ST. MARY'S COLLEGE (Autonomous)

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

Thoothukudi - 628001, Tamil Nadu

(Affiliated to Manonmaniam Sundaranar University)

Syllabus

M.Sc. Microbiology

School of Biological Sciences

Outcome Based Curriculum

(W.e.f.2024)

Preamble

Microbiology is a wide area of science that includes Bacteriology, Virology, Mycology, Phycology, Parasitology and other branches of biology. Microbiology is the study of microorganisms which are unicellular or cell cluster microscopic organisms this include eukaryotes such as Fungi and protests and prokaryotes such as bacteria and certain algae also viruses are included, the scope of microbiology in huge and have involvement in various fields such as pharmacy, medicine, clinical, research, agriculture, dairy industry, water industry, nanotechnology and chemical technology.

Vision

To make young woman as an effective science personalities 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 Postgraduate programme the students of St. Mary's College will be able to
PO 1	acquire expertise knowledge in their respective disciplines and become professionals.
PO 2	develop critical/logical thinking skills, managerial skills and become locally, nationally & globally competent and be a lifelong learner
PO 3	pursue research / higher learning programme & apply their experiment and research skills to analyse and solve complex problems.
PO 4	compete in the job market by applying the knowledge acquired in Arts, Science, Economics, Commerce and Management studies
PO 5	be an empowered and economically independent woman with efficient leadership qualities and develop the themselves as a holistic person

Programme Specific Outcome:

PSO No	Upon completion of M.Sc. Microbiology Degree Programme, the Postgraduates will be able to
PSO-1	Prepare the students in varied disciplines like agriculture, industry - medical, pharma, dairy, hotel, food and food processing, immunological, cosmetics, 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 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	Develop as an empowered and economically independent women by various laboratory techniques

Department of Microbiology

PG Microbiology

Course Structure (w. e. f 2024)

Semester – I

Components	**Course Code**	**Course Title**	**Contact Hours / Week**	**Credits**	**Max Marks**		
					CIA	ESE	Total
Core I	24PMIC11	General Microbiology	6	5	40	60	100
Core II	24PMIC12	Microbial Diversity	5	4	40	60	100
Core III	24PMIC13	Microbial Physiology	5	4	40	60	100
Core Practical I	24PMICR1	Practical in General Microbiology and Microbial Diversity	4	2	40	60	100
Core Practical II	24PMICR2	Practical in Microbial Physiology	4	2	40	60	100
Discipline specific Elective I	24PMIE11 / 24PMIE12	**Biochemistry** / Epidemiology	3	2	40	60	100
Skill Enhancement Course I	24PMISE1	Bioinstrumentation	3	3	40	60	100
		Total	**30**	**22**			

Semester – II

Components	Course Code	Course Title	Contact Hours / Week	Credits	Max Marks		
					CIA	ESE	Total
Core IV	24PMIC21	Medical Bacteriology and Mycology	6	5	40	60	100
Core V	24PMIC22	Medical Virology and Parasitology	5	4	40	60	100
Core VI	24PMIC23	Immunology	5	4	40	60	100
Core Practical III	24PMICR3	Practical in Medical Bacteriology, Mycology Virology and Parasitology	4	2	40	60	100
Core Practical IV	24PMICR4	Practical in Immunology	2	1	40	60	100
Discipline specific Elective II	24PMIE21 / 24PMIE22	**Marine Microbiology** / Toxicology	4	3	40	60	100
Skill Enhancement Course II	24PMISE2	Sea Food Processing and Preservation	4	3	40	60	100
MOOC (Compulsory)				+2			
Total			**30**	**22+2**			

Note : MOOC should be completed in the I Year.

Internship can be completed during the II Semester vacation.

Semester – III

Components	Course Code	Course Title	Contact Hours / Week	Credits	Max Marks		
					CIA	ESE	Total
Core VII	24PMIC31	Industrial and Pharmaceutical Microbiology	5	5	40	60	100
Core VIII	24PMIC32	Research Methodology & Biostatistics	5	4	40	60	100
Core IX	24PMIC33	Agricultural and Environmental Microbiology	5	4	40	60	100
Core Practical V	24PMICR5	Practical in Industrial, Pharmaceutical Microbiology, Research Methodology & Biostatistics	4	2	40	60	100
Core Practical VI	24PMICR6	Practical in Agricultural and Environmental Microbiology	3	2	40	60	100
Discipline Specific Elective III	24PMIE31 / 24PMIE32	**Bioinformatics** / Bioremediation	4	3	40	60	100
Skill Enhancement Course III	24PMISE3	Nano Biotechnology	4	3	40	60	100
Internship / Self-Study (Optional)	24PMISS1	Vermitechnology		+2	--	50	50
		Total	**30**	**23+2**			

Semester – IV

Components	Course Code	Course Title	Contact Hours / Week	Credits	Max Marks		
					CIA	ESE	Total
Core X	24PMIC41	Microbial Genetics	6	5	40	60	100
Core XI	24PMIC42	Molecular Biology and Genetic Engineering	6	5	40	60	100
Core XII	24PMIC43	Food and Dairy Microbiology	5	4	40	60	100
Core Practical VII	24PMICR7	Practical in Microbial Genetics, Molecular Biology and Genetic Engineering	4	2	40	60	100
Core Practical VIII	24PMICR8	Practical in Food and Dairy Microbiology	3	2	40	60	100
Core XIII	24PMIP41	Project and Viva Voce	6	5	40	60	100
		Total	**30**	**23**			

Note: 1. It is mandatory for all I PG students to attend the course through Swayam Portal. Students who pass in MOOC through portals will get extra credit. Students who fail in MOOC can appear for supplementary exam and the institution will provide the certificate. No extra credits will be given.

2. Internship can be completed on or before II Semester vacation.

SEMESTER I			
Core I General Microbiology			
Course Code : 24PMIC11	**Hrs/Week :6**	**Hrs/Sem :90**	**Credits:5**

Objectives:

- Learn the fundamental principles about different aspects of Microbiology including recent developments in the area.
- 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 about the historical events in microbiology and know parts of microscope, type and its principle	K2
CO-2	Describe the structural organization, morphology and reproduction of microbes	K1
CO-3	Compile various physical and chemical means of sterilization	K3
CO-4	Outline various culture media and its application	K4
CO-5	Evaluate the techniques for isolation of pure culture of microorganisms	K5

SEMESTER I			
Core I General Microbiology			
Course Code :24PMIC11	**Hrs/Week :6**	**Hrs/Sem :90**	**Credits:5**

Unit I : **(18 hours)**

Historical and recent developments – spontaneous generation , germ theory of disease, Scope and developments of medical microbiology, microbial genetics physiology ,virology, plant pathology, soil microbiology, industrial microbiology and molecular biology. Microscopy :simple, compound, dark field, phase contrast, fluorescence and electron microscopy

Unit II: **(18 hours)**

Ultra structure of prokaryotic and Eukaryotic cell- Prokaryotic cell : size ,shape , arrangement of bacterial cells ; structure of cell wall , structure external (glycocalyx , flagella, pili, etc)and internal (plasma membrane, cytoplasm, inclusion bodies etc) to the cell wall. The Eukaryotic cell : cilia flagella, cytoskeleton, cytomembrane systems, mitochondria and chloroplast comparison of Prokaryotic and Eukaryotic cell

Unit-III : **(18 hours)**

Sterilization : dry heat, moist heat, filtration, tyndallization, pasteurization, radiation, antimicrobial chemicals- classification -mode of action – antibiotic resistance -test for antibiosis

Unit-IV : **(18 hours)**

Cultural techniques : pure culture techniques ,type of media- media preparation – preservation of culture-aerobic &anaerobic culture techniques-growth of bacteria : batch and synchronous culture- factors influencing growth - growth curve, Methods of study microbial morphology -wet mount and hanging drop method ,staining techniques-grams, acid fast, spore, capsule staining.

Unit-V : **(18 hours)**

Microbe -human interaction : Infection and disease – resident flora -pathogenicity and virulence, varied pattern of infection – Epidemiology- infectious disease -recognition of an infectious disease in a population- recognition of epidemic- the infectious disease cycle – study of disease-virulence and the mode of transmission -the emergence of new diseases – control of epidemics

Text books:

1. Prescott L.M. Harley J.P. and Klein D.A (2008). *Microbiology* 7th Edition McGraw Hill, New York.
2. Pelzar Jr., M.J.Chan E.C.S., and Kreig N.R. (2000). *Microbiology* – McGraw Hill, Inc., New York.
3. Dubey R.C. and Maheshwari D. K. (2009). Textbook of Microbiology. S. Chand, Limited.

Books for Reference:

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1. Tortora, Funke, Case Addison (2001), *Microbiology – An Introduction* – 7th Edition, Wesley Longman Inc.
2. Dubey R.C., and Maheswari,S. (2003) *A Text Book of Microbiology.* S. Chand & Co, New Delhi.

3. Talaro K.P., and Talaro.A. (2004). *Foundations in Microbiology*. WCP McGraw – Hill, New York.
4. Dubey and Maheshwari. (2012). *A text book of Biotechnology*. Chand publications
5. Jeffrey C. Pommerville., (2010), *Alcamo's Fundamentals of Microbiology* (Ninth edition). Jones & Bartlett learning.
6. Prescott L.M. Harley J.P. and Klein D.A (2008). *Microbiology* 7th Edition McGraw Hill, New York.
7. Pelzar Jr., M.J.Chan E.C.S., and Kreig N.R. (2003). *Microbiology* – McGraw Hill, Inc., New York.

Web Resources

1. http://sciencenetlinks.com/tools/microbeworld
2. https://www.microbes.info/
3. https://www.asmscience.org/VisualLibrary
4. https://open.umn.edu/opentextbooks/BookDetail.aspx?bookId=404
5. https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.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 I			
Core II Microbial Diversity			
Course Code : 24PMIC12	**Hrs/ Week: 5**	**Hrs/ Sem: 75**	**Credits: 4**

Objectives:

- Acquire knowledge on the identification and classification of microorganisms.
- Discuss the structure and characteristics of bacteria based on their characteristics.
- Identify and study the different group of fungi and understanding their habitat..
- Classify viruses based on their genomic structure.
- Discuss the host parasite relationship and summarize the particular protozoa..

Course Outcome:

CO. No	Upon completion of this course, students will be able to	Cognitive Level
CO1	Examine various microbes employing the microscopic techniques learnt. Measure and compare the size of microbes.	K4
CO2	Differentiate and explain bacteria based on their characteristics	K2
CO3	Identify and study the different group of fungi and understanding their habitat. Analyze the morphology, classify and propagate the algae depending on its economic importance.	K1
CO4	Classify viruses based on their genetic material and explain the particular viruses.	K3
CO5	Discriminate host parasite relationship and briefly explain about parasites and helminthes.	K5

SEMESTER I			
Core II Microbial Diversity			
Course Code : 24PMIC12	**Hrs/ Week: 5**	**Hrs/ Sem: 75**	**Credits: 4**

Unit I: **(15 hrs)**

Classification of microorganisms – Introduction – Haeckel's three kingdom concept – Whittaker' five kingdom concept – Three domain concept of Carl Woese basis of microbial classification, Salient features of bacteria according to Bergey's manual of determinative bacteriology. Identification of Microorganisms –phenotypic classification, phylogenetic classification, genotypic classification.

Unit II: **(15 hrs)**

General characters, Classification, nomenclature and properties. Structure and characteristics: Gram positive cocci– *Staphylococci, Streptococci.* Gram negative cocci– *Gonococci*. Gram positive non spore forming bacilli: aerobic – *Corynebacteria* and anaerobic- *Actinomyces.* Gram positive spore forming bacilli: aerobic- *Bacillus anthracis* and anaerobic *Clostridia.*

Unit III: **(15 hrs)**

General characters, Morphology, taxonomy and classification, structure and cell differentiation of *Aspergillus* sp, *Candida* sp, *Agaricus* sp. Mycorrhiza – Ectomycorrhizae, Endomycorrhizae, Vesicular Arbuscular Mycorrhizae. Algae: Distribution, general characters, thallus and its structure, classification, nutrition and reproduction – Characters of selected groups – Blue green algae, Euglenophyta, Chrysophyta, Phaeophyta and Rhodophyta – Economic importance of algae.

Unit IV: **(15 hrs)**

Classification, nomenclature and properties. Structure and characteristics of Plant virus (CaMV ,TMV) Animal virus (Adeno virus, HIV, Rhabdo virus) Insect virus (NPV,CPV) Brief outline on virion and Prions.

Unit V: **(15 hrs)**

Distinguishing characters, classification, host-parasite relationship, life cycle for the following: *Entamoeba* sp, *Leishmania* sp, *Giardia* sp and *Trichomonas* sp. Helminthes: Classification, lifecycle for Cestodes (*Taenia solium*) – Nematodes (*Ascaris lumbricoides*) – Arthropod vectors: Tick and mosquitoes.

Text Books:

1. Talaro. K.P. and A.Talaro.(2009). Foundations in Microbiology.WCP McGraw-Hill, New York.
2. Jagadish Chandar (2006). A Text Book of Medical Mycology. Inter Print. New Delhi.
3. Powar C.B and Daginawala H.F (2005). General Microbiology, Volume I & II, 8th Edition, Himalaya Publishing House, Mumbai.
4. Dubey. R.C., and Maheswari, S. (2009). A Text Book of Microbiology – Chand & Co, New Delhi.

Books for Reference:

1. Prescott L.M., Harley J.P., and Klein D.A (2008). Microbiology 7th Edition McGraw Hill, New York.
2. Madigan M.T., Martinko. J.M. Parker .J., and brock T.D. (2007). Biology of Microorganisms.8th Edition. Prentice Hall International Inc, London.
3. Alexopoulos, C.J.,and Mims,C.W.(1979). Introductory Mycology,Wiley,New York.
4. Stainer R.Y., In graham J.L., Wheelis M.L., and Painter P.R. (2012). General Microbiology, Macmillan Education Lt., London.
5. Pelczar Jr. M.J., Chan E.C.S., and Kreig N.R. (2003). Microbiology – McGraw Hill, Inc., New York.

Web Resources

1. https://biologyteach.com/haeckels-three-kingdom-classification-system/
2. https://study.com/academy/lesson/bacterial-cell-walls-and-the-gram-stain-test.html
3. https://doctor2018.jumedicine.com/wp-content/uploads/sites/9/2019/11/Lecture-20.-Non-Spore-forming-Gram-positive-rods19.pdf
4. https://bio.libretexts.org/Bookshelves/Microbiology/Microbiology_(Boundless)/08%3A_Microbial_Evolution_Phylogeny_and_Diversity/8.20%3A_Helminths/8.20D%3A_Arthropods_as_Vectors

Mapping of Course Outcomes with Pos and PSOs

Course Outcomes	ProgrammeOutcomes(PO)					ProgrammeSpecificOutcomes(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	MediumLevel	High Level
Scale	1	2	3

SEMESTER I			
Core II Microbial Physiology			
Course Code: 24PMIC13	**Hrs/Week:5**	**Hrs/Sem:75**	**Credits:4**

Objectives

- To provide information on sources of energy and its utilization by microorganisms.
- To explain about types of microorganism based on nutritional and energy requirements
- To gain a fundamental understanding of cellular composition, membrane transport, diversity of metabolic processes, growth and cell death
- To be familiarize bacterial photosynthesis and reproduction

Course outcome

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Describe different types of microbes based on nutritional and energy source	K1
CO-2	Explain basic concepts of microbial physiology.	K2
CO-3	Demonstrate types of membrane transport for nutrient uptake and protein excretion.	K3
CO-4	Examine microbial growth, growth kinetics and factors affecting growth.	K4
CO-5	Evaluate bacterial photosynthesis and reproduction	K5

SEMESTER I			
Core Microbial Physiology			
Course Code: 24PMIC13	Hrs/Week:5	Hrs/Sem:75	Credits:4

Unit I **(15Hrs)**

Classification of microorganisms based on energy- Phototroph and chemotroph, electron-lithotroph and organotroph and carbon source- Autotroph and Heterotroph - Major nutritional type of Microorganisms: Chemolithotroph, photolithoautotroph and Photo organoheterotroph. Nutritional requirements of Microorganisms. Elementary nutrients: Carbon, Nitrogen, Sulphur, Oxygen and Energy sources, Vitamins and Growth factors.

Unit II **(15Hrs)**

Uptake of nutrients: Diffusion- Simple and Facilitated, Active transport (use of Proton Motive force, ATP: ABC transporter), Passive transport - Group translocation, Iron uptake. Physiology of microbial growth: Batch – continuous - synchronous cultures; Growth Curve - Criteria for growth measurement: Cell mass and cell number.

Unit III **(15Hrs)**

Metabolic pathways in bacteria - Energy production in bacteria – energy and ATP, aerobic and anaerobic respiration, glycolysis, tricarboxylic acid cycle, electron transport and oxidative phosphorylation, phosphoketolase pathway, pentose phosphate pathway, gluconeogenesis and glyoxylate cycle. Fermentative pathways in specific group of microbes: alcoholic, lactic acid, formic, mixed, propionic, butyric, butanol, butanediol.

Unit IV **(15Hrs)**

Photosynthesis: Major groups of photosynthetic prokaryotic microbes. Ultrastructure of reaction centre, arrangements of light harvesting pigments, light reaction & electron flow in photosynthesis. CO_2 fixation pathways. Cyclic and non-cyclic and Photophosphorylation

Unit V **(15Hrs)**

Bio luminescence - The concept of growth and definition - Factors influencing microbial growth - Bacterial reproduction - Binary fission, Budding, Reproduction through conidia, cyst formation, endospore formation. Cell cycle in microbes and generation time.

Text Books

1.Prescott L M, J P Harley and D A Klein (2005). Microbiology. Sixth edition, International edition, McGraw Hill.

2. Schlegal, H.G. (1993). General Microbiology.,7th Edition, Press syndicate of the University of Cambridge.

3. MeenaKumari. S. (2006). Microbial Physiology, Chennai 1st Edition MJP Publishers

4. Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.

Books for Reference:

1.Moat G, John W. Foster and Michael P.Spector (2002). Microbial physiology. Fourth edition, A John Wiley sons, Inc. publication. New Delhi.

2. Albert G Moat, John W Foster, Michael P Spector. Microbial Physiology. (2002). Willey-Liss.

3.Tortora, Funke Case Addison.(2001). Introduction to Microbiology, Newyork: (7thedition) Wesley Longman Inc.

4. Pelczar TR M J Chan ECS and Kreig N R (2006). Microbiology. Tata McGraw Hill INC., New York.

5 Caldwell, D. R. (1995) – Microbial Physiology and Metabolism. Brown Publishers.

6 Brock Biology of Microorganisms, M.T.Madigan, J.M.Martinko, P. V. Dunlap, D. P. Clark. (2009). 12th edition, Pearson International edition. Pearson Benjamin Cummings.

Web Resources

1. https://microbenotes.com/classification-of-bacteria-on-the-basis-of-nutrition/
2. http://biocheminfo.com/2020/05/04/transport-in-cells-uptake-of-nutrients/
3. https://www.britannica.com/science/cellular-respiration
4. https://bio.libretexts.org/Bookshelves/Microbiology/Microbiology_(Kaiser)/Unit_7%3A_Microbial_Genetics_and_Microbial_Metabolism/18%3A_Microbial_Metabolism/18.7%3A_Photosynthesis/18.7A%3A_Introduction_to_Photosynthesis
5. https://www.britannica.com/science/bioluminescence

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 I			
Core Practical I Practical in General Microbiology and Microbial Diversity			
Course Code: 24PMICR1	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 2**

Objectives:

- To enhance the students with a broad-based knowledge in concepts and principles of fundamentals of microbiology and microbial diversity.

Course Outcome:

CO. No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Outline bio-safety procedures in microbiology.	K1
CO-2	Infer basic skill in aseptic techniques	K2
CO-3	Predict various staining techniques.	K3
CO-4	Describe bacteria with different cultivation techniques.	K4
CO-5	Evaluate with various sterilization techniques.	K5

SEMESTER – I			
Core Practical - Practical in General Microbiology and Microbial Diversity			
Course Code: 24PMICR1	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 2**

1. Laboratory Precautions ,Washing and cleaning of glass wares, biological safety cabinets
2. Hay mount to show different types of microbes
3. Hanging drop technique
4. Gram's staining
5. Acid fast staining (Demonstration)
6. Spore staining
7. Capsule staining
8. Preparation of culture media for microorganisms.
9. Techniques for pure culture of microorganisms by serial dilution technique and determination of bacterial numbers.
10. Techniques for pure culture of microorganisms by Pour plate method and determination of bacterial numbers.
11. Techniques for pure culture of microorganisms by Streak plate method and determination of bacterial numbers.
12. Techniques for pure culture of microorganisms by Spread plate method and determination of bacterial numbers.
13. Enumeration of bacteria – Water and soil samples
14. Microbial sampling of air
15. Cultivation of anaerobic microorganisms – Pyrogallol method.
16. Cultural characteristics of microorganisms.
17. Generic identification of unknown bacterial cultures.
18. Generic identification of an unknown fungi.
19. Cultivation and morphology of molds – Lacto phenol cotton blue staining

Books for Reference:

1. Cappuccino & Sherman, (2011). *Microbiology A laboratory manual,*. IX Edition. Pearson Publication
2. Kannan.N. (2005). *Laboratory Manual in General Microbiology*. Palani Paramount Publication, Palani.
3. Gunasekaran. P. (2006). *Laboratory Manual in Microbiology*. New Age International Ltd., Publishers, New Delhi.
4. Rajan.S.,Selvi Christy. R , (2012). *Experimental procedure in Life sciences.* Anjanaa Book House.
5. Aneja.K.R., (2007). *Experiments in Microbiology, Plant pathology and Biotechnology.* Fourth Revised Edition. New Age International Publishers.

Web Resources:

1. https://microbenotes.com/pour-plate-technique-procedure-significance-advantages-limitations/
2. https://apsjournals.apsnet.org/doi/10.1094/PHYTO-11-20-0512-PER
3. https://www.sigmaaldrich.com/IN/en/applications/microbiological-testing/microbial-culture-media-preparation

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	3	2	2	2
CO-3	2	3	2	2	3	2	3	2	1	3
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	2.4	2	1.4	1.8

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

SEMESTER I			
Core Practical II Practical in Microbial Physiology			
Course Code: 24PMICR2	**Hrs/Week:4**	**Hrs/Sem:60**	**Credits:2**

Objectives:

- To be familiar with production of extracellular enzymes
- To gain knowledge on effect of abiotic factors on microbial growth
- To gain a fundamental understanding of cellular composition, membrane transport, diversity of metabolic processes, growth and cell death
- To gain basic knowledge on growth and plotting growth curve

Course outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Explain effect of temperature, pH and salt concentration on the growth of bacteria	K2
CO-2	Identify the different mechanisms that provide a basis for microbial bioenergetics	K1
CO-3	Compile energy yielding central metabolic pathways and its regulations	K3
CO-4	Examine hydrolysis of starch, protein and Gelatin based on extracellular enzyme	K4
CO-5	Combine the adaptive features of aerobic, anaerobic and photosynthetic microorganism based on growth in culture media	K5

SEMESTER I			
Core Practical II Practical in Microbial Physiology			
Course Code: 24PMICR2	**Hrs/Week:4**	**Hrs/Sem:60**	**Credits:2**

1. IMViC test
2. Isolation of photosynthetic bacteria from soil and fresh water
3. Effect of P^H and temperature on bacterial growth
4. Study and plot the growth curve of *E. coli* by turbidometric method
5. Study of anaerobic fermentation (Production of alcohol by yeast)
6. Carbohydrate fermentation test (Glucose)
7. TSI test
8. Urease test
9. Catalase test
10. Extracellular enzyme production test – Starch hydrolysis and Casein hydrolysis
11. Lipid and Gelatin hydrolysis
12. Endospore staining (Demonstration)
13. Glucose uptake by *E. coli* - Active and Passive diffusion (Demonstration)
14. Effect of salt concentration on the growth of bacteria
15. Effect of light on growth of photosynthetic microorganism (Demonstration)

Books for Reference

1. Cappuccino & Sherman. (2011). Microbiology A laboratory manual,. 9 th Edition.Pearson Publication.
2. Gunasekaran. P. (2001). Laboratory Manual in Microbiology. New Age International Ltd., Publishers, New Delhi.
3. Jayaraman, J. (2000). Laboratory Manual in Biochemistry. New Delhi: Wiley Eastern Ltd.,.
4. Aneja.K.R., (2007). Experiments in Microbiology, Plant pathology and Biotechnology. Fourth Revised Edition. New Age International Publishers.
5. Kannan.N. (2009). Laboratory Manual in General Microbiology. Palani: Palani Paramount Publication,
6. Rajan.S., Selvi Christy. R. (2012). Experimental procedure in Life sciences. Anjanaa Book House.

Web Resources

1. https://www.frontiersin.org/journals/microbiology/articles/10.3389/fmicb.2020.589222/full
2. https://microbiologyinfo.com/starch-hydrolysis-test/
3. https://www.docsity.com/en/study-plot-the-growth-curve-of-e-coli-using-turbidimetric-method-and-calculate-the-growth-rate-specificity-generation-time/7139017/

4. https://ugcmoocs.inflibnet.ac.in/assets/uploads/1/78/2353/et/Module%2032-Academic%20script20022405050202525 2.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 I			
Discipline specific Elective I Biochemistry			
Course Code: 24PMIE11	**Hrs/ Week: 3**	**Hrs/ Sem: 45**	**Credits: 2**

Objectives:

- To study various biomolecules of a cell.
- To study structural characterization of biomolecules

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Describe how to compare and contrast the structure, classification and function of the carbohydrates.	K1
CO-2	Summarize the structure, classification and Function of lipids.	K2
CO-3	Known the compare and contrast saturated, mono-saturated and poly-saturated fatty acids.	K3
CO-4	Outline the structure and classification of proteins	K4
CO-5	Evaluate the classification and properties of amino Acids.	K5

SEMESTER I			
Discipline specific Elective I Biochemistry			
Course Code: 24PMIE11	**Hrs/ Week: 3**	**Hrs/ Sem: 45**	**Credits: 2**

Unit I **(9 Hrs)**

Monosaccharides - structure of aldoses and ketoses, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and non- reducing disaccharides. Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides.

Unit II **(9 Hrs)**

Proteins- classification, structure of primary, secondary, tertiary and quaternary protein, classification of amino acids, properties, peptide bond, formation and types.

Nucleic acid- structure of nitrogen bases and base pairing, structure of nucleosides, nucleotides, Ribose, Deoxyribose sugar. DNA, RNA structure, function, types and importance

Unit III **(9 Hrs)**

Lipids- classification, chemistry of fatty acids- unsaturated, saturated fatty acids, triglycerides, saponification, sterols, cholesterol, prostaglandins, glycolipids and function of lipids.

Unit IV **(9 Hrs)**

Vitamins: Classification of vitamins. Chemistry, properties, biological importance and deficiency manifestations of fat soluble and water soluble vitamins. Hormones: Classification of hormones, mechanism of hormone action, regulation of hormone secretion. Chemistry, metabolism, biological functions and disorders of- Pituitary hormones, Thyroid hormones, pancreatic hormones Adrenal hormones.

Unit V **(9 Hrs)**

Enzymes- concept, definition, nature, active site, properties, classification, physico-chemical properties. Factors affecting the enzyme synthesis and activity. Allosterism – Determination of Michaelis Menten constant – Factors affecting Km Value – Mode of Enzyme action (Lock and Key model and Induced fit model)- coenzymes – Cofactors – Isozymes and Inhibitors

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,LubertStryer, John L. Tymoczko, Gregory J. Gatto (2015). Biochemistry, 8th edition. WH Freeman publisher.

Books for Reference:

1. AmitKessel&Nir Ben-Tal (2018). Introduction to Proteins: structure, function and motion. 2ndEdition, Chapman and Hall.
2. David L. Nelson and Michael M. Cox (2017).Lehninger Principles of Biochemistry, 7thEdition W.H. Freeman and Co., NY.
3. LupertStyrer, Jeremy M. Berg, John L. Tymaczko, Gatto Jr., Gregory J (2019). Biochemistry. 9thEdition ,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	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 I			
Discipline specific Elective I Epidemiology			
Course Code: 24PMIE12	**Hrs/ Week: 3**	**Hrs/ Sem: 45**	**Credits: 2**

Objectives

- Describe the role of epidemiology in public health.
- Explain about epidemiology tools and disease surveillance methods.
- Analyze various communicable and non-communicable diseases in India.
- Discuss on mechanism of antimicrobial resistance.
- Outline on National health programmes that have been designed to address the issues.

Course outcome

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	apply the knowledge acquired on concepts of epidemiology to clinical and public health environment.	K3
CO-2	plan various strategies to trace the epidemiology.	K6
CO-3	Plan the control of communicable and non-communicable diseases.	K6
CO-4	Analyze the implications of drug resistance in the society and design the control of antimicrobial resistance and its management.	K4
CO-5	Estimate National control programs related to Communicable and Non-Communicable diseases with the public.	K5

SEMESTER I			
Discipline specific Elective I Epidemiology			
Course Code: 24PMIE12	**Hrs/ Week: 3**	**Hrs/ Sem: 45**	**Credits: 2**

Unit I **(9 Hrs)**

Fundamentals of epidemiology - Definitions of epidemiology – Epidemiology of infectious diseases in Public Health. Natural history of disease - Historical aspects of epidemiology. Common risk factors - Epidemiologic Triad - Agent factors, host factors and environmental factors. Transmission basics - Chain of infection, portal of entry. Modes of transmission -Direct and indirect. Stages of infectious diseases. Agents and vectors of communicable diseases of public health importance and dynamics of disease transmission. Epidemiology of Zoonosis - Factors, routes of transmission of bacterial, viral, parasitic and fungal zoonotic agents. Control of zoonosis.

Unit II **(9 Hrs)**

Tools of Epidemiology - Measures of Disease - Prevalence, incidence. Index case. Risk rates. Descriptive Epidemiology - Cohort studies, measuring infectivity, survey methodology including census procedures. Surveillance strategies - Disease surveillance, geographical indication system, outbreak investigation in public health and contact investigation.

Unit III **(9 Hrs)**

Epidemiological aspects of diseases of national importance - Background to communicable and non-communicable diseases. Vector borne diseases in India. Diarrhoeal diseases. Zoonoses. Viral haemorrhagic fevers. Mycobacterial infections. Sexually transmitted diseases. Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS). Emerging disease threats - Severe Acute Respiratory Syndrome (SARS), Covid-19, Ebola, MDR-TB, Malaria, Mucor mycosis, Avian flu. Dengue, Swine Flu, Chikungunya. Epidemiology, prevention, and control of non-communicable diseases - Asthma, Coronary heart disease, Malignancy, diabetes mellitus, respiratory diseases, eye diseases, Dental disorders. Emerging and Re-emerging Diseases.

Unit IV **(9 Hrs)**

Mechanisms of Antimicrobial resistance - Multidrug Efflux pumps, Extended Spectrum β-lactamases (ESBL). Hospital acquired infections - Factors, infection sites, mechanisms, Role of Multidrug resistant pathogens. Role of *Pseudomonas, Acinetobacter, Clostridium difficile,* HBV, HCV, Rotavirus*, Cryptosporidium* and *Aspergillus*

in Nosocomial infections. Prevention and management of nosocomial infections.

Unit V **(9 Hrs)**

National Programmes related to Communicable and Non-Communicable diseases - National Malaria Eradication Programme, Revised National Tuberculosis Control Programme, Vector Borne Disease Control Programme, National AIDS Control Programme, National Cancer Control Programme and National Diabetes Control Programme. Biochemical and immunological tools in epidemiology - Biotyping, Serotyping, Phage typing, FAME (Fatty acid methyl ester analysis), Curie Point PyMS (Pyrolysis Mass spectrometry), Protein profiling, Molecular typing methods.

Text Books

1. Dicker R., Coronado F., Koo. D. and Parrish. R. G. (2012). Principles of Epidemiology in Public Health Practice., (3rd Edition). CDC.
2. Gerstman B. (2013). Epidemiology Kept Simple: An Introduction to Classic and Modern Epidemiology. (3rd Edition). Wiley Blackwell.
3. Greenwood, D., Slack, R. B. and Peutherer, J. F. (2012) Medical Microbiology, (18th Edition). Churchill Livingstone, London.
4. Jawetz E., Melnick J. L. and Adelberg E. A. (2000). Review of Medical Microbiology. (19th Edition). Lange Medical Publications, U.S.A.
5. Dimmok N. J. and Primrose S. B. (1994). Introduction to Modern Virology.5th edn. Blackwell Scientific Publishers.

Books for References

1. Bhopal R. S. (2016).Concepts of Epidemiology - An Integrated Introduction to the Ideas, Theories, Principles and Methods of Epidemiology. (3rd Edition). Oxford University Press, New York.
2. Celentano D. D. and Szklo M. (2018). Gordis Epidemiology. (6th Edition). Elseiver, USA.
3. Cheesbrough, M. (2004). District Laboratory Practice in Tropical Countries - Part 2, (2nd Edition). Cambridge University Press.
4. Ryan K. J. and Ray C. G. (2004). Sherris Medical Microbiology. (4th Edition), McGraw Hill, New York.
5. Topley W.W. C., Wilson, G. S., Parker M. T. and Collier L. H. (1998). Principles of Bacteriology. (9th Edition). Edward Arnold, London.

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	1	2	3	2	3	2	2	2
CO-2	3	2	1	3	2	3	2	2	1	3
CO-3	3	2	2	3	3	2	2	3	3	1
CO-4	3	3	2	2	2	3	1	2	2	2
CO-5	2	2	3	2	2	2	3	2	2	3
Ave.	2.6	2.4	1.8	2.4	2.6	2.2	2.2	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			
Skill Enhancement Course Bioinstrumentation			
Course Code 24PMISE1	**Hrs/ Week: 3**	**Hrs/ Sem: 45**	**Credits: 3**

Objectives:

- Explain the principles and working mechanisms of laboratory instruments.
- Discuss chromatography techniques and molecular biology techniques.
- Illustrate molecular techniques in biological applications.
- Acquire knowledge on spectroscopic techniques
- Demonstrate the use of radio isotopes in various techniques.

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Estimate the use of the laboratory instruments following SOP.	K5
CO-2	Apply chromatography techniques in the separation of biomolecules.	K3
CO-3	Analyze the types of electrophoresis	K4
CO-4	Estimate molecules in biological samples by adopting spectroscopic techniques.	K2
CO-5	Describe the radio isotopic techniques	K1

SEMESTER I			
Skill Enhancement Course Bioinstrumentation			
Course Code : 24PMISE1	**Hrs/Week: 3**	**Hrs/Sem: 45**	**Credits: 3**

Unit I: **(9 Hrs)**

pH meter, Lyophilizer, Flow cytometry. Centrifugation techniques: Basic principles of centrifugation - Standard sedimentation coefficient - measurement of sedimentation co-efficient; Principles, methodology and applications of differential, rate zonal and density gradient centrifugation.

Unit II: **(9 Hrs)**

General principles of chromatography - Types- Thin layer chromatography, Paper Chromatography, Liquid chromatography (HPLC), Adsorption, ion exchange, Gas liquid (GLC). Flash Chromatography, Two dimensional chromatography.

Unit III: **(9 Hrs)**

Electrophoresis: General principles - electrophoretic mobility – supportive materials – electro endosmosis – Principle and applications - paper electrophoresis, Serum electrophoresis, starch gel electrophoresis, Agarose gel, SDS – PAGE. Blotting techniques -Southern, northern and western blotting.

Unit IV: **(9 Hrs)**

Spectroscopic techniques: Principle, simple theory of absorption of light by molecules, electromagnetic spectrum, instrumentation and application of UV- visible, Raman, Atomic Absorption Spectrophotometer, NMR, Emission Flame Photometry and GC-MS.

Unit V: **(9 Hrs)**

Radioisotopic techniques: Principle and applications of tracer techniques in biology. Radioactive isotopes - radioactive decay; Detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- Muller and Scintillation counters, auto radiography and its applications.

Text books:

1. Sharma B. K. (2014). Instrumental Method of Chemical Analysis. Krishna Prakashan Media (P) Ltd.
2. Chatwal G. R and Anand S. K. (2014.) Instrumental Methods of Chemical Analysis. Himalaya Publishing House.
3. Mitchell G. H. (2017). Gel Electrophoresis: Types, Applications and Research. Nova Science Publishers Inc.
4. Holme D. Peck H. (1998). Analytical Biochemistry. (3rd Edition). Prentice Hall.
5. Jayaraman J. (2011). Laboratory Manual in Biochemistry. (2ndEdition). Wiley Eastern Ltd., New Delhi.

Books for Reference:

1. Pavia D. L. (2012) Spectroscopy (4th Edition). Cengage.
2. Skoog A. and West M. (2014). Principles of Instrumental Analysis. (14th Edition).
3. Miller J. M. (2007). Chromatography: Concepts and Contrasts (2nd Edition) Wiley-Blackwell.
4. Gurumani N. (2006). Research Methodology for Biological Sciences. (1st Edition) MJP Publishers.
5. Ponmurugan P. and Gangathara P. B. (2012). Biotechniques. (1st Edition). MJP Publishers.

Web Resources:

1. https://www.biologydiscussion.com/biochemistry/centrifugation/basic-principles-of-sedimentation-and-sedimentation-coefficient-centrifugation/12487#google_vignette
2. https://mvpsvktcollege.ac.in/wp-content/uploads/2022/11/3-TYGC.pdf
3. https://www.sigmaaldrich.com/IN/en/technical-documents/protocol/protein-biology/gel-electrophoresis/southern-and-northern-blotting?utm_source=google&utm_medium=cpc&utm_campaign=15000381747&utm_content=129438265155&gclid=Cj0KCQjw-_mvBhDwARIsAA-Q0Q4h8geNWy6-Jdk3q9SJgUYvT-Slt_8t0KNe6rQhuxHhU_nO0GrY76MaAj8fEALw_wcB
4. https://www.vedantu.com/physics/spectroscopy

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	2	3	2	3	3	3
CO – 2	3	3	3	3	2	2	1	3	2	3
CO – 3	3	2	2	3	2	3	1	3	3	3
CO – 4	3	3	2	3	2	3	2	3	2	3
CO – 5	3	2	2	2	2	2	1	3	3	3
Ave.	3	2.4	2.2	2.6	2	2.6	1.4	3	2.6	3

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

SEMESTER II			
Core IV Medical Bacteriology and Mycology			
Course Code : 24PMIC21	**Hrs/Week : 6**	**Hrs/Sem : 90**	**Credits : 5**

Objectives:

- Acquire Knowledge on collection, transportation and processing of various kinds of clinical specimens.
- Explain morphology, characteristics and pathogenesis of bacteria.
- Discuss various factors leading to pathogenesis of bacteria.
- Acquire knowledge on antifungal agents and their importance.
- Describe various diagnostic methods available for fungal disease diagnosis.

Course Outcome:

CO No	**Upon completion of this course, students will be able to**	**Cognitive Level**
CO1	Evaluate Collection, transportation and process of various kinds of clinical specimens.	K5
CO2	Analyze various bacteria based on morphology and pathogenesis.	K4
CO3	Discuss various treatment methods for bacterial disease.	K2
CO4	Describe various methods detect fungi in clinical samples and apply knowledge on antifungal agents..	K1
CO5	Apply various immunodiagnostic method to detect fungal infections.	K3

SEMESTER II			
Core IV Medical Bacteriology and Mycology			
Course Code : 24PMIC21	**Hrs/Week : 6**	**Hrs/Sem : 90**	**Credits : 5**

Unit I: **(18 Hrs)**

Classification of medically important bacteria, Normal flora of human body, Collection, transport, storage and processing of clinical specimens, Microbiological examination of clinical specimens, antimicrobial susceptibility testing. Handling and maintenance of laboratory animals – Rabbits, Guinea pigs and Mice.

Unit II: **(18 Hrs)**

Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by species of *Staphylococci, Streptococci, Pneumococci, Neisseriae*., *Bacillus, Corynebacteria, Mycobacteria* and *Clostridium.*

Unit III: **(18 Hrs)**

Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by Enterobacteriaceae members, *Yersinia, Pseudomonas, Vibrio, Helicobacter, Rickettsiae, Chlamydiae, Bordetella, Francisella., Spirochaetes-Leptospira, Treponema* and *Borrelia*. Nosocomial, zoonotic and opportunistic infections -prevention and control.

Unit IV: **(18 Hrs)**

Morphology, taxonomy and classification of fungi. Detection and recovery of fungi from clinical specimens. Dermatophytes and agents of superficial mycoses. *Trichophyton, Epidermophyton & Microsporum*. Yeasts of medical importance – *Candida, Cryptococcus*. Mycotoxins. Antifungal agents, testing methods and quality control.

UnitV: **(18 Hrs)**

Dimorphic fungi causing Systemic mycoses, *Histoplasma, Coccidioides, Sporothrix, Blastomyces*. Fungi causing Eumycotic Mycetoma, Opportunistic fungi- Fungi causing secondary infections in immunocompromised patients. Immunodiagnostic methods in mycology- Recent advancements in diagnosis. Antifungal agents.

Text Books

1. Kanunga R. (2017). Ananthanarayanan and Panicker's Text book of Microbiology. (2017).Orient Longman, Hyderabad.

2. Greenwood, D., Slack, R. B. and Peutherer, J. F. (2012) Medical Microbiology, (18th Edition). Churchill Livingstone, London.

3. Finegold, S. M. (2000) Diagnostic Microbiology, (10th Edition). C.V. Mosby Company, St. Louis.

4. Alexopoulos C. J., Mims C. W. and Blackwell M. (2007). Introductory Mycology, (4th Edition). Wiley Publishers.

5. Chander J. (2018). Textbook of Medical Mycology. (4th Edition). Jaypee brothers Medical Publishers.

Books for Reference:

1. Salle A. J. (2007). Fundamental Principles of Bacteriology. (4th Edition). Tata McGraw-Hill Publications.

2. Collee J.C. Duguid J.P. Foraser, A.C, Marimon B.P, (1996). Mackie & McCartney Practical Medical Microbiology. 14thedn, Churchill Livingston.

3. Cheesbrough M. (2006). District Laboratory Practice in Tropical countries.- Part 22ndedn.Cambridge University Press.

4. Topley and Wilson's. (2000). Principles of Bacteriology.9th edn. Edward Arnold, London.

Web Resources

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

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	2	3	2	3	3	3	3	2
CO – 2	3	3	2	2	2	3	2	3	2	2
CO – 3	3	3	2	3	1	3	3	3	3	2
CO – 4	2	3	2	2	2	3	2	3	1	2
CO – 5	3	3	1	2	1	3	3	3	2	2
Ave.	2.6	2.8	1.8	2.4	1.6	3	2.6	3	2.2	2

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

SEMESTER II			
Core V Medical Virology and Parasitology			
Course Code: 24PMIC22	**Hrs/ Week: 5**	**Hrs/ Sem: 75**	**Credits: 4**

Objectives:

- Describe the replication strategy and cultivation methods of viruses.
- Acquire knowledge about oncogenic virus and human viral infections.
- Develop diagnostic skills, in the identification of virus infections.
- Impart knowledge about parasitic infections.
- Develop diagnostic skills, in the identification of parasitic infections.

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Manipulate cultivation of viruses by different methods and aid in diagnosis. Perform purification and viral assay.	K3
CO-2	Investigate the symptoms of viral infections and presumptively identify the viral disease.	K4
CO-3	Examine various viral diseases by different methods (serological, conventional and molecular)	K2
CO-4	Recommend public about the spread, control and prevention of parasitic diseases.	K5
CO-5	Identify the protozoans and helminthes present in stool and blood specimens.	K1

SEMESTER II			
Core V Medical Virology and Parasitology			
Course Code: 24PMIC22	**Hrs/ Week: 5**	**Hrs/ Sem: 75**	**Credits: 4**

Unit I: **(15 hrs)**

General properties of viruses - Structure and Classification - viroids, prions, satellite RNAs and virusoids. Cultivation of viruses - embryonated eggs, experimental animals and cell cultures. Purification of virus – Physical and Chemical methods - Assay of viruses - Infectivity Assays (Plaque and end-point).

Unit II: **(15 hrs)**

Virus Entry, Host Defenses Against Viral Infections, Epidemiology, pathogenic mechanisms, Pathogenesis, laboratory diagnosis, treatment for the following viruses: DNA Viruses- Pox , Herpes , Adeno , Papova and Hepadna viruses. Diagnosis of viral infections –conventional serological and molecular methods.

Unit III **(15 hrs)**

Virus Entry, Host Defenses Against Viral Infections, Epidemiology, pathogenic mechanisms, Pathogenesis, laboratory diagnosis, treatment for the following viruses: RNA Viruses- Picorna, Orthomyxo, Paramyxo, Rhabdo, Rota, HIV and other Hepatitis viruses. Antiviral agents and viral vaccines.

Unit IV: **(15 hrs)**

Introduction to Medical Parasitology – Classification, host-parasite relationships. Epidemiology, life cycle, pathogenic mechanisms, laboratory diagnosis, treatment for the following: Protozoa causing human infections – *Entamoeba*, *Giardia*, *Trichomonas*, *Toxoplasma*, *Leishmania*, and *Trypanasoma*.

Unit V: **(15 hrs)**

Classification, life cycle, pathogenicity, laboratory diagnosis and treatment for parasites – Helminthes - Cestodes – *Taenia Solium* - Trematodes – *Fasciola hepatica*, *Schistosomes* - Nematodes - *Ascaris*, *Strongyloides* and *Wuchereria*.

Text Books

1. Kanunga R. (2017). Ananthanarayanan and Panicker's Text book of Microbiology. (10th Edition). Universities Press (India) Pvt. Ltd.
2. Dubey, R.C. and Maheshwari D.K. (2010). A Text Book of Microbiology. S. Chand & Co.
3. Rajan S. (2007). Medical Microbiology. MJP publisher.

4. Paniker J. (2006). Text Book of Parasitology. Jay Pee Brothers, New Delhi.
5. Arora, D. R. and Arora B. B. (2020). Medical Parasitology. (5th Edition). CBS Publishers & Distributors Pvt. Ltd. New Delhi.

Books for Reference:

1. Carter J. (2001). Virology: Principles and Applications (1st Edition). Wiley Publications.
2. Willey J., Sandman K. and Wood D. Prescott's Microbiology. (11th Edition). McGraw Hill Book.
3. Jawetz E., Melnick J. L. and Adelberg E. A. (2000). Review of Medical Microbiology. (19th Edition). Lange Medical Publications, U.S.A.
4. Finegold S.M. (2000). Diagnostic Microbiology. (10th Edition). C.V. Mosby Company, St. Louis.

Web Resources

1. https://en.wikipedia.org/wiki/Virology
2. https://academic.oup.com/femsre/article/30/3/321/546048
3. https://www.sciencedirect.com/science/article/pii/S0042682215000859
4. https://nptel.ac.in/courses/102/103/102103039/
5. https://www.healthline.com/health/viral-diseases#contagiousness

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	2	3	3	2	1	2	2
CO-2	2	2	2	3	2	2	3	2	1	3
CO-3	3	2	3	2	1	2	3	3	2	1
CO-4	2	3	2	1	2	2	1	3	3	2
CO-5	2	3	2	3	3	3	1	2	2	3
Ave.	2.4	2.2	2.4	2.2	2.2	2.4	2.0	2.2	2.0	2.2

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

SEMESTER II			
Core VI Immunology			
Course Code : 24PMIC23	**Hrs/ Week: 5**	**Hrs/ Sem: 60**	**Credits: 4**

Objectives:

- Discuss immunity, organs and cells involved in immunity.
- Compare the types of antigens and their properties.
- Describe immunoglobulin and its types. Categorize MHC and understand its significance.
- Elucidate the mechanisms of different hypersensitivity reactions.
- List out the Vaccines and discuss their development.

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO1	Describe the immune response to a variety of antigens. Identify different immune cells involved in immunity.	K1
CO2	Discriminate the significance of MHC molecules in immune response and antibody production.	K5
CO3	Discuss antibodies and evaluate immunological assays in patient samples.	K2
CO4	Investigate the knowledge about various hypersensitivity reactions and transplantation immunology.	K4
CO5	Compile various applications of monoclonal antibodies and types of vaccines.	K3

SEMESTER II			
Core VI Immunology			
Course Code : 24PMIC23	**Hrs/ Week: 5**	**Hrs/ Sem: 60**	**Credits: 4**

Unit: I **(15 Hrs)**

History and development of immunology - Immunity: Innate & Acquired. An over view on the cells of immune system. Organs & tissues of immune system. Clonal selection theory. Immune response: HIR & CMI. Phagocytosis.

Unit: II **(15 Hrs)**

Antigens and antibody – structure, types and functions. Antibody diversity: isotypes, allotypes and idiotypes. Biology of T & B cell. Major Histo compatibility Complex (MHC). Human leucocyte antigen (HLA). Complement pathways: classical and alternative.

Unit: III **(15 Hrs)**

Agglutination. Precipitation. Complement fixation. Immunoblotting. Immunofluorescence. Immunodiffusion: SRID, ODD & Immnoelectrophoresis - RIEP. Flow cytometry. Radio Immuno Assay.

Unit: IV **(15 Hrs)**

Hypersensitivity - immediate & delayed type. Autoimmunity. Transplantation immunology. Tumor immunology. Immuno deficiency diseases - AIDS

Unit: V **(15 Hrs)**

Monoclonal antibody: production & applications. Vaccination: types, principle & applications. Current basic immunization schedule.

Text Books:

1. Coico R., Sunshine G. and Benjamini E. (2003). Immunology – A Short Course. (5th Edition). Wiley-Blackwell, New York.

2. Owen J. A., Punt J., Stranford S. A. and Kuby J. (2013). Immunology, (7th Edition). W. H. Freeman and Company, New York.

3. Abbas A. K., Lichtman A. H. and Pillai S. (2021). Cellular and Molecular Immunology. (10th Edition). Elsevier.

Books for Reference:

1. Travers J. (1997). Immunobiology - The Immune System in Health and Disease. (3rd Edition). Current Biology Ltd. New York.

2. Delves P.J., Martin S., Burton D. R. and Roitt I. M. (2006). Roitt's Essential

Immunology. (11th Edition). Wiley-Blackwell.

3. Hay F. C. and Westwood O. M. R. (2002). Practical Immunology (4th Edition). Wiley-Blackwell.

Web resources:

1. https://microbenotes.com/vaccines-introduction-and-types/
2. https://byjus.com/current-affairs/monoclonal-antibodies/
3. https://www.britannica.com/science/major-histocompatibility-complex

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	1	1	3	1	1	2	3
CO – 2	3	1	2	1	1	3	1	1	2	3
CO - 3	3	1	3	1	3	2	1	1	1	1
CO - 4	2	1	2	1	1	1	1	2	1	2
CO - 5	3	1	3	2	3	3	2	3	3	3
Ave.	2.8	1	2.4	1.2	1.8	2.4	1.2	1.6	1.8	2.4

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

SEMESTER II			
Core Practical III Practical in Medical Bacteriology, Mycology Virology and Parasitology			
Course Code : 24PMICR3	**Hrs/Week : 4**	**Hrs/Sem : 60**	**Credits : 2**

Objectives

- Develop skills in the diagnosis of bacterial infections and antimicrobial sensitivity.
- Impart knowledge on fungal infections and its diagnosis.
- Diagnose parasitic infection

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO1	Examine different clinical samples, transport, culture and examination.	K4
CO2	Identify medically important bacteria, fungus and parasites from the clinical samples by staining and biochemical tests.	K1
CO3	Produce diagnostic skills; interpret laboratory tests in the diagnosis of infectious diseases.	K3
CO4	compare antibiotic sensitivity tests with the standard tests.	K2
CO5	Evaluate common arthropods	K5

SEMESTER II			
Core Practical III Practical in Medical Bacteriology, Mycology Virology and Parasitology			
Course Code : 24PMICR3	**Hrs/Week : 4**	**Hrs/Sem : 60**	**Credits :2**

1. Isolation and identification of bacterial pathogens from clinical specimens (Throat, skin, urine, stool)
2. Biochemical identification tests.
3. Antimicrobial sensitivity testing - Kirby Bauer method.
4. Minimum inhibitory concentration (MIC) test.
5. Examination of different fungi by Lactophenol cotton blue staining.
6. Cultivation of fungi and their identification - *Mucor, Rhizopus, Aspergillus, Penicillium.*
7. Microscopic observation of different asexual fungal spores.
8. Isolation of bacteriophage from natural sources
9. Cultivation of viruses –Egg Inoculation methods (Demonstration)
10. Diagnosis of Viral Infections – ELISA –HIA.
11. Viral inclusions and CPE-stained smears. (Demonstration)
12. Examination of parasites in clinical specimens - Ova/cysts in faeces.
13. Concentration methods – Floatation methods - Zinc sulphate methods
14. Sedimentation methods- Formal ether method.
15. Blood smear examination for malarial parasites - Thin smear – Thick smear
16. Identification of common arthropods of medical importance - spotters of *Anopheles, Glossina, Phlebotomus, Aedes,* Ticks and mites.

Books for Reference:

1. Parija S. C. (2012). Textbook of Practical Microbiology. Ahuja Publishing House.
2. Cappuccimo, J. and Sherman, N. (2002) Microbiology: A Laboratory Manual, (6thEdition). Pearson Education, Publication, New Delhi.
3. Collee J. G., Fraser A.G. Marmion B. P. and Simmons A. (1996). Mackie & McCartney Practical Medical Microbiology. (14th Edition). Elsevier, New Delhi.

4. Chart H. (2018). Practical Laboratory Bacteriology. CRC Press.
5. Cheesbrough M. (2006). District Laboratory Practice in Tropical countries.- Part 22nd Edition.Cambridge University Press.
6. Murray P.R., Rosenthal K.S. and Michael A. (2013). Medical Microbiology. Pfaller. 7th Edition. Elsevier, Mosby Saunders

Web Resources

1. http://textbookofbacteriology.net/nd
2. https://www.isham.org/mycology-resources/mycological-links
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4047123/
4. 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	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	3	1	3	1	2	2	3
CO – 4	3	2	3	3	2	3	2	2	2	3
CO – 5	3	2	2	3	1	2	1	2	2	3
Ave.	3	2	2.2	3	1.4	2.8	1.6	2.4	2	3

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

SEMESTER II			
Core Practical IV Practical in Immunology			
Course Code :24PMICR4	**Hrs/ Week: 2**	**Hrs/ Sem: 30**	**Credit: 1**

Objective:

- To impart advanced practical knowledge in Immunology.
- To perform highly specific advanced methodologies for the study of human immune system towards the pathogens.

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Describe the various immuno diffusion test.	K1
CO -2	Summarize qualitative and quantitative assay of widal test.	K2
CO-3	Demonstrate rpr test for syphilis.	K3
CO-4	Analyze how to perform latex agglutination and blood grouping techniques.	K4
CO-5	Evaluate the separation and purification of immunoglobulin	K5

SEMESTER II			
Core Practical IV Practical in Immunology			
Course Code :24PMICR4	**Hrs/ Week: 2**	**Hrs/ Sem: 30**	**Credit: 1**

1. ABO Blood Grouping & Rh Typing
2. Blood smear identification of leucocytes by Giemsa stain
3. Latex Agglutination reactions- ASO
4. C - Reactive Protein.
5. Detection of HBs Ag by ELISA.
6. Ouchterlony double immunodiffusion (ODD)
7. Mancini's single radial immunodiffusion (SRID)
8. Rocket immuno electrophoresis (Demonstration)
9. Counter current immuno electrophoresis (Demonstration)
10. Preparation of lymphocytes from peripheral blood by density gradient centrifugation (Demonstration)
11. Purification of immunoglobulin– Ammonium Sulphate Precipitation (Demonstration)
12. Separation of Ig G by chromatography using DEAE cellulose or Sephadex.
13. WIDAL test – Qualitative assay.
14. WIDAL test – Quantitative assay.
15. RPR test for syphilis
16. Examination of Blood cells - Total count
17. Examination of Blood cells - Differential count

Books for Reference:

1. R.C. Dubey & Maheswari, (2002) *Practical microbiology*. New Delhi, S. Chand & Co.Ltd.,.

2. Kanika L. Mukherjee,.(2010) *Medical Laboratory Technology – Procedure manual for routine diagnostic tests* – McGraw – Hill Publishing Co., Ltd., New Delhi. Vol.I-III.

3. R.C. Dubey & Maheswari, (2007) *Practical Microbiology*. New Delhi: S.Chand & Co.Ltd.

4. Kannan. N. (1996) *Laboratory Manual in General Microbiology*. Palani Paramount Publication.

5. Cappuccino & Sherman, (2011) *Microbiology A laboratory manual,*. IX Edition. Pearson Publication.

Web resources:

1. **https://www.testing.com/tests/complete-blood-count-cbc/**
2. **https://vlab.amrita.edu/?sub=3&brch=70&sim=722&cnt=1**

3. https://www.cellbiolabs.com/hbsag-elisa-kit

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	1	3	3	1	3	1	3
CO – 2	3	1	2	1	1	3	1	1	2	3
CO - 3	2	1	2	1	3	3	1	1	1	3
CO - 4	2	1	2	1	1	3	2	3	1	3
CO - 5	3	1	3	2	3	3	2	3	3	3
Ave.	2.6	1	2.2	1.2	2.2	3	1.4	2.2	1.6	3

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

SEMESTER II			
Discipline Specific Elective II Marine Microbiology			
Course Code: 24PMIE21	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 3**

Objectives:

- To impart advanced level information in the subject of Marine Microbiology

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Analyze the marine ecosystem and classification of marine organisms and different ecosystems	K4
CO-2	Define marine microorganisms	K1
CO-3	Interpret marine food chain, degradation of natural compounds and xenobiotics	K2
CO-4	Evaluate Extremophiles and marine microbial interaction	K5
CO-5	Relate bio fouling, bioleaching and metal corrosion	K3

SEMESTER II			
Discipline Specific Elective II Marine Microbiology			
Course Code: 24PMIE21	Hrs/ Week: 4	Hrs/ Sem: 60	Credits: 3

Unit I: **(12 Hrs)**

Classification of marine organisms- Marine ecosystem: Intertidal zones, inhabitants- Ecology of estuaries, salt marshes, mangroves, swamps, coral reefs and deep sea- Conventional and modern methods of studying microorganisms.

Unit II: **(12 Hrs)**

Methods of studying marine microorganisms- Collection, enumeration, isolation and identification based on morphological, physiological and biochemical characteristics- Microbial nutrition- Influence of environmental factors on microbial growth and activity.

Unit III: **(12 Hrs)**

Marine food chain- primary production- Eutrophication-Effect of global warming in marine ecosystem- Role of marine microbes in oil degradation - Microbial processes - Biodegradation of natural and xenobiotics; biotransformation - bioaccumulation - Bioremediation - Biomineralization.

Unit IV: **(12 Hrs)**

Extremophiles - Thermophiles - Halophiles - Acidophiles - Alkaliphiles - Barophiles - Baropsychrophiles - Psychrophiles - Marine microbial interactions - bacterial invertebrates - symbiosis - Coral diseases and microbial associates. Deep Sea microbes - Bioluminescence.

Unit V: **(12 Hrs)**

Bio fouling and prevention - Biofilms and Microbial mats- Bioactive compounds from marine microbes. Primary and secondary metabolites Microbial - leaching of ore and metal corrosion. Microbial indicator organism of marine pollution.

Text books:

1. Atlas, R.M., and Bartha, M. (2003). Microbial ecology- Fundamentals and Applications. Benjamin- Cummings, Menlo Park, California.
2. Brock, T.D., and Madigan, M.T. (2000). Biology of Microorganisms. (8th edition). Prentice Hall, Inc, New York.
3. Vijaya Ramesh, K. (2004). Environmental Microbiology. MJP Publishers Chennai.
4. C.B. Munn (2003) Marine Microbiology: Ecology and applications.

Books for Reference:

1. Mitchel, R. (2002). Environmental Microbiology. Wiley- John Wiley and Sons. Inc. New York.
2. Talaro, K.P., and Talaro. A. (1999). Foundations in Microbiology. WCB Mc Graw Hill, New York.
3. Grant, W.D. and Long, P.L. (2001). Environmental Microbiology. Blackie Glasgow and London.

Web Resources

1. http://oceanography.asu.edu/Oc_Nov21_pos.pdf
2. https://www.slideshare.net/twitchangel/the-methods-for-studying-microorganisms-25445400
3. https://sciencing.com/major-primary-producer-marine-ecosystem-4683.html
4. https://study.com/learn/lesson/extremophiles-types-examples.html#:~:text=The%20five%20main%20types%20of,are%20found%20in%20areas%20that
5. https://www.researchgate.net/publication/279947511_Biofouling_and_Prevention

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 II			
Discipline Specific Elective II Toxicology			
Course Code : **24PMIE22**	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 3**

Objectives:

- Recognize the various categories of environmental toxins and their hazardous consequence
- Enhance the knowledge of underlying etiology of diseases
- Strengthen the evidence for a causal link between the exposure of hazardous agent and the development of diseases
- Illustrate various techniques to isolate and characterize the toxin
- Examine, interpret and discuss the certainty of toxic substances, proposing the deep understanding of medicinal and industrial applications

Course Outcomes

CO NO	On completion of this course, students will;	Cognitive Level
CO1	examine the adverse effects of toxin and its potential role in research.	K4
CO2	indicate the toxicity, properties and mode of actions of microbial toxins.	K2
CO3	illustrate the mode of actions and their biological significance.	K2
CO4	evaluate the toxicity level with the help of advanced techniques.	K5
CO5	estimate the various natures of application of toxic substances.	K5

SEMESTER II			
Discipline Specific Elective II Toxicology			
Course Code : **24PMIE22**	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 3**

Unit I **(12 Hrs)**

General Introduction - Definition of toxins, different categories of toxins and venoms, recent trends in venom and toxin research.

Unit II **(12 Hrs)**

Bacterial toxins - Bacterial toxins Bacterial toxinogenesis, endotoxins, exotoxins, exotoxins, bacterial protein toxins with special reference to cholera, diphtheria and tetanus toxins, molecular mechanism of action of endotoxins, exotoxins, enterotoxins, neurotoxins and mycotoxins.

Unit III **(12 Hrs)**

Plant toxic proteins, impact of plant toxin on human, natural toxins in food, plants, allelopathy. Toxins from snake venom Snakes and Biological significance of their venoms, composition of snake venom, evolution of venom, 3D structure of some important venom constituents and their mechanism of action (phospholipase A2, cardiotoxin, neurotoxin) three-finger toxins, anti-venom and medicinal plants in treatment of snakebite patients.

Unit IV **(12 Hrs)**

Tools for isolation and characterization of toxins - Multidimensional chromatographic techniques (gel-filtration, ion-exchange reverse-phase HPLC, SDS-PAGE, 2-dimensional gel electrophoresis), toxin mass fingerprinting, N-terminal peptide sequencing, analysis of protein data by using proteomics software.

Unit V **(12 Hrs)**

Medicinal and industrial applications of venoms and toxins. Use of toxin in neurobiology and muscular research, anticancer drug, diagnosis of haemostatic disorders, antibacterial agents, bioinsecticides and other industrial applications.

Text Books:

1. Holst O. (2008). Bacterial Toxin –Methods & Protocols. Humana Press.ISBN 9781592590520.
2. Shier W. T. (1990). Handbook of Toxinology. CRC Press. ISBN 9780824783747.
3. Wilson K. and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. (7thEdition). Cambridge University Press India Pvt.Ltd. ISBN 1-4051-3544-1.
4. Pholtan Rajeev S.R. (2021Pictorial handbookfor toxinology. Rudra Publications.
5. Cora Lancester. (2015). Molecular Toxinology Handbook. Callisto Reference

Books for Reference:

1. Reilly M. J. (2018). Bioinstrumentation. CBS Publishers and Distributors Pvt Ltd. ISBN 13 978-8123928395.
2. Greenberg M., Hamilton R., Phillips S. and McCluskey G. J. (2003). Occupational, Industrial and Environmental Toxicology. St Louis: C.V. Mosby.
3. Wiley-Vch. (2005). Ullmann's Industrial Toxicology. New York: John Wiley & Sons.
4. Winder C. and Stacey N.H. and Boca Raton F. L. (2004). Occupational Toxicology. (2nd Edition). CRC Press.
5. Gopalakrishnakone (2015). Biological Toxins and Bioterrorism. Springer.

SEMESTER II			
Skill Enhancement Course II Sea Food Processing and Preservation			
Course Code : 24PMISE2	**Hrs/ Week: 4**	**Hrs/ Sem: 45**	**Credits: 3**

Objectives:

- Explain various microbiological quality standards for sea food, water and air regulatory practices and policies.
- Discuss collection, processing and preservation of sea food samples from industries in different areas.
- Enumeration and isolation of microorganism from the sea food and water samples.
- Enumeration and isolation of microorganism from the air samples.

Course Outcome:

CO No	Upon completion of this course, students will be able to	Cognitive Level
CO1	Apply knowledge in quality analysis techniques suitable for industries.	K3
CO2	Analyze water managements, treat sewage, water pollutions and remedies.	K4
CO3	Evaluate sea food quality.	K5
CO4	Explain bioaerosols, impact and prevention	K2
CO5	Describe quality control techniques for sea food industrial products	K1

SEMESTER II			
Skill Enhancement Course II Sea Food Processing and Preservation			
Course Code : 24PMISE2	**Hrs/ Week: 4**	**Hrs/ Sem: 45**	**Credits: 3**

Unit I **(12 Hrs)**

Plant design: Fundamentals of processing plant design: Site selection, design and preparation of layout of processing plants - freezing plant, cold storage, canning plant, dryers etc. Site building, water supply, equipments and clothing.

Unit II **(12Hrs)**

Preservation in sea food industries: Block freezing, Blast freezing, Individual Quick Freezing, Canning , artificial dryers, and smoking.

Unit III **(12 Hrs)**

Effluent treatment: Legislation and standards of effluent discharge, water pollution control measures in the food industry, waste water treatment process; dissolved air floatation, sedimentation, chemical treatment, biological treatment, aeration, carbon adsorption, granular media filtration and sludge handling. Boilers - Classification and selection of boilers.

Unit IV **(12 Hrs)**

Hazard Analysis Critical Control Point (HACCP) system, Good Manufacturing Practices (GMP) Microbial Hazards- *Listeria monocytogenes, Salmonella, Vibrio cholera, V.parahemolyticus* in sea foods. Chemical Hazards in sea foods – importance and detection methods, Antibiotic and pesticide residues in sea foods.

Unit V **(12 Hrs)**

Quality Assurance in Sea food industry – Sea food quality indices – Microbial and biochemical – Standard Sanitary Operating Procedures (SSOP), Sanitary Control Procedures (SCP), ISO and European Union (EU) hygienic regulations for sea foods and sea food industries- National Standards for sea foods and sea food industries.

Text Books:

1. Dr. G.Jeyasekaran. Dr. R.Jeya Shakila, Dr. P.Velayutham. (2002).Quality control of fish and fishery products

2. Fish Processing Plant-Guidelines for the application of HACCP program –prepared by Food Protection Services, BC centre for disease control-Revised January 2011.

3. Gopakumar K., (2002) Text Book of Fish Processing Technology. 3rd Edition., Indian Council of Agricultural Research

Books for Reference:

1. Cullimore D. R. (2010). Practical Atlas for Bacterial Identification. (2nd Edition). -Taylor &Francis.
2. Sundararaj T. (2003). Microbiology Laboratory Manual. (2nd Edition). Published by A. Sundararaj
3. Amitava Mitra. (2013). Fundamentals of Quality control and Improvement. (3rd Edition). Wiley Publications

Web links:

1. https://www.niftem.ac.in/site/pmfme/processingnew/frozenfishprocessing.pdf
2. https://www.bluecoldref.com/frequently-asked-questions/food-industry
3. https://www.epcbboiler.com/2023-food-industry-boiler-selection-guide.html

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	2	2	3	3	3	3	2
CO – 2	2	1	2	2	2	3	2	3	2	2
CO – 3	2	1	2	1	2	3	3	3	3	2
CO – 4	2	1	2	2	2	3	2	3	2	2
CO – 5	3	1	1	2	3	3	2	3	2	2
Ave.	2.4	1.2	1.6	1.8	2.2	3	2.4	3	2.4	2

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