPT, and HCPCS codes	PO5
CO3	Understanding the Health Insurance Portability and Accountability Act (HIPAA)	PO7,PO10
CO4	Understanding the molecular mechanisms involved in different microbial diseases	PO9,PO10
CO5	Learning role of different micro-organisms causing human diseases and the strategies used to treat/control these diseases	PO3,PO5

SEC –V BASICS OF MEDICAL CODING AND DISEASE MANAGEMENT

Unit	Details	No. of Hours
I	Language of Medicine – (Medical terminology, Anatomy, physiology, Pathology, Lab techniques, etc.).	6
II	ICD-10 CM Coding Conventions, General Coding and Chapter specific Guidelines. Introduction of CPT and HCPCS coding.	6
III	HIPAA Training (Health Insurance Portability and Accountability Act), Health information technology, Patient's Rights under HIPAA.	6
IV	Infectious and non-infectious diseases, microbial and non-microbial diseases, Deficiency diseases, occupational diseases, Incubation period, mortality-morbidity rate, nosocomial infections. Model Preparation- Deficiency diseases.	6
V	General preventive measures, Importance of personal hygiene, environmental sanitation and methods to prevent the spread of infectious agents transmitted by direct contact, food, water and insect vectors. Vaccines: Importance, vaccination schedule (compulsory and preventive) in the Indian context. Power point Presentation- General preventive measures to prevent the spread of infectious agents.	6
Total		30
Model Preparation & Power point Presentation – related to the above topic are to be considered for internal exam only		

Text / Reference Books:

- ❖ Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication.
- ❖ Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.
- ❖ Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier.
- ❖ Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education.
- ❖ Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	3	3	2	1	2	2
CO2	3	2	2	3	3	3	3	2	2	2
CO3	3	2	3	2	3	2	2	1	2	2
CO4	3	2	2	3	3	3	3	1	3	2
CO5	3	2	2	3	3	3	3	1	3	2

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	1
CO2	2	3	2	1	1
CO3	1	3	1	1	2
CO4	3	2	3	2	1
CO5	3	2	3	2	1
Weightage	12	12	11	7	6
Weighted percentage of Course Contribution to Pos	2.4	2.4	2.2	1.4	1.v2

Course Coordinator**BOS Chairman**

GENERIC ELECTIVE IV – FUNDAMENTALS OF MICROBIOLOGY

Subject Code	Subject	Category	L	T	P	Hours	Credit
24S4UMBA01	Generic Elective	Theory	Y	-	-	3	3

Learning Objectives

- ❖ To understand the basic structure of microorganism such as bacteria, viruses, algae fungi and phage.
- ❖ To have a brief knowledge about the nutrition requirements and growth curve of bacteria and also to understand the various methods to control the Microbes.

Course Outcomes		
Course Outcomes	On completion of this course, students will able to	Programme Outcomes
CO1	Understand the History of Microbiology	PO1,PO2, PO9
CO2	Know the bionomical nomenclature of microbes	PO1,PO2, PO9
CO3	Understand the basic structure and morphology of various classes of microbes	PO1,PO2, PO9
CO4	Understand multiplication of various microbes will be acquired	PO1,PO2, PO9
CO5	Solve the problems in microbial infection and their control	PO1,PO2, PO9

GENERIC ELECTIVE IV – FUNDAMENTALS OF MICROBIOLOGY

Unit	Details	No. of Hours
I	History of Microbiology: History and scope of Microbiology, Contribution of Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch , Joseph lister, Edward Jenner,Alexandar flemming, contribution of Indian scientists in the field of microbiology.	9
II	Classification of Microbiology: Bionomial nomenclature of Microbes, Classification five Kingdom concept – Eight Kingdom Concept, Haeckel's three kingdom concept. Model Preparation: Prokaryotic cell morphology	9
III	Bacteria & Fungi: Structure of prokaryotic cell morphology and structure - Bacteria Fungi: Classification of fungi, Study of Yeasts – morphology, reproduction and industrial application.	9
IV	Virus: Structure (general morphology, nucleic acids, capsid and envelope), characteristics and Classification of viruses based on genetic material, host and capsid material. Bacteriophages and phage study, Multiplication of bacteriophages; lytic cycle, lysogenic cycle. PPT Preparation: Lytic and lysogenic cycle	9
V	Control of Sterilization: Control of microbial growth by sterilization & Disinfection- Disinfection methods: Physical, Chemical methods – Antiseptics, Antimicrobial agents-Antibacterial antifungal and antiviral agents with examples.	9
	Total	45

Text books

- ❖ Michael J. Pelezar, J.R.E.C.S Chan, Noel R. Erieg,2005, “Microbiology “ TATA McGraw Hill, 5thEdition
- ❖ Anantha Narayan, C.K. JayaramPaniker, 2009, “Text Book of Microbiology” Orient Blackswan, 7th. Edition
- ❖ Joanne Willey, 2010. Prescott.s Microbiology, eighth edition, McGraw Hill, Newyork.

Reference books

- ❖ Jacquelyn and G.Black (2000) Microbiology :Principles and Explorations (7 th Ed) wiley.
- ❖ John Webster Roland Weber.(2007) Introduction to fungi Cambridge University Press,

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	2	2	1	1	1	3	0
CO2	3	1	2	2	2	1	1	1	3	0
CO3	3	1	2	2	2	1	1	1	3	0
CO4	3	1	2	2	2	1	1	1	3	0
CO5	3	1	2	2	2	1	1	1	3	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
Weightage	12	12	12	12	12
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

SEMESTER V

THIRD YEAR - SEMESTER V
CORE –V BACTERIOLOGY AND MYCOLOGY

Subject Code	Major	Category	L	T	P	Hours	Credit
24S5UMB05	Core-V	Theory	Y	Y	-	5	4

Learning Objectives

- ❖ Understand the role of normal flora and pathogenic microbes of various diseases and clinical microbiological techniques.
- ❖ Basic knowledge about Gram positive pathogenic bacteria and their epidemiology.
- ❖ Acquire knowledge about Gram negative pathogenic bacteria and nosocomial Infections.
- ❖ Comprehensive knowledge about medically important, its classification and its
- ❖ Significance. Gain knowledge about the general characteristics and mode of action of various Antibacterial agents.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the importance of normal flora of human body and acquire knowledge on the process of infectious disease.	PO1, PO3, PO5, PO7, PO10, PO11
CO2	Explain the various bacterial pathological events during the progression of an infectious disease, and apply the underlying mechanisms of spread of disease and its control.	PO1, PO3, PO5, PO7, PO10, PO11
CO3	Compile a list of disease-causing bacteria and compare their modes of infection, symptoms, diagnosis and treatment.	PO1, PO3, PO5, PO7, PO10, PO11
CO4	Comprehend human-fungal interaction, which can be applied to obtain in-depth knowledge on fungal diseases and the mechanism behind the disease process.	PO1, PO3, PO5, PO7, PO10, PO11
CO5	Explain the types of mycoses caused in humans and categorize the modes of infection, pathogenesis, and treatment with introduction to mycotoxins.	PO1, PO3, PO4, PO5, PO6, PO7, PO9, PO10

CORE –V BACTERIOLOGY AND MYCOLOGY

Unit	Details	No. of Hours
I	History, Classification of and their infections, Koch's, and River's postulates- A brief account on the normal microbial flora of the healthy human body – Host-pathogen interactions: Definitions of infection, invasion, primary and opportunistic pathogens, pathogenicity, virulence, toxigenicity, carriers, and epidemiology – putative virulence factors of human pathogens –infectious disease cycle. Collection and transport of clinical specimens for bacterial and fungal infections.	15
II	Medically important Gram Positive infections - Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases (a) Streptococcal infections (<i>Streptococcus pyogenes</i> , <i>Streptococcus faecalis</i>), (b) Staphylococcal infections (<i>Staphylococcus aureus</i>), (c) Tetanus (<i>Clostridium tetani</i>) (d) Diphtheria (<i>Corynebacterium diphtheriae</i>) (e) Anthrax (<i>Bacillus anthracis</i>) (f) Tuberculosis (<i>Mycobacterium tuberculosis</i>), (g) Leprosy (<i>Mycobacterium leprae</i>).	15
III	Medically important Gram-Negative infections – Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention, and treatment of the following bacterial diseases (a) Meningitis (<i>Streptococcus pneumoniae</i> , <i>Neisseria meningitidis</i>) (b) typhoid (<i>Salmonella typhi</i> , <i>Salmonella paratyphi</i>) (c) cholera (<i>Vibrio cholerae</i>) (d) bacillary dysentery (<i>Shigelladysenteriae</i>); Sexually Transmitted disease (syphilis– <i>Treponemapallidum</i> . <i>Gonorrhoea</i> - <i>Neisseria gonorrhoeae</i>); Nosocomial infections – definition, importance, and their control (<i>Pseudomonas aeruginosa</i>), Arthropods disease – (<i>Rickettsiae</i>), Waterborne disease –(<i>Leptospira</i>).	15
IV	Medically important Fungi - Classification of medically importantfungi; Superficial mycoses: <i>Pityriasis Versicolor</i> ; <i>Tinea Nigra</i> ; <i>Piedra</i> . Cutaneous mycoses: <i>Microsporum</i> sps., <i>Trichophyton</i> sps., and <i>Epidermophyton floccosum</i> . Subcutaneous mycoses: <i>Chromoblastomycosis</i> ; <i>Sporotrichosis</i> ; Systemic Mycoses - <i>Blastomycosis</i> ; <i>Histoplasmosis</i> ; Opportunistic Infections – <i>Aspegillois</i> ; <i>Candidiasis</i> ; <i>Cryptococcosis</i> ; <i>Zygomycosis</i> ; Mycotoxins: Aflatoxin.	15
V	. Antimicrobial agents -General characteristics and mode of action of Antibacterial agents: Modes of action with an example for each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin.	15
	Total	75
Model Preparation &Power point Presentation – related to the above topic are to be considered for internal exam only		

Text Books

- ❖ Greenwood, D., Slack, R.B. and Peutherer, J.F. (2012) Medical Microbiology, 18th Edition. Churchill Livingstone, London.
- ❖ Finegold, S.M. (2000) Diagnostic Microbiology, 10th Edition. C.V. Mosby Company, St. Louis.
- ❖ Ananthanarayanan, R. and JayaramPanicker C.K. (2020) Text book of Microbiology. Orient Longman, Hyderabad.
- ❖ Jagdish Chander (2018). Textbook of Medical Mycology, 4th edition, Jaypee brothers medical publishers.

References Books

- ❖ Kevin Kavanagh, (2018). Fungi Biology and Applications 3rd Edition. Wiley Blackwell publishers.
- ❖ A.J. Salle (2007). Fundamental principles of bacteriology, fourth edition, Tata McGraw-Hill Publications.
- ❖ Christopher C. Kibbler, Richard Barton, Neil A. R. Gow, Susan Howell, Donna M. MacCallum, Rohini J. Manuel (2017). Oxford Textbook of Medical Mycology. Oxford University Press.

Web Resources

- ❖ <http://textbookofbacteriology.net/nd>
- ❖ <https://microbiologysociety.org/members-outreach-resources/links.html>
- ❖ <https://www.isham.org/mycology-resources/mycological-links>.

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	2	1	3	1	1	2	1	3
CO2	2	1	2	2	3	2	1	2	1	3
CO3	2	1	2	2	3	1	1	2	1	3
CO4	2	1	1	1	3	1	1	2	1	2
CO5	2	1	1	1	3	1	1	2	1	2

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

CORE –VI VIROLOGY AND PARASITOLOGY

Subject Code	Major	Category	L	T	P	Hours	Credit
24S5UMB06	Core - VI	Theory	Y	Y	-	5	4

Learning Objectives

- ❖ To gain knowledge on properties and classification of viruses and collection of relevant clinical samples for diagnosing viral infections.
- ❖ To understand pathogenic microorganisms of viruses and the mechanisms by which they cause disease in the human body.
- ❖ To gain knowledge about reemerging viral infections and develop diagnostic skills, including the use and interpretation of laboratory test in the diagnosis of infectious diseases.
- ❖ Understand the types of parasites causing infections in the intestine.
- ❖ To develop skills in the diagnosis of parasitic infections.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the structure and properties of viruses, cultivation methods and diagnosis of viral diseases.	PO5,PO10
CO2	Knowledge of basic and general concepts of causation of disease by the pathogenic microorganisms and various parameters of assessment of their severity and the methods of diagnosis.	PO5,PO10
CO3	Insights to treatment options of viral diseases.	PO5,PO10
CO4	Knowledge about the importance of protozoan's in the intestine.	PO5,PO10
CO5	Knowledge of Nematodes as infectious agent.	PO5,PO10

CORE –VI VIROLOGY AND PARASITOLOGY

Unit	Details	No. of Hours
I	Introduction and General Properties, replication and Classification of viruses (Baltimore classification), Cultivation of viruses- in animals, embryonated eggs and tissue culture, Virus purification assays - collection and transport of clinical specimens for viral infections.	15
II	RNA Viral diseases - symptoms, pathogenesis, transmission, diagnosis, prophylaxis and control – Arboviruses (Flavi virus), Picorna viruses (Polio virus and Rhinovirus), Hepatitis viruses (HAV, HBV, HCV, HDV, HEV), Rabies virus, Orthomyoviruses (Influenza virus) and Paramyxoviruses (Mumps and Measles virus), Impact and consciousness of Emerging and re-emerging viral infections (SARS, Swine flu, Ebola, Dengue, Chikungunya- and Corona).	15
III	DNA Viral diseases - symptoms, pathogenesis, transmission, diagnosis, prophylaxis and control - Pox viruses (Variola and Vaccinia), Herpes viruses (Herpes simplex and Varicella zoster), Adeno viruses, Rota viruses and HIV viruses. Oncogenic viruses (Human Papilloma virus): Introduction, characteristics of transformed cells, mechanism of viral oncogenesis and clinical manifestations. Detection of viruses in clinical specimens – Serological and Molecular diagnosis of virus infections – Antiviral agents, Interferons and Viral Vaccines, Immunization schedules.	15
IV	General introduction to Medical Parasitology, Classification of medically important parasites. Morphology, life cycle, pathogenesis, clinical features, laboratory diagnosis, prevention and treatment of diseases caused by the following organisms: <i>Entameoba histolytica</i> , <i>flagellates (Giardia lamblia, Leishmaniadonovani)</i> , <i>Sporozoa-Plasmodium</i> spps.	15
V	Introduction to Helminthes, Platyhelminthes – Type of tapeworm (<i>Taenia solium</i> , <i>Taenia saginata</i>) – Fasciola –Paragonimus – <i>Schistosomas</i> spps. Nematelminthes – Ascaris– <i>Ankylostoma</i> – <i>Enterobius</i> – <i>Trichuris</i> – <i>Trichinella</i> – <i>Wuchereria</i> – <i>Dracanculus</i> . Collection, transport and examination of specimen Laboratory techniques in parasitology Examination of faeces for ova and cyst by direct wet mount and iodine wet mount, Concentration methods (Floatation and Sedimentation techniques), Examination of blood for parasites. Cultivation of parasites.	15
	Total	75

Text Books

- ❖ S., Rajan(2007). Medical microbiology, MJP publisher.
- ❖ JeyaramPaniker, C.K. (2006). Text Book of Parasitology Jay Pee Brothers, New Delhi.
- ❖ Arora D.R. and Arora B. (2002). Medical Parasitology, 1st Edition CBS Publishers & Distributors, New Delhi.
- ❖ Chatterjee (1986). Medical Parasitology. Tata McGraw Hill, Calcutta
- ❖ Parija S. C. (1996). Text Book of Medical Parasitology. 4th edition, Orient Longman, All India Publishers & Distributors.

References Books

- ❖ Jawetz, E., Melnick, J.L. and Adelberg, E.A. (2000). Review of Medical Microbiology, 19th Edition. Lange Medical Publications, U.S.A.
- ❖ Ananthanarayan, R. and JeyaramPaniker, C.K. (2009). Text Book of Microbiology, 8th Edition. Orient Longman, Chennai.
- ❖ Conrat HF, Kimball PC and Levy JA. (1988). Virology. II edition. Prentice Hall, Englewood Cliff, New Jersey.
- ❖ Topley & Wilson's (1990). Principles of Bacteriology, Virology and Immunity, 8th Edition, Vol. III Bacterial Diseases, Edward Arnold, London.
- ❖ Finegold, S.M. (2000). Diagnostic Microbiology, 10th Edition. C.V. Mosby Company, St. Louis.

Web Resources

- ❖ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4047123/>
- ❖ <https://www.ncbi.nlm.nih.gov/pubmed/21722309>
- ❖ <https://www.sciencedirect.com/science/article/pii/S2211753919300193>
- ❖ <https://cmr.asm.org/content/30/3/811>
- ❖ <https://www.nejm.org/doi/full/10.1056/NEJMoa1811400>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 - Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	1	2	1	3	1	2
CO2	3	1	3	2	2	2	1	3	1	1
CO3	3	2	3	3	2	3	1	3	1	2
CO4	3	1	2	2	2	1	1	3	1	1
CO5	3	2	2	3	2	3	1	3	1	2

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

CORE PRACTICAL - V

Subject Code	Major	Category	L	T	P	Hours	Credit
24S5UMBP05	Practical V	Practical	-	-	Y	5	4

Learning Objectives

- ❖ To familiarize students with medical microbiology techniques and technical knowledge on collection and processing of clinical samples.
- ❖ To learn the techniques for isolation and identification of bacterial pathogens.
- ❖ To gain expertise in various techniques of clinically important viral pathogens and their identification.
- ❖ To get acquainted with medically important fungi and their metabolism.
- ❖ To categorize parasites and understand their role in infections.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Demonstrate methods to observe and measure microorganisms by standard microbiological techniques.	PO4, PO5, PO7.
CO2	Identify pathogenic microorganisms in the laboratory set-up and interpret their sensitivity towards commonly administered antibiotics.	PO4, PO5, PO7, PO8.
CO3	Understand experimental tools used to cultivate and characterize clinically important viruses and Bacteriophages.	PO4, PO5, PO7, PO8.
CO4	Elucidate clinically important fungi.	PO4, PO5, PO7, PO8.
CO5	Investigate Parasites of medical importance and identify them from clinical specimens.	PO4, PO5, PO7, PO8.

CORE PRACTICAL – V

Unit	Details	No. of Hours
I	1. Collection and Transport of Clinical specimens. 2. Simple, Differential and Special staining of Clinical materials. 3. Culture techniques used to isolate microorganisms.	15
II	4. Identification of bacterial pathogens by their biochemical reactions. 5. Antimicrobial susceptibility testing by disc-diffusion technique and determination of Minimum Inhibitory Concentration.	15
III	6. Isolation of Bacteriophages from Sewage and other natural sources. 7. Identification of Viruses in Slides/Smears/Spotters. Demonstration of Negri bodies (Staining). 8. Cultivation of Viruses in Embryonated eggs – Amniotic, Allantoic, Yolk sac routes and Chorio-allantoic membrane.	15
IV	9. Microscopic identification of medically important Fungi – KOH and Lactophenol cotton Blue staining. 10. Slide culture techniques for fungal Identification 11. Identification of Dermatophytes. 12. Germ tube test, Carbohydrate fermentation and assimilation tests for Yeasts.	15
V	13. Direct Examination of Faeces – wet mount and Iodine mount – Demonstration of Protozoan cysts and Helminthes eggs. 14. Concentration techniques of stool specimen – Floatation and Sedimentation methods. 15. Examination of blood for Malarial parasites – thin and thick smear preparations. 16. Identification of Medically important parasites in slides / specimens as spotters.	15
	Total	75

Text / Reference Books:

- ❖ Dubey, R.C. and Maheswari, D.K. (2020). S. Chand Publishers. ISBN-13: 9788121921534, ISBN-10: 8121921538.
- ❖ K.R. Aneja (2017). Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology. 5th Edition. New Age International Publishers. ISBN-10: 9386418304, ISBN-13: 978-9386418302.
- ❖ Prince CP (2009). Practical Manual of Medical Microbiology, 1st edition, Jaypee digital publishing.
- ❖ James H. Jorgensen, Karen C. Carroll, Guido Funke, Michael A. Pfaller, Marie Louise Landry, Sandra S. Richter, David W. Warnock (2015). Manual of Clinical Microbiology, 11th Edition, ASM press.

Reference Books

- ❖ Patricia M. Tille (2021). Bailey & Scott's Diagnostic Microbiology, 15th Edition. Elsevier. ISBN-10: 0323681050, ISBN-13: 978-0323681056.
- ❖ Monica Cheesbrough (2006). District Laboratory Practice in Tropical Countries. Part 1. 2nd Edition. Cambridge University Press. ISBN-10: 0521171571, ISBN-13: 9780521171571.
- ❖ Michael A. Pfaller (ed.) (2015). Manual of Clinical Microbiology. Vol. 1 and 2. 11th Edition. ASM Press. ISBN-10: 9781555817374, ISBN-13: 978-1555817374.
- ❖ Josephine A. Morello, Paul A. Granato and Helen EckelMizer (2002). Laboratory Manual and Workbook in Microbiology. 7th Edition. The McGraw Hill Company. ISBN: 0-07246354-6.
- ❖ Rowland, S.S., Walsh, S.R., Teel, L.D. and Carnahan, A.M. ((1994). Pathogenic and Clinical Microbiology: A Laboratory Manual. Lippincott Williams & Wilkins. ISBN-10: 0316760498, ISBN-13: 9780316760492.

Web Resources

- ❖ <https://www.microcarelab.in/media/microcarelab.in/files/Sample-Collection-Manual.pdf>
- ❖ http://ssu.ac.ir/cms/fileadmin/user_upload/Daneshkadaha/pezeshki/microb/file_amuzeshi/Lab_QA_Microbiology_QA.pdf.
- ❖ https://www.academia.edu/11977315/Basic_Laboratory_Procedures_in_Clinical_Bacteriology.
- ❖ <https://cmr.asm.org/content/31/3/e00062-17.full.pdf>
- ❖ <https://microbiologyinfo.com/techniques-of-virus-cultivation/>

Mapping with Programme Outcomes: 3 Strong, 2 – Medium, 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	0	0	2	0	0	2	3	2	2
CO2	0	0	0	3	0	0	2	2	2	0
CO3	0	0	0	3	0	0	3	3	2	2
CO4	0	0	0	3	0	0	3	2	2	0
CO5	0	0	0	3	0	0	3	2	2	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Coordinator

BOS Chairman

ELECTIVE V – RECOMBINANT DNA TECHNOLOGY

Subject Code	Major	Category	L	T	P	Hours	Credit
24S5UMBE05	Elective- V	Theory	Y	Y	-	4	3

Learning Objectives

- ❖ Understand the principles of rDNA technology.
- ❖ Illustrate the molecular tools employed in gene cloning.
- ❖ Discuss the importance of various molecular techniques and importance in Biotechnology.
- ❖ Acquire knowledge about the concepts of tissue culture methods and transgenic organisms.
- ❖ Examine recent trends in genetic engineering and its application in human welfare.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	Programme Outcomes
CO1	Illustrate the steps involved in introduction and expression of foreign DNA into bacteria, animal and plants cells and their screening.	PO4, PO6, PO7, PO9
CO2	Discuss the various cloning vectors and their applications.	PO4, PO6, PO7, PO9
CO3	Assess the usage and advantages of molecular tools.	PO4, PO6, PO7, PO9
CO4	Explain plant and animal tissue culture protocols and gene transfer mechanism.	PO4, PO6, PO7, PO9
CO5	Elucidate and understand the application of genetic engineering and gene therapy.	PO4, PO6, PO7, PO9

ELECTIVE V – RECOMBINANT DNA TECHNOLOGY

Unit	Details	No. of Hours
I	Milestones in rDNA Technology- Gene Manipulation- Steps involved in Gene Cloning. Isolation of Chromosomal and Plasmid DNA. Restriction endonuclease - Discovery, Types, Mode of action- Application of Ligase, DNA Polymerase, DNA Modifying enzymes and Topoisomerases. Use of Linkers and Adapters.	12
II	Artificial Gene Transfer methods- Calcium Chloride Induction, Electroporation, Microinjection, Biolistic method, Liposome and Viral-mediated delivery. Cloning vectors – Properties and Applications - Plasmid Based Vectors- Natural Vectors-pSC101 and pMB1. Artificial Vectors- pBR322 and pUC. Phage Based Vectors- Lambda phage. Hybrid Vectors, Phagemid, Cosmid, BAC and YAC. Screening of Recombinants. Genomic DNA and cDNA library- Construction and Screening.	12
III	Molecular Tools- PCR- Types. Gel Electrophoresis- AGE and PAGE Blotting Techniques- Southern, Western & Northern. DNA sequencing methods- Sanger's and Automated method. Recent Trends in Genetic Engineering- Targeted Genome Editing- ZFNs, TALENs, CRISPR/CAS9. Gene Targeting- Knock-in & Knock-outs. DNA Finger Printing.	12
IV	Plant Biotechnology – Media, Growth Regulators and Equipment for Plant Tissue Culture- Explant Culture- Micropropagation- Callus and Protoplast Culture- Production of Bio-Active Secondary Metabolites by Plant Tissue Culture - Agrobacterium and Crown Gall Tumors, Ti Plasmid and Ri Plasmid- Animal Biotechnology- Principles of Animal Cell Culture, Media and Equipment for Animal Cell Culture – Primary and Secondary Cultures- Cell Lines- Types, Establishment and Maintenance of Cell Lines.	12
V	Applications of Genetic Engineering - Transgenic Animals – Mice and Sheep- Recombinant Cytokines and their use in the Treatment of Animal infections- Monoclonal Antibodies in Therapy- Vaccines and their Applications in Animal Infections - Human Gene Therapy- Germline and Somatic Cell Therapy- Ex- vivo Gene Therapy- SCID (Severe Combined Immuno Deficiency) – In-vivo Gene Therapy- CFTR (Cystic Fibrosis Trans membrane Regulator) – Vectors in Gene Therapy- Viral and Non- Viral Vectors. Transgenic Plants– Bt Cotton, Bt Corn, Round Ready soybean, FlavrSavr Tomato and Golden Rice.	12
	Total	60

Text Books:

- ❖ Brown T.A. (2016). Gene Cloning and DNA Analysis. 7th Edition . John Wiley and Jones, Ltd.
- ❖ Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. 3rd Edition. John Wileys and Sons Ltd.
- ❖ Keya Chaudhuri (2013). Recombinant DNA technology. The Energy and Resources Institute.
- ❖ Siddra Ijaz, Imran UlHaq (2019). Recombinant DNA Technology. Cambridge Scholars Publishing.
- ❖ Monika Jain (2012). Recombinant DNA Techniques: A Textbook, I Edition, Alpha Science International Ltd.

References Books

- ❖ Maloy S. R., Cronan J.E. Jr. and Freifelder D.(2011). Microbial Genetics. 2nd Edition. Narosa Publishing Home Pvt Ltd.
- ❖ Glick B. R. and Patten C.L.(2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press.
- ❖ Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition. Pearson New International Edition.
- ❖ Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4th Edition. ASM Press Washington-D.C. ASM Press.
- ❖ James D.Watson, Michael Gilman, Jan Witkowski, Mark Zoller (1992). Recombinant

Web Resources

- ❖ <https://www.britannica.com/recombinant-DNA-technology>
- ❖ <https://www.byjus.com/recombinant-dna-technology>
- ❖ <https://www..rpi.edu>
- ❖ <https://www..ncbi.nlm.nih.gov>
- ❖ <https://www.le.ac.uk/recombinant-dna-and-genetic-techniques>
- ❖ DNA. Scientific American Books

Mapping with Programme Outcomes: 3Strong, 2–Medium, 1–Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	0	0	0	3	3	0	0	0	0
CO2	3	3	0	2	3	3	0	0	3	0
CO3	0	0	0	2	3	3	0	0	0	0
CO4	3	0	0	3	3	2	0	0	0	0
CO5	3	0	0	0	3	3	0	0	0	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of CourseContributiontoPOs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

CORE ELECTIVE - VI BIOSAFETY AND BIOETHICS

Subject Code	Major	Category	L	T	P	Hours	Credit
24S5UMBE06	Core Elective-VI	Theory	Y	Y	-	4	3

Learning Objectives

- ❖ To create a research environment - encourage investigation, analysis and studying the bioethical principles, values, concepts, and social and juridical implications contained in the Universal Declaration on Bioethics and Human.
- ❖ Rights in order to assist their application and promotion in the areas of science, biotechnology and medicine.
- ❖ To discuss about various aspects of biosafety regulations, IPR and bioethics concerns arising from the commercialization of biotech products.
- ❖ To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
- ❖ To understand the importance of IPR, Patents and Patent laws.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	Programme Outcomes
CO1	Understand the control measures of laboratory hazards (chemical, biological and physical) and to practice safety strategies and personal protective equipment.	PO1, PO2, PO3, PO7, PO10
CO2	Develop stratagems for the use of genetically modified organisms and Hazardous materials.	PO1, PO3, PO4
CO3	Develop skills of critical ethical analysis of contemporary moral problems in medicine and health care.	PO1, PO6
CO4	Analyze and respond to the comments of other students regarding philosophical issues.	PO3, PO4
CO5	Pave the way for the students to catch up Intellectual Property(IP) as a career option a. R&D IP Counsel b. Government Jobs – Patent Examiner c. Private Job's d. Patent agent and Trademark agent. e. Entrepreneur.	PO1, PO7, PO10

CORE ELECTIVE - VI BIOSAFETY AND BIOETHICS

Unit	Details	No. of Hours
I	Basics of Biosafety - Laboratory Hazards and Hazard symbols. Definitions on Biohazard, Biosafety and Biosecurity- Biohazard- LAI, BP. Biohazard classification. Biological Risk Groups. Need and application of biosafety. Good Laboratory Practices (GLP), Good Manufacturing Practices (GMP).	12
II	Hazardous materials in Biotechnology - Categories of Waste in the Biotechnology Laboratories, Biohazardous waste and their disposal and treatments- issues in use of GMO's, risk for animal/human/ agriculture and environment owing to GMO. Hazardous materials, Emergency response/ first aids in Laboratories.	12
III	Biological Safety Containment in Laboratory - Primary and secondary containments - Physical and biological containment. Types of biosafety containments (level I, II, III), PPE, Biosafety guidelines in India - Roles of Institutional Biosafety Committee, Review Committee on Genetic Manipulation (RCGM), Genetic Engineering Appraisal Committee (GEAC).	12
IV	Introduction and need of Bioethics - its relationship with other branches, Ethical implications of biotechnological products and techniques. Ethical Issues involving human cloning, human genome project, prenatal diagnosis, agriculture and animal rights, Social and ethical implications of biological weapons.	12
V	Types and importance of IPR, Patents and Patent laws - Intellectual property rights-TRIP- GATT International conventions patents, Methods of application of patents, Legal implications. Biodiversity and farmer rights, Objectives of the patent system, Basic principles and general requirements of patent law, Biotechnological inventions, and patent law. Legal development-Patentable subjects and protection in biotechnology. The patenting of living organisms.	12
	Total	60

Text / Reference Books:

- ❖ Usharani .B, S Anbazhagi, C K Vidya, (2019). Biosafety in Microbiological Laboratories- 1st Edition, Notion Press, ISBN-105151505511.
- ❖ Satheesh.M.K.,(2009). Bioethics and Biosafety- 1st Edition, J. K International Publishing House Pvt. Ltd: Delhi, ISBN :9788190675703.
- ❖ DeepaGoel and ShominiParashar, (2013). IPR, Biosaftey and Bioethics- 1st Edition, Pearson education: Chennai, ISBN-13: 978-8131774700.
- ❖ Rajmohan Joshi (2006). Biosafety and Bioethics. Gyan Books publisher.
- ❖ Sateesh. M.K. (2013). Bioethics and Biosafety. i.K. International pvt,Ltd.

Reference Books

- ❖ Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management, India, IN: Cengage Learning India Private Limited, ISBN-10: 2751115109.
- ❖ Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights, India, IN: PHI learning Private Limited, ISBN: 9788120349896.
- ❖ Ahuja, V K. (2017). Law relating to Intellectual Property Rights, India, IN: Lexis Nexis, ISBN-10: 8131251659.
- ❖ Edited by Sylvia Uzochukwu, Nwadiuto (Diuto) Esiobu, Arinze Stanley Okoli, Emeka Godfrey Nwoba, Ezebuiro Nwagbo Christpeace, Charles Oluwaseun Adetunji, Abdulrazak B. Ibrahim, Benjamin Ewa Ubi (2022). Biosafety and Bioethics in Biotechnology-Policy, Advocacy, and Capacity Building,1st edition. CRC Press.
- ❖ Sree Krishna. V (2007). Bioethics and Biosafety in Biotechnology. New age international publishers.

Web Resources

- ❖ <http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf>.
- ❖ https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf.
- ❖ <https://www..niehs.nih.gov/bioethics>.
- ❖ <https://www.sist.sathyabama.ac.in>.
- ❖ <https://www.longdom.org/bioethics-and-biosafety>.

Mapping with Programme Outcomes: 3Strong, 2–Medium, 1–Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	0	0	0	3	3	0	0	0	0
CO2	3	3	0	2	3	3	0	0	3	0
CO3	0	0	0	2	3	3	0	0	0	0
CO4	3	0	0	3	3	2	0	0	0	0
CO5	3	0	0	0	3	3	0	0	0	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs			3.0	3.0	3.0

Course Coordinator**BOS Chairman**

SEMESTER VI

SEMESTER VI**CORE –VII ENVIRONMENTAL AND AGRICULTURE MICROBIOLOGY**

Subject Code	Major	Category	L	T	P	Hours	Credit
24S6UMB07	Core-VII	Theory	Y	Y	-	6	4

Learning Objectives

- ❖ To discuss the distribution and association of microorganism in various ecosystems and to know about the role of microorganism in water pollution and water quality.
- ❖ To acquire knowledge about the role of microorganism in water pollution and water quality.
- ❖ Gain knowledge about microbes as biofertilizers and the aspects of application.
- ❖ To learn about the process of solid waste management and sewage water treatment.
- ❖ Gain knowledge on various plant diseases and pathogens.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	Programme Outcomes
CO1	Describe about the structure and function of ecosystems and understand the role of microbes in various environments.	PO1
CO2	Identify the cause of water pollution, and perform methods to assess the quality of water.	PO4,PO5,PO6, PO7, PO8
CO3	Explain about waste treatment process and microbial decomposition and bio-remediation process	PO6
CO4	Explain the production of biofertilizers and biopesticides	PO1, PO7,PO8 PO6
CO5	Describe about plant diseases caused by microbes and acquire a clear idea on plant pathogenic interaction.	PO1, PO5

CORE –VII ENVIRONMENTAL AND AGRICULTURE MICROBIOLOGY

Unit	Details	No. of Hours
I	Microorganisms and their Habitats: Structure and function of ecosystems Terrestrial Environment: Soil profile and soil microflora, Microbial succession in decomposition of soil organic matter. Role of microorganisms in elemental cycles in nature: Carbon, Nitrogen. Aquatic Environment: Microflora of fresh water and marine habitats, factors influencing microbial growth in the aquatic environments. Atmosphere: Aeromicroflora and dispersal of microbes, Assessment of air quality, Enumeration of microorganism in air, Air sanitation. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Predisposing factors for Environmental diseases – infectious (water and air borne) and pollution related, spread and control of these diseases.	18
II	Water potability: Sources and types of water surface, ground, stored, distilled, mineral and de-mineralized water and their pollution, biological indicators of water Pollution, Eutrophication. Conventional Bacteriological standards of Water Quality, MPN index, coliform test, Membrane filtration. BOD, COD. Advanced molecular methods for water analysis. Water borne diseases. Central Pollution Control Board (CPCB) standards.	18
III	Waste treatment and bioremediation: Need and scope of bioremediation - Types and bioaugmentation. Solid waste management - Sources and types of solid waste, composting, vermi composting, production of biogas. Liquid waste management: Primary, secondary, and tertiary sewage treatment. Degradation of hydrocarbons, oil spills, heavy metals – Chromium, lead, and xenobiotics – PCB.	18
IV	Microbial Interactions: Rhizosphere microflora. Concepts of Nitrogen fixation – Symbiotic and asymbiotic nitrogen fixers. Brief account of microbial interactions: Symbiosis, neutralism, commensalism, competition, Ammensalism, Synergism, parasitism, and predation. General account and Significance of Biofertilizers– Bacterial, cyanobacterial, VAM. Mass production of Rhizobialbiofertilizer.	18
V	Plant pathology and bio control agents: Mode of entry of pathogens, Microbial enzymes, toxins, growth regulators and suppressor of plant defense in plant diseases. Plant defence mechanisms. Bacterial diseases – Citrus canker, Blight of paddy. Viral disease – TMV, CMV. Fungal disease- red rot of sugarcane, Tikka disease. Plant disease management. Biocontrol agents – Bacterial (Bacillus thuringiensis), viral (Baculoviruses), fungal (Trichoderma).	18
	Total	90

Text Books

- ❖ Joseph C. Daniel. (2006). Environmental aspects of Microbiology 2nd Edition. BrightSun Publications.
- ❖ Pradipta. K.M. (2008). Textbook of Environmental Microbiology. I.K. Publishing. House.
- ❖ Ramanathan, and Muthukaruppan SM. (2005). Environmental Microbiology. OmSakthi Pathipagam, Annamalai Nagar.
- ❖ K. Vijaya Ramesh. (2004). Environmental Microbiology. 1st Edition. MJP Publishers.
- ❖ Subba Rao. N.S. (2017). Soil Microbiology. 4th Edition. Oxford and IBH Publishing Pvt. Ltd.

References Books

- ❖ Dirk, J. Elsas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology, Marcel Dekker INC, New York, Hong Kong.
- ❖ EcEldowney S, Hardman D.J., Waite D.J., Waite S. (1993). Pollution: Ecology and Biotreatment – Longman Scientific Technical.
- ❖ Mitchel, R. (1992). Environmental Microbiology. Wiley – John Wiley and Sons. Inc. Publications, New York.
- ❖ Clescri, L.S., Greenberg, A.E. and Eaton, A.D. (1998). Standard Methods for Examination of Water and Wastewater, 20th Edition. American Public Health Association.
- ❖ Atlas, R.M. and Bartha, R. (1992). Microbial Ecology: Fundamentals and Applications, 2nd Edition. The Benjamin / Cummings Publishing Co., Redwood City, CA.

Web Resources

- ❖ <https://nptel.ac.in/courses/126105016>
- ❖ <https://www.classcentral.com/course/swayam-plant-pathology-and-soil-health-14236>
- ❖ <https://www.wasteonline.org.uk/resources/InformationSheets/WasteDisposal.htm>
- ❖ https://plantpath.cornell.edu/labs/enelson/PDFs/Hill_et_al_2000.pdf
- ❖ <https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2389.2005.00781.x>

Mapping with Programme Outcomes: 3Strong, 2–Medium, 1–Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	0	0	0	3	0	3	0	0	0
CO2	3	3	0	0	0	0	0	0	0	0
CO3	0	0	0	0	0	0	3	3	0	3
CO4	3	0	0	0	3	0	0	0	0	0
CO5	0	0	0	0	3	0	3	3	0	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

CORE –VIII FOOD, DAIRY AND PROBIOTIC MICROBIOLOGY

Subject Code	Major	Category	L	T	P	Hours	Credit
24S6UMB08	CORE –VIII	Theory	Y	Y	-	6	4

Learning Objectives

- ❖ To impart current knowledge of basic and applied microbiological aspects of fluid milks and dairy products for improved quality and food safety.
- ❖ Gives an insight into various types of food borne diseases and their prevention.
- ❖ To gain information about micro flora of milk.
- ❖ To study about the production of fermented dairy products.
- ❖ To impart current knowledge of probiotics, prebiotics and functional dairy foods for the health benefits.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	Programme Outcomes
CO1	Gain knowledge about food as a substrate for various microbes, Understand about the principles and application of different types of food spoilage and preservation technique,	PO7,PO8, PO10
CO2	Acquire a thorough understanding of food borne diseases, testing methods, and preventive technique	PO5,PO10
CO3	Learn about the various fermented product and its various stage spoilage	PO7,PO8, PO10
CO4	Gain information about spoilage of milk and its products and its antimicrobial properties	PO5,PO7
CO5	Impart current knowledge of probiotics, prebiotics and functional dairy foods for the health benefits	PO5,PO6

CORE –VIII FOOD, DAIRY AND PROBIOTIC MICROBIOLOGY

Unit	Details	No. of Hours
I	Food as a substrate for microorganisms - Microorganisms important in food microbiology; Molds, yeasts and bacteria -General Characteristics - Classification and importance. Principles of food preservation - Asepsis - Removal of microorganisms, - High temperature - Low temperature – Pasteurization -Drying - Food additives. Nanoscience in food preservation; microencapsulation.	18
II	Contamination and spoilage of food products -Food borne infections (<i>Bacillus cereus</i> , Salmonellosis, Shigellosis, <i>Listeria monocytogenes</i> and <i>Campylobacter jejuni</i>) and intoxications – (<i>Staphylococcus aureus</i> , <i>Clostridium botulinum</i> , <i>Clostridium perfringens</i> and mycotoxins) Food borne disease outbreaks - newly emerging pathogens. Conventional and Novel technology in control of food borne pathogens and preventive measures - Food sanitation- plant sanitation -Employees’ health standards. Regulatory Agencies & criteria for food safety. Food safety standards- HACCP and FSSAI.	20
III	Food fermentations: Indian Pickles, Bread, vinegar, fermented vegetables (sauerkraut), fermented dairy products (yoghurt, cheese, Acidophilus Milk, Kefir, Koumiss). Oriental fermented foods- Miso –Tempeh Ontjom. Natto, Idli. Spoilage and defects of fermented dairy products -. Functional fermented foods and nutraceuticals, bioactive proteins and bioactive peptides, genetically modified foods.	18
IV	Microflora of raw milk - sources of contamination. Spoilage and preservation of milk and milk products. -antimicrobial systems in raw milk. Importance of biofilms, their role in transmission of pathogens in dairy products and preventive strategies.	14
V	Probiotic microorganisms, concept, definition safety of probiotic microorganisms, legal status of probiotics Characteristics of Probiotics for selection: stability maintenance of probiotic. Microorganisms. Role of probiotics in health and disease: Mechanism of probiotics. Application of bacteriocins in foods. Bio preservation. Prebiotics: concept, definition, criteria, types and sources of prebiotics, prebiotics and gut microflora - Prebiotics and health benefits: mineral absorption, immune response, cancer prevention, elderly health and infant health, prebiotics in foods. Pre- Pro- Post and Symbiotic.	20
Total		90

Text Books

- ❖ Frazier WC and West off DC. (2017). Food microbiology. 5th Edition TATA McGraw Hill Publishing Company Ltd. New Delhi.
- ❖ Adams, M.R., Moss, M.O.(2018). Food Microbiology 1st edition. New Age Publishers by New Age International (P) Ltd., Publishers.
- ❖ R.C. Dubey. (2014). Advanced Biotechnology. S. Chand publishers.
- ❖ Banwart GJ. (1989). Basic food microbiology, Chapman & Hall, New York.
- ❖ Sugumar D. (1997). Outlines of dairy technology, Oxford University press. 1997.

References Books

- ❖ Jay JM, Loessner MJ and Golden DA.(2005). Modern Food Microbiology. 7th Edition CBS Publishers and Distributors, Delhi, India.
- ❖ Prescott, Harley and Klein Wim.(2008). Microbiology, 7th Edition McGraw Hill Publications.
- ❖ Robinson, R. K.(2002). Dairy Microbiology Handbook - The Microbiology of Milk and Milk Products (Third Edition), A John Wiley & Sons, Inc., New York.
- ❖ Yuankunlee,Sepposalminen. (2008). Handbook of probiotics and prebiotics Second Edition. A John Wiley & Sons publication Inc.
- ❖ DharumauraiDhansekaran, AlwarappanSankaranarayanan. (2021). Advances in Probiotics Microorganisms in Food and Health 1st Edition. eBook ISBN:9780128230916.

Web Resources

- ❖ https://www.researchgate.net/publication/15326559_A_Dynamic_Approach_to_Predicting_BacterialGrowth_in_Food/link/5a1d2e02aca2726120b28eba/download
- ❖ <https://www.fda.gov/food/laboratory-methods-food/bam-foodsamplingpreparation-sample-homogenate>
- ❖ https://www.researchgate.net/publication/243462186_Foodborne_diseases_in_India_A_review
- ❖ https://www.researchgate.net/publication/228662659_Fermented_Dairy_Products_Starter_Cultures_and_Potential_Nutritional_Benefits/link/000084160cf23f86393d5764/download
- ❖ <https://www.fda.gov/food>

Mapping with Programme Outcomes: 3Strong, 2–Medium,1–Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	3	0	0	0	3	0	0	0	3
CO2	0	0	0	2	0	0	0	0	0	3
CO3	0	0	0	3	0	0	0	2	0	0
CO4	0	0	0	0	0	3	0	0	2	0
CO5	0	0	2	0	0	0	0	0	0	2

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

CORE PRACTICAL - VI

Subject Code	Major	Category	L	T	P	Hours	Credit
24S6UMBP06	Practical VI	Practical	-	-	Y	6	4

Learning Objectives

- ❖ To assess the water quality and potability.
- ❖ To acquire knowledge on enumeration of bacteria from milk and milk quality analysis
- ❖ To investigate various extracellular enzyme producers in soil and to gain knowledge on preparation of biofertilizers
- ❖ Improve knowledge on plant pathogens
- ❖ To acquire knowledge on preparation of probiotics and prebiotics

Course Outcomes		
Course Outcomes	On completion of this course, students will;	Programme Outcomes
CO1	Assess the microbial quality of water and relate the experimental results to the prescribed standards by the statutory bodies	PO1, PO4, PO5, PO6, PO7, PO8
CO2	Evaluate the quality of milk and enumerate bacteria in milk by standard plate count method	PO5, PO6, PO7, PO8
CO3	Identify extracellular enzyme producing and nitrogen fixing microorganism from soil and to prepare a biofertilizer.	PO1, PO8
CO4	Identify various plant pathogenic bacteria	PO1
CO5	Synthesize probiotic fermented milks using microorganisms	PO1, PO7, PO8

CORE PRACTICAL – VI

Unit	Details	No. of Hours
I	1. Physical, chemical, and microbiological assessment of water and potability test for water. o Physical – Color, pH, o Chemical - alkalinity, acidity, DO, BOD, COD o Microbiological – MPN index (Presumptive, Confirmatory and Completed test) 2. Study of air microflora by settle plate method and centrifugal air sampler	18
II	3. Isolation and identification of bacteria and fungi from fruits and vegetables 4. Direct microscopic count of milk. 5. Methylene blue reductase test and Resazurin test 6. Microbiological examination of milk by SPC.	18
III	7. Isolation of extracellular enzyme producers –Amylase, protease, lipase 8. Microbiological assay of antibiotics by cup plate method and other methods 9. Isolation of <i>Rhizobium</i> / <i>Azotobacter</i> / phosphate solubilizing organisms 10. Preparation of biofertilizers – Demonstration	18
IV	11. Study of plant pathogens- Tikka Disease, Red rot of sugarcane, Citrus canker, Blight of paddy, wilt disease. 12. Study of fungi - <i>Curvularia</i> , <i>Alternaria</i> , <i>Rhizopus</i> , <i>Aspergillus</i> , <i>Mucor</i> , <i>Penicillium</i> .	18
V	13. Isolation of constituent flora of fermented milk. 14. Growth of probiotic LAB in broth, milk and whey. 15. Preparation of probiotic fermented milks like dahi, yoghurt and whey drink. 16. Effect of prebiotics on the growth of LAB in milk and broth. 17. Survivability of probiotic organisms in fermented milks. 18. Antimicrobial potential of the functional dairy products.	18
	Total	90

Text Books

- ❖ Cappucino J and Sherman N.(2010). Microbiology: A Laboratory Manual. 9th Edition. Pearson Education Limited.
- ❖ Kannan. N. (1996). Laboratory manual in General Microbiology. Palani Publications.
- ❖ R C Dubey and D K Maheswari.(2002). Practical Microbiology. S. Chand Publishing.
- ❖ NeelimaGarg, K.L. Garg, K.G. Mukerji (2010).Laboratory Manual of Food Microbiology, Wiley publication
- ❖ Aneja, KR.(2010). Experiments in Microbiology, Plant pathology and Biotechnology. New Age International (P) Limited.

Reference Books

- ❖ Christon J. Hurst Editor in Chief, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, Linda D. Stetzenbach (2007). Manual of Environmental Microbiology, Third Edition,Wiley publication.
- ❖ James G Cappucino and Natalie Sherman.(2016). Microbiology – A laboratory manual. 4thEdition. The Benjamin publishing company, New York.
- ❖ Marylynn V. Yates, Cindy H. Nakatsu, Robert V. Miller, Suresh D. Pillai 2016). Manual of Environmental Microbiology, 4th Edition,ASM press.
- ❖ Burns, Richard G (2005). Environmental MicrobiologyA Laboratory Manual, 2nd Edition .Lippincott Williams & Wilkins, Inc.
- ❖ Ian Pepper, Charles Gerba, Jeffrey Bredecke (2004). Environmental Microbiology-A laboratory manual, Elsevier.

Web Resources

- ❖ <https://micobenotes.com/fields-of-microbiology/>
- ❖ <https://bio.libretexts.org>
- ❖ <https://www.google.com>
- ❖ <https://www.sfamjournals.onlinelibrary.wiley.com>
- ❖ <https://www.degruyter.com>

Mapping with Programme Outcomes: 3Strong, 2–Medium, 1–Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	0	0	0	0	3	0	0	3	0
CO2	0	0	0	0	0	3	2	0	3	0
CO3	0	0	0	0	0	3	0	0	3	0
CO4	0	0	0	0	0	3	0	0	3	0
CO5	0	0	0	0	0	3	0	0	3	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

ELECTIVE– VII PHARMACEUTICAL MICROBIOLOGY

Subject Code	Major	Category	L	T	P	Hours	Credit
24S6UMBE07	ELECTIVE VII	Theory	Y	Y	-	5	3

Learning Objectives

- ❖ To provide the knowledge on basics of chemotherapy
- ❖ To acquire adequate skill to perform latex agglutination reactions.
- ❖ To gain information about spoilage of pharmaceutical products.
- ❖ To provide the knowledge on drug discovery and clinical trials.
- ❖ To learn about regulations in pharmaceutical industry.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Learn the basics of chemotherapy and action of antibiotics.	PO1, PO10
CO2	Carry out the microbiological assay of antibiotics.	PO7
CO3	Analyze Microbiological standardization of Pharmaceuticals, sterility testing of pharmaceutical products Apply sterilization in pharmaceutical industry.	PO5, PO8, PO10
CO4	Evaluate the process and develop new strategies for rational drug design.	PO9, PO10
CO5	Learn the Regulatory guidelines in pharmaceuticals product.	PO3,PO5

ELECTIVE– VII INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY

Unit	Details	No. of Hours
I	Introduction to Pharmaceutical microbiology: Ecology of microorganisms in pharmaceutical industry: Atmosphere, water, skin and respiratory flora of workers, raw materials, packaging, building and equipment's and their control measures; Design and layout of sterile manufacturing.	15
II	Microbial contamination and spoilage of pharmaceutical products: Microbial aspects of pharmaceutical products; Sterilization of pharmaceutical products: Heat, gaseous, radiation and filtration; Contamination and Spoilage of Pharmaceutical products: sterile injectable and non-injectable, ophthalmologic preparation, implants.	15
III	Production of antibiotics: Production of antibacterial – Penicillin, Tetracycline; antifungal – Griseofulvin, Amphotericin; antiparasitic agents – Artemesin, Metronidazole; Semi-synthetic antibiotics and anticancerous agents; Additional application of microorganisms in pharmaceutical sciences: Enzymes- Streptokinase, Streptodornase, L-asperginase and clinical dextrin; Immobilization procedures for pharmaceutical applications (liposomes); Biosensors in pharmaceuticals.	15
IV	Production of immunological products and their quality control: Vaccines - DNA vaccines, synthetic peptide vaccines, multivalent vaccines; Vaccine clinical trials; Quality control in Pharmaceutical: In – Process and Final Product Control; Sterility tests.	15
V	Quality Assurance and Validation: Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry; Regulatory aspects of quality control; Quality assurance and quality management in pharmaceuticals – BIS (IS), ISI, ISO, WHO and US certification.	15
Total		75

Text Books

- ❖ Chand Pasha Kedernath. (2021). Text book of Pharmaceutical Microbiology. Ramnath Publisher.
- ❖ Hugo WB and Russell AD. (2004).Pharmaceutical Microbiology VII edition. Blackwell Scientific Publication, Oxford.
- ❖ Franklin, DJ. And Snow, GA. (2013). Biochemistry of antimicrobial action. Chapman& Hall.
- ❖ Kuntal Das (2019). Pharmaceutical Microbiology, second edition, Nirali Prakashan.
- ❖ Priyatama Powar, Shital Nimbargi, Vaijayanti Sapre (2020). Pharmaceutical Microbiology, Iedition, Technical publications.

References Books

- ❖ Handa,S.S.andKapoor,V.K.(2022).Pharamcognosy.4thEdition.VallabhPrakashanPublishers, New Delhi.
- ❖ Kokate, C.K., Durohit, A.P. and Gokhale, S.R.,(2002). Pharmacognosy. 12theditionNiraliPrakasham Publishers, Pune.
- ❖ S. P. Vyas & V. K. Dixit.(2003). Pharmaceutical Biotechnology. CBS Publishers &Distributors, New Delhi.
- ❖ Wallis, T.E. (2005). Text book of Pharmacognosy. 5th edition. CBS publishers and distributors, New Delhi.
- ❖ Garrod, L.P., Lambert, HP. And C'Grady, F. (1973). Antibiotics and Chemotherapy. (eds).Churchill Livingstone.

Web Resources

- ❖ <https://www.pharmapproach.com/introduction-to-pharmaceutical-microbiology/>
- ❖ https://www.iptsalipur.org/wp-content/uploads/2020/08/BP303T_PMB_UNIT_I.pdf
- ❖ <https://www.pharmanotes.org/2021/11/pharmaceutical-microbiology-b-pharma.html>
- ❖ https://sncourseware.org/snscphs/notes.php?cw=CW_604b15c6313c5
- ❖ <https://www.thermofisher.com>

Mapping with Programme Outcomes: 3Strong,2–Medium,1–Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	0	0	0	0	3	0	0	3	0
CO2	0	0	0	0	0	3	2	0	3	0
CO3	0	0	0	0	0	3	0	0	3	0
CO4	0	0	0	0	0	3	0	0	3	0
CO5	0	0	0	0	0	3	0	0	3	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

ELECTIVE –VIII ENTREPRENEURSHIP AND BIO-BUSINESS

Subject Code	Major	Category	L	T	P	Hours	Credit
24S6UMBSE08	Elective –VIII	Theory	Y	Y	-	5	3

Learning Objectives

- ❖ Understanding basic concepts in the area of entrepreneurship, the role and importance of entrepreneurship for economic development.
- ❖ Developing personal creativity and entrepreneurial initiative, adopting the key steps in the elaboration of business idea.
- ❖ Understanding the stages of the entrepreneurial process and the resources needed for the successful development of entrepreneurial ventures.
- ❖ Explain the central components of successful business strategies in biotechnology, and create a business plan.
- ❖ Understand the various funding resources and develop as Entrepreneur.

Course Outcomes		
Course Outcomes	On completion of this course, students will	
CO1	Describe and apply several entrepreneurial ideas and business theories in practical framework.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12, PO13, PO14
CO2	Analyse the business environment in order to identify business opportunities, identify the elements of success of entrepreneurial ventures, evaluate the effectiveness of different entrepreneurial strategies and interpret their own business plan.	PO2, PO5, PO7, PO8, PO10, PO12, PO14
CO3	Express the mass production of microbial inoculants used as Biofertilizers and Bioinsecticides in response with field application and crop response.	PO4, PO6, PO9, PO11
CO4	Analyze the application and commercial production of Monoclonal antibodies, Cytokines. TPH and teaching kits.	PO5, PO6, PO9, PO11
CO5	Integrate and apply knowledge of the regulation of biotechnology industries, utilize effective team work skills within an effective management team with a common objective, and gain effective team work skills, with an awareness of cultural diversity and social inclusiveness.	PO2, PO7, PO8

ELECTIVE –VIII ENTREPRENEURSHIP AND BIO-BUSINESS

Unit	Details	No. of Hours
I	Bio Entrepreneurship: Introduction to bio-business, SWOT analysis of bio-business. Ownership, Development of Entrepreneurship; Stages in entrepreneurial process; Government schemes and funding. Small scale industries: Definition; Characteristics; Need and rationale.	15
II	Entrepreneurship Opportunity in Agricultural Biotechnology: Business opportunity, Essential requirement, marketing, strategies, schemes, challenges and scope-with case study on Plant cell and tissue culture technique, polyhouse culture. Herbal bulk drug production, Nutraceuticals, value added herbal products. Bioethanol production using Agricultural waste, Algal source. Integration of system biology for agricultural applications. Biosensor development in Agriculture management.	18
III	Entrepreneurship Opportunity in Industrial Biotechnology: Use of AI biobusiness – Implementation of microorganisms. Integrated compost production- microbe enriched compost. Bio pesticide/ insecticide production. Biofertilizer. Single cell protein.	12
IV	Therapeutic and Fermented products: Stem cell production, stem cell bank, production of monoclonal/polyclonal antibodies, secondary metabolite production – antibiotics, probiotic and prebiotics.	12
V	Project Management, Technology Management and Start-up Schemes: Building Biotech business challenges in Indian context-biotech partners (BIRAC, DBT, Incubation centers. etc.), operational biotech parks in India. Indian Company act for Bio business-schemes and subsidies. Project proposal preparation, Microbial start-ups-case study.	18
Total		75

Text Books

- ❖ Craig Shimasaki. (2014). Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Academic Press
- ❖ Ashton Acton, O. (2012). Biological Pigments– Advances in Research and Application Scholarly Editions: Atlanta, Georgia.
- ❖ Jennifer Merritt, Jason Feifer (2018). Start Your Own Business, 7th edition, Entrepreneur Press publisher.
- ❖ Peter F. Drucker (2006). Innovation and Entrepreneurship. Harper Business publisher.
- ❖ Leah Cannon (2017). How to Start a Life Science Company: A Comprehensive Guide for First-Time Entrepreneurs. International Kindle paperwhite.

References Books

- ❖ Crueger, W and Crueger. A. (2000). Biotechnology: A Text Book Of Industrial microbiology, 2nd Edition, Sinauer Associates: Sunderland. Mass.
- ❖ Paul S Teng. (2008). Bioscience Entrepreneurship in Asia World Scientific Publishing Company.
- ❖ Charles E. Bamford, Garry D. Bruton (2015). Entrepreneurship: The Art, Science, and Process for Success, 2nd Edition, McGraw Hill publisher.
- ❖ Yali Friedman (2014). Building Biotechnology: Biotechnology Business, Regulations, Patents, Law, Policy and Science 4th Edition, Logos press publication.
- ❖ Stephanie A. Wisner (2022). Building Backwards to Biotech: The Power of Entrepreneurship to Drive Cutting-Edge Science to Market, International Kindle paper white.

Web Resources

- ❖ <https://www.bio-rad.com/webroot/web/pdf/lse/literature/Biobusiness.pdf>
- ❖ <https://www.crg.eu/biobusiness-entrepreneurship>
- ❖ <https://www.entrepreneur.com>
- ❖ <https://www.birac.nic.in>
- ❖ <https://www.springer.com>

Mapping with Programme Outcomes: 3Strong, 2–Medium, 1–Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	0	0	0	0	0	3	2	3	2	0
CO2	0	0	0	0	0	3	3	2	3	0
CO3	0	0	0	0	0	2	3	3	2	0
CO4	0	0	0	0	0	3	3	3	3	0
CO5	0	0	0	0	0	3	3	3	3	0

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**

PROFESSIONAL COMPETENCY SKILL
MICROBIAL QUALITY CONTROL AND TESTING

Subject Code	Major	Category	L	T	P	Hours	Credit
24S6UMBPC01	Professional Competency Skill	Theory	Y	Y	-	2	2

Learning Objectives

- ❖ To understand the use of various advanced techniques for application in the field of quality control and quality assurance.
- ❖ To cultivate skills involved execution of microbiological techniques and to develop the good laboratory practices.
- ❖ To ensure the food safety regulations and its standards.
- ❖ To acquire knowledge on laboratory testing, Control & safety process.
- ❖ To analyze microbial standards to establish the quality of food products.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the theoretical assessment of microbial quality methods and its good laboratory practices.	PO1, PO5, PO6, PO9, PO10
CO2	Describe the microbiological aspects of quality control of food and pharmaceutical products.	PO1, PO4, PO5, PO6
CO3	Explain the identification of pathogenic microorganisms and good laboratory practices.	PO1, PO3, PO5, PO6, PO9
CO4	Acquire the knowledge of different sterility test for the pharmaceutical products.	PO1, PO4, PO5, PO6
CO5	Illustrate the safety concern management and regulations of food and pharmaceutical industry and learn the basic standard methods and procedures for the microbiological analysis of food.	PO1, PO3, PO4, PO5, PO6, PO9, PO10

**PROFESSIONAL COMPETENCY SKILL
MICROBIAL QUALITY CONTROL AND TESTING**

Unit	Details	No.of Hours
I	Microbial quality control: definition, history and introduction. Standard Methods involved in assessment of microbial quality control. Q.A and Q.C definitions and importance. Traditional Microbiological Quality Controlling methods: Sampling methods, TVC, APC and serial dilution techniques. Good laboratory practices, Good microbiological practices.	6
II	Instruments associated in QC & QA: Principles involved, working conditions, uses and precautions of Laminar Air Flow (LAF), Autoclave, Incubator, pH meter, Colony counter, Hot air oven, Centrifuges, colorimeter/spectrophotometer, ELISA and storage devices. Methodology of Disinfection, Autoclaving & Incineration.	6
III	Culture media used in QC and QA: Design of specialized media for identification of pathogens. Good laboratory practices in culture media preparation: raw material, water, pH. Uses of media. Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Mannitol salt agar, EMB agar, McConkey Agar, Saboraud Dextrose Agar.	6
IV	Determining Microbes in Pharmaceutical Samples: Sterility testing for pharmaceutical products, Bioburden, pyrogen test, inprocess and final process control, safety and sterility test.	4
V	HACCP for Food Safety and Microbial Standards: Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations. Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water. Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centers.	8
Total		30

Text / Reference Books:

- ❖ W. B. Hugo & A.D. Russell. (1998). Pharmaceutical Microbiology. 6th Edition. Blackwell scientific Publications.
- ❖ Kulkarni A. K. Bewoor V. A. () Quality Control, Wiley India Pvt. Ltd,
- ❖ Chandrakant Kokare (2016). Pharmaceutical Microbiology, 1st Edition, Nirali Publication.
- ❖ Brown. M.R.W. (2017). Microbiological Quality Assurance. A Guide Towards Relevance and Reproducibility of Inocula, 1st Edition. CRC press.
- ❖ Dev Raj Rakesh Sharma And V K Joshi (2011). Quality Control For Value Addition In Food Processing, New India Publishing Agency.

References Books

- ❖ Rosamund M. Baird, Norman A. Hodges, Stephen P. Denyer. (2000). Handbook of Microbiological Quality Control in Pharmaceuticals and Medical Devices. 1st Edition, CRC Press.
- ❖ Konieczka, (2012). Quality Assurance and Quality Control in the Analytical Chemical Laboratory A Practical Approach (Hb), Routledge, Taylor and Francis group.
- ❖ Singh Gajjar, Budhrani, Usman. (2021). Quality Control and Quality Assurance (M.Pharm) S Vikas And Company.
- ❖ David Roesti, Marcel Goverde (2019). Pharmaceutical Microbiological Quality Assurance and Control: Practical Guide for Non-Sterile Manufacturing, Wiley publication.
- ❖ Amihud Kramer Bernard A. Twigg (2017). Quality Control for the Food Industry Fundamentals & Applications (Vol.1) 3rd Edition, MEDTEC publication.

Web Resources

- ❖ <https://www.study.com/microbiology-quality-control-testing-definition-procedures>.
- ❖ <https://www.sigmaaldrich.com>
- ❖ <https://www.coursera.org>
- ❖ <https://www.atcc.org>
- ❖ <https://www.fao.org>

Mapping with Programme Outcomes: 3 Strong, 2 –Medium, 1–Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	0	0	3	0	0	0	0	0	0
CO2	0	0	0	2	0	0	0	0	0	3
CO3	0	0	0	2	0	0	0	0	0	0
CO4	0	0	0	0	0	0	3	0	0	0
CO5	0	0	0	0	0	0	3	3	0	3

Mapping with Programme: Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Coordinator**BOS Chairman**