ST. MARY'S COLLEGE (Autonomous)

(Re-accredited with 'A$^+$' Grade by NAAC)

Thoothukudi-628001, Tamil Nadu

(Affiliated to Manonmaniam Sundaranar University)

Syllabus

B.Sc. Microbiology

School of Biological Sciences

***O**utcome **B**ased **C**urriculum*

(W.e.f.2023)

Preamble

Microbiology is the branch of biology dealing with the structure, function, uses, and modes of existence of microscopic organisms. Microbiology is the study of microorganisms such as bacteria, fungi, algae, protozoa and virus. Microbiology encompasses numerous sub- disciplines including virology, parasitology, mycology and bacteriology.

Vision

To make young women as an effective science personality through experimental scientific education.

Mission

To empower and enrich women with scientific knowledge so that they are skilled to compete in this global sphere of education as an eminent personalities.

Programme Outcome

PO No.	**After completion of the Undergraduate programme the students of St. Mary's College will be able to**
PO 1	acquire an in-depth domain knowledge and a comprehensive knowledge of various disciplines to become skilled professionals
PO 2	enrich their communicative skills, and enhance their creative, numerical, analytical and problem solving skills
PO 3	gain potential skills to excel in digital literacy, team management, scientific reasoning, research and self-directed life-long learning to emerge as entrepreneurs
PO 4	be aware of the environment with a social responsibility for the well-being of humanity and the planet at large
PO 5	be an empowered, economically independent woman with a global perspective to emerge holistically in the egalitarian society

Programme Specific Outcome

PSO No.	Students of B.Sc. Microbiology will be able to
PSO-1	Prepare the students in all disciplines like agriculture, industry, medical, dairy, food and sea food processing, immunologicals, vermitechnology and water treatment for effective and respectful placement.
PSO-2	Create effective entrepreneur by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.
PSO-3	Design and implement microbiological systems that comply with good laboratory practices, following ethical values, leading the organization towards growth and development.
PSO-4	Contribute to the development of society and produce microbiological products, by collaborating with stake holders, related to the betterment of environment and mankind at the national and global level.
PSO-5	Enhancing the practical skill in various fields of microbiology and empowering women through microbiological techniques.

ST. MARY'S COLLEGE (Autonomous) THOOTHUKUDI

Department of Microbiology

UG Course structure (w.e.f. 2023)

Semester I

Part	Components	Course Code	Course Title	Contact Hours / Week	Credits	Max. Marks		
						CIA	ESE	Total
I	Tamil / French	23ULTA11 23ULFA11	,f;fhy ,yf;fpak; : (nra;As;> ,yf;fzk;> ,yf;fpa tuyhW> rpWfij) Foundation Course French I	6	3	25	75	100
II	General English	23UGEN11	Poetry, Prose, Extensive Reading and Communicative English I	6	3	25	75	100
III	Core I	23UMIC11	Fundamentals of Microbiology and Microbial Diversity	5	5	25	75	100
	Core Practical I	23UMICR1	Practical I Fundamentals of Microbiology and Microbial Diversity	5	5	40	60	100
	Generic Elective I	23UMIE11	Basic and Clinical Biochemistry	4	3	25	75	100
IV	Skill Enhancement Course I (Discipline specific)	23UMISE1	Social and Preventive medicine	2	2	20	30	50
	Foundation Course	23UMIF11	Basic Microbiology	2	2	20	30	50
			Total	**30**	**23**			

Semester II

Part	Components	Course Code	Course Title	Contact Hours / Week	Credits	Max Marks		
						CIA	ESE	Total
I	Tamil / French	23ULTA21 23ULFA21	rka ,yf;fpaq;fs; : (nra;As;> ,yf;fzk;> ,yf;fpa tuyhW) Foundation Course: French II	6	3	25	75	100
II	General English	23UGEN21	Poetry, Prose, Extensive Reading, and Communicative English II	6	3	25	75	100
III	Core II	23UMIC21	Microbial Physiology and Metabolism	5	5	25	75	100
	Core Practical II	23UMICR2	Laboratory in Microbial Physiology and Metabolism	3	3	40	60	100
	Generic Elective II	23UMIE21	Dairy Technology	4	4	25	75	100
	Generic Elective Practical I	23UMIER1	Laboratory in Dairy Technology	2	1	40	60	100
IV	Skill Enhancement Course II (Discipline specific)	23UMISE2	Bioinstrumentation	2	2	20	30	50
	Skill Enhancement Course III (Discipline specific)	23UMISE3	Mushroom Technology	2	2	20	30	50
			Total	**30**	**23**			

Semester III

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
I	Tamil /	23ULTA31	fhg;gpa ,yf;fpaq;fs; : nra;As;> ,yf;fzk;> ,yf;fpa tuyhW> Gjpdk;	6	3	25	75	100
	French	23ULFA31	French Literature and Grammar I					
II	General English	23UGEN31	English Poetry, Prose, Extensive Reading and Communicative English III	6	3	25	75	100
III	Core III	23UMIC31	Bacteriology and Mycology	5	5	25	75	100
	Core Practical III	23UMICR3	Practical in Bacteriology and Mycology	2	2	40	60	100
	Generic Elective III	23UMIE31	Medical Laboratory Technology	4	3	25	75	100
	Generic Elective Practical II	23UMIER2	Practical in Medical Laboratory Technology	2	1	40	60	100
	NME I	23UMIN31	Food Microbiology	2	2	20	30	50
IV	Skill Enhancement Course IV (Discipline Specific)	23UMISE4	Nanotechnology	2	2	20	30	50
	Ability Enhancement Course I	23UAYM31	Yoga and Meditation	1	1	20	30	50
	Self Study/ MOOC / Internship (Compulsory)	23UMISS1	Sea food processing		+2			
Total				**30**	**22+2**			

Semester IV

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
I	Tamil /	23ULTA41	rq;f ,yf;fpaq;fs; : nra;As;> ,yf;fzk;> ,yf;fpa tuyhW> ehlfk;	6	3	25	75	100
	French	23ULFA41	French Literature and Grammar II					
II	General English	23UGEN41	English Poetry, Prose, Extensive Reading and Communicative English IV	6	3	25	75	100
III	Core IV	23UMIC41	Virology and Parasitology	5	5	25	75	100
	Core Practical IV	23UMICR4	Practical in Virology and Parasitology	2	2	40	60	100
	Generic Elective IV	23UMIE41	Marine Biology	4	3	25	75	100
	Generic Elective Practical III	23UMIER3	Practical in Marine Biology	2	1	40	60	100
	NME II	23UMIN41	Clinical Microbiology	2	2	20	30	50
IV	Skill Enhancement Course V (Discipline Specific)	23UMISE5	Biofertilizer technology	2	2	20	30	50
	Ability Enhancement Course II (Entrepreneurial Based)	23UAMI41	Vermitechnology	1	1	20	30	50
V	NCC / NSS / Sports				1			
	CDP Extension Activity				+1			
Total				**30**	**23+1**			

Note : Ability Enhancement course 23UAMI41
Evaluation 20 : 30 will be done only by the department.
Internal and External examinations will be in the form of Practical / Presentation of models / Reports.

Semester V

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
III	Core V	23UMIC51	Molecular Biology and Microbial genetics	4	4	25	75	100
	Core VI	23UMIC52	Recombinant DNA Technology	4	4	25	75	100
	Core VII	23UMIC53	Environmental and Agricultural Microbiology	4	4	25	75	100
	Core VIII	23UMIC54	Industrial Microbiology	4	4	25	75	100
	Core Practical V	23UMICR5	Practical in Molecular Biology, Microbial genetics and Recombinant DNA Technology	4	2	40	60	100
	Core Practical VI	23UMICR6	Practical in Environmental, Agricultural and Industrial Microbiology	4	2	40	60	100
	Discipline Specific Elective I	23UMIE51/ 23UMIE52	**Basics of Computers and Biostatistics** / Biosafety and Bioethics	4	4	25	75	100
IV	Ability Enhancement Course III	23UAEV51	Environmental Studies	2	1	20	30	50
	Self Study / MOOC / Internship (Optional)	23UMISS2	Probiotics		+2			
				30	**25+2**			

Semester VI

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
III	Core IX	23UMIC61	Food Microbiology	4	4	25	75	100
	Core X	23UMIC62	Immunology	4	4	25	75	100
	Core XI	23UMIC63	Pharmaceutical Microbiology	4	4	25	75	100
	Core Practical VII	23UMICR7	Practical in Food Microbiology	2	1	40	60	100
	Core Practical VIII	23UMICR8	Practical in Immunology and Pharmaceutical Microbiology	4	2	40	60	100
	Core XII (Project)	23UMIP61	Project and Viva Voce	6	4	40	60	100
	Discipline Specific Elective II	23UMIE61 / 23UMIE62	**Bioinformatics** / Entrepreneurship and Bio business	4	3	25	75	100
IV	Skill Enhancement Course VI (Discipline specific)	23UMISE6	Microbial quality control and testing	2	2	20	30	50
				30	**24**			

SEMESTER I			
Core I FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY			
Course Code: 23UMIC11	**Hrs / Week: 5**	**Hrs/ Sem: 75**	**Credits: 5**

Objectives:

- Learn the fundamental principles about different aspects of Microbiology including recent developments in the area.
- Describe the structural organization, morphology and reproduction of microbes.
- Explain the methods of cultivation of microbes and measurement of growth.
- Understand the microscopy and other basic laboratory techniques – culturing, disinfection and sterilization in Microbiology.
- Compare and contrast the different methods of sterilization.

Course Outcome:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Summarize the historical events and inventions and understand the classification of microorganisms.	K1
CO-2	Demonstrate detailed structure and functions of prokaryotic cell organelles.	K2
CO-3	Analyse the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.	K3
CO-4	Convince the principles and working mechanism of different microscopes/Microscope, their function and scope of application.	K4
CO-5	Manage the concept of asepsis and modes of sterilization and disinfectants**.**	K5

SEMESTER I			
Core I FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY			
Course Code: 23UMIC11	**Hrs / Week: 5**	**Hrs/ Sem: 75**	**Credits: 5**

Unit -I: **(15Hrs)**

History and Evolution of Microbiology, Classification – Three kingdom, five kingdom, six kingdom and eight kingdom. Microbial biodiversity: Introduction to microbial biodiversity-ecological niche. Basic concepts of Eubacteria, Archaebacteria and Eucarya. Conservation of Biodiversity.

Unit II: **(15Hrs)**

General characteristics of cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) and acellular microorganisms - (Viruses, Viroids, Prions), Differences between prokaryotic and eukaryotic microorganisms. Structure of Bacterial cell wall, cell membrane, capsule, flagella, pili, mesosomes, chlorosomes, phycobilisomes, spores, and gas vesicles. Structure of fungi (Mold and Yeast), Structure of microalgae.

Unit III: **(15Hrs)**

Bacterial culture media and pure culture techniques. Mode of cell division, Quantitative measurement of growth. Anaerobic culture techniques.

Unit IV: **(15Hrs)**

Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM & SEM, Confocal microscopy, and Atomic Force Microscopy. Stains and staining methods.

Unit V: **(15Hrs)**

Sterilization–moist heat - autoclaving, dry heat – Hot air oven, radiation – UV, Ionization, filtration – membrane filter and disinfection, antiseptic; Antimicrobial agents.

Text Books:

1. Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition.,McGraw –Hill, New York.
2. Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th Edition., McGraw-Hill International edition.
3. Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11th Edition., A La Carte Pearson.
4. Salle. A.J (1992). Fundamental Principles of Bacteriology. 7th Edition., McGraw Hill Inc.New

York.

5. Boyd, R.F. (1998). General Microbiology,2nd Edition., Times Mirror, Mosby College publishing, St Louis.

Books for Reference:

1. Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9th Edition). Jones &Bartlett learning 2010.
2. Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5th Edition., MacMillan Press Ltd
3. Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction,
4. 11th Edition., Benjamin Cummings.
5. Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5th Edition., McGraw Hill Publications.
6. Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of
7. Microorganisms, 13th Edition Benjamin-Cummings Pub Co.

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	3	2	3	2	2	2	1	2	2	2
CO-2	2	2	2	1	3	2	3	2	1	3
CO-3	3	2	2	2	3	1	2	2	3	2
CO-4	2	2	1	2	2	3	3	2	2	1
CO-5	2	1	2	2	2	1	2	2	1	2
Ave.	2.4	1.8	2.0	1.8	2.4	1.8	2.2	2.0	1.8	2.0

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER I			
Core Practical I Practical I FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY			
Course Code : 23UMICR1	**Hrs/ Week: 5**	**Hrs/ Sem: 75**	**Credit: 5**

Objectives:

- Acquire knowledge on Cleaning of glass wares, GLP and sterilization.
- Gain knowledge on media preparation and cultural characteristics.
- Learn the pure culture technique
- Learn the microscopic techniques and staining methods.
- Acquire knowledge on stain and staining methods

Course Outcome:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Interpret sterilization methods; learn to prepare media and their quality control.	K1
CO-2	Implement streak plate, pour plate and serial dilution and pigment production of microbes.	K2
CO-3	Examine Microscopy methods, different Staining techniques and motility test.	K3
CO-4	Prove culture characteristics of microorganisms.	K4
CO-5	Formulate study on Microbial Diversity using Hay Infusion Broth-Wet mount	K5

SEMESTER I			
Core Practical Practical I FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY			
Course Code : 23UMICR1	**Hrs / Week: 5**	**Hrs/ Sem: 75**	**Credit: 5**

Unit I

Cleaning of glass wares, Microbiological good laboratory practice and safety. Sterilization and assessment of sterility– Autoclave, hot air oven, and membrane filtration.

Unit II

Media preparation: liquid media, solid media, semi-solid media, agar slants, agar deeps, agar plates.

Unit III

Preparation of basal, differential, enriched, enrichment, transport, and selective media preparation-quality control of media, growth supporting properties, sterility check of media.

Pure culture techniques: streak plate, pour plate, decimal dilution.

Unit IV

Culture characteristics of microorganisms: growth on different media, growth characteristics, and description. Demonstration of pigment production. Microscopy: light microscopy and bright field microscopy.

Unit V

Staining techniques: smear preparation, simple staining, Gram's staining and endospore staining.

Study on Microbial Diversity using Hay Infusion Broth-Wet mount to show different types of microbes, hanging drop.

Text books:

1. James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996.
2. Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
3. Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
4. Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi.
5. R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.

Books for Reference:

1. Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C.Brown publishers.
2. Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India
3. Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS
4. Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication.
5. Lim D. (1998). Microbiology, 2nd Edition, WCB McGraw Hill Publications.

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	3	2	2	1	1	2	2	1	1
CO-2	3	2	3	3	3	3	3	2	3	3
CO-3	3	3	3	2	2	2	2	3	2	2
CO-4	2	1	1	2	2	1	2	2	2	2
CO-5	1	2	2	1	1	2	3	2	2	3
Ave.	2.2	2.2	2.2	2.0	1.8	1.8	2.4	2.2	2.0	2.2

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER I			
Generic Elective I Basic and Clinical Biochemistry			
Course Code : 23UMIA11	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 3**

Objectives:

- Attain thorough knowledge on carbohydrates and lipids, their characteristic properties and organization in carrying out all the living functions which constitute the life.
- Explain the biological activity of amino acids and proteins.
- Identify the metabolic errors in enzymes of carbohydrates and lipids.
- Describe the disorders in amino acid metabolism.
- Interpret the consequences, biochemical, clinical features, diagnosis and treatment of metabolic diseases of day today life.

Course Outcome:

CO.No.	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Explain the structure, classification , biochemical functions and significance of carbohydrates and lipids	K1
CO-2	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 level organization of proteins, its functions and denaturation.	K2
CO-3	Investigate defective enzymes and Inborn errors. Recognize diseases related to carbohydrate and lipid metabolism.	K4
CO-4	Evaluate the pathology of aminoacid metabolic disorders.	K5
CO-5	Produce the imbalances of enzymes in organ function and relate the role of Clinical Biochemistry in screening and diagnosis.	K3

SEMESTER I			
Generic Elective I Basic and Clinical Biochemistry			
Course Code : 23UMIA11	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 3**

Unit I **(12Hrs)**

Biomolecules -Carbohydrate – General properties, function, structure, classification– monosaccharides (Glucose, Fructose, Galactose), Oligosaccharides (Sucrose, Maltose, Lactose) and polysaccharides (Starch, Glycogen,) and biological significance. Lipids – General properties, functions, structure, classification (Simple, Derived and Complex), Cholesterol, LDL, HDL – biological significance.

Unit II **(12Hrs)**

Biomolecules - Amino acids – General properties, functions, structure, classification and biological significance. Proteins– General structure, Properties, functions, classification and biological significance.Test

Unit III **(12Hrs)**

Disorders of Metabolism: Disorders of carbohydrate metabolism: diabetes mellitus,ketoacidosis, hypoglycemia, glycogen storage diseases, galactosemia and lactose intolerance. Disorders of lipid metabolism: hyperlipidemia, hyperlipoproteinemia, hypercholesterolemia, hypertriglyceridemia, sphingolipidosis.

Unit IV **(12Hrs)**

Disorders of Metabolism: Disorders of amino acid metabolism:alkaptonuria, phenylketonuria, phenylalaninemia, homocystineuria, tyrosinemia, aminoacidurias.

Unit V **(12Hrs)**

Evaluation of organ function tests: Assessment and clinical manifestations of renal, hepatic, pancreatic, gastric and intestinal functions. Diagnostic enzymes: Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase.

Text books:

1. Satyanarayana, U. and Chakrapani, U(2014).Biochemistry,4th Edition, Made Simple Publisher.
2. Jain J L, Sunjay Jain and Nitin Jain (2016).Fundamentals of Biochemistry, 7th Edition, S Chand Company.
3. AmbikaShanmugam's (2016). Fundamentals of Biochemistry for Medical Students, 8th Edition.

Wolters Kluwer India Pvt Ltd.

4. Vasudevan. D.M.Sreekumari.S, Kannan Vaidyanathan (2019). Textbook Of Biochemistry For Medical Students. Kindle edition, Jaypee Brothers Medical Publishers
5. Jeremy M. Berg, Lubert Stryer, John L. Tymoczko, Gregory J. Gatto (2015). Biochemistry, 8th edition. WH Freeman publisher.

Books for Reference:

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

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO - 1	**PO -2**	**PO -3**	**PO -4**	**PO -5**	**PSO -1**	**PSO -2**	**PSO -3**	**PSO -4**	**PSO -5**
CO - 1	3	1	3	1	1	3	1	1	2	1
CO – 2	3	1	3	1	1	3	1	1	1	2
CO - 3	3	1	3	1	1	3	1	1	1	1
CO - 4	3	1	3	1	1	1	1	2	1	2
CO - 5	3	1	3	2	3	3	2	3	3	3
Ave.	**3**	**1**	**3**	**1.2**	**1.4**	**2.6**	**1.2**	**1.6**	**1.6**	**1.8**

Mapping	**<40%**	**≥40% and < 70%**	**≥70%**
Relation	**Low level**	**Medium level**	**High level**
Scale	**1**	**2**	**3**

SEMESTER I			
Skill Enhancement Course I Social and Preventive medicine			
Course Code : 23UMISE1	**Hrs/ Week: 2**	**Hrs/ Sem: 30**	**Credit: 2**

Objectives:

- Describe the concepts of health and disease and their social determinants
- Summarize the health management system
- Know about the various health care services
- Outline the goals of preventive medicine
- Gain knowledge about alternate medicine

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Describe the concepts of health and disease and their social determinants	K1
CO-2	Summarize the health management system	K2
CO-3	Know about the various health care services	K3
CO-4	Outline the goals of preventive medicine	K4
CO-5	Evaluate the knowledge about alternate medicine	K5

SEMESTER I			
Skill Enhancement Course I Social and Preventive medicine			
Course Code : 23UMISE1	**Hrs/ Week: 2**	**Hrs/ Sem: 30**	**Credit: 2**

Unit I **(6 hrs)**

Introduction to social medicine:

History of social medicine-concepts of health and disease-social determinants of health and disease-Health and quality of life-Health information system- measures of population health-health policies.

Unit II **(6 hrs)**

Health management:

Applications of behavioral sciences and psychology in health management- nutritional programs for health management-water and sanitation in human health-national programs for communicable and non-communicable diseases- environmental and occupational hazards and their control.

Unit III **(6 hrs)**

Health care and services:

Health care of the community-information, education, communication and training in health-maternal & child health-school health services- Geriatrics-care and welfare of the aged-mental health-health services through general practitioners.

Unit IV **(6 hrs)**

Preventive medicine:

Introduction- role of preventive medicine- 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.

Unit V **(6 hrs)**

Prevention through alternate medicine:

Unani, Ayurveda, Homeopathy, Naturopathy systems in epidemic and pandemic outbreaks. International health regulations. Infectious disease outbreak case studies and precautionary response during SARS and MERS coronavirus, Ebola and novel SARS-COV2 outbreaks.

Text Books

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

Books for Reference:

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

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	1	3	2	3	1	2	1	2	2
CO-2	2	3	2	3	2	2	1	2	1	3
CO-3	3	2	3	2	1	2	3	2	2	1
CO-4	2	3	1	1	2	2	1	3	2	3
CO-5	2	3	2	2	3	3	1	2	2	3
Ave.	2.2	2.4	2.2	2.0	2.2	2.0	1.6	2.0	1.8	2.4

Mapping	<40%	≥ 40%and<70%	≥ 70%
Relation	Low Level	MediumLevel	High Level
Scale	1	2	3

SEMESTER I			
Foundation Course Basic Microbiology			
Course Code : 23UMIF11	**Hrs/ Week: 2**	**Hrs/ Sem: 30**	**Credits: 2**

Objectives:

- Learn the fundamental principles of Prokaryotic and Eukaryotic Cellular Organisation and microbial cell division
- Describe the Importance and Application of Microbiology in various fields of Life Sciences
- Introduce different types of microbial classification
- Understand the basic methods of identifying microbes from different sources
- Explain different types of microbial adaptations in different sources.

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Describe the basic aspects of Prokaryotic and Eukaryotic cell and the different types of microbial cell division.	K1
CO-2	compile Knowledge on the scope, importance and Application of Microbes in different fields of Lifesciences.	K3
CO -3	examine Microbial Taxonomy and learn the Bergeys manual of Systematic Bacteriology.	K4
CO - 4	explain different methods of Identifying microbes from various sources.	K2
CO-5	Evaluate the important microbes in different sources.	K5

SEMESTER I			
Foundation Course Basic Microbiology			
Course Code : 23UMIF11	**Hrs/ Week: 2**	**Hrs/ Sem: 30**	**Credits: 2**

Unit I: **(6 Hrs)**

Prokaryotes and Eukaryotes. Difference between Prokaryotes and Eukaryotes. Bacteria- basic cell structure with examples. Microbial cell division and its types.

Unit II: **(6 Hrs)**

Scope , Importance and Applications of Microbes in different fields of Lifescience**.**

Unit III: **(6 Hrs)**

Microbial Taxonomy, Bergeys Manual of Systematic Bacteriology.

Unit IV: **(6 Hrs)**

Basic methods of Identifying Microbes from different sources and its importance

Unit V: **(6 Hrs)**

Important microbes in soil, water , Air, Food and other sources

Text books:

1. Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition.,McGraw –Hill, New York.
2. Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th
3. Edition., McGraw-Hill International edition.
4. Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11th Edition., A La Carte Pearson.
5. Salle. A.J (1992). Fundamental Principles of Bacteriology. 7th Edition., McGraw Hill Inc.New York.
6. Boyd, R.F. (1998). General Microbiology,2nd Edition., Times Mirror, Mosby CollegePublishing, St Louis.

Books for Reference:

1. Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9th Edition). Jones &Bartlett learning 2010.
2. Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5th Edition., MacMillan Press Ltd
3. Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction,
4. 11th Edition., Benjamin Cummings.

5. Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5th Edition., McGraw Hill Publications.

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	3	1	1	3	1	3	1	1	2	2
CO-2	3	2	1	2	1	3	3	3	1	3
CO-3	2	3	3	2	2	2	1	3	2	2
CO-4	2	2	3	3	2	2	3	2	3	3
CO-5	2	3	2	3	1	3	3	2	3	2
Ave.	2.4	2.2	2	2.6	1.4	2.6	2.2	2.2	2.2	2.4

Mapping	<40%	≥40% and < 70%	≥ 70%
Relation	Low level	Medium level	High level
Scale	1	2	3

SEMESTER II			
Core II Microbial Physiology and Metabolism			
Course Code: 23UMIC21	**Hrs/Week:5**	**Hrs/Sem:75**	**Credits:5**

Objectives

- To understand the basic concepts of aerobic and anaerobic metabolic pathway
- To analyse the role of individual components in overall cell function
- To provide information on sources of energy and its utilization by microorganisms
- To know the concept of microbial growth and identify the factors affecting bacterial growth.

Course outcome

CO. No.	**Upon completion of this course, students will be able to**	**Cognitive Level**
CO-1	Interpret the basic knowledge about microbial metabolism	K1
CO-2	Demonstrate the applications of the various culture and their pathway	K2
CO-3	Analyse the growth and sporulation process of microbes and significance of aerobic and anaerobic metabolism	K3
CO-4	Evaluate the methods of nutrient uptake and methods of microbial control	K4
CO-5	Invent the process of bacterial photosynthesis and reproduction.	K5

SEMESTER II			
Core II Microbial Physiology and Metabolism			
Course Code: 23UMIC21	**Hrs/Week:5**	**Hrs/Sem:75**	**Credits:5**

Unit I : Introduction to microbial culture and growth (15 Hrs)

Physiology of microbial growth: Batch – continuous - synchronous cultures; Growth Curve and measurement method (turbidity, biomass, and cell count). Control of microbial growth.

Unit II: Nutritional requirement and transport (15 Hrs)

Nutrition requirements - Photoautotrophs, Photo organotrophs, Chemolithotrophs (Nitrite, Sulphur, Bacteria), Chemoorganotrophs. Nutrition transport mechanisms – Passive diffusion and Active transport. Factors affecting microbial growth

Unit III: Metabolic pathway and fermentation (15 Hrs)

An overview of Metabolism - Embden Meyerhof Pathway, Pentose Phosphate Pathway, Tricarboxylic Acid Cycle. Electron Transport Chain and Oxidative Phosphorylation. ATP synthesis. Fermentation-Homolactic Fermentation, Heterolactic Fermentation, Mixed Acid Fermentation, Butanediol Fermentation

Unit IV: Photosynthesis types (15 Hrs)

Photosynthesis - An overview of chloroplast structure. Photosynthetic Pigments, Light Reaction-Cyclic and non-cyclic and Photophosphorylation.

Unit V: Bacterial reproduction (15 Hrs)

Bacterial reproduction - Binary fission, Budding, Reproduction through conidia, cyst formation, endospore formation. Fungi asexual and sexual reproduction, Asexual and sexual reproduction of protozoa.

Text Books

1. Schlegal, H.G. (1993). General Microbiology.,7th Edition, Press syndicate of the University of Cambridge.
2. MeenaKumari. S. Microbial Physiology, Chennai 1st Edition MJP Publishers 2006.
3. Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.

Books for Reference

1. Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
2. Lansing M. Prescott John.P. Harley and Donald A, Klein. Microbiology. Newyork: (5thedition). McGraw –Hill Company, 2003.

3. Tortora, Funke Case Addison. Introduction to Microbiology, Newyork: (7thedition) Wesley Longman Inc. 2001.
4. Moat, A.G and J.W Foaster (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.
5. Bhanu Shrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	3	3	3	2	1	2	2	2	2	1
CO-2	1	3	3	3	3	3	3	3	3	2
CO-3	2	3	3	3	3	2	3	2	3	2
CO-4	3	2	2	2	1	2	3	3	3	2
CO-5	3	2	3	3	2	3	2	3	1	2
Ave.	2.4	2.6	2.8	2.6	2.0	2.4	2.6	2.6	2.4	1.8

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER II			
Core Practical	**Laboratory in Microbial Physiology and Metabolism**		
Course Code: 23UMICR2	**Hrs/Week:3**	**Hrs/Sem:45**	**Credits:3**

Objectives

- To study the biochemical identification of the bacteria.
- To discuss on the different phases of microbial growth.
- To explain the basic concepts of microbial growth based on nutritional requirements
- To demonstrate the basic principle of microbial metabolism

Course outcome

CO. No.	**Upon completion of this course, students will be able to**	**Cognitive Level**
CO-1	Illustrate IMViC test series to identify bacteria	K1
CO-2	Experiment antibiotic sensitivity testing: Disc diffusion test	K2
CO-3	Outline the size of unicellular organism and methods of bacterial counting	K3
CO-4	Evaluate the concept of microbial growth, its measurement and growth curve.	K4
CO-5	Integrate the importance of morphological variations and aerobic and anaerobic energy production.	K5

SEMESTER II			
Core Practical	**Laboratory in Microbial Physiology and Metabolism**		
Course Code: 23UMICR2	**Hrs/Week:3**	**Hrs/Sem:45**	**Credits:3**

1. IMViC test
2. Carbohydrate fermentation-Glucose.
3. TSI test
4. Urease test
5. Catalase test
6. Viable count - pour plate, spread plate
7. Antibiotic sensitivity testing: Disc diffusion test
8. Micrometry: Determination of the size of yeast (Demonstration)
9. Capsular staining
10. Estimation of proteins (Lowry's method)
11. Separation of amino acids paper chromatography
12. Maintenance of pure culture, paraffin method, stab culture
13. Effect of P^H and temperature on bacterial growth

Books for Reference

1. Kannan. N (1996).Laboratory manual in General Microbiology. Palani Publications.
2. Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
3. Gunasekaran. P (2007). Laboratory manual in Microbiology. New age international publisher.
4. James G Cappucino and N. Sherman MB (1996). A lab manual Benjamin Cummins, New York
5. DavidWhite., James Drummond., Clay Fuqua (2012) Physiology and Biochemistry of Prokaryotes. 4th Ed. Oxford University Press, New York.
6. Moat, A.G and J.W Foaster, (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.
7. Plummer,D.T. An Introduction to Practical Biochemistry. New Delhi: Tata McGraw- Hill. 1998.
8. Palanivelu.P. Analytical Biochemistry and Separation techniques. Chennai: 21st Century Publications. 1998.

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	1	3	2	2	2	2	3	2	2	2
CO-2	2	2	1	2	2	2	2	2	3	3
CO-3	1	3	2	3	1	2	2	3	3	2
CO-4	2	3	2	1	2	3	1	2	2	1
CO-5	2	1	3	2	1	2	3	2	2	3
Ave.	1.6	2.4	2..0	2.0	1.6	2.2	2.2	2.2	2.4	2.2

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER II			
Generic Elective II Dairy Technology			
Course Code: 23UMIE21	**Hrs/ Week:4**	**Hrs/ Sem:60**	**Credits: 4**

Objectives:

- To provide the leadership, voice and programs for a vibrant dairy industry where farm families, dairy businesses and associated organizations can thrive and be profitable.
- To create a sustainable environmentally and technologically advanced dairy farm.

Course Outcome

CO.No.	Upon completion of this course, students will be able	Cognitive Level
CO 1	Summarize the different types of milk and its composition	K1
CO 2	Predict the factors affecting milk production	K2
CO 3	Analyse the quality of milk	K3
CO 4	Criticize on the adulteration of milk and milk borne disease	K4
CO 5	Compose methods for manufacturing various milk products	K5

SEMESTER II			
Generic Elective II Dairy Technology			
Course Code: 23UMIE21	**Hrs/ Week:4**	**Hrs/ Sem:60**	**Credits:4**

Unit I **(12 hours)**

Clean milk production technique- secretion of milk in the udder- sources of micro organisms- cleanliness of the animal- Udder- Utensils- Detergents and Sanitizers- Different micro organisms of milk – Differences between goat's, buffalow's and cow's milk - Colostrums- Importance of colostrums

Unit II **(12 hours)**

Importance of milk and its composition, properties and nutritive value of milk - Specific gravity of milk- Lactometer reading- Acidity test estimation of fat, SNF, total solids of milk- Factors that alter the quality and quantities of milk – common adulterants of milk, detection of adulterants- water adulteration- MBRT- Resazurin

Test

Unit III **(12 hours)**

Chilling – Heat processing – Sterilization- pasteurization- test for effective pasteurization – phosphates test – Holding the milk – packing – transport- various types of transports – marketing of fluid milks – special milks- Toned milk, standard milk, UHT milk

Unit IV **(12 hours)**

Starter culture preparation and their biochemical activities- Methods of manufacture and uses of fermented and non fermented milk products, yoghurt, cheese skim milk, condensed milk.

Unit V **(12 hours)**

Milk Borne disease- An Introduction to milk Borne disease, Milk borne infections, *Salmonella* poisoning, bacillary dysentery (Shigellosis). Milk borne intoxication – *Staphylococcal* poisoning, Botulism. Other milk borne diseases- Tuberculosis, Brucellosis

Text book:

1. Sugumar D.*Outlines of dairy technology*, Oxford University press, 1997

Books for Reference:

1. Clarence Henry, Heckles, *Milk and Milk products*, New Delhi: Tata. McGraw Hill Publishing company Ltd. 4th edition, 1957.
2. Sugumar D. *Outlines of dairy technology*, Oxford University press. 1997.
3. Ramasamy. *Hand book of Dairy technologies*, International Book distributing and Company, 1996.

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	2	1	3	3	3	3	2	1	1	3
CO-2	1	3	1	2	1	3	1	2	2	3
CO-3	3	3	2	1	1	2	3	3	2	2
CO-4	2	2	2	2	1	2	2	3	2	2
CO-5	2	2	2	2	3	3	3	2	2	3
Ave.	**2**	**2.2**	**2**	**2**	**1.8**	**2.6**	**2.2**	**2.2**	**1.8**	**2.6**

Mapping	**<40%**	**≥ 40% and <70%**	**≥ 70%**
Relation	**Low Level**	**Medium Level**	**High Level**
Scale	**1**	**2**	**3**

SEMESTER II			
Generic Elective Practical I Laboratory in Dairy Technology			
Course Code :23UMIER1	**Hrs/ Week: 2**	**Hrs/ Sem: 30**	**Credit: 1**

Objectives:

- To create the ability to be multi-skilled in the field of dairy microbiology with a good technical knowledge.
- To educate with the prime intension of providing practical training in the area of milk processing and preparation of various milk products

Course Outcome:

CO.No.	**Upon completion of this course, students will be able to**	**Cognitive Level**
CO 1	Illustrate sampling of milk	K1
CO 2	Experiment platform test for milk samples	K2
CO 3	Outline the preparation of various milk products	K3
CO 4	Evaluate enumeration of various milk products by standard plate count method	K4
CO 5	Integrate the importance of dairy products and dairy federations	K5

SEMESTER II			
Generic Elective Practical I Laboratory in Dairy Technology			
Course Code :23UMIER1	**Hrs/ Week: 2**	**Hrs/ Sem: 30**	**Credit: 1**

Practicals:

1. Sampling of milk
2. Platform test, COB, MBRT, acidity test
3. Estimation of fat in milk and skim milk
4. Estimation of SNF and total solids
5. Detection of adulterants and preservatives
6. Preparation and enumeration of cream, yoghurt
7. Preparation and enumeration of butter and ghee
8. Preparation and enumeration of koha and flavoured milk
9. Preparation and enumeration of ice cream
10. Grading of milk and milk products by standard plate count
11. Grading of milk and milk products by coliform count
12. Visit to important places related to dairy products and dairy federations**.**

Books for Reference:

1. Clarence Henry, Heckles, *Milk and Milk products.* New Delhi: 4th edition Tata Mc Graw Hill Publishing Company Ltd., 1957.

2. Sugumar D. *outlines of dairy technology*, Oxford University press. 1997.

3. Ramasamy. *Hand book of Dairy technologies*, Lucknow: International Book distributing and Company. 1996.

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	**Programme Outcomes (PO)**					**Programme Specific Outcomes (PSO)**				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	3	1	2	3	3	3	3	1	1	2
CO-2	3	1	2	2	2	3	2	1	3	3
CO-3	3	1	3	2	3	3	2	1	1	2
CO-4	3	1	2	3	1	3	1	1	3	2
CO-5	3	2	3	2	3	3	2	2	2	3
Ave.	**3**	**1.2**	**2.4**	**2.4**	**2.4**	**3**	**2**	**1.2**	**2**	**2.4**

Mapping	**<40%**	**≥ 40% and <70%**	**≥ 70%**
Relation	**Low Level**	**Medium Level**	**High Level**
Scale	**1**	**2**	**3**

SEMESTER II			
Skill Enhancement Course II Bioinstrumentation			
Course Code : **23UMISE2**	**Hrs/ Week: 2**	**Hrs/ Sem: 30**	**Credits: 2**

Objectives:

- Understand the basic analytical instruments and study the basic principles in the field of sciences.
- To gain knowledge about principles of spectroscopy
- Understand the analytical techniques of Chromatography
- To understand the principle of electrophoresis
- To gain information about the principles of Fluorescence and radiation based techniques

Course Outcome:

CO No	**Upon completion of this course, students will be able to**	**Cognitive Level**
CO-1	Interpret knowledge about the basic instruments	K2
CO-2	Describe the structure of atoms and molecules by using the principles of spectroscopy	K1
CO-3	Evaluate by separating and purifying the components using Chromatography	K5
CO-4	demonstrate the need and applications of electrophoretic techniques	K3
CO-5	Analyse the working principle and applications of fluorescence and radiation based techniques	K4

SEMESTER II			
Skill Enhancement Course II Bioinstrumentation			
Course Code : **23UMISE2**	**Hrs/ Week: 2**	**Hrs/ Sem: 30**	**Credits: 2**

Unit I: **(6 Hrs)**

Basic instruments: pH meter, Buffers- Buffer of biological importance (Phosphate, Acetate, TE, TAE), Centrifuge, Autoclave, Hot Air Oven and Incubator.

Unit II: **(6 Hrs)**

Spectroscopic Techniques: Colorimeter, Ultraviolet and visible, Infrared and Mass Spectroscopy.

Unit III: **(6 Hrs)**

Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC.

Unit IV: **(6 Hrs)**

Electrophoresis Techniques: Starch gel, AGE, Native PAGE, SDS PAGE, Gradient gel

Unit V: **(6 Hrs)**

Fluorescence and radiation based techniques: Spectrofluorimeter, Flame photometer, Scintillationcounter, Geiger Muller counter, Autoradiography.

Text books:

1. Jayaraman J (2011). Laboratory Manual in Biochemistry, 2 nd Edition. Wiley Eastern Ltd., New Delhi .
2. Ponmurugan. P and Gangathara PB (2012). Biotechniques.1 st Edition. MJP publishers.
3. Veerakumari, L (2009).Bioinstrumentation- 5th Edition - MJP publishers.
4. Upadhyay, Upadhyay and Nath (2002). Biophysical chemistry – Principles and techniques 3rd Edition.Himalaya publishing home.
5. Chatwal G and Anand (1989). Instrumental Methods of Chemical Analysis. S.Himalaya PublishingHouse, Mumbai.

Books for Reference:

1. Rodney.F. Boyer (2000). Modern Experimental Biochemistry, 3 rd Edition. Pearson Publication.
2. Skoog A.,West M (2014). Principles of Instrumental Analysis – 14th Edition W.B.SaundersCo.,Philadephia.
3. N.Gurumani. (2006). Research Methodology for biological sciences- 1st Edition – MJP Publishers.

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	3	2	1	1	2	3	2	1	1	3
CO-2	3	2	2	1	1	3	1	2	2	3
CO-3	3	3	2	2	1	2	3	3	2	3
CO-4	2	3	2	1	1	2	3	3	2	3
CO-5	3	3	1	1	1	3	3	3	2	2
Ave.	2.8	2.6	1.6	1.2	1.2	2.6	2.6	2.4	1.8	2.8

Mapping	<40%	≥40% and < 70%	≥ 70%
Relation	Low level	Medium level	High level
Scale	1	2	3

SEMESTER II			
Skill Enhancement Course III Mushroom Technology			
Course Code: 23UMISE3	**Hrs/Week: 2**	**Hrs/Sem: 30**	**Credit:2**

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 Outcome:

CO No	**Upon completion of this course, students Will be able to**	**Cognitive Level**
CO-1	Describe about the detailed information of edible and non – edible mushroom	K1
CO-2	Compare the cultivation of various types of Mushrooms.	K2
CO-3	Construct the mushroom house mushroom cultivation techniques and pure culture preparation.	K3
CO-4	Compare different modes of storage of mushroom.	K4
CO-5	Evaluate the use of various types of foods prepared from mushroom.	K5

SEMESTER II			
Skill Enhancement Course III Mushroom Technology			
Course Code: 23UMISE3	**Hrs/Week :2**	**Hrs/Sem:30**	**Credit:2**

UNIT I **(6 hrs)**

Introduction – History of mushroom cultivation; Classification and distribution of mushroom; life cycle of mushroom. Identification of poisonous mushrooms.

UNIT II **(6 hrs)**

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.

UNIT III **(6 hrs)**

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.

UNIT IV **(6 hrs)**

Cultivation of types of mushrooms – milky mushroom; oyster mushroom, button mushroom and any one medically valuable mushroom**.** Short time storage, long term storage, Drying, Storage in salt solutions. Nutrition – Proteins, Amino acids, Mineral elements nutrition – Carbohydrate, Vitamins, Crude fiber content

UNIT–V **(6 hrs)**

Value added products - Mushroom - Soup, Pickles, Powders, Jams, Cutlet, Omelette, Samosa, Curry, mushroom biscuits, mushroom ketchup, mushroom chips, mushroom candy

Text Books:

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R, 1991. *Oyster Mushrooms, Department of Plant Pathology*, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan,M.1990. *Food and Nutrition*. Bappco,The Bangalore Printing and Publishing Co.Ltd.,No.88, Mysore Road, Bangalore-560018.
3. NitaBahl,1988. *Hand book of Mushrooms*,IIEdition,Vol.I&Vol.II.

Books for Reference:

1. BiswasS.,Datta M.and Ngachan S.V.2012.*Mushrooms:AManual for Cultivation,* PHI.
2. ZadrazilF. and GrabbeK.1983. *Edible Mushroom,Biotechnology*Vol.3,Weinheim:VerlagChemie,Berlin
3. ChangsT. and HayanesW.A.(Ed.)1978. *Biology and Cultivation of Edible Mushrooms.* Academic Press. NewYork.
4. Tewari, Pankaj Kapoor, S.C.,1988. *Mushroom cultivation*, Mittal Publications, Delhi.

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	3	2	2	2	1	1	2	2	3	2
CO-2	2	3	2	1	2	2	1	2	2	3
CO-3	3	2	1	3	2	3	2	2	1	3
CO-4	2	1	2	2	3	3	3	1	2	1
CO-5	2	3	1	2	3	2	2	3	3	1
Ave.	2.4	2.2	1.6	2.0	2.2	2.2	2.0	2.0	2.2	2.0

Mapping	<40%	≥ 40%and<70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER III			
CORE III BACTERIOLOGY AND MYCOLOGY			
Course Code : 23UMIC31	**Hrs/Week : 5**	**Hrs/Sem : 75**	**Credits : 5**

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 Outcome:

CO No	Upon completion of this course, students will be able to	CL
CO1	Describe the importance of normal flora of human body and acquire knowledge on the process of infectious disease.	K1
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.	K2
CO3	Produce a list of disease-causing bacteria and compare their modes of infection, symptoms, diagnosis and treatment.	K3
CO4	Analyze human-fungal interaction, which can be applied to obtain in-depth knowledge on fungal diseases and the mechanism behind the disease process.	K4
CO5	Evaluate the types of mycoses caused in humans and categorize the modes of infection, pathogenesis, and treatment with introduction to mycotoxins.	K5

SEMESTER III			
CORE III BACTERIOLOGY AND MYCOLOGY			
Course Code : 23UMIC31	**Hrs/Week : 5**	**Hrs/Sem : 75**	**Credits : 5**

Unit I: **(15 Hrs)**

History, 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, endemic, epidemic, pandemic diseases and epidemiology – putative virulence factors of human pathogens –infectious disease cycle. Collection and transport of clinical specimens for bacterial and fungal infections.

Unit II: **(15 Hrs)**

Medically important Gram Positive infections - Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases (a) Streptococcal infections (*Streptococcus pyogenes*), (b) Staphylococcal infections (*Staphylococcus aureus*), (c) Tetanus (*Clostridium tetani*) (d) Diphtheria (*Corynebacterium diphtheriae*) (e) Tuberculosis (*Mycobacterium tuberculosis*).

Unit III: **(15 Hrs)**

Medically important Gram-Negative infections - Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention, and treatment of the following bacterial diseases (a) Meningitis (*Neisseria meningitidis*) (b) typhoid (*Salmonella typhi*) (c) cholera (*Vibrio cholerae*) (d) bacillary dysentery (*Shigella dysenteriae*); Sexually Transmitted disease (syphilis–*Treponemapallidum*); Nosocomial infections – definition, importance, and their control.

Unit IV: **(15 Hrs)**

Medically important Fungi - Classification of medically important fungi; Superficial mycoses: Pityriasis Versicolor; Tinea Nigra. Cutaneous mycoses: *Trichophyton* spps and *Epidermophytonfloccosum*. Subcutaneous mycoses: Chromo blastomycosis; Sporotrichosis; Systemic Mycoses - Blastomycosis; Histoplasmosis*;* Opportunistic Infections -Candidiasis; Cryptococcosis; Zygomycosis.

Unit V: **(15 Hrs)**

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.

Text Books

1. Tom Parker, M. Leslie H. Collier. (1990). Topley&Wilson's Principles of Bacteriology, Virology and Immunity,8th Edition. London: Edward Arnold.
2. Greenwood, D., Slack, R.B. and Peutherer, J.F. (2012) Medical Microbiology, 18thEdition. Churchill Livingstone, London.
3. Finegold, S.M. (2000) Diagnostic Microbiology, 10th Edition. C.V. Mosby Company, St. Louis.
4. Ananthanarayanan, R. and JayaramPanicker C.K. (2020) Text book of Microbiology. Orient Longman, Hyderabad.
5. JagdishChander (2018). Textbook of Medical Mycology, 4th edition, Jaypeebrothers medical publishers.

Books for Reference

1. Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC.
2. Kevin Kavanagh, (2018). Fungi Biology and Applications 3rd Edition. Wiley Blackwell publishers.
3. C.J. Alexopoulos, C.W. Mims, M. Blackwell, (2007). Introductory Mycology, 4th edition. Wiley publishers.
4. A.J. Salle (2007). Fundamental principles of bacteriology, fourth edition, Tata McGraw-Hill Publications.
5. 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

1. http://textbookofbacteriology.net/nd
2. https://microbiologysociety.org/members-outreach-resources/links.html
3. http://mycology.cornell.edu/fteach.html
4. https://www.adelaide.edu.au/mycology/
5. https://www.isham.org/mycology-resources/mycological-links

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO – 1	3	1	1	3	2	3	2	2	3	2
CO – 2	3	1	1	3	2	3	2	3	2	2
CO – 3	3	1	1	1	2	3	2	2	1	2
CO – 4	3	1	1	1	2	2	2	3	1	3
CO – 5	3	1	1	2	3	3	1	3	1	2
Ave.	3	1	1	2	2.2	2.8	1.8	2.6	1.6	2.2

Mapping	<40%	≥40% and < 70%	≥ 70%
Relation	Low level	Medium level	High level
Scale	1	2	3

SEMESTER III			
Core Practical III Practical in Bacteriology and Mycology			
Course Code : 23UMICR3	**Hrs/Week: 2**	**Hrs/Sem: 30**	**Credits: 2**

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 be able to perform cultivation and identification of fungi.

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Demonstrate methods to observe and measure microorganisms by standard microbiological techniques	K3
CO-2	Identify pathogenic microorganisms in the laboratory set-up and interpret their sensitivity towards commonly administered antibiotics.	K1
CO-3	Discuss the cultivation of fungi	K2
CO-4	Analyze clinically important fungi.	K4
CO-5	Evaluate testing procedure for yeast	K5

SEMESTER III			
Core Practical III Practical in Bacteriology and Mycology			
Course Code : 23UMICR3	**Hrs/Week: 2**	**Hrs/Sem: 30**	**Credits: 2**

1. Collection of specimens – Blood, urine
2. Transport of specimens - Urine
3. Simple staining of materials
4. Differential staining – Gram's staining
5. Special staining – Metachromatic granule staining.
6. Culture techniques used to isolate microorganisms.
7. Identification of bacterial pathogens by their biochemical reactions.
8. Antimicrobial susceptibility testing by disc-diffusion technique.
9. Determination of Minimum Inhibitory Concentration.
10. Microscopic identification of Fungi – KOH.
11. Lactophenol cotton blue staining.
12. Slide culture techniques for fungal Identification.
13. Identification of Dermatophytes (Demonstration)
14. Germ tube test, Carbohydrate fermentation and assimilation tests for Yeasts.
15. Cultivation and Identification of Fungi

Books for Reference:

1. Dubey, R.C. and Maheswari, D.K. (2020). S. Chand Publishers. ISBN-13: 978-8121921534, ISBN-10: 8121921538.
2. 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.
3. Collee, J.G., Fraser, A.G., Marnion, B.P. and Simmons, A. (1996). Mackie & McCartney Practical Medical Microbiology. 14th Edition. Elsevier. ISBN-10: 813120393X, ISBN-13: 978-8131203934.
4. Prince CP (2009). Practical Manual of Medical Microbiology, Ist edition, Jaypee digital publishing.
5. 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

Web Resources

1. https://www.microcarelab.in/media/microcarelab.in/files/Sample-Collection-Manual.pdf
2. http://ssu.ac.ir/cms/fileadmin/user_upload/Daneshkadaha/pezeshki/microb/file_amuzeshi/Lab_QA_Microbiology_QA.pdf
3. https://www.academia.edu/11977315/Basic_Laboratory_Procedures_in_Clinical_Bacteriology
4. https://cmr.asm.org/content/31/3/e00062-17.full.pdf

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	2	1	2	1	1	2	2	3	2	3
CO-2	2	1	1	1	2	3	3	2	2	3
CO-3	2	1	2	2	1	3	3	3	3	3
CO-4	2	1	1	2	1	3	3	3	1	3
CO-5	2	1	2	2	1	3	3	3	1	3
Ave.	2	1	1.6	1.6	1.2	2.8	2.8	2.8	1.8	3

Mapping	**<40%**	**≥ 40% and <70%**	**≥ 70%**
Relation	**Low Level**	**Medium Level**	**High Level**
Scale	**1**	**2**	**3**

SEMESTER III			
Generic Elective III Medical Laboratory Technology			
Course Code: 23UMIE31	**Hrs/Week: 4**	**Hrs/Sem:60**	**Credits:3**

Objectives:

- To provide the leadership, voice and programs for a vibrant laboratory where families, businesses and associated organizations can thrive and be profitable.
- To create a sustainable environmentally and technologically advanced medical lab.

Course Outcome

CO. No.	Upon completion of this course, students will be able	Cognitive Level
CO 1	Summarize ethical and professional conduct with patients, laboratory personnel, health- care professionals, and the public.	K1
CO 2	Predict how accurate and reliable information might be obtained about proper procurement, storage, and *handling* of laboratory *specimens.*	K2
CO 3	Develop a sound scientific knowledge foundation that prepares them to interpret, analyze and evaluate scientific knowledge in clinical practice.	K3
CO 4	Criticize on the laboratory tests with accuracy and precision.	K4
CO 5	Compose quality assurance principles and practices to ensure the accuracy and reliability of laboratory information.	K5

SEMESTER III			
Generic Elective III Medical Laboratory Technology			
Course Code: 23UMIE31	**Hrs / Week:4**	**Hrs/ Sem:60**	**Credits: 3**

UNIT I **(12 hours)**

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. Maintenance of Hygiene & Infection Control Practices.

UNIT II **(12 hours)**

Specimen collection: 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. Manual Vs Automation in Clinical Laboratory Types of analyzer- Semi-auto analyzer - Batch analyzer - Random Access auto-analyzer. Steps in the automated systems - Responsibilities of a technician in the maintenance of the analyzers.

UNIT III **(12 hours)**

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.

UNIT IV **(12 hours)**

Introduction to Haematology-Laboratory methods used in the investigation of coagulation disorders - coagulation tests , Routine coagulation tests, (prothrombin time , plasma recalcification time, partial thromboplastin time , activated partial thromboplastin time, thrombin time), Laboratory diagnosis of bleeding disorders. Estimation of fibrinogen, Assay of coagulation factors.

UNIT V **(12 hours)**

Quality Standards in Health Laboratories - Development and implementation of standards, Accreditation Boards –NABL, ISO, CAP, COLA, Performing quality assessment - pre-analytical, analytical, and post-analytical phases of testing.

Text book:

1. Kanai L. Mukherjee, 2007, Medical laboratory technology Vol.1.Tata McGraw Hill.
2. Talib V.H. (2019).*Handbook Medical Laboratory Technology, 2nd* Edition, *Directorate of health services, Government of India.*

Books for Reference:

1. Kanai L. Mukherjee, (2007). Medical laboratory technology Vol.1.Tata McGraw Hill.
2. James G Cappucino. and Natalie Sherman. (2016). Microbiology – A laboratory manual. (5th Edition). The Benjamin publishing company. New York.
3. Rutherford, B.H. Gradwohl , A.C. Sonnenwirth L. Jarett. Gradwohls. (2000). Clinical Laboratory Methods and Diagnosis, Vol-I, 8th edition, Mosby.
4. Godkar (2021).Textbook of Medical Laboratory Technology, 3rd Edition, Bhalani Publishing House.
5. M.N.Chatterjee and RanaShinde.(2008). Textbook of Medical Biochemistry, 7th Edition, Jaypee Brothers Medical Publishers Pvt. Limited.

Web Resources

1.https://www.testmenu.com/lexington/TestDirectory/SiteFile?fileName=sidebar%5CSpecimenCollectionHandlingTransport032715.pdf
2 https://webpath.med.utah.edu/HISTHTML/HISTOTCH/HISTOTCH.html
3 https://opentextbc.ca/clinicalskills/chapter/positioning-a-patient-in-bed/
4 https://www.cambridge.org/core/journals/infection-control-and-hospital-epidemiology/article/development-and-implementation-of-quality-standards/02A0EA3E3AAC66E67853D7E0555F4959

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	2	1	3	3	3	3	2	1	1	3
CO-2	1	3	1	2	1	3	1	2	2	3
CO-3	3	3	2	1	1	2	3	3	2	2
CO-4	2	2	2	2	1	2	2	3	2	2
CO-5	2	2	2	2	3	3	3	2	2	3
Ave.	2	2.2	2	2	1.8	2.6	2.2	2.2	1.8	2.6

Mapping	<40%	≥ 40% and <70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER III			
Generic Elective Practical II Practical in Medical Laboratory Technology			
Course Code: 23UMIER2	**Hrs /Week : 2**	**Hrs/Sem : 30**	**Credit: 1**

Objectives:

- The Medical Laboratory Technology graduates excel as innovative practitioners committed to excellence and a collaborative and healthy work environment.
- These graduates play a vital role in the provision of quality health care and in scholarship for the advancement of self, the profession and society.

Course Outcome:

CO NO.	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Recall the laboratory practices and know how to maintain the laboratory instruments	K1
CO-2	Interpret and distinguish various types of blood Groups	K2
CO-3	Produce culture tests and understand the pathological diseases of humans	K3
CO-4	Analyze the physical, chemical and microscopicanalysis of culture samples	K4
CO-5	Evaluate various techniques on isolation of micro-organisms for various sources	K5

SEMESTER III			
Generic Elective Practical II Practical in Medical Laboratory Technology			
Course Code: 23UMIER2	**Hrs/week : 2**	**Hrs/Sem : 30**	**Credit: 1**

1. Separation of blood.
2. Collection and preservation of blood sample.
3. Estimation of glucose from serum (Demonstration).
4. Estimation of cholesterol from serum (Demonstration).
5. Estimation of hemoglobin by Sahli's method
6. Qualitative test of carbohydrates from urine.
7. Qualitative test of proteins from urine.
8. Staining of blood smear
9. Examination of urine- physical, chemical, & microscopic
10. Urine analysis: urea, creatinine and bilirubin.
11. Culture tests- urine, nasal, throat swab, stool & pus
12. Pregnancy test from urine sample.
13. Erythrocyte Sedimentation Rate.
14. Testing of stool samples for parasite-ova & cysts- (Demonstration).
15. Visit to clinical laboratory.

Books for Reference:

1. Rajan S., Selvi Christy R.,(2010) *Experimental procedures in Life Sciences.* Chennai:Anjanaa Publishers,
2. Kanai Mukerjee L., (2005)*Medical Laboratory Technology – A procedure manual for routinediagnosis tests*- Vol III Tata mc Graw Hill Publishing Co. Ltd., New Delhi:.
3. Cappucino.J.G., and Sherman. N. (2000) *Microbiology – a laboratory manual.* BenjaminCummins. New York.
4. Kannan.N. (2002.) *A laboratory manual in general Microbiology*. Palani: Palani paramount publication,
5. Gunasekaran. P. (2000)*Laboratory manual in Microbiology.* New Delhi: A new age International Ltd.,publishers,

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	2	1	3	3	3	3	2	1	1	3
CO-2	1	3	1	2	1	3	1	2	2	3
CO-3	3	3	2	1	1	2	3	3	2	2
CO-4	2	2	2	2	1	2	2	3	2	2
CO-5	2	2	2	2	3	3	3	2	2	3
Ave.	2	2.2	2	2	1.8	2.6	2.2	2.2	1.8	2.6

Mapping	**<40%**	**≥ 40% and <70%**	**≥ 70%**
Relation	**Low Level**	**Medium Level**	**High Level**
Scale	**1**	**2**	**3**

SEMESTER III

NME I Food Microbiology			
Course Code: 23UMIN31	**Hrs/Week:2**	**Hrs/Sem:30**	**Credit:2**

Objectives

- To highlight student about the microorganisms are their importance of food, food hygiene, sanitation and food safety.
- To identify desirable microorganisms and their effects in preservation spoilage and contamination

Course Outcome:

CO. No	Upon completion of this course, students Will be able to	Cognitive Level
CO-1	Describe how to provide knowledge on the importance of food microbiology	K1
CO-2	Summarize brief knowledge on food microbes and various types of preservation	K2
CO-3	Know to predict and acquire knowledge on contamination and spoilage problems	K3
CO-4	Outline the knowledge on food borne disease and diagnosis of disease	K4
CO-5	Evaluate the information about the quality control Principles and importance	K5

SEMESTER III			
NME I Food Microbiology			
Course Code: 23UMIN31	**Hrs/Week:2**	**Hrs/Sem:30**	**Credit:2**

Unit-I: **6 hrs**

Food as a substrate for microorganisms - factors affecting the growth of microorganism in food. Mold, yeast and bacteria- general characteristics & importance.

Unit-II: **6 hrs**

Principles of food preservation – Methods of food preservation – asepsis, removal of microorganism anaerobic conditions, high temperature- low temperature, drying and food additives – Canning.

Unit–III: **6 hrs**

Contamination and spoilage of milk and milk products, meat and meat products, Fish and fish products, vegetables and fruits and canned food.

Unit-IV: **6 hrs**

Food Borne diseases: Mode of Transmission –Food Poisoning –Food Infection-Bacterial (*Staphylococcal*), Fungal (*Aspergillus*) and Viral infection (*Hepatitis*)

Unit-V: **6 hrs**

Food Laws and Regulations. Export Act- AGMARK -FPO, FAO- WHO-HACCP-Principles and Importance.

Textbook:

1. Frazier W.C., Westhoff. D. C. and Vanitha K.N. (2013). Food Microbiology. (6th Edition). McGraw Hill Education.
2. Ray B. and Bhunia A. (2013). Fundamentals of Food Microbiology. (5th Edition). CRC Press.

Books for Reference:

1. Adams M.R., and Moss M.O., (2005). *Food Microbiology*. Cambridge: The Royal Society of chemistry.
2. Banwarst. G.J. (2003). Basic Food Microbiology 2nd edn, CBS Publishers and distributors.
3. Robinson R. K. (2000). Dairy Microbiology3rdedn, Elsevier Applied Science, London.
4. Vijaya R K, (2004). Food Microbiology 1st edn. MJP Publishers, Chennai.

Web Resources

1. https://www.fssai.gov.in
2. https://www.who.int/news-room/fact-sheets/detail/food-safety
3. https://www.fda.gov/food/hazard-analysis-critical-control-point-haccp/haccp-principles-application-guidelines

SEMESTER III

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	1	3	2	3	1	2	1	2	2
CO-2	1	3	2	3	3	2	1	2	1	3
CO-3	3	2	3	2	1	2	2	3	3	1
CO-4	2	3	3	1	2	2	1	3	2	1
CO-5	2	3	2	2	3	3	1	2	2	2
Ave.	2.2	2.4	2.2	2.0	2.2	2.0	1.6	2.0	1.8	2.4

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

Skill Enhancement Course IV Nanotechnology			
Course Code: 23UMISE4	**Hrs/Week:2**	**Hrs/Sem:30**	**Credits:2**

Objectives:

- To impart knowledge on characterize the nanoparticles using standard methods
- To introduce advanced ideas and techniques required in emergent area of nanotechnology.
- To develop human resource with specialization in theoretical and experimental techniques.
- To apply the scientific knowledge of Physics, Mathematics, Chemistry, and Engineering for deeper understanding of the matter at nanoscale.

Course outcome

CO No	**Upon completion of this course,students will be able to**	**Cognitive Level**
CO-1	Compare different types of Nanoparticles	K2
CO-2	Identify the sensor system and probe	K1
CO-3	Demonstrate the methods of Nanomaterial synthesis	K3
CO-4	Examine the applications of nano technology in medicine and agriculture	K4
CO-5	Discriminate the present and future prospectives of bio particles	K5

SEMESTER III			
Skill Enhancement Course IV Nanotechnology			
Course Code: 23UMISE4	**Hrs/Week:2**	**Hrs/Sem:30**	**Credits:2**

Unit I **(6 Hrs)**

Introduction to nanotechnology- Types of nano particles. Carbon nano tubes, Carbon nano cones - Applications of nanotechnology

Unit II **(6 Hrs)**

Nanoparticles synthesis by plants and bacteria and yeast. Analysis of bimolecular Nano structures by Atomic Force Microscopy, Scanning Probe Electron Microscopy

Unit III **(6 Hrs)**

Sensor system and probe Biosensors–optical nanosensors, multi-functional biochip (MFB)

Unit IV **(6 Hrs)**

Nano technology in medical field Application of Nano biotechnology in medicine – Cancer diagnosis and treatment, Drug designing and delivery

Unit V **(6 Hrs)**

Nano technology in agriculture – crop improvement and Pest management. Biosecurity.

Text Books

1. Fulekar M.H., (2014) Nanotechnology: Importance and Applications. I K international Pvt Ltd, New Delhi.

2. David.S.Goodsell.(2006) Jhonwiley.Bio nanotechnology. Lessons from Nature. NewDelhi.

Books for Reference

1. Jain K.K., TailorL.(2009) Nano biotechnology: Molecular Diagnosis. Francis Group. London: Horizon scientific press.

3. R.K.Rathi.(2009) Nanotechnology . 1stEdition.S.Chand&CompanyLtd,. NewDehli

Web Resources

1. https://link.springer.com/chapter/10.1007/978-3-319-41129-3_2
2. https://pubs.rsc.org/en/content/articlelanding/2021/ra/d0ra09941d
3. https://www.mdpi.com/2079-6374/13/1/85
4. https://www.researchgate.net/publication/368819179_Applications_of_Nanotechnology_in_Medical_field
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8658860/

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	1	2	3	2	2	2	1	2	2	2
CO-2	2	2	1	1	3	2	3	2	1	3
CO-3	3	2	2	2	3	1	2	2	3	2
CO-4	2	2	1	2	2	3	3	2	2	1
CO-5	2	1	2	1	2	1	2	1	1	2
Ave.	2	1.8	1.8	1.6	2.4	1.8	2.2	2.0	1.8	2.0

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER III	
Self Study (Compulsory) Sea Food Processing	
Course Code: 23UMISS1	**Credits:+2**

Objectives:

- To understand the different food sources from the sea environment
- To gain knowledge in the concept of sea food processing.

Course Outcome :

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO- 1	Recall an idea about the sea environmental science.	K1
CO -2	Describe the importance of food processing.	K2
CO- 3	Produce preservation methods- canning, smoking, drying, chilling and freezing.	K3
CO -4	Analyze to handle and store the fish products	K4
CO- 5	Evaluate packaging and labelling techniques.	K5

SEMESTER III	
Self Study (Compulsory) Sea Food Processing	
Course Code: 23UMISS1	**Credits:+2**

Unit – I

Sea environmental science: Marine eco system - Nutritional benefits of marine resources – fish, fish oil, seaweeds.

Unit- II

Scope and importance of food processing - principles and methods of food preservation - Sun drying, Smoking, Salt curing, Chilling, Pickling, Drying, Frying.

Unit- III

Preservation methods: freezing techniques, irradiation process, canning ,value addition and chemical preservatives**.**

Unit– IV

Microbiology of fish products - storage and handling- enumeration of total viable count- bacteria and *E.coli,* preparation of fish products -Fermented fish, Fish soups, Fish powder, Prawnpowder and Fish and Prawn Cutlets

Unit– V

Introduction to packaging and labelling - packaging principles and operation - packaging materials - deteriorative changes in foodstuff and packaging methods for prevention - shelf life of packaged foodstuffs - methods to extend shelf life, requisites of good packages.

Text book:

1) Bonnell A. D. (1993) *Quality Assurance in Sea Food Processing:* A practical guide – Chap-manand Hall, Inc.

Books for Reference:

1. Linda Ankenman Granata, George J. Flick, Jr, Roy E. Martin.(2012) *The sea food industry – Spices, products, processing and safety–*. – 2nd edition, Wiley Blackwell Publication.

2 Hall G. M. – (1997)*Fish Processing Technology* . Blackie academic and Professional publication.2nd Edition.

3 Ioannis S. Boziaris.(2013.) *Sea food processing – Technology, Quality and safety* – WileyBlackwell publication.

Web Resources

1https://www.nature.com/articles/s41598-023-37338-z
2.https://www.ficsi.in/blog/unveiling-the-scope-of-the-food-processing-industry-in-india/
3. https://pubmed.ncbi.nlm.nih.gov/32044653/
4. http://ecoursesonline.iasri.res.in/course/view.php?id=286
5 https://pubmed.ncbi.nlm.nih.gov/8913809/

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	**Programme Outcomes (PO)**					**Programme Specific Outcomes (PSO)**				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	2	1	3	3	3	3	2	1	1	3
CO-2	1	3	1	2	1	3	1	2	2	3
CO-3	3	3	2	1	1	2	3	3	2	2
CO-4	2	2	2	2	1	2	2	3	2	2
CO-5	2	2	2	2	3	3	3	2	2	3
Ave.	2	2.2	2	2	1.8	2.6	2.2	2.2	1.8	2.6

Mapping	**<40%**	**≥ 40% and <70%**	**≥ 70%**
Relation	**Low Level**	**Medium Level**	**High Level**
Scale	**1**	**2**	**3**

SEMESTER IV			
CORE IV Virology and Parasitology			
Course Code: 23UMIC41	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits: 5**

Course Objectives

- Describe the properties and classification of viruses and collection of relevant clinical samples for diagnosing viral infections.
- Acquire knowledge about pathogenic microorganisms of viruses and the mechanisms by which they cause disease in the human body.
- Develop diagnostic skills, including the use and interpretation of laboratory test in the diagnosis of infectious diseases.
- Develop skills in the diagnosis of parasitic infections.

Course Outcome:

CO.No	**Upon completion of this course, students will be able to**	**Cognitive Level**
CO1	Discuss the structure and properties of viruses, cultivation methods and diagnosis of viral diseases.	K1
CO2	Explain the symptoms of viral infections and presumptively identify the viral disease.	K2
CO3	Analyze the emerging and reemerging viral diseases	K3
CO4	Recommend public about the spread, control and prevention of medically important parasites	K5
CO5	Examine the laboratory techniques in parasitology	K4

SEMESTER IV			
CORE IV Virology and Parasitology			
Course Code: 23UMIC41	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits: 5**

Unit I **(15 hrs)**

General properties, classification and replication of viruses, Cultivation of viruses- in animals, embryonated eggs and tissue culture, Virus purification assays - collection and transport of clinical specimens for viral infections.

Unit II **(15 hrs)**

Viral diseases with reference to symptoms, pathogenesis, transmission, prophylaxis and control – Hepatitis viruses, Rabies virus, Influenza virus, Herpes viruses, Adeno viruses and HIV virus. Oncogenic viruses (Human Papilloma virus): Introduction, characteristics of transformed cells, mechanism of viral oncogenesis and clinical manifestations.

Unit III **(15 hrs)**

Emerging and reemerging viral infections (SARS, Ebola, Dengue, Chikungunya- and Corona) – causes, spread and preventive measures. Detection of viruses in clinical specimens – Serological and Molecular diagnosis of virus infections – Antiviral agents, Interferons and Viral Vaccines, Immunization schedules.

Unit IV **(15 hrs)**

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: *Entameoba histolytica, Giardia lamblia, Leishmania donovani* and *Plasmodium* species.

Unit V **(15 hrs)**

Introduction to Helminthes, Platyhelminthes – *Taenia* – *Paragonimus* – *Schistosoma* spps.. Nemathelminthes – *Ascaris* and *Wuchereria.* 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.

Text Books

1. S., Rajan (2007). Medical microbiology, MJP publisher, Chennai.
2. JeyaramPaniker, C.K. (2006). Text Book of Parasitology Jay Pee Brothers, NewDelhi.

3. AroraD.R. and AroraB. (2002). Medical Parasitology, 1st Edition CBS Publishers & Distributors, New Delhi.
4. Chatterjee (1986). Medical Parasitology. Tata McGraw Hill, Calcutta.
5. Parija S. C. (1996). Text Book of Medical Parasitology.4th edition, Orient Longman, AllIndia Publishers & Distributors.

References Books

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

Web Resources

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

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	3	2	1	1	1	2	2	1	1
CO-2	3	2	3	3	3	3	3	2	3	3
CO-3	3	3	3	2	2	2	2	3	2	1
CO-4	1	1	1	2	1	1	2	1	1	1
CO-5	1	2	2	1	1	2	3	2	2	3
Ave.	2	2.2	2.2	1.6	1.4	1.8	2.4	2.0	1.6	1.8

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER IV			
CORE PRACTICAL IV PRACTICAL IN VIROLOGY AND PARASITOLOGY			
Course Code: 23UMICR4	**Hrs/Week: 2**	**Hrs/Sem: 30**	**Credits: 2**

Objectives

- Identify the viral pathogens
- To cultivate the viruses
- To examine the protozoa and helminths
- Identify medically important parasites.

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO1	Examine different clinical samples, transport, Culture and isolate	K4
CO2	Identify medically important viruses	K1
CO3	Analyze laboratory tests in the diagnosis of infectious diseases.	K3
CO4	Summarize of malarial parasites	K2
CO5	Evaluate ova and cyst of medically important parasites and helminthes	K5

SEMESTER IV			
CORE PRACTICAL IV PRACTICAL IN VIROLOGY AND PARASITOLOGY			
Course Code: 23UMICR4	**Hrs/Week: 2**	**Hrs/Sem: 30**	**Credits: 2**

1. Isolation of Bacteriophages from natural sources.
2. Cultivation of Viruses in Embryonated eggs (Demonstration)
3. Detection of HIV antibody using ELISA.
4. Identification of Viruses in Slides/Smears/Spotters.
5. Identification of Negri bodies (Demonstration)
6. Direct Examination of faeces by wet mount method.
7. Direct Examination of faeces by Iodine mount method.
8. Examination of parasites in clinical specimens –cysts/ova in faeces.
9. Concentration techniques of stool specimen - Floatation method (Zinc Sulphate)
10. Concentration techniques of stool specimen - Sedimentation method (Formal Ether method)
11. Examination of blood for Malarial parasites - thin and thick smear preparations.
12. Identification of Medically important parasites in slides/ specimens as spotters.

Books for References:

1. Parija S.C.(2012).Textbook of Practical Microbiology. Ahuja Publishing House.
2. Cappuccimo,J.andSherman,N.(2002)Microbiology:ALaboratoryManual,(6thE dition).PearsonEducation,Publication,NewDelhi.
3. Morag C. and Timbury M.C. (1994). Medical Virology. 4thedn. Blackwell Scientific Publishers.
4. Collee J. G.,Fraser A. G. Marmion B.P and SimmonsA. (1996).Mackie&McCartney Practical Medical Microbiology.(14thEdition). Elsevier,NewDelhi.
5. Chart H.(2018).Practical Laboratory Bacteriology. CRC Press.
6. MooreV.A.(2017). Laboratory Directions for Beginners in Bacteriology. Triste Publishing Ltd.
7. Cheesbrough M. (2006).DistrictLaboratoryPracticeinTropicalcountries.-Part 22ndEdition.CambridgeUniversityPress.
8. Murray P.R., Rosenthal K.S. and Michael A. (2013). Medical Microbiology. Pfaller. 7thEdition.Elsevier,MosbySaunders

Web Resources

1. https://www.microcarelab.in/media/microcarelab.in/files/Sample-Collection-Manual.pdf
2. http://ssu.ac.ir/cms/fileadmin/user_upload/Daneshkadaha/pezeshki/microb/file_amuzeshi/Lab_QA_Microbiology_QA.pdf
3. https://cmr.asm.org/content/31/3/e00062-17.full.pdf

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO – 1	3	2	3	3	1	3	2	3	2	3
CO – 2	3	2	2	3	2	3	2	3	2	3
CO – 3	3	2	1	2	1	3	1	2	2	3
CO – 4	3	2	3	2	2	3	2	2	2	2
CO – 5	2	2	2	3	1	2	1	2	2	3
Ave.	2.8	2	2.2	2.6	1.4	2.8	1.6	2.4	2	2.8

Mapping	<40%	≥40% and < 70%	≥ 70%
Relation	Low level	Medium level	High level
Scale	1	2	3

SEMESTER IV			
Generic Elective IV Marine Biology			
Course Code : 23UMIE41	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 3**

Objectives:

- To understand the marine ecosystems.
- To learn the different adaptations of marine organisms, microbial process, marine pollution,living and nonliving resources.

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Describe classification of environment and different marine Ecosystem	K1
CO-2	Interpret the properties of sea water	K2
CO-3	Relate Biogeochemical cycling	K3
CO-4	Analyze different types of marine pollution and microbial indicators of pollution	K4
CO-5	Evaluate the Living and non living marine resources	K5

SEMESTER IV			
Generic Elective IV Marine Biology			
Course Code - 23UMIE41	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 3**

Unit I: (12 Hrs)

Sea as a biological environment. Classification of marine environment– Plankton – classification (size, life, habitat) and adaptations. Estuaries, salt marshes, mangroves. Coral reef – ecology and types, species interaction, adaptations and importance. Threats and conservation of coastal ecosystems (coral reef and mangroves).

Unit II: (12 Hrs)

Physical properties: waves, tides, currents- types, causes, and their impact on marine organisms. Illumination, temperature, pressure. Chemical properties: nutrients, (major, minor, and trace elements), salinity, pH, density, dissolved gases (oxygen, carbon-di-oxide).

Unit III: (12 Hrs)

Microbial processes of marine ecosystems- biogeochemical cycling of Carbon, Nitrogen, Phosphorous, Sulphur, Iron.

Unit IV: (12 Hrs)

Sources, effects and control measures of heavy metal, radioactive, oil, and thermal pollutions. Algal blooms-sources and effects. Microbial indicators of pollution. Role of microbes in pollution abatement.

Unit V: (12 Hrs)

Living resources: Fishery products- fish meal and fish oil. Natural pearls: formation, ornamental and medicinal importance. Non-living resources: mineral wealth (manganese nodules, beach placers, glauconite and garnet). Bioactive compounds from marine organisms (bacteria, fungi, macro algae and sponges). Phycocolloids; agar-agar and algin.

Text books:

1. Olivia J.Fernando (1999)Sea water-Properties and dynamics, Dhanesh Publications, Ponnagam,Thanjavur
2. Vijaya Ramesh, K. (2004). Environmental Microbiology. MJP Publishers Chennai.
3. C.B. Munn (2003) Marine Microbiology: Ecology and applications.

Books for Reference:

1. MoshrafuddinAhamed and Basumatary. S.K.(2006). Applied Microbiology. MJP Publishers Chennai
2. Tait, R.V. and Dipper F.A (1998) Elements of marine ecology.-4thed. British Library Cataloguing in Publication Data.
3. Gross, G., (1993)Oceanography: A view of the Earth. Sixth edition. Prentice Hall Inc., NewJersey.
4. Nybakken, J.W. 1997. Marine Biology – An Ecological Approach. Addison Weslay

Longman, Inc. California.
5. Daws, C.J.1981. Marine Botany John Wiley and Sons, New York.

Web Resources

1. https://plantlet.org/marine-environment-classification-productivity/
2. https://www.clearias.com/movements-ocean-waves-tides-currents/
3. https://ocean.si.edu/ocean-life/microbes/marine-microbes
4. https://www.peertechzpublications.org/articles/OJEB-2-107.php
5. https://www.sciencedirect.com/science/article/pii/S1319562X20304605

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	2	3	2	1	3	2	2	2	1
CO-2	2	2	3	2	2	3	2	2	2	2
CO-3	2	3	2	1	3	2	1	1	1	2
CO-4	2	2	2	2	3	3	2	2	2	2
CO-5	2	2	2	2	1	3	1	2	1	1
Ave.	2	2.2	2.4	1.2	2	2.8	1.6	1.8	1.6	1.6

Mapping	<40%	≥40% and < 70%	≥ 70%
Relation	Low level	Medium level	High level
Scale	1	2	3

SEMESTER IV			
Generic Elective Practical III		**Practical in Marine biology**	
Course Code : 23UMIER3	**Hrs/Week:2**	**Hrs/Sem:30**	**Credits:1**

Objectives

- To impart students with a practical knowledge in marine biology techniques.

Course outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Examine the isolation of microbes from different marine sources	K4
CO-2	Evaluate the chemical parameters of marine water	K5
CO-3	Retrieve the microbes responsible for degradation of oil spill	K1
CO-4	Illustrate about phytoplankton and zooplankton	K2
CO-5	Compile the knowledge on valuable compounds from marine environment	K3

SEMESTER IV			
Generic Elective Practical III Practical in Marine biology			
Course Code : 23UMIER3	**Hrs/Week:2**	**Hrs/Sem:30**	**Credits:1**

1. Enumeration of microorganisms from marine water sample.
2. Isolation of microbes associated with marine sponges.
3. Isolation of fungi from mangroves.
4. Identification of fungi from mangroves.
5. Determination of alkalinity of marine water.
6. Determination of salinity of marine water.
7. Isolation of crude oil degrading marine bacteria.
8. Isolation of antibiotic producing microorganism from marine water.
9. Determination of BOD from marine water.
10. Determination of COD from marine water.
11. Spotters of any three Phytoplankton and Zooplankton
12. Extraction of alginate from sea weed (Demonstration)

Books for Reference:

1. Amy Sauter MarineHill Marine Biology(2001) Lab Manual – An introduction to ocean ecosystem,Walch publishing.
2. Peter Castro and Michael E.Huber (2001) . Marine science Laboratory manual, Eighth edition
3. Karleskint Turner Small (1998)- Introduction to Marine biology (Lan manual) - 4th edition

Web Resources

1. https://onlinelibrary.wiley.com/doi/abs/10.1002/iroh.19740590503
2. https://manoa.hawaii.edu/exploringourfluidearth/physical/density-effects/measuring-salinity
3. https://byjus.com/biology/phytoplankton/
4. https://ijrti.org/papers/IJRTI2112001.pdf

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	2	1	2	1	3	2	2	1	1
CO-2	1	2	1	3	2	3	2	2	1	2
CO-3	2	3	2	2	3	2	2	3	1	2
CO-4	2	2	2	2	3	3	2	2	2	2
CO-5	2	2	2	3	2	3	2	2	1	1
Ave.	1.8	2.2	1.6	2.4	2.2	2.8	2	2.2	1.2	1.6

Mapping	<40%	≥40% and < 70%	≥ 70%
Relation	Low level	Medium level	High level
Scale	1	2	3

SEMESTER IV			
NME II Clinical Microbiology			
Course Code: 23UMIN41	**Hrs/Week:2**	**Hrs/Sem:30**	**Credit:2**

Objectives

- To gain knowledge on the relevant clinical examples of bacterial, viral, fungal, and parasiticpathogens and the diseases they cause. To understand pathogenic microorganisms and the mechanisms by which they cause disease in the human body.
- To develop informatics and diagnostic skills, including the use and interpretation of laboratorytest in the diagnosis of infectious diseases

Course Outcome:

CO No	Upon completion of this course students will be able to	Cognitive Level
CO-1	Describe how to provide knowledge on the importance of clinical microbiology	K1
CO-2	Summarize the knowledge on normal flora on human body.	K2
CO-3	Know the knowledge on various types of diseases.	K3
CO-4	Outline information about the mechanisms of Infectious disease transmission	K4
CO-5	Evaluate the acquire knowledge on causative agent, treatment, prevention and control measures.	K5

SEMESTER IV			
NME II Clinical Microbiology			
Course Code: 23UMIN41	**Hrs/Week:2**	**Hrs/Sem:30**	**Credit:2**

Unit-I: **6 hrs**

Sources of infection- Routes of transmission-control measures-Testing by Koch's postulates – Antibiotic sensitivity testing

Unit-II: **6 hrs**

Bacterial pathogens- *Streptococcal, Staphylococci, E. coliPseudomonas, and Vibrio cholerae.*

Unit–III: **6 hrs**

Fungal pathogens- Mycosis, *Candida, Aspergillus-Dermatophytes*

Unit-IV: **6 hrs**

Viral pathogens- Polio, Rabies virus, Dengue, AIDS and CoronaVirus.

Unit-V: **6 hrs**

Protozoan pathogens - *E.histolytica*, Plasmodium, Giardia, Taenia solium,Ascaris

Text Books:

1. Ananthanaryanan R and Panikar J, (2007) Textbook of Microbiology, Orient Longmans. 2000.
2. Rajan.S. Medical Microbiology, Chennai, MJP Publisher,

Books for Reference:

1. Kanai L Mukherjee, (1996.) Medical Laboratory Technology, 2nd edition McGraw Hill Education;. India.
2. Salle, A.J. (2010) Fundamental Principles of Bacteriology. .(7thedition), Tata McGraw-Hill Publishing Company Ltd. New Delhi
3. PelczarJr., M. J. Chan.E.C.S. and Kreig, N.R. (2012)Microbiology, McGraw-Hill., New York.

Web Resources

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6627445/
2. https://www.sciencedirect.com/science/article/abs/pii/S1357303921002486
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4109575/
4. https://www.toppr.com/ask/question/identify-the-diseases-caused-by-the-virus/
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7660559/

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	1	3	2	3	1	2	1	2	2
CO-2	2	3	2	3	2	2	1	2	1	3
CO-3	3	3	3	2	1	2	3	2	2	1
CO-4	2	3	1	1	2	2	1	3	2	3
CO-5	2	3	2	2	3	3	1	2	2	3
Ave.	2.2	2.6	2.2	2.0	2.2	2.0	1.6	2.0	1.8	2.4

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER IV			
Skill Enhancement Course V Bio fertilizer Technology			
Course Code : 23UMISE5	**Hrs/ Week: 2**	**Hrs/ Sem: 30**	**Credits: 2**

Objectives:

- To impart the skill of bio fertilizer technology and bio fertilizer organisms.
- To learn the types of bio fertilizer

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Describe the general aspects of bio fertilizer organisms	K1
CO-2	Express about Bacterial bio fertilizer	K2
CO-3	Demonstrate about Fungal bio fertilizer	K3
CO-4	Analyze about Cyanobacterial bio fertilizer	K4
CO-5	Recommend BIS specification and quality control for bio fertilizer	K5

SEMESTER IV			
Skill Enhancement Course V Bio fertilizer Technology			
Course Code : 23UMISE5	**Hrs/ Week: 2**	**Hrs/ Sem: 30**	**Credits: 2**

Unit-I: **(6 hours)**

Bio fertilizers - Introduction, history and scope. A general account of Bio fertilizers organisms - Bacteria, Mycorrhizae and Cyanobacteria (BGA).

Unit-II: **(6 hours)**

A general account of bacterial bio fertilizers organisms. *Azospirillum*, *Azotobacter*, and *Rhizobium*. Isolation and Cultural characteristics - *Azotobacter* - Ashby's mannitol agar, *Azospirillum* - Semisolid medium. *Rhizobium* - Yeast Extract Mannitol Agar medium.

Unit-III: **(6 hours)**

A general account of fungal bio fertilizer. Ecto, Endo and Arbuscular mycorrhizae (AM). Culture of mycorrhizae in Modified Melin - Norkrans (MMN) agar medium.

Unit-IV: **(6 hours)**

A general account of Cyanobacterial bio fertilizers. *Anabaena*, *Nostoc* and *Tolypothrix*. Isolation of cyanobacteria. Formation of Fogg's medium - Symbiotic association of Cyanobacteria (*Azolla*).

Unit-V: **(6 hours)**

Production of biofertilizers - Field application of bio fertilizers - Quality control of bio fertilizers – BIS specification - National and Regional Bio fertilizers Production and Development Centres..

Text books:

1. Dubey, R. C. (2008). A Textbook of Biotechnology. S. Chand & Co., New Delhi.
2. Newton, W. E. et al. (1977). Recent Developments in Nitrogen Fixation. Academic Press, New York.
3. Schwintzer, C. R. and Tjepkema, J. D. (1990). The Biology of Frankia and Actinorhizal Plants. Academic Press Inc., San Diego, USA.

Books for Reference:

1. Stewart, W. D. P. and Gallon, J. R. (1980). Nitrogen Fixation. Academic Press, New York.
2. Subba Rao, N. S. (2002). Soil Microbiology. 4th ed. Soil Microorganisms and Plant Growth. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Subba Rao, N. S. and Dommergues, Y. R. (1998). Microbial Interactions in Agriculture and

Forestry. Vol. I, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

4. Wallanda, T. et al. (1997). Mycorrhizae. Backley's Publishers, The Netherlands.

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1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9445558/
2. https://core.ac.uk/download/pdf/158352931.pdf
3. https://unacademy.com/content/cbse-class-12/study-material/biology/microbes-as-biofertilisers/
4. https://www.ijcmas.com/7-10-2018/K.T.%20Thakare,%20et%20al.pdf
5. https://www.toppr.com/ask/question/write-down-the-application-of-biofertilizers-explain-the-role-of/

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	2	3	2	2	3	2	2	2	1
CO-2	2	2	3	2	2	3	2	2	2	2
CO-3	3	3	3	1	3	2	1	2	1	2
CO-4	2	2	2	2	3	3	2	2	1	1
CO-5	3	2	2	2	1	3	1	2	1	1
Ave.	2.4	2.2	2.6	1.2	2.2	2.8	1.6	2	1.4	1.4

Mapping	<40%	≥40% and < 70%	≥ 70%
Relation	Low level	Medium level	High level
Scale	1	2	3

SEMESTER – IV			
ABILITY ENHANCEMENT COURSE II Vermitechnology			
Course Code : 23UAMI41	**Hrs/Week : 1**	**Hrs/Sem : 15**	**Credits : 1**

Objectives:

- To get the thorough knowledge on making Vermicomposting and vermiculture.
- To learn about species used in Vermicomposting and Culture techniques of earthworms
- To study the Vermicomposting production
- To encourage the self-employment practice and save the human being by the way of minimizing the use of chemical fertilizers.

Course Outcome:

CO No	**Upon completion of this course, students will be able to**	**CL**
CO1	Describe earthworms about the various morphology	K1
CO2	Manipulate the awareness of field sampling using Vermicomposting	K3
CO3	Discuss appropriate awareness of parasites and predators	K2
CO4	Investigate the awareness among the present status and importance of composting methods and Vermicomposting	K4
CO5	Evaluate the nutrient availability in the Vermicomposting	K5

SEMESTER IV			
ABILITY ENHANCEMENT COURSE II Vermitechnology			
Course Code : 23UAMI41	**Hrs/Week : 1**	**Hrs/Sem : 15**	**Credits : 1**

Unit-I: **(3 hrs)**

Earthworm classification. Morphology and Anatomy. Biology of *Lumbricus terrestris*. – Digestive system–Excretion – Reproduction.

Unit-II: **(3 hrs)**

Vermicomposting materials. Physical, chemical and biological and environmental changes brought by earth worm in soil structure.

Unit-III: **(3 hrs)**

Vermicomposting production Requirements – Different methods of Vermicomposting – Heap method – Pot method and Tray method.

Unit-IV: **(3 hrs)**

Vermicomposting in Homes. Earthworm predators, Parasites and pathogens. - Economics of Vermicomposting and vermiwash production.

Unit-V: **(3 hrs)**

Vermicomposting advantages Role of in plant growth, Earthworms as animal feed – Role of Earthworms in Solid Waste, and Sewage waste management.

Text Books

1. Mary Violet Christy. A. (2014.) Vermitechnology MJP Publishers, – Chennai:

Books for Reference

1. Edwards,C.A .and Bohlen, P.J., (1996) Ecology of earthworms. 3 rd Edition,. Chapman and hall.
2. Ranganathan L.S. (2006) Vermibiotechnology from soil health to human health. India: Agrobios,
3. GuptaP.K. (2008.)Vermicomposting for sustainable Agriculture. India. Agrobios.

Web Resources

1. https://soil.evs.buffalo.edu/index.php/Earthworm
2. https://worms.as.ucsb.edu/2015/11/05/vermicomposting-materials-and-setup/
3. https://static.vikaspedia.in/media/files_en/agriculture/farm-based-enterprises/vermicompost-production-and-practices.pdf

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO – 1	3	1	3	3	3	3	2	2	3	2
CO – 2	3	3	1	3	2	3	2	3	2	3
CO – 3	3	2	3	1	3	3	2	2	1	2
CO – 4	3	1	3	1	2	2	2	1	1	3
CO – 5	3	1	1	2	2	1	1	3	1	3
Ave.	3	1.6	2.2	2.2	2.4	2.4	1.8	2.2	1.6	2.6

Mapping	<40%	≥40% and < 70%	≥ 70%
Relation	Low level	Medium level	High level
Scale	1	2	3

SEMESTER V			
CORE V Molecular Biology and Microbial Genetics			
Course Code : 23UMIC51	**Hrs/Week : 4**	**Hrs/Sem : 60**	**Credits : 4**

Objectives:

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

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO1	Analyze the significance of DNA and elucidate the replication mechanism.	K4
CO2	ஜடடரளவசயவந வாந வலிநள ழக சுயே யனெ சிழவநலை ளலவொநளளை அயஉானெநசல.	K2
CO3	Produce the causes and types of DNA mutation and summarize the DNA repair mechanisms.	K3
CO4	Describe the importance of plasmids and phages in genetics.	K1
CO5	Evaluate gene transfer and recombination methods.	K5

SEMESTER V			
CORE V Molecular Biology and Microbial Genetics			
Course Code : 23UMIC51	**Hrs/Week : 4**	**Hrs/Sem : 60**	**Credits : 4**

Unit I: (12 Hrs)

DNA Structure - Salient features of double helix, forms of DNA. Denaturation and renaturation. DNA organization in prokaryotes. Replication of DNA in prokaryotes - Bidirectional and unidirectional replication, semi-conservative and semi-discontinuous replication. Mechanism of DNA replication – enzymes involved – DNA polymerases, DNA ligase, primase. DNA replication modes - rolling circle, D-loop modes**.**

Unit II: (12 Hrs)

Transcription in Prokaryotes. Concept of transcription. RNA Polymerases. Translation in prokaryotes - Translational machinery - ribosome structure in prokaryotes. tRNA structure and processing. Inhibitors of protein synthesis in prokaryotes. Overview of regulation of gene expression - *lac, trp* and *ara* operons as examples. Regulation of gene expression by DNA methylation.

Unit III: (12 Hrs)

Mutation - Definition and types - base substitutions, frame shifts, deletions, insertions, duplications, inversions. Silent, conditional, and lethal mutations. Physical and chemical mutagens. Reversion and suppression. Uses of mutations. Repair Mechanisms – Photo-reactivation, Nucleotide Repair, Base Excision Repair, Methyl Directed Mismatch Repair and SOS Repair.

Unit IV: (12 Hrs)

Plasmid replication. Types of plasmids – R Plasmids, F plasmids, colicinogenic plasmids, metal resistance plasmids, Ti plasmid, linear plasmids, yeast 2µ plasmid. Bacteriophage-T4, Virulent Phage – Structure and lifecycle. Lambda phage-Structure, Lytic and Lysogenic cycle. Applications of Phages in Microbial Genetics.

Unit V: (12 Hrs)

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.

Text Books

1. Malacinski G.M. (2008). Freifelder's Essentials of Molecular Biology. 4th Edition. Narosa Publishing House, New Delhi.
2. Gardner E. J. Simmons M. J. and SnustedD.P.(2006). Principles of Genetics. 8th Edition. Wiley India Pvt. Ltd.
3. Trun N. and Trempy J. (2009). Fundamental Bacterial Genetics. 1st Edition. Blackwell Science Ltd.
4. Brown T. A. (2016). Gene Cloning and DNA Analysis- An Introduction. (7th Edition). John Wiley and Sons, Ltd.
5. 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.

Books for Reference

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

Web Resources

1. https://biokimicroki.com/denaturation-and-renaturation-of-dna/
2. https://pressbooks-dev.oer.hawaii.edu/biology/chapter/prokaryotic-transcription/
3. https://www.sciencedirect.com/topics/neuroscience/plasmid
4. https://microbenotes.com/plasmids/
5. https://www.frontiersin.org/journals/microbiology/articles/10.3389/fmicb.2021.673260/full

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO – 1	3	1	1	1	2	3	3	3	3	2
CO – 2	3	1	1	1	1	3	2	3	2	2
CO – 3	3	1	1	1	2	3	3	3	3	2
CO – 4	3	1	1	3	2	2	2	3	1	3
CO – 5	3	2	1	2	3	3	3	3	2	3
Ave.	3	1.2	1	1.6	2	2.8	2.6	3	2.2	2.4

Mapping	<40%	≥40% and < 70%	≥ 70%
Relation	Low level	Medium level	High level
Scale	1	2	3

SEMESTER V			
Core VI Recombinant DNA Technology			
Course Code: 23UMIC52	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Objectives

- Understand the principles of rDNA technology.
- Illustrate the molecular tools employed in gene cloning
- Discuss the importance of various molecular techniques and their 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

CO No	On completion of this course, students will;	Cognitive Level
CO1	Describe the steps involved in introduction and expression of foreign DNA into bacteria, animal and plants cells and their screening.	K1
CO2	னுளைஉரளள வாந எயசழைரள உடழனெபெ எநஉவழசள யனெ வாநசை யீடஉையவழைளெ.	K2
CO3	Construct recombinant DNA using molecular tools.	K3
CO4	Differentiate plant and animal tissue culture protocols and gene transfer mechanism.	K4
CO5	Evaluate and understand the application of genetic engineering and gene therapy.	K5

SEMESTER V			
CORE VI Recombinant DNA Technology			
Course Code: 23UMIC52	Hrs/Week: 4	Hrs/Sem: 60	Credits: 4

Unit I **(12 hrs)**

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.

Unit II **(12 hrs)**

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. Cosmid, BAC and YAC. Screening of Recombinants. Genomic DNA and cDNA library-Construction and Screening.

Unit III **(12 hrs)**

Molecular Tools- PCR- Types. Gel Electrophoresis- AGE and PAGE. Blotting Techniques-Southern, Western & Northern. DNA sequencing methods - Sanger's and automated method. Gene Targeting-Knock-in & Knock-outs. DNA Finger Printing,

Unit IV **(12 hrs)**

Plant Biotechnology – Media, Growth Regulators and Equipment for Plant Tissue Culture-Explant Culture-Micro propagation- 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.

Unit V **(12 hrs)**

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 – Transgenic Plants– Bt Cotton, Bt Corn and Golden Rice.

Text Books

1. Brown T.A.(2016). Gene Cloning and DNA Analysis. 7th Edition . John Wiley and Jones, Ltd.
2. 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.
3. Keya Chaudhuri (2013). Recombinant DNA technology. The Energy and Resources Institute.
4. SiddraIjaz, Imran UlHaq (2019). Recombinant DNA Technology. Cambridge Scholars Publishing.
5. Monika Jain (2012). Recombinant DNA Techniques: A Textbook, I Edition,Alpha Science International Ltd.

Books for References

1. Maloy S. R., Cronan J.E. Jr. and FreifelderD.(2011). Microbial Genetics. 2nd Edition. Narosa Publishing Home Pvt Ltd.

2. Glick B. R. and Patten C.L.(2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press.
3. Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition. Pearson New International Edition.
4. 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.
5. James D.Watson, Michael Gilman, Jan Witkowski, Mark Zoller (1992). Recombinant DNA. Scientific American Books

Web Resources

1. https://www.ncbi.nlm.nih.gov/books/NBK195888/
2. https://pubmed.ncbi.nlm.nih.gov/32242300/
3. https://www.ijpcbs.com/articles/different-types-of-pcr-techniques-and-its-applications.pdf
4. https://colostate.pressbooks.pub/clonalcryopreservation/chapter/media/
5. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000002BI/P001357/M021491/ET/1501755083geneticengineeringetextpathshaala(corrected.pdf

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	1	2	3	2	2	2	1	2	2	2
CO-2	2	2	1	1	3	2	3	2	1	3
CO-3	3	2	2	2	3	1	2	2	3	2
CO-4	2	2	1	2	2	3	3	2	2	1
CO-5	2	1	2	1	2	1	2	1	1	2
Ave.	2	1.8	1.8	1.6	2.4	1.8	2.2	2.0	1.8	2.0

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER V			
Core VII Environmental and Agricultural Microbiology			
Course Code : **23UMIC53**	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 4**

Objectives:

- To discuss the distribution and association 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 Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Describe about the properties of soil, soil microflora, biogeochemical cycle	K1
CO-2	Infer the cause of water pollution, and perform methods to assess the quality of water.	K2
CO-3	Demonstrate the production of biofertilizers and biopesticides.	K3
CO-4	Examine about waste treatment process and microbial decomposition and bio-remediation process.	K4
CO-5	Evaluate about plant diseases caused by microbes and acquire a clear idea on plant pathogenic interaction	K5

SEMESTER V			
Core VII Environmental and Agricultural Microbiology			
Course Code : 23UMIC53	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 4**

Unit I: **(12 Hrs)**

Soil properties and soil microflora, Factors affecting microbial population. Decomposition of soil organic matter. Role of microorganisms in elemental cycles in nature: Carbon, Nitrogen, Sulphur, Phosphorus. Concepts of Nitrogen fixation – Symbiotic and asymbiotic nitrogen fixers.

Unit II: **(12 Hrs)**

Sources and types of water: surface, ground, stored, distilled, mineral and de-mineralized water, biological indicators of water Pollution, Eutrophication. Conventional Bacteriological standards of Water Quality, MPN index, coliform test, Membrane filtration. BOD, COD.

Unit III: **(12 Hrs)**

Sources and types of solid waste, composting, vermi composting, production of biogas. Liquid waste management: Primary, secondary, and tertiary sewage treatment. Bioremediation and waste management: Need and scope of bioremediation. Degradation of hydrocarbons, oil spills, heavy metals – Chromium, lead, and xenobiotics – PCB.

Unit IV: **(12 Hrs)**

Microbial Interactions in Rhizosphere and Phyllosphere. Brief account of microbial interactions: Symbiosis, neutralism, commensalism, competition, Ammensalism, Synergism, parasitism, and predation. Biofertilizers – Bacterial - Rhizobial biofertilizer, cyanobacterial, VAM. Biopesticides - Bacteria - *Bacillus thuringiensis* and Fungi - *Trichoderma*

Unit V: **(12 Hrs)**

Plant pathology: Mode of entry of pathogens, symptoms and transmission of plant diseases. Plant defense mechanisms. Bacterial diseases – Citrus canker, Blight of paddy. Viral disease – TMV, CMV. Fungal disease- red rot of sugarcane, Tikka disease. Plant disease management.

Text books:

1) Joseph C. Daniel. (2006). Environmental aspects of Microbiology 2nd Edition. Bright SunPublications.

2) Pradipta. K.M. (2008). Textbook of Environmental Microbiology.I.K.Publishing. House.

3) Ramanathan, and Muthukaruppan SM. (2005). Environmental Microbiology.Om Sakthi Pathipagam,

Annamalai Nagar.

4) K. Vijaya Ramesh.(2004).Environmental Microbiology. 1st Edition. MJP Publishers.

5) SubbaRao.N.S.(2017). Soil Microbiology.4th Edition. Oxford and IBH Publishing Pvt.Ltd.

Books for Reference:

1) Dirk, J. Elasas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology, Marcel Dekker INC, New York, Hong Kong.

2) EcEldowney S, Hardman D.J., Waite D.J., Waite S.(1993). Pollution: Ecology and Biotreatment – Longman Scientific Technical.

3) Mitchel, R.(1992). Environmental Microbiology. Wiley –John Wiley and Sons. Inc. Publications, New York.

4) Clescri, L.S., Greenberg, A.E. and Eaton, A.D.(1998). Standard Methods for Examination of Water and Wastewater, 20thEdition. American Public Health Association.

5) Atlas, R.M. and Bartha, R.(1992). Microbial Ecology: Fundamentals andApplications, 2nd Edition.The Benjamin / Cummings Publishing Co.,Redwood City, CA.

Web Resources

1. https://microbenotes.com/microorganisms-in-soil/
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2266883/
3. https://www.membracon.co.uk/blog/what-is-a-sewage-treatment-plant-how-does-it-work-2/
4. https://www.sciencedirect.com/science/article/pii/S1369527423000346
5. https://www.apsnet.org/edcenter/disandpath/prokaryote/pdlessons/Pages/CitrusCanker.aspx

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	2	3	2	1	3	2	2	1	1
CO-2	1	2	3	2	1	3	2	2	1	2
CO-3	2	3	2	2	1	2	2	1	1	2
CO-4	2	2	2	2	1	3	2	2	2	2
CO-5	2	2	2	2	1	3	2	2	1	1
Ave.	1.8	2.2	2.4	2	1	2.8	2	1.8	1.2	1.6

Mapping	<40%	≥40% and < 70%	≥ 70%
Relation	Low level	Medium level	High level
Scale	1	2	3

SEMESTER V			
CORE VII Industrial Microbiology			
Course Code: 23UMIC54	**Hrs/Week:4**	**Hrs/Sem:60**	**Credits :4**

Objectives:

- To identify and explore industrially important microbes
- To impart knowledge on production of recombinant proteins
- To describe types of fermentation process with respect to fermentative process
- To make aware of biology of microbes involved in fermentation process

Course outcome

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Define different kinds of fermentation process	K1
CO-2	Explain about production of recombinant proteins.	K2
CO-3	Compile the downstream and upstream processing methods	K3
CO-4	Compare fermented and non-fermented microbial products.	K4
CO-5	Evaluate new method for cell lysis	K5

CORE VIII Industrial Microbiology			
Course Code: 23UMIC54	**Hrs/Week:4**	**Hrs/Sem:60**	**Credits :4**

Unit-I **(12Hrs)**

Introduction to fermentation - History of industrial Microbiology, Isolation, screening, preservation and improvement of industrially important microorganisms - Media design for fermentation processes; Development of inoculums for industrial fermentations

Unit-II **(12Hrs)**

Types of fermentation- Batch, continuous, Surface, Submerged, Aerobic and Anaerobic fermenter - Design and types, sterilization methods of industrial microbiology - Enzymes and cell immobilization, Production of recombinant proteins: Insulin, Interferon, Somatotropin, Exploitation of microorganism and their products

Unit-III **(12Hrs)**

Sources of industrial products :Biology of industrial microorganisms. Streptomyces, Yeasts (*Saccharomyces cerevisiae*) *Spirulina* and *Penicillium*. Single cell protein (*Spirulina*) Biofuels from microbial sources. Recovery and purification of fermentation products. (Downstream processing) Method for cell lysis.

Unit-IV **(12Hrs)**

Industrial products Alcohols (Ethanol and Butanol); Beverages (Beer and Wine); Amino acids (Glutamic acid and Lysine); Organic acids (Citric acid and acetic acid); Production of enzymes (Protease, Amylase and Lipase); Biopolymers (Xanthan gum and PHB)

Unit-V **(12Hrs)**

Pharmaceutical products Antibiotics (Penicillin, Cephalosporin and Streptomycin); Vitamins (Riboflavin and Cyanocobalamin); Production of Hormones (Testosterone); Vaccines (Plant–Agrobacterium tumefaciens, Animal–Leptospirosis, Microbes-DPT).

Text Books:

1. Wulf Crueger A. A(2000) Text Book of Industrial Microbiology. 2nd edition ,Panima Publishing Corporation, New Delhi.
2. Peter F. Stanbury.,Whittaker, A. and Hali.S.J.(1997) Principles of Fermentation- Technology. 2nd edition. Pergamon Press. NewDelhi:
3. Patel A.H. Industrial Microbiology. (1996) Macmillan India Limited. Kolkata

Books for Reference

1. Prescott & Dunn.(1986) Industrial Microbiology, CBS publishers and Distributors, NewYork
2. Casida, L.E. Industrial Microbiology. (1997) Eastern Limited, Mysore
3. Michael J.,Waites, Neil L., Morgan, John S.Rockey and Gray Higton .(2001) An Introduction to industrial Microbiology , Replika press Pvt. New Delhi
4. Purohit, S.S., Kakrani, H.N., Saluja,(1996) A.K. Pharmaceutical Biotechnology. Student edition, Jodhpur

Web Resources

1. https://application.wiley-vch.de/books/sample/3527314423_c01.pdf
2. https://microbenotes.com/batch-vs-fed-batch-vs-continuous-culture/
3. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/industrial-microbiology
4. https://www.sciencedirect.com/science/article/pii/S1658365514000697
5. https://nap.nationalacademies.org/read/6015/chapter/11

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	3	2	1	1	1	2	2	1	1
CO-2	3	2	3	3	3	3	3	2	3	3
CO-3	3	3	3	2	2	2	2	3	2	1
CO-4	1	1	1	2	1	1	2	1	1	1
CO-5	1	2	2	1	1	2	3	2	2	3
Ave.	2	2.2	2.2	1.6	1.4	1.8	2.4	2.0	1.6	1.8

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER V			
CORE PRACTICAL V Practical in Molecular Biology, Microbial genetics and Recombinant DNA technology			
Course Code: 23UMICR5	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits:2**

Objectives

- Provide knowledge on structure and replication of DNA.
- Explain artificial transformation method.
- Illustrate the molecular tools employed in gene cloning
- Discuss the importance of various molecular techniques and their importance in Biotechnology.

Course Outcome:

CO No	Upon completion of this course, students will be able to	CL
CO1	Illustrate different types of DNA and RNA.	K2
CO2	Describe the significance of Phages.	K1
CO3	Evaluate the importance of experimental microbial genetics.	K5
CO4	Construct recombinant DNA technology using molecular tools.	K3
CO5	Differentiate plant and animal biotechnology	K4

SEMESTER V			
CORE PRACTICAL V Practical in Molecular Biology, Microbial genetics and Recombinant DNA Technology			
Course Code: 23UMICR5	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits:2**

1. Plasmid DNA isolation from *E.coli*
2. Isolation of spontaneous mutants.
3. Isolation of induced mutant by UV
4. Isolation of antibiotic resistant mutants by gradient plate technique
5. Production and isolation of UV induced auxotrophic mutants by replica plating technique
6. Agarose Gel Electrophoresis
7. Genetic recombination in Bacteria by conjugation (Demonstration)
8. Preparation of competent cell (Demonstration)
9. Bacterial Transformation (Demonstration).
10. Polymerase chain reaction (Demonstration)
11. Isolation of plasmid DNA from animal source.
12. Isolation of plasmid DNA from plant source.
13. Isolation of RNA from plant source.
14. Induction of gene expression in *E.coli* cell lysis and protein extraction
15. Visualization of proteins by polyacrylamide gel electrophoresis (SDS-PAGE)
16. Restriction Digestion of DNA (Demonstration)
17. Determination of unknown fragment using marker DNA – (Demonstration)
18. Western blotting (Demonstration)

Books for Reference

1. Gunasekaran P. (2007). Laboratory Manual in Microbiology. New Age International.
2. James G Cappucino. and Natalie Sherman. (2016). Microbiology – A laboratory manual. (5^{th} Edition). The Benjamin publishing company. New York.
3. Judith W. Zyskind and Sanford I. Bernstein (1989) Recombinant DNA laboratory Manual. San Diego State University, San Diego, California.
4. Jyoti Saxena, Mamta aunthiyal, InduRavi.(2012) *Laboratory manual for Microbiology, Biochemistryand Molecular Biology*,Scientific Publishers, India

Web Resources

1. https://www.iitg.ac.in/biotech/MTechLabProtocols/Expt-6%20(Isolation%20of%20Plasmid%20DNA).pdf
2. https://microbenotes.com/polyacrylamide-gel-electrophoresis-page/
3. https://www.sciencedirect.com/science/article/abs/pii/0006291X69906664
4. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0023457
5. https://bio.libretexts.org/Courses/North_Carolina_State_University/MB352_General_Microbiology_Laboratory_2021_(Lee)/08%3A_

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	3	2	2	2	1	1	2	2	3	2
CO-2	2	3	1	1	2	2	1	2	2	3
CO-3	3	2	1	3	2	3	2	1	1	3
CO-4	2	1	2	2	3	3	3	1	2	1
CO-5	2	3	1	1	3	2	2	3	3	1
Ave.	2.4	2.2	1.4	1.8	2.2	2.2	2.0	1.8	2.2	2.0

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER V			
CORE PRACTICAL VI Practical in Environmental, Agricultural And Industrial Microbiology			
Course Code: 23UMICR6	**Hrs/Week:4**	**Hrs/Sem:60**	**Credits:2**

Objectives

- To acquaint with basic concepts of production of fermentative products
- To inculcate technical skills involved in industrial microbiology
- To assess water quality and portability.
- To enumerate microbes from natural sources.
- To isolate agriculturally important bacteria

Course outcome

CO No	**Upon completion of this course,students will be able to**	**Cognitive Level**
CO-1	Apply scientific principle to obtain fermentative products	K3
CO-2	Summarize the basics of fermentation technology, screening techniques and fermentative products from microbes.	K2
CO-3	Describe the role of industrially important microbes in obtaining human high value products	K1
CO-4	Examine the microbial quality of water and relate the experimentalresults to the prescribed standards by the statutory bodies	K4
CO-5	Evaluate nitrogen fixing and phosphate solubilizing microorganism form soil	K5

SEMESTER V			
CORE PRACTICAL VI Practical in Environmental, Agricultural And Industrial Microbiology			
Course Code: 23UMICR6	**Hrs/Week:4**	**Hrs/Sem:60**	**Credits:2**

1. Immobilization of bacterial cells (*Escherichia coli* and *Bacillus*)
2. Isolation and production of protease enzyme from soil bacteria
3. Screening of antibiotic producing *Streptomyces* sps from soil
4. Development of bacterial inoculum for fermentation process
5. Production of vinegar from cherry fruit
6. Chemical method of cell lysis
7. Isolation and screening of industrially important microbes (Demonstration)
8. Isolation of yeast and lactic acid bacteria from grapes and fermented product (Curd / Cheese)
9. Alkalinity test for water
10. Acidity test for water
11. Estimation of Dissolved Oxygen in water
12. Estimation of Biological Oxygen Demand in pond water
13. Estimation of Chemical Oxygen Demand in pond water
14. Determination of Most Probable Number
15. Study of air microflora by settle plate method.
16. Isolation of *Rhizobium*/ *Azotobacter*/ phosphate solubilizing organisms

Books for Reference

1. Brian McNeil, Linda Harvey, Wiley. (1991) Practical Fermentation Technology. New age International (P) Limited, Publishers.

2 T.C.K. Sugitha,P. Raja, R. Rajesh and U. Sivakumar (2019) Practical manual cum workbook – Industrial microbiology.

3 Modern Industrial Microbiology and Biotechnology (2007) by Nduka Okafor. Published by Science Publishers, Enfield, NH, USA

4 Kannan. N. (1996). Laboratory manual in General Microbiology. Palani Publications.

5 R C Dubey and D K Maheswari.(2002). Practical Microbiology. S. Chand Publishing.

6 .Aneja, KR.(2010). Experiments in Microbiology, Plant pathology and Biotechnology. New Age International (P) Limited

Web Resources

1. https://info.gbiosciences.com/blog/physical-disruption-or-chemical-cell-lysis-how-to-decide
2. https://www.horiba.com/usa/water-quality/support/electrochemistry/the-story-of-dissolved-oxygen/methods-for-measuring-dissolved-oxygen-levels/
3. https://www.ijcmas.com/vol-4-8/Dalal%20Rupali,%20et%20al.pdf

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	3	3	3	2	1	2	2	2	2	1
CO-2	1	3	3	3	3	3	3	3	3	2
CO-3	2	3	3	3	3	2	3	2	3	2
CO-4	3	2	2	2	1	2	3	3	3	2
CO-5	3	2	3	3	2	3	2	3	1	2
Ave.	2.4	2.6	2.8	2.6	2.0	2.4	2.6	2.6	2.4	1.8

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER V			
DISCIPLINE SPECIFIC ELECTIVE I Basics of Computers and Biostatistics			
Course Code: 23UMIE51	**Hrs/Week:4**	**Hrs/Sem:60**	**Credits:4**

Objectives

- To identify different types of computer systems and software's used
- To study and describe the fundamental concepts and applications of computer.
- To describe appropriate statistical methods to quantify random and systematic effects in biological data
- To determine and validate the results of a hypothesis

Course outcome

CO No	**Upon completion of this course,students will be able to**	**Cognitive Level**
CO-1	Explain quantitative and comparative studies on various aspects of biological sciences	K2
CO-2	Define and construct empirical evidence in relation to bio statistical problems	K1
CO-3	Demonstrate the role of computers in scientific applications	K3
CO-4	Analyze the applications of software usage.	K4
CO-5	Defend hypothesis testing and standard values	K5

SEMESTER V			
DISCIPLINE SPECIFIC ELECTIVE I Basics of Computers and Biostatistics			
Course Code: 23UMIE51	**Hrs/Week:4**	**Hrs/Sem:60**	**Credits:4**

Unit I **(12Hrs)**

Introduction to computers - History - Components of computers-Working Principle-Types of computers-Tablet-Notebook-Smart phone- Impact of computers on society

Unit II **(12Hrs)**

Types of software - System software – Applications software - MS Office (Word and PowerPoint) – Usage of computer in education – cyber security – Threats to computer usage – Basics of computer networks

Unit III **(12Hrs)**

Recent Trends in Computer Science - IoT - applications- Mobile applications - E-Learning digital payments - Advantages of Social Networking – Internet search Engines – URLs,How to use web browser

Unit IV **(12Hrs)**

Biostatistics - Definition - Statistical methods - Basic principles. Variables - Measurements, Functions, Limitations and Uses of statistics. Collection of data - Methods of data collection procedures - merits and demerits.

Unit V **(12Hrs)**

Classification - Tabulation and Presentation of data - sampling methods. Central tendency Mean, Median, Mode, Geometric mean - merits & demerits. Measures of dispersion - Range, Standard deviation and Mean deviation.

Text book

1 B Antonisamy, Prasanna S. Premkumar, Solomon Christopher (2017): Principles and Practice of Biostatistics. Elsevier India

2 K. Janardhan P. Hanmanth Rao (2019): Fundamentals of Biostatistics. Publisher Dreamtech Press.

3. Attwood T and Parry D.(2009) Introduction to computers, Pearson Education Asia

Books for Reference

1 Baldi, B. & Moore, D. (2018). The Practice of Statistics in the Life Sciences. (4th ed.). New York, NY: W.H. Freeman and Company.

2 Anita Goel (2010) Computer fundamentals -Pearson India publishers ISBN: 9788131770948

3 A. Fielding.(1985) Computing for biologists,Benjamin/ Cuming Publishing Co, . New Jersey.

Web Resources

1. https://www.spiceworks.com/tech/tech-general/articles/what-is-computer-architecture/
2. https://www.geeksforgeeks.org/software-and-its-types/
3. https://www.geeksforgeeks.org/software-and-its-types/
4. https://www.simplilearn.com/what-is-statistical-analysis-article
5. https://statistics.laerd.com/statistical-guides/measures-central-tendency-mean-mode-median.php

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	3	3	3	2	1	2	2	2	2	1
CO-2	1	3	3	3	3	3	3	3	3	2
CO-3	2	3	3	3	3	2	3	2	3	2
CO-4	3	2	2	2	1	2	3	3	3	2
CO-5	3	2	3	3	2	3	2	3	1	2
Ave.	2.4	2.6	2.8	2.6	2.0	2.4	2.6	2.6	2.4	1.8

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER V			
DISCIPLINE SPECIFIC ELECTIVE I Biosafety and Bioethics			
Course Code: 23UMIE52	**Hrs/Week:4**	**Hrs/Sem: 60**	**Credits:4**

Objectives

- To understand the control measures of laboratory hazards (chemical, biological and physical) and to practice safety strategies and personal protective equipment
- To develop stratagems for the use of genetically modified organisms and Hazardous materials.

Course outcome:

CO No	Upon completion of this course,students will be able to	Cognitive Level
CO-1	Describe 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	K1
CO-2	Summarize and discuss rights in order to assist their application and promotion in the areas of science, biotechnology and medicine.	K2
CO-3	To discuss about various aspects of biosafety regulations, IPR and bioethics concerns arising from the commercialization of biotech products.	K3
CO-4	Outline the 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.	K4
CO-5	Evaluate the understand the importance of IPR, Patents and Patent laws.	K5

SEMESTER V			
DISCIPLINE SPECIFIC ELECTIVE I Biosafety and Bioethics			
Course Code: 23UMIE52	**Hrs/Week:4**	**Hrs/Sem:60**	**Credits:4**

Unit I **12 hrs**

Biosafety and risk assessment issues; Regulatory framework; National biosafety policies and law, The Cartagena protocol on biosafety, WTO and other international agreements related to biosafety, Cross border movement of germplasm; Risk management issues - containment.

Unit II **12 hrs**

General principles for the laboratory and environmental biosafety; Health aspects; toxicology, allergenicity, antibiotic resistance, etc., Impact on environment: gene flow in natural and artificial ecologies; Sources of gene escape, tolerance of target organisms, creation of superweeds/superviruses, etc.

Unit III **12 hrs**

Ecological aspects of GMOs and impact on biodiversity; Monitoring strategies and methods for detecting transgenics; Radiation safety and nonradio isotopic procedure; Benefits of transgenics to human health, society and the environment.

Unit IV **12 hrs**

The WTO and other international agreements; Intellectual properties, copyrights, trademarks, trade secrets, patents, geographical indications, etc.; Protection of plant variety and farmers right act; Indian patent act and amendments, patent filing; Convention on biological diversity; Implications of intellectual property rights on the commercialization of biotechnology products.

Unit V

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

Text Books

1. Usharani .B, S Anbazhagi, C K Vidya, (2019). Biosafety in Microbiological Laboratories- 1st Edition, Notion Press, ISBN-101645878856
2. Satheesh.M.K.,(2009). Bioethics and Biosafety- 1st Edition, J. K International Publishing House Pvt. Ltd: Delhi, ISBN :9788190675703

3. DeepaGoel and ShominiParashar, (2013). IPR, Biosaftey and Bioethics- 1st Edition, Pearson education: Chennai, ISBN-13: 978-8131774700
4. Rajmohan Joshi (2006). Biosafety and Bioethics. Gyan Books publisher.

Books for Reference

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management, India, IN: Cengage Learning India Private Limited, ISBN-10: 9386668572
2. Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights, India, IN: PHI learning Private Limited, ISBN : 9788120349896
3. 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, EzebuiroNwagboChristpeace, Charles OluwaseunAdetunji, Abdulrazak B. Ibrahim, Benjamin Ewa Ubi
4. Sree Krishna. V(2007). Bioethics and Biosafety in Biotechnology. New age international publishers.

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	2	3	2	3	2	2	1	2	2
CO-2	2	3	2	3	2	2	1	2	1	3
CO-3	3	2	3	2	1	2	3	2	2	1
CO-4	2	3	2	3	2	2	1	3	2	3
CO-5	2	3	2	2	3	3	1	2	2	3
Ave.	2.2	2.6	2.4	2.2	2.2	2.2	1.6	2.0	1.8	2.4

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER V	
SELF STUDY (OPTIONAL) Probiotics	
Course code: 23UMISS2	**Credits: +2**

Objectives:

- To provide the learners with the best learning experience in Probiotics by self-study education and enabling the students to become entrepreneurs and socially responsible.

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive level
CO-1	Summarize the basic knowledge on probiotics	K2
CO-2	Describe the characteristics of probiotics	K1
CO-3	Evaluate the probiotics organisms	K5
CO-4	Compile the knowledge on the roles of probiotics.	K3
CO-5	Outline the probiotics and prebiotics	K4

SEMESTER V	
SELF STUDY (OPTIONAL) PROBIOTICS	
Course code: 23UMISS2	**Credits: +2**

Unit I:

Introduction and history of Probiotics, Probiotic microorganisms.

Unit II:

Characteristics of Probiotics for selection: Tolerance to additives, stability during storage, stability maintenance of probiotic microorganisms.

Unit III:

Role of Probiotics in health and disease: prevention and treatment of gastro-intestinal bacterial infection treatment of chronic urinary tract infection, antitumor and cholesterol level.

Unit IV:

Mechanism of probiotics: production of antimicrobial substances, modulation of immune system, alteration of intestinal bacterial metabolite action.

Unit V:

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.

Text books:

1. Salminen. S and Wright A. V. (1998). *Lactic Acid Bacteria*, Marcel Dekker.

2. Glenn R. G. Marcel R. (2008) *Handbook of Prebiotics* CRC press.

Books for References:

1. LeeY K, Salminen S (2009) *Handbook of Probiotics and Prebiotics* . A John Willey and Sons Inc. Publication.

2. Sandholm. T. M. Saarela M (2003) *Functional Dairy Products* CRC Wood- head Publishing Limited.

Web resources:

1. https://www.nccih.nih.gov/health/probiotics-what-you-need-to-
2. https://www.vedantu.com/biology/probiotics
3. https://en.wikipedia.org/wiki/Prebiotic_(nutrition)

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	2	3	2	3	2	2	1	2	2
CO-2	2	3	2	3	2	2	1	2	1	3
CO-3	3	2	3	2	1	2	3	2	2	1
CO-4	2	3	2	3	2	2	1	3	2	3
CO-5	2	3	2	2	3	3	1	2	2	3
Ave.	2.2	2.6	2.4	2.2	2.2	2.2	1.6	2.0	1.8	2.4

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER VI			
CORE IX Food Microbiology			
Course Code: 23UMIC61	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Objectives:

- To highlight the basic concepts and principles about the techniques in food microbiology and advanced level information about food microbiology.
- To enhance the students with the basic knowledge on various techniques involved in food production and preservation.

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Recall food microbiology and classify food.	K1
CO-2	Explain food as a substrate for microorganisms and determines microbial contamination of food.	K2
CO-3	Compile food preservation- physical and chemical methods.	K3
CO-4	Analyze the causes of food spoilage-fruits, vegetables,dairy products, meat and fish.	K4
CO-5	Evaluate food borne disease and food spoilage.	K5

SEMESTER VI			
CORE IX Food Microbiology			
Course Code: 23UMIC61	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Unit – I **(12 hours)**

Food as a substrate for microorganisms- Microorganisms important in food microbiology- Bacteria, Molds and Yeasts- Brief account of each group – General characteristics and importance – Microbiological examination of food - Microscopic techniques. Direct microscopic examination, totalcolony counts and differential enumeration and Most probable number

Unit- II **(12 hours)**

Microbial contamination of foods - spoilage of food by microbes in cereals and cereal products- Eggs and poultry – meat – fish, fruits, vegetables and its dried products- pickles- bread – canned foods.

Unit- III **(12 hours)**

Methods of food preservation: Aseptic handling, removal of microorganisms, anaerobicconditions, heat processing, refrigeration and freezing, drying, osmotic pressure- Chemical preservatives - Radiation- UV light, irradiation – Canning.

Unit- IV **(12 hours)**

Food poisoning- Food borne diseases- Food intoxication and Food infection- Bacterialtoxins (*Staphylococcus*, *Clostridium*, *Escherichia* and *Salmonella*) – Fungal (Mycotoxins) – Viral (Hepatitis A-E) – Protozoan (*Entamoeba Histolytica*)- Algal (Ciguatoxin).

Unit-V **(12 hours)**

Microbial standards in food – *fssai* – Hazard Analysis Critical Control point (HACCP) -Food laws and Regulations- FAO, FDA, WHO, AGMARK, ISI, ISO. - BIS Laboratory Services, BIS product certification and licensing quality systems. Food Hygiene and sanitation.

Text Book:

1. Frazier, W.C. and Westhoff, D.C. (2008.) *Food Microbiology*. 4th Edition. TataMcGraw-Hill publishing Co Ltd., New Delhi:

Books for Reference:

1. Adams, M.R. and Moss, M.O.(1995) *Food Microbiology*. 4thedition, McGraw Hill, New York.
2. Jay, J.M. *Modern Food Microbiology*.(2006) CBS Publishers and Distributors.,New Delhi.
3. Hobbs, B.C. and Roberts, D.(1993) *Food Poisoining and Food Hygiene*, London

Web Resources

1. https://www.slideshare.net/subliminalMaC/microorganisms-important-in-food-microbiology-bacteria-yeast-molds
2. https://microbenotes.com/spoilage-cereal-products/
3. https://www.healthline.com/health/aseptic-technique
4. https://dchealth.dc.gov/service/food-borne-infections-and-intoxications

5. https://krishi.icar.gov.in/jspui/bitstream/123456789/20496/1/HACCP.pdf

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	1	3	3	3	3	2	1	1	3
CO-2	1	3	1	2	1	3	1	2	2	3
CO-3	3	3	2	1	1	2	3	3	2	2
CO-4	2	2	2	2	1	2	2	3	2	2
CO-5	2	2	2	2	3	3	3	2	2	3
Ave.	2	2.2	2	2	1.8	2.6	2.2	2.2	1.8	2.6

Mapping	<40%	≥ 40% and <70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER VI			
CORE X Immunology			
Course Code: 23UMIC62	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 4**

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 essential information on body defence lines and biological barriers
- To be familiar with transplantation and tumour immunology

Course outcome

CO No	Upon completion of this course,students will be able to	Cognitive Level
CO-1	List antigens and antibodies types and properties	K1
CO-2	Explain principle of immunoassays	K2
CO-3	Relate types of hypersensitivity reaction	K3
CO-4	Investigate specific and nonspecific auto immune disorder	K4
CO-5	Discriminate immune response to tumor and cancer therapy	K5

SEMESTER VI			
CORE X Immunology			
Course Code: 23UMIC62	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 4**

Unit I **(12 Hrs)**

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; Physiology of immune response- innate, humoral and cell mediated immunity

Unit II **(12 Hrs)**

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.

Unit III **(12 Hrs)**

Immunoassay and Immunotechniques - Preparation and standardization of bacterial antigens; Raising of monoclonal and polyclonal antibodies; Purification of antibodies. Immunotechniques - RIA, RAST, Immuno fluorescence techniques and Flow cytometry

Unit IV **(12 Hrs)**

Transplantation and TumorImmunology - MHC Antigens - structure and function; HLA system - Transplantation immunology - tissue transplantation and grafting; Mechanism of graft acceptance and rejection; HLA typing; Tumour specific antigens; Immune response to tumors; cancer immune therapy

Unit V **(12 Hrs)**

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.

Text books

1. Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5thEdition., Wiley-Blackwell, New York.
2. Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7thEdition., W. H. Freeman and Company, New York.
3. 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.
4. Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. (2021). Cellular and Molecular Immunology, 10thEdition., Elsevier.

Books for Reference

1.Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
2. Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11thEdition., Wiley-Blackwell
3. William R Clark. (1991). The Experimental Foundations of Modern Immunology. 3rdEdition. John Wiley and Sons Inc. New York.
4. Frank C. Hay, Olwyn M. R. Westwood. (2002). Practical Immunology, 4thEdition., Wiley-Blackwell.

Web Resources

1. https://www.histology.leeds.ac.uk/lymphoid/prim_sec_lymp_tiss.php
2. https://www.deshbandhucollege.ac.in/pdf/resources/1589561583_LS-VI-Immuno-Unit_3.1.pdf
3. https://www.mdpi.com/2079-6374/13/10/921
4. https://www.ncbi.nlm.nih.gov/books/NBK459467/

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	1	3	2	2	2	2	3	2	2	2
CO-2	2	2	1	2	2	1	2	2	3	3
CO-3	1	3	2	3	1	2	2	3	3	1
CO-4	2	3	2	1	2	3	1	2	2	1
CO-5	2	1	3	2	1	2	3	2	2	3
Ave.	1.6	2.4	2..0	2.0	1.6	2.0	2.2	2.2	2.4	2.0

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER VI			
CORE XI Pharmaceutical Microbiology			
Course Code : 23UMIC63	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Objectives:

- To provide the knowledge on basics of chemotherapy.
- To learn the assays and testing methods of antibiotics.
- 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 Outcome:

CO. No	Upon completion of this course, students will be able to	Cognitive Level
CO- 1	Identify the basics of chemotherapy and action of antibiotics	K1
CO- 2	Interpret the microbiological assay of antibiotics	K2
CO -3	Analyse Microbiological standardization of Pharmaceuticals ,sterility testing of pharmaceutical products and apply sterilization in pharmaceutical industry	K4
CO -4	Evaluate the process and develop new strategies for rational drug design	K5
CO-5	Implement the preservation system employed on pharmaceuticals.	K3

SEMESTER VI			
CORE XI Pharmaceutical Microbiology			
Course Code : 23UMIC63	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Unit I: **(12 hours)**

Introduction to Pharmaceutical microbiology: Ecology of microorganisms in pharmaceutical industry: Atmosphere, water, skin and respiratory flora of workers, raw materials, packaging, building and equipments and their control measures; Design and layout of sterile manufacturing.

Unit II: **(12 hours)**

Sterilization of pharmaceutical products: Heat, gaseous, radiation and filtration. Pharmaceutical Formulation (Tablets, Capsule, Oinments, Syrup, Gel), stages of pharmaceutical product development.

Unit III: **(12 hours)**

Production of antibiotics: Production of antibacterial – Penicillin; antifungal – Griseofulvin; antiparasitic agents – Metronidazole; Semi-synthetic antibiotics; Additional application of microorganisms in pharmaceutical sciences: Enzymes- Streptokinase; Immobilization procedures for pharmaceutical applications (liposomes); Biosensors in pharmaceuticals.

Unit IV: (12 hours)

Production of immunological products and their quality control: Vaccines - DNA vaccines, synthetic peptide vaccines, multivalent vaccines; Vaccine clinical trials; Immunodiagnostics - immuno sera and immunoglobulin; Quality control in Pharmaceutical: In – Process and Final Product Control; Sterility tests.

Unit V: (12 hours)

Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. Objectives of preservation, the ideal preservative, preservative system. Antimicrobial preservatives and their properties. Preservative stability and efficacy.

Textbooks:

1. Chand Pasha Kedernath. (2021). Text book of Pharmaceutical Microbiology. Ramnath Publisher.
2. Hugo WB and Russell AD. (2004).Pharmaceutical Microbiology VII edition. Blackwell Scientific Publication, Oxford.
3. Franklin,DJ. and Snow, GA. (2013). Biochemistry of antimicrobial action.Chapman& Hall.
4. Kuntal Das (2019). Pharmaceutical Microbiology, second edition, NiraliPrakashan.
5. Priyatama Powar, Shital Nimbargi, Vaijayanti Sapre (2020). Pharmaceutical Microbiology, I edition, Technical publications.

Books for Reference:

1. Handa, S.S. and Kapoor, V.K. (2022) .Pharamcognosy. 4thEdition.VallabhPrakashanPublishers,New Delhi.
2. Kokate, C.K., Durohit, A.P. and Gokhale, S.R.,(2002). Pharmacognosy. 12thedition
3. NiraliPrakasham Publishers, Pune.
4. S. P. Vyas & V. K. Dixit.(2003). Pharmaceutical Biotechnology. CBS Publishers & Distributors, New Delhi.
5. Wallis, T.E. (2005). Text book of Pharmacognosy. 5th edition. CBS publishers and distributors, New Delhi.

6. Garrod, L.P., Lambert, HP. And C'Grady, F. (1973). Antibiotics and Chemotherapy. (eds). Churchill Livingstone.

Web Resources

1. https://onlinelibrary.wiley.com/doi/abs/10.1002/9780470988329.ch15
2. https://www.iptsalipur.org/wp-content/uploads/2020/08/502T_IP2_UNIT-_II.pdf
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9933091/
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10383774/
5. https://ebooks.inflibnet.ac.in/ftp03/chapter/preservatives-and-antimicrobial-agents-for-the-food-industry/

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	**Programme Outcomes (PO)**					**Programme Specific Outcomes (PSO)**				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	2	3	3	1	3	3	2	3	3	3
CO-2	2	3	2	2	1	2	2	2	3	2
CO-3	2	3	2	3	3	1	2	1	2	1
CO-4	1	2	2	3	2	3	3	1	2	1
CO-5	1	2	2	2	2	1	3	2	2	1
Ave.	1.6	2.6	2.2	2.2	2.2	2	2.4	2	2.4	1.6

Mapping	<40%	≥ 40% and <70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER VI			
CORE PRACTICAL VII Practical in Food Microbiology			
Course Code : 23UMICR7	**Hrs/Week: 2**	**Hrs/Sem: 30**	**Credits: 1**

Objectives:

- To highlight the techniques involved in food and industrial microbiology
- To expose the students to different processes used in industries, food production and preservation.
- To get information about thespoilage microorganisms.

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Evaluate the milk quality and working place hygiene	K1
CO-2	Interpret the microbial examination of food materials	K2
CO-3	Produce isolation of yeast from idly batter	K3
CO-4	Analyze mycotoxin in fungal contaminated food materials.	K4
CO-5	Evaluate soft drinks by MPN method	K5

SEMESTER VI			
CORE PRACTICAL VII Practical in Food Microbiology			
Course Code : 23UMICR7	**Hrs/Week: 2**	**Hrs/Sem: 30**	**Credits: 1**

1. Evaluation of Milk quality- Resazurin method.
2. Swab test and air sampling - worker's hand, surface, working table.
3. Microbiological analysis of Curd- TVC
4. Microbial Examination of Fruits - Surface washing and internal tissues- TVC.
5. Microbial Examination of Vegetables - Surface washing and internal tissues- TVC.
6. Microbial examination of Meat- Surface washing and internal tissues- TVC.
7. Microbial examination of Fish- Surface washing and internal tissues- TVC.
8. Isolation of yeast from idly batter.
9. Testing of soft drinks by MPN method (Demonstration)
10. Wine production using yeast.(Demonstration)
11. Industrial visit.

Books for Reference:

1. Cappuccino J.G. and Sherman N.(1996.) Microbiology : *A Laboratory manual*,Benjamin Cummings Publishing Co. Inc,. San Francisco
2. David greenwood, Richard. B., Slack & John. F.,(2002) 16th edition. *Medical microbiology*. Peutherer,
3. Murray P.R; Baron E.J; Jorgerson J.H; Pfaller M.A. and Yolker R.H.(2003) *Manual of Clinical microbiology*, Vol. 1 & 2 8th edition ASM Poem
4. Gunasekaran, P.(1996.) *Laboratory Manual in Microbiology.* New Delhi: New Age International Ltd., Publishers,
5. Jayaraman, J.,(1985) *Laboratory Manual in Biochemistry* WileyEasternLtd., . New Delhi
6. Dubey, R.C.and Maheswari, (2002.) D.K. *Practical Microbiology*, India: Chandand Company Ltd., 1st edition.

Web Resources

1. https://www.aicompanies.com/education-training/knowledge-center/alkaline-phosphatase-testing-for-pasteurized-milk/
2. https://www.ijsr.net/archive/v10i2/SR21211121624.pdf
3. https://simdos.unud.ac.id/uploads/file_penelitian_dir/bebf6a432de377c893650bde7b946b68.pdf
4. https://www.cfs.gov.hk/english/food_leg/files/food_leg_Microbiological_Guidelines_for_Food_e.pdf

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	2	1	3	3	3	3	2	1	1	3
CO-2	1	3	1	2	1	3	1	2	2	3
CO-3	3	3	2	1	1	2	3	3	2	2
CO-4	2	2	2	2	1	2	2	3	2	2
CO-5	2	2	2	2	3	3	3	2	2	3
Ave.	2	2.2	2	2	1.8	2.6	2.2	2.2	1.8	2.6

Mapping	<40%	≥ 40% and <70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER VI
CORE PRACTICAL VIII Practical in Immunology and Pharmaceutical Microbiology

Course Code: 23UMICR8	Hrs/Week: 4	Hrs/Sem: 60	Credits: 2

Objective

- To screen and understand morphological and physical, properties of cells of the immune system using smear techniques.
- To describe the basic principle of antigen – antibody interaction through agglutination and precipitation method.
- To learn the sterility of pharmaceutical products.
- To understand enzyme immobilization and to know the isolation and screening of pharmaceutically important microbes.

Course outcome

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Describe Heme agglutination tests for identification ofdifferent antigens.	K1
CO-2	Explain principle of immunoassays	K2
CO-3	Analyze the role of industrially important microbes in obtaining human high value products	K4
CO-4	Estimate the safety of pharmaceutical products	K5
CO-5	Construct an conducive environment to discover newantibiotic producing microorganisms	K3

SEMESTER VI			
CORE PRACTICAL VIII Practical In Immunology and Pharmaceutical Microbiology			
Course Code: 23UMICR8	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 2**

1. WIDAL test–qualitative assay
2. Identification of various immune cells by morphology using - Leishman and Giemsa stainingmethod
3. Urine culture and its microbiological analysis (*E.coli*)
4. Single Radial Immunodiffusion
5. Haemagglutination tests with reference to blood grouping and Rh factor
6. ELISA HIV/HBSAg - (Demonstration)
7. Rose Bengal test
8. Diagnostic test for Rheumatoid arthritis - anti-cyclic citrullinated peptide (anti-CCP) antibodies
9. Sterility test for pharmaceutical products (any two product)
10. Isolation of antibiotic producing microorganism.
11. Screening of antibiotic producing microorganism.
12. Microbiological assay of antibiotics by cup plate method
13. Enzyme Immobilization

Books for Reference

1. Kanika L Mukherjee,(2007) Medical Laboratory Technology, Vol.I,II and III. A procedure manual for routine diagnosis tests. Tata McGraw–Hill Publishing Co.,Ltd., New Delhi:
2. Dubey,R.C.and Maheswari,D.K.(2002) Practical Microbiology. 1stEditionChand and CompanyLtd., Chenai.
3. Frank Hay, (2009)Practical immunology, 4th Edition , Blackwell Science
4. J Cappuccino J.G. and Sherman N. (1997) Microbiology A Laboratory manual, Benjamin Cummings Publishing Co. Inc,. S an Fr an cis co
5. Murray P.R; BaronE.J; Jorgerson J.H;P faller M.A.and Yolker R.H.(2003) Manual of Clinical microbiology, 8thedition.Vol. 1 &2. ASM Poem Washington D.C

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	3	2	3	1	2	3	2	3	2	3
CO-2	3	2	3	1	1	3	2	3	2	3
CO-3	3	2	2	1	1	3	2	3	2	3
CO-4	3	2	2	1	1	3	2	2	3	3
CO-5	3	1	2	1	2	3	2	2	3	3
Ave.	3	1.8	2.4	1	1.4	3	2	2.6	2.4	3

Mapping	<40%	≥40% and < 70%	≥ 70%
Relation	Low level	Medium level	High level
Scale	1	2	3

SEMESTER VI			
CORE XII Project and Viva voce			
Course Code:23UMIP61	**Hrs/ Week: 6**	**Hrs/ Sem: 90**	**Credits: 4**

Objective

- To enable students to get hands-on training in microbiological techniques needed for research.
- To promote team work and collaboration and convert scientific ideas to reality
- To enable students to share pooling of knowledge and skills
- To assist students to choose a research design, solve real life problems and benefit the society at large

Course outcome

CO No	**Upon completion of this course,students will be able to**	**Cognitive Level**
CO-1	Find the significance of data analysis in research	K1
CO-2	Explain scientific concept and research theme	K2
CO-3	Demonstrate different hypothesis invented by the researcher to the concerned title	K3
CO-4	Examine outcome of the research to the society and scientific community	K4
CO-5	Defend the research gap and challenges to adopt for the improvement	K5

SEMESTER VI			
CORE XII Project and Viva voce			
Course Code:23UMIP61	**Hrs/ Week: 6**	**Hrs/ Sem: 90**	**Credits: 4**

Guidelines for group project:

A research problem need to be selected based on creative ability and scientific thought.

A brief description of the problem needs to be given.

Hypothesis statement should be framed.

Objectives by which the project work is to be carried out should be clearly stated.

Methodology has to be designed to test the hypothesis.

Results obtained need to be replicable.

Documented report has to be submitted on completion of the project.

PRESENTATION OF SCIENTIFIC FINDINGS: Each student will have to present their scientific finding so individual work(or)collaborative work in any State / Regional / National International Seminar or Symposia. Alternatively, they can attend any workshops conducted by the State / National Organizations of Scientific Recognition. Abstracts/Papers presented along with certificates will have to be produced during examination. Scientific papers published in Journals / Proceedings during his /her Master Program will be given special weightage.

GENERAL VIVA- VOCE The examiners shall conduct a General Viva-Voce pertaining to the core course papers as an overall component.

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	3	3	2	2	3	2	3	2	2	2
CO-2	2	3	1	2	2	1	2	2	3	3
CO-3	3	3	2	3	3	2	2	3	3	1
CO-4	2	3	2	1	2	3	1	2	2	2
CO-5	2	1	3	2	2	2	3	3	2	3
Ave.	2.4	2.6	2..0	2.0	2.4	2.0	2.2	2.4	2.4	2.2

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER VI			
DISCIPLINE SPECIFIC ELECTIVE II Bioinformatics			
Course code: 23UMIE61	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits:3**

Objectives

- Understand the basics of bioinformatics and its role in biosciences.
- Gain knowledge about biological database and its types.
- Familiarize with the nucleotide sequence databases.
- Know about proteomics and genomics.
- Understand gene finding, protein prediction, phylogenetic analysis and drug designing.

Course Outcome:

CO No	Upon completion of this course, students Will be able to	Cognitive Level
CO-1	Describe how to develop an understanding of the basic concepts of bioinformatics	K1
CO-2	Summarize and explain the methods in database	K2
CO-3	Known to predict the collection, processing and Presentation of data	K3
CO-4	Outline measures of protein and its structure	K4
CO-5	Evaluate the acquire knowledge on the application of bioinformatics and drug designing.	K5

SEMESTER VI			
DISCIPLINE SPECIFIC ELECTIVE II Bioinformatics			
Course code: 23UMIE61	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credit:3**

Unit-I:

Introduction to Bioinformatics, Sequences used in Bioinformatics – DNA, RNA and Protein Sequences, Scope and application of Bioinformatics.

Unit-II:

Biological databases and its significance – objectives, properties and classification of biological databases, Hard – link relationships between databases, Symbols used in databases.

Unit-III:

Biological database NCBI – Gen Bank, EMBL, DDBJ. Sequence Alignment Pairwise (BLAST and FASTA) and multiple sequence alignment (Clustal W).

Unit IV:

Proteomics – Structure of Protein; Nomenclature of Protein Sequences; Protein Database Swiss PROT, SCOP, CATH. Protein visualization tools – RASMOL, Swiss PDB viewer

Unit V:

Gene finding, protein prediction, Phylogenetic Tree Construction - Concept of Dendrograms. Evolutionary Trees & Drug designing.

Text Book

1. K.Mani and Vijayaraj. (2002) Bioinformatics for beginners, McGraw–Hill Publishing Co.,Ltd., New Delhi
2. S.Sudarrajan (2009) Introduction to Bioinformatics ASM Poem Washington D.C

Books for reference:

1. A.D.Baxevanis and B.J.Francis(Eds) (1998). "Bio-informatics"- A practical guide to the analyzing of gene protein", John Wiley and Sons.

2 .David W.Mount (2001). Bioinformatics Sequence and Genome analysis, McGraw–Hill Publishing Co.,Ltd., New Delhi

3.Stuart M. (2000). Bioinformatics–A biologist's guide to bio-computing and the internet,

Web Resources

1. https://omicstutorials.com/what-are-sequence-databases-and-how-are-they-used-in-bioinformatics/
2. https://www.geeksforgeeks.org/difference-between-hard-link-and-soft-link/
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC29766/

4. https://peakproteins.com/wp-content/uploads/2022/06/PPP_Protein-Construct-Naming-Convention.pdf
5. https://academic.oup.com/mbe/article/30/5/1229/992850

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	1	3	2	3	1	2	1	2	2
CO-2	2	3	2	3	2	2	1	2	1	3
CO-3	3	2	3	2	1	2	3	2	2	1
CO-4	2	3	1	1	2	2	1	3	2	3
CO-5	2	3	2	2	3	3	1	2	2	3
Ave.	2.2	2.4	2.2	2.0	2.2	2.0	1.6	2.0	1.8	2.4

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER VI			
DISCIPLINE SPECIFIC ELECTIVE II Entrepreneurship and Bio business			
Course Code: 23UMIE62	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 3**

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 Outcome	On completion of this course, students will;	**Cognitive Level**
CO1	Describe and apply several entrepreneurial ideas and business theories in practical framework.	K1
ஊழ2	ீசழனரஉந வாந டிரளனைநெளள நஎெசைழஎஅநவெ னை ழசனநச வழ னைநவெகைல டிரளனைநெளள ழீழிசவரவைனைநளஇ னைநவெகைல வாந நடநஅநவெள ழக ளரஉஉநளள ழக நவெசநிசநநெரசயைட எநவெரசநளஇ நஎயடரயவந வாந நககநஉவளைநநெளள ழக னகைககநசநவெ நவெசநிசநநெரசயைட ளவசயவநபனைநள யனெ வைநெசிசநவ வாநசை ழறெ டிரளனைநெளள டயெ.	K3
CO3	Express the mass production of microbial inoculants used as Biofertilizers and Bioinsecticides in response with field application and crop response.	K2
CO4	Analyze the application and commercial production of Monoclonal antibodies	K4
CO5	Evaluate and apply knowledge of the regulation of biotechnology industries,	K5

SEMESTER –VI			
DISCIPLINE SPECIFIC ELECTIVE II Entrepreneurship and Bio business			
Course Code: 23UMIE62	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 3**

Unit-I **(12 hrs)**

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.

Unit-II **(12 hrs)**

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.

Unit-III **(12 hrs)**

Entrepreneurship Opportunity in Industrial Biotechnology**:** Business opportunity, Essential requirement, marketing strategies, schemes, challenges, and scope- Pollution monitoring and Bioremediation for Industrial pollutants. Integrated compost production- microbe enriched compost.

Unit-IV **(12 hrs)**

Therapeutic and Fermented products: Stem cell production, stem cell bank, production of monoclonal/polyclonal antibodies, secondary metabolite production –probiotic and prebiotics.

Unit-V **(12 hrs)**

Project Management, Technology Management and Startup Schemes: Building Biotech business challenges in Indian context-biotech partners (BIRAC, DBT, Incubation centers. etc.,), operational biotech parks in India. Project proposal preparation, Successful start-ups-case study.

Text Books

1. Craig Shimasaki. (2014). Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Academic Press.
2. Ashton Acton, O. (2012). Biological Pigments– Advances in Research and Application Scholorly Editions: Atlanta, Georgia.
3. Jennifer Merritt, Jason Feifer (2018). Start Your Own Business, 7th edition, Entrepreneur Press publisher.
4. Peter F. Drucker (2006). Innovation and Entrepreneurship. Harper Business publisher.

5. Leah Cannon (2017). How to Start a Life Science Company: A Comprehensive Guide for First-Time Entrepreneurs. International Kindle paperwhite.

References Books

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

Web Resources

1. https://projects4mba.com/swot-analysis-of-bharat-biotech/4974/
2. https://www.business.qld.gov.au/running-business/marketing-sales/marketing/strategy-planning/writing-strategy-plan
3. https://etheses.whiterose.ac.uk/4021/
4. https://www.coriell.org/1/Services/Stem-Cells/Stem-Cells-at-Coriell?gad_source=1&gclid=EAIaIQobChMIseKA3dWJhQMVTotLBR3CNQ_vEAAYAyAAEgKoPfD_BwE
5. https://www.fool.com/the-ascent/small-business/project-management/articles/project-proposal/

Mapping of Course Outcomes with POs and PSOs

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	3	2	2	2	1	1	2	2	3	2
CO-2	2	3	1	1	2	2	1	2	2	3
CO-3	3	2	1	3	2	3	2	1	1	3
CO-4	2	1	2	2	3	3	3	1	2	1
CO-5	2	3	1	1	3	2	2	3	3	1
Ave.	2.4	2.2	1.4	1.8	2.2	2.2	2.0	1.8	2.2	2.0

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

SEMESTER VI			
SKILL ENHANCEMENT COURSE VI Microbial Quality Control and Testing			
Course Code : 23UMISE6	**Hrs/Week: 2**	**Hrs/Sem: 30**	**Credits: 2**

Objectives:

- To highlight the basic concepts and principles about the microbial quality control products.
- To analyze laboratory testing, control & safety process.

Course Outcome

CO. No	Upon completion of this course, students will be able to	Cognitive Level
CO- 1	Recall the techniques for application in the field of quality control and quality assurance.	K1
CO- 2	Explain the skills involved execution of microbiological techniques and to develop the good laboratory practices.	K2
CO -3	Compile the food safety regulations , its standards and auditing.	K3
CO -4	Analyze laboratory testing, Control & safety process.	K4
CO-5	Evaluate microbial standards to establish the quality of food products.	K5

SEMESTER VI			
SKILL ENHANCEMENT COURSE VI Microbial Quality Control and Testing			
Course Code : 23UMISE6	**Hrs/Week: 2**	**Hrs/Sem: 30**	**Credits: 2**

Unit I **(6 hours)**

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: SSOP, Good laboratory practices, Good microbiological practices.

Unit II **(6 hours)**

Auditing-Scope of the standard terms & definitions, internal audit, External audit, combined audit, Joint Audit. Principal of auditing, competence and evaluations of auditors, quality management principles. ISO 9001: 2000, quality management system, Clauses of ISO 9001: 2000.

Unit III **(6 hours)**

Standardization and accreditation **:** Introduction, International accreditation forum (IAF), Internal Laboratory Accreditation Cooperation (ILAC), Quality Council of India (QCI), National Accreditation Board for Testing and Calibration Laboratories (NABL).

Unit IV **(6 hours)**

Quality Control & Selection**:** Introduction, Legislative requirement, FSA surveillance, Laboratory accreditation and quality control, proficiency testing, Analytical methods: codex Alimentarius commission, European Union, other organizations.

Unit V **(6 hours)**

Radiation: Safety of use of irradiated food, preservation of food by radiation, measurement of radiations, specific type of radiations treatment for safety of food, uses of radiations and prevention of food adulteration.

Textbook:

1. Brown.M.R.W. (2017).Microbiological Quality Assurance
A Guide Towards Relevance and Reproducibility of Inocula,1st Edition. CRC press.
2. Bhatnagar, D. and Cleveland, T. (Eds.). (1992). Molecular Approaches to Improving Food Quality and Safety. Van Nostrand Reinhold, New York
3 .Hubbert. W and Hagstad, H. (1996). Food Safety & Quality Assurance. 2nd ed. Iowa State University Press, Ames, Iowa

Books for Reference:

1 Rosamund M. Baird, Norman A. Hodges, Stephen P. Denyer. (2000). *Handbook of Microbiological Quality Control in Pharmaceuticals and Medical Devices*. 1 st Edition, CRC Press.

2 Konieczka, (2012). *Quality Assurance and Quality Control in the Analytical Chemical Laboratory A Practical Approach* (Hb), Routledge, Taylor and Francis group.

3. Singh Gajjar, Budhrani, Usman. (2021). Quality Control And Quality Assurance (M.Pharm)SVikas And Company.

4 .Jones, J. (1992). *Food Safety*. 2nd ed. Eagen Press, St. Paul Minnesota

5.Sohrab.(2001) *A Practical Guide For Implementation Of Integrated ISO 9001 HACCP System For Food Processing Industries*. Allied Publishers.

Web Resources

1.https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/microbiological-quality

2 https://www.audit.pitt.edu/services/audit-services/audit-scope-and-objectives

3 https://en.wikipedia.org/wiki/International_Laboratory_Accreditation_Cooperation

4 https://portal.nebih.gov.hu/documents/10182/323940/ma35_06e.pdf/eaabdf50-a368-4df6-a372-d51d130c8c3a

5 https://www.iaea.org/topics/food-irradiation

Mapping of Course Outcomes with Pos and PSOs

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	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	1	3	3	3	3	2	1	1	3
CO-2	1	3	1	2	1	3	1	2	2	3
CO-3	3	3	2	1	1	2	3	3	2	2
CO-4	2	2	2	2	1	2	2	3	2	2
CO-5	2	2	2	2	3	3	3	2	2	3
Ave.	2	2.2	2	2	1.8	2.6	2.2	2.2	1.8	2.6

Mapping	<40%	≥ 40% and <70%	≥ 70%
Relation	Low Level	Medium Level	High Level
	1	2	3