Thiagarajar College

(An Autonomous Institution Affiliated to Madurai Kamaraj University)
Re-Accredited with "A^{++}" Grade by NAAC

Academic Council Meeting (ACM)
June-2023

M.Sc., Microbiology
Syllabus 2023-2024

M.Sc., Microbiology

(Programme Code: PMB)

Dr.RM.Murugappan
Dean- Curriculum Development

Programme Outcome - PO (Aligned with Graduate Attributes) - Master of Science (M. Sc.,)

PO1 Knowledge

Acquire an overview of concepts, fundamentals and advancements of science across a range of fields, with in-depth knowledge in at least one area of study. Develop focused field knowledge and amalgamate knowledge across different disciplines.

PO2 Complementary skills

Students will be able to engage in critical investigation through principle approaches or methods and through effective information search and evaluation strategies. Employ highly developed conceptual, analytical, quantitative and technical skills and are adept with a range of technologies;

PO3 Applied learning

Students will be able to apply disciplinary or interdisciplinary learning across multiple contexts, integrating knowledge and practice. Recognize the need for information; effectively search for, evaluate, manage and apply that information in support of scientific investigation or scholarly debate.

PO4 Communication

Communicate effectively on scientific achievements, basic concepts and recent developments with experts and with society at large. Able to comprehend and write reports, documents, make effective presentation by oral and/or written form.

PO5 Problem solving

Investigate, design and apply appropriate methods to solve problems in science, mathematics, technology and/or engineering.

PO6 Environment and sustainability

Understand the impact of the solutions in ethical, societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

PO7 Teamwork, collaborative and management skills

Recognize the opportunities and contribute positively in collaborative scientific research. Engage in intellectual exchange of ideas with researchers of other disciplines to address important research issues

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Vision

- To render exemplary quality education in Life Sciences and laboratory skills in order to produce generations of responsible, competent and employable graduates

Mission

- To provide a comprehensive set of courses in biological sciences that enhances the understanding, depth of knowledge and technical competency of the students
- To prepare the students for entry – level research and teaching positions in biological sciences
- To provide an educational environment that fosters the development of appropriate scientific vocabulary, reasoning skills, and effective oral and written communication abilities for students
- To create a holistic understanding of the allied subjects through interdisciplinary learning

Programme Educational Objectives (PEO)

The Objectives of this programme is to equip/ prepare the students

PEO1	Adopt for careers in the food/agriculture/ pharmaceutical industry, agriculture, and applied research
PEO2	To compete in competitive exams like NET, SET and civil services
PEO3	Analyze and interpret scientific data collected with microbiological laboratory techniques and safety procedures
PEO4	To utilize the scientific literature effectively for the successful completion of research projects related to microbiology
PEO5	A proficient microbiological quality analyst in a reputed company or will be an entrepreneur in the field concerned

Programme Specific Outcome (PSO)

On the successful completion of M. Sc Microbiology, the students will

PSO1	Comprehend the core theories, concepts, practices and methods related to the different disciplines in microbiology
PSO2	Analyze the scientific information related to microbial processes and their role in ecosystem functioning and health issues
PSO3	Plan and execute safely a series of food, environment and medical microbiological experiments
PSO4	Be equipped with interdisciplinary skills, computational tools and techniques related to microbiology
PSO5	Exhibit their ideas/knowledge through their involvement in research/internship activities, association club and outreach activities specific to microbiology

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M.Sc., Microbiology Course Structure (w.e.f. 2023 batch onwards)
Programme code: PMB
I semester

Course	Code	Subject/Paper	Hr/ w	Cred	Tot Hr	CA	SE	Total
PART -A								
Core-I	PMB23CT11	General Microbiology and Microbial Diversity	4	4	60	25	75	100
Core-II	PMB23CT12	Immunobiology	4	4	60	25	75	100
Core- L1	PMB23CL11	Lab in General Microbiology and Microbial Diversity	4	2	60	25	75	100
Core- L2	PMB23CL12	Lab in Immunobiology	4	2	60	25	75	100
Core Elec-I	PMB23ET11 A,B,C	Forensic Science/Cell structure and Dynamics/ Bioinstrumentation	4	3	60	25	75	100
Core Elect-II	PMB23ET12 A,B, C	Molecular Biology and Microbial Genetics/ Essentials of Laboratory Management and Biosafety/Microalgal Technology	4	3	60	25	75	100
PART -B								
SEC-I	PMB23SL11	Lab in Molecular Biology and Microbial Genetics	4	2	60	25	75	100
AECC I	PMB23AT11	Bioentrepreneurship	2	2	30	25	75	100
		Total	**30**	**22**				

II Semester

Course	Code	Subject/Paper	Hrs /w	Cred	Tot Hrs	CA	SE	Total
PART- A								
Core-IV	PMB23CT21	Medical Microbiology	4	4	60	25	75	100
Core-V	PMB23CT22	Microbial Biochemistry and Physiology	4	4	60	25	75	100
Core-L3	PMB23CL21	Lab in Medical Microbiology	4	2	60	25	75	100
Core- L4	PMB23CL22	Lab in Microbial Biochemistry and Physiology	4	2	60	25	75	100
Core Elective-III	PMB23ET21 A,B,C	IPR, Bioethics and Biosafety/ Herbal Technology/ Clinical Diagnostic Microbiology	4	3	60	25	75	100
Core Elective-IV	PMB23ET22 A,B,C	Bioinformatics/ Epidemiology/ Bioremediation	4	3	60	25	75	100
PART -B								
SEC-II	PMB23SL21	Lab in Bioinformatics	4	2	60	25	75	100
AECC-II	PMB23AT21	Vermitechnology	2	2	15	25	75	100
		Total	**30**	**22**				

III Semester

Course	Code	Subject/Paper	Hrs/ w	Cred	Tot Hrs	CA	SE	Total
PART- A								
Core-IV	PMB23CT31	Environmental and Agricultural Microbiology	4	4	60	25	75	100
Core-V	PMB23CT32	Recombinant DNA Technology	4	4	60	25	75	100
Core-L5	PMB23CL31	Lab in Environmental and Agricultural Microbiology	4	2	60	25	75	100
Core- L6	PMB23CL32	Lab in Recombinant DNA Technology	4	2	60	25	75	100
Core Elective-V	PMB23ET31 A,B,C	Microbial Quality Control and Testing/Clinical Research and Clinical Trial/ Nanobiotechnology	4	3	60	25	75	100
Core Elective-VI Indus module	PMB23ET32 IM	Fermentation Technology	4	3	60	25	75	100
PART -B								
SEC-III	PMB23ST3	Lab in Fermentation Technology	4	2	60	25	75	100
AECC-III	PMB23AC3	Palliative Science	2	2	30	25	75	100
		Internship / Industrial Activity		2				
		Total	**30**	**24**				

IV Semester

Course	Code	Subject/Paper	Hrs/ w	Cred	Tot Hrs	CA	SE	Total
PART- A								
Core-IV	PMB23CT41	Food & Dairy Microbiology	5	4	75	25	75	100
Core-V	PMB23CT42	Research Methodology & Biostatistics	5	4	75	25	75	100
Core-L7	PMB23CL41	Lab in Food and Diary Microbiology	4	2	60	25	75	100
Core Elective-VII	PMB23ET41 A,B,C	Bioenergy/ Microbial Genomics/ Toxicology	5	4	75	25	75	100
Core Elective-VIII	PMB23PJ41	Project	5	4	75	25	75	100
PART -B								
SEC-IV	PMB23ST4	Life Science for Competitive Examinations	4	2	60	25	75	100
AECC-IV	PMB23AC4	Microbial Culturing Techniques	2	2	30	25	75	100
PART-C								
Extension Activity/ MOOC	PMB23ME41			**1**				
		Total	**30**	**23**				

Component wise Credit Distribution

Credits	Sem I	Sem II	Sem III	Sem IV	Total
Part A	**18**	**18**	**18**	**18**	**72**
Part B **(i) Discipline Centric / Generic Skill**	**2**	**2**	**2**	**2**	**8**
(ii) Soft Skill	**2**	**2**	**2**	**2**	**10**
(iii) Summer Internship / Industrial training			**2**		
Part C **Extension/MOOC Course**				**1**	**1**
Total	**22**	**22**	**24**	**24**	**91**

Part A component and Part B (i) will be taken into account for CGPA calculation for the postgraduate programme and the other components Part B and Part C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree

	No of papers	Credit/ paper	Total Credit	Cumulative Credits
PART-A				
Core Theory	8	4	32	**72**
Core Lab	8	2	16	
Elective	6	3	18	
	1 (Ind Mod)	3	03	
Project	1 (Project	3	03	
PART-B				
SEC	4	2	08	**18**
AECC	4	2	08	
Internship	1	2	02	
		1	01	
PART -C				
Extension Act/ MOOC course	1	1	01	**01**
Total			91	**91**

For Choice Based Credit System (CBCS)

- Choices are offered for Elective Courses
- Total Credits for Core Courses -48
- Total Credits for Elective Courses- 24 (6 Electives + 1 Ind Mod. +1 Project)
- Total credits for SEC, AECC- 19

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DEPARTMENT OF MICROBIOLOGY
(For those joined M.Sc., Microbiology on or after June 2023)
Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23CT11	General Microbiology and Microbial Diversity	Core-I	4	-	-	4

L - Lecture T - Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble

Provide comprehensive knowledge on the history and development of microbiology. Explains the significance of beneficial microbes and methods for the control of pathogenic microbes

Prerequisite

Basic knowledge on microbes, culture media, staining methods.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Acquire knowledge on the principles of different types of microscopes and their applications.	**80**	**75**
CO2	Compare and contrast the structure of bacteria. Illustrate nutritional requirements and growth in bacteria.	**80**	**75**
CO3	Exemplify, isolate and cultivate microalgae and fungi from diverse environmental sources.	**80**	**75**
CO4	Explain various pure culture techniques and discuss sterilization methods.	**80**	**75**
CO5	Discuss the importance and conservation of microbial diversity.	**80**	**75**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**M**	**L**	**-**	**L**	**M**	**L**
CO2	**S**	**S**	**S**	**-**	**M**	**M**	**-**
CO3	**S**	**M**	**S**	**L**	**L**	**L**	**M**
CO4	**S**	**S**	**M**	**M**	**M**	**M**	**M**
CO5	**S**	**M**	**S**	**L**	**M**	**M**	**S**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	L	S	L
CO2	S	S	S	-	L
CO3	S	S	M	-	M
CO4	S	S	L	-	S
CO5	S	S	M	M	S

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second (Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Title of the Paper: General Microbiology and Microbial Diversity

Unit I

History and scope of microbiology. Microscopy – Principles and applications. Types of Microscopes - Bright field, Dark-field, Phase-contrast, Fluorescence microscope, Transmission electron microscope (TEM) and Scanning electron microscope (SEM). Sample preparation for SEM & TEM. Microbial taxonomy- Nomenclature rules and identification- Haeckel's three kingdom classification, Whittaker's five kingdom approach - Woese domain system. Bergey's Manual of Systematic Bacteriology (9th edition). Numerical Taxonomy- 16S rRNA based classification. Bacterial identification methods. Ribotyping, Ribosomal Database Project.

Unit II

BacterialStructure, properties and biosynthesis of cellular components – Internal structure- cell membrane, cell inclusions. Cell wall (Gram positive and Gram negative). External structure and chemical composition of -flagella, pili, capsules, sheaths, prostheca and cell wall (Gram positive and Gram negative). Sporulation. Growth and nutrition - Nutritional requirements, Growth curve, Kinetics of growth, Batch culture, Synchronous growth, Measurement of growth and factors affecting growth.Actinomycetes- Distribution, morphology, classification, reproduction and economic importance

Unit III

Algae - Distribution, morphology, classification (Fristch System), reproduction and economic importance. Isolation of algae from soil and water. Media and methods used for culturing algae, Strain selection and large-scale cultivation. Life cycle - *Chlamydomonas*, *VolvoxSpirogyra* (Green algae), *Nostoc.* (Cyanobacteria) *Ectocarpus*, *Sargassum* (Brown algae), *Polysiphonia*, *Batrachospermum* (Red algae). Fungi - Distribution, morphology, classification (Alexopoulos method), reproduction and economic importance- *Rhizopus*, *Saccharomyces*, *Agaricus* and *Fusarium*. Lichens - Structures and types.

Unit IV

Safety guidelines in Microbiology Laboratories. Sterilization- Physical and chemical agents.Disinfection and its validation. Staining methods – Simple, Differential and Special staining. Automated Microbial identification systems - Pure cultures techniques – Cultivation of Anaerobic organisms. Maintenance and preservation of pure cultures. Culture collection centres - National and International. Indicator microorganism for sterilization methods. Evaluation of antimicrobial chemical agents – MIC and MBC assays.

Unit V

Biodiversity - Introduction to microbial biodiversity – Thermophiles - Classification, Thermophilic Archaebacteria and its applications. Methanogens - Classification, Habitats, applications. Alkaliphiles and Acidophiles - Classification, discovery basin, its cell wall and membrane. Barophiles - Classification and its applications. Halophiles - Classification, discovery basin, cell walls and membranes – purple membrane, compatible solutes, Osmoadaptation / halotolerance - Applications of halophiles. Conservation of Biodiversity.

Reference Books:

- Tortora G. J., Funke B. R. and Case C. L. (2015). Microbiology: An Introduction (12th Edition).Pearson, London, United Kingdom
- Black JG, Black LJ (2017). Microbiology: Principles and Explorations. Tenth Edition, John Wiley & Sons. Australia
- Pelczar MJ, Chan ECS and Kreig NR (2006). Microbiology. Fifth edition, Tata McGraw-Hill INC. New York.
- Prescott LM, Harley JP and Klein DA (2005). Microbiology. McGraw Hill International edition, New York.
- Madigan M. T., Bender K.S., Buckley D. H. Sattley W. M. and Stahl (2018) Brock Biology of Microorganisms. (15th Edition). Pearson.
- Holt J.S., Kreig, N.R., Sneath, P.H.A and Williams, S.T. (2020)Bergey's Manual of Determinative Bacteriology. Ninth Edition, Williams and Wilkins, Baltimore.

Online Resource:

- http://sciencenetlinks.com/tools/microbeworld
- https://www.microbes.info/
- https://www.asmscience.org/VisualLibrary

Course Designers:

1. Dr. A. Kanakalakshmi
2. Dr. M. Karthikeyan

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DEPARTMENT OF MICROBIOLOGY
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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23CT12	Immunobiology	Core - II	4	-	-	4

L - Lecture T - Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble

Elaborates the functional and developmental aspects of the immune system and highlights its defense mechanism against various infectious agents.

Prerequisite

Basics knowledge on biology

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcomes	Expected Proficiency (%)	Expected Attainment (%)
CO1	Appraise the importance of immunology, types of immune system, lymphoid organs and development of the immune cells	**70**	**60**
CO2	Spell the types of antigens and immunoglobulins and its production	**70**	**60**
CO3	Interpret the Immune effector mechanisms and its tolerance	**70**	**60**
CO4	Distinguish the defense mechanisms of infections and disorders	**60**	**70**
CO5	Outline the immunodiagnostic methods and transplantation immunology	**70**	**60**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**M**	**M**	**S**	**L**	**-**	**M**
CO2	**S**	**S**	**S**	**M**	**M**	**M**	**M**
CO3	**S**	**S**	**S**	**M**	**M**	**-**	**L**
CO4	**S**	**S**	**S**	**M**	**S**	**S**	**L**
CO5	**S**	**S**	**S**	**L**	**S**	**M**	**S**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	-	S	-	L
CO2	S	S	L	M	S
CO3	S	M	L	-	L
CO4	S	M	M	L	L
CO5	S	L	M	S	M

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second (Marks)	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Total Marks	**60**	**60**	**130**

Title of the Paper: Immunobiology

Unit I

History and scope of immunology. Types of immunity – innate, acquired, passive and active. Physiology of immune response – humoral and cell-mediated immunity. Lymphoid organs – primary and secondary. Cells of the immune system – origin, development, differentiation of cells in innate and adaptive immune system. Hematopoiesis and stem cells

Unit II

Antigens – characteristics, types, cross-reactivity, hapten, adjuvant, immunogenicity and antigenicity. Immunoglobulins – types, structure, and functions. Molecular biology of immunoglobulin synthesis, antibody diversity, and Class switching. Antigen recognition – TCR, Diversity of TCR. Antigen processing and presentation by T and B lymphocytes. Clonal proliferation and differentiation. Kinetics of antibody response.Immunotechnology – hybridoma, monoclonal and polyclonal antibody, antibody engineering – production of chimeric and hybrid monoclonal antibodies.

Unit III

Immune effector mechanisms: Cytokines, lymphokines, and chemokines – properties and functions. Complement components – classical, alternate, and lectin pathways, complement activation, and complement deficiencies. Toll-like receptors. Hypersensitivity – anaphylaxis, cytotoxic, immune complex deposition, and cell-mediated. Autoimmunity - idiotype network and autoimmune diseases. Mechanism of immune regulation – immune induction, immunosuppression, immunomodulation, immune tolerance.

Unit IV

Immunity to infectious diseases – bacterial (Tuberculosis), viral (AIDS), protozoan and parasitic diseases (Malaria and Leishmaniasis). Immune deficiency disorders – T cells,

B cells, phagocytic, natural killer cell-associated diseases, and AIDS. Failures of host defense mechanisms to infectious diseases. Vaccines: Types – inactivated, subunit, synthetic, DNA, RNA, and live attenuated vaccines, Development of vaccines, multiepitope vaccines. Reverse vaccinology

Unit V

Transplantation immunology: Graft versus host reactions. Structure, functions of class I and class II MHC molecules, HLA typing. Principles of tumor immunology: Tumor antigens, immune responses to tumor, and immunotherapy of malignancy. Immuno diagnosis based on antigen and antibody interaction - precipitation, agglutination, ELISA, EIA, RIA, FISH, ELISPOT assay, immunofluorescence techniques - flow cytometry, Immuno histochemistry, Immuno blotting techniques – Western blotting, Immunodeficient techniques.

Reference Books:

- Punt J, Stranford S, Jones P, Owen JA (2018). Kuby Immunology. Eight edition. W.H. Freeman and Company, Macmillan Learning, New York.
- Abbas, A. K., Lichtmann A. H and Pillai S. (2021), Cellular and Molecular Immunology, Tenth edition, Elsevier, Philadelphia, Pennsylvania.
- Male D, Brostaffand J, Roth D, Roitt I. (2020). Immunology, Ninth Edition, Elsevier Saunders, London.
- Richard C, and Geoffrey S (2015). Immunology – a short course, Seventh Edition, Wiley – Blackwell, New York.
- Arora, M.P. (2010). Immunology, Ane Books Pvt. Ltd., New Delhi.

ICT Tutorials

- Antigen Recognition - https://www.youtube.com/watch?v=VAHdJMZDKjA
- Isotype, allotype and idiotype-https://www.youtube.com/watch?v=fa3nQGxaDO8
- Vaccine - https://www.youtube.com/watch?v=lZ0qhiMHg4U

Course Designers:

1. **Dr. M. Vijayasarathy**
2. **Dr. A. Kanakalakshmi**

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23CL11	Lab in General Microbiology and Microbial Diversity	Core Lab-I	-	-	4	2

L - Lecture T - Tutorial P – Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble

Provide practical knowledge on isolation, cultivation and characterization of microorganisms.

Prerequisite

Basic knowledge on sterilization techniques, characteristics of different microbes (Bacteria fungi, yeast and viruses) and types of media.

Course Outcomes

On the completion of the course the student will be able to

#	Course outcomes	Expected Proficiency %	Expected Attainment %
CO1	Elaborate physical and chemical means of sterilization. Prepare various Culture media, for culturing different types of microbes.	70	75
CO2	Perform microbial techniques for isolation of pure cultures of bacteria, fungi and algae.	70	75
CO3	Comprehend the various methods for identification of unknown microorganisms.	60	75
CO4	Interpret the Microbiology techniques in research or internship activities.	70	75
CO5	Develops basic skills necessary to work in the microbiology laboratory or start a clinical lab.	70	75

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	S	M	S
CO2	S	S	S	M	L	M	S
CO3	S	S	S	L	M	M	M
CO4	S	S	S	M	M	M	M
CO5	S	S	S	M	M	M	M

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	S	L	S	M	S
CO3	S	S	S	M	S
CO4	S	L	M	L	S
CO5	S	M	L	L	S

S: Strong M: Medium L: Low

Title of the Paper : Lab in General Microbiology and Microbial Diversity

1. Laboratory rules and regulations.
2. Cleaning and methods of sterilization.
3. Preparation of culture media.
4. Serial dilution technique.
5. Pure culture technique (A) Pour plate (B) spread plate (C) streak plate.
6. Isolation of bacteria from soil/water/air.
7. Isolation of fungi from soil/water/air.
8. Isolation of Actinomycetes from soil.
9. Staining techniques - Simple, Negative, Gram's, Capsule, Spores.
10. Motility test – Hanging drop method.
11. Measurement of microbial cell size – Micrometry method.
12. Cultivation of anaerobic microbes by pyrogallic acid method.
13. Identification of fungi by lactophenol cotton blue staining method.
14. Fungi slide culture technique.
15. Measurement of fungal growth rate – colony diameter method.
16. Study of microbial taxonomy by using bacterial morphology and biochemical tests.
17. Collection and identification of algae and Cyanobacteria.

Reference Books:

- Cappuccino, J.H. andSherman,N. (2012). Microbiology – A Lab Manual, Seventh Edition, Dorling Kidersley(India)Pvt., Ltd.,NewDelhi.
- Gunasekaran, P. (2008). Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi.
- Kannan, N. (1996). Laboratory Manual in General Microbiology, Palani Paramount Publication,Palani.
- Aneja, K.R. (1993). Experiments in Microbiology: Plant Pathology and Tissue Culture, WishwaPrakashan, NewDelhi.

Course Designers:

1. **Dr. A. Kanakalakshmi**

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DEPARTMENT OF MICROBIOLOGY
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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23CL12	Lab in Immunobiology	Core Lab-II	-	-	4	2

L - Lecture T - Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble
Provide hands on training on immunological techniques and demonstration of immunization protocols

Prerequisite
Basic knowledge on biology.

Course Outcomes
On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Define the elemental concepts of immunology	**65**	**80**
CO2	Demonstrate the protocols involved in the preparation of antigen and antibodies	**70**	**80**
CO3	Distinguish the salient features of antigen antibody reaction and it’s in diagnostics	**60**	**80**
CO4	Make use of biotechnological tools for the separation and purification of serum proteins	**60**	**80**
CO5	Evaluate the methods involved in the isolation and enumeration of immune cells	**70**	**80**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	M	M	L	L	-
CO2	S	S	S	M	M	L	L
CO3	S	S	S	L	S	-	M
CO4	S	M	S	-	M	L	L
CO5	S	S	S	L	S	M	L

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	L	-	M
CO2	S	M	M	L	S
CO3	S	S	M	L	S
CO4	S	M	L	L	M
CO5	S	L	M	L	M

S:Strong M: Medium L: Low

Title of the Paper: Lab in Immunobiology

1. Identification of various immune cells from human peripheral blood.
2. Lymphocyte separation and identification
3. Determination of lymphocyte viability by trypan blue exclusion test.
4. WBC counting
5. Electrophoretic profiling of serum proteins in native PAGE
6. Protocols of immunization.
7. Preparation of soluble antigen – BSA & human serum
8. Preparation of cellular (particulate) antigen - bacterial antigen
9. Immunodiagnostics : CRP, ASO, RA, hcG, ELISA
10. Radioimmunoassays (Demonstration)
11. Direct agglutination to determine ABO blood grouping.
12. Immuno electrophoretic technique (Rocket, counter -current)
13. Agar gel Ouchterlony double immuno diffusion.
14. Mancini single radial immuno diffusion.
15. Haemagglutination titration assay.
16. Visualization and study of Lymphoid Organs from mice and Chicken (Model).
17. Identification and enumeration of human T – lymphocyte using E – rosette technique.

Reference Books:

- Rastogi S.C. (1996). Immunodiagnostics Principles and Practice, New Age International (P) Ltd., New Delhi.
- Talwar, G.P. and Gupta, S.K. (1992). A Hand Book of Practical and Clinical Immunology, Vol. 1 -2, CBS Publishers & Distributors, Delhi.
- Myers, R.L. (1989). Immunology: A Laboratory Manual, Wm. C. Brown Publishers, Dubuque, Lowa.
- Talwar, G.P. (1983). A Hand Book of Practical Immunology, Vikas Publishing House Pvt. Ltd., New Delhi.

Online Resource

- https://www.youtube.com/watch?v=sJptG3_uiVg
- https://www.youtube.com/watch?v=C3WmRCVFCK0
- https://www.youtube.com/watch?v=Cl4sTwKFe9k

Course Designers:

1. **Dr. M. Vijayasarathy**

THIAGARAJAR COLLEGE, MADURAI:: 9
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DEPARTMENT OF MICROBIOLOGY
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23ET11A	**Forensic Science**	Core Elective-I	3	1	-	3

L - Lecture **T - Tutorial** **P – Practicals**

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble

Acquire knowledge on the fundamental principles of forensic science and its functions. Introduce the biological aspects of forensic science and its applications in crime scene investigations.

Prerequisite

Basic Knowledge of chemistry and biology.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Demonstrate the competency in the collection, processing, analyses, evaluation and documentation evidences.	**60**	**70**
CO2	Prove the competency in the principles of Forensic science laboratories - Organizational setup and functions in crime scene investigation	**60**	**70**
CO3	Appraise the significance of forensic microbiology and epidemiology of bioterrorism	**60**	**70**
CO4	Explain the fundamental concepts in wild life forensics and illegal trading	**60**	**70**
CO5	Define the principles and significance of fingerprints in crime investigation and forensic toxicology	**70**	**70**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**S**	**M**	**M**	**L**
CO2	**S**	**S**	**M**	**S**	**M**	**M**	**M**
CO3	**S**	**S**	**S**	**M**	**S**	**M**	**M**
CO4	**S**	**S**	**S**	**M**	**M**	**M**	**L**
CO5	**S**	**S**	**S**	**M**	**S**	**M**	**M**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**L**	**S**	**S**	**S**	**M**
CO2	**L**	**L**	**S**	**S**	**S**
CO3	**S**	**M**	**S**	**M**	**M**
CO4	**M**	**L**	**S**	**S**	**S**
CO5	**L**	**L**	**L**	**M**	**M**

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Total Marks	**60**	**60**	**130**

Title of the paper: Forensic Science

Unit I

Introduction to forensic Science – Definition, history and development of forensic science. Scope and need of forensic science in present scenario. Branches of forensic science. Tools and techniques of forensic science. Duties of a forensic scientist- Crime scene evidence- Locard Principle- Physical and trace evidences - their classification and significance, Crime Scene examinations - recognition, collection, preservation and transportation- documentation. Forensic report. Frye case and Daubert standard.

Unit II

Forensic science laboratories - Organizational setup and functions of forensic science laboratory in India. Central and State level laboratories in India. Mobile forensic science laboratory and its functions. Foot and tyre impressions - examination of foot and tyre prints. Finger prints - Finger print patterns and classification. Techniques in Finger printing- Ear prints- collection and evaluation. Fundamentals of crime scene photography- Micro and Macro photography-principles of black & white and color photography. Tool marks - identification - restoration of field off/erased marks.

Unit III

Insects of forensic importance- ants, blowflies, beetles. Forensic microbiology - Types and identification of microbial organisms of forensic significance. Techniques in forensic microbiology. Microbial forensic investigation of the anthrax letter attacks.

Impact of Meningitis on cognitive skills and development in children due to microbial toxicity. Bioterrorism- Categories-Types of biological agents. Planning and response to bioterrorism – Preparedness, Bio surveillance, Biodefence. Epidemiology of Bioterrorism- Study of spore, powdered minerals and pollens of forensic importance in criminal or civil investigation.

Unit IV

Fundamentals of wildlife forensic. Significance of wildlife forensic. Protected and endangered species of animals and plants. Illegal trading of animal skin, fur, bone, horn, teeth. Identification of physical evidence pertaining to wildlife forensics. Identification of pug marks of various animals. Illegal trading of flowers, plants and Herbal drug formulations. Forensic serology - Definition, identification and examination of body fluids - Blood, semen, saliva, sweat and urine. Forensic examination and identification of hair and fibre.

Unit V

Forensic toxicology - Introduction and concept of forensic toxicology. Poisons - Types of poisons and their mode of action. Medico legal post mortem and their examination. Narcotic drugs - alcoholic beverages – drugs prohibited in Sports. Fundamentals of DNA profiling- techniques RFLP, VNTR, PCR, STR and mitochondrial DNA. Applications in paternity cases, DNA testing in disputed paternity.

Reference Books:

- Sharma B.R (2020) Forensic science in criminal investigation and trials. (6th Edition)Universal Press.
- Parikh CK. (2019). Text book of Medical Jurisprudence, Forensic Medicine and Toxicology, 8th Edition, CBS Publishers, New Delhi.
- Richard Saferstein (2017). Criminalistics- An introduction to Forensic Science. (12th Edition).Pearson Press.
- James S. H. and Nordby, J. J. (2015) Forensic Science: An Introduction to Scientific and Investigative Techniques. (5th Edition). CRC Press. ISBN-10:9781439853832 / ISBN-13:978-1439853832.
- Li R. (2015) Forensic Biology. (2nd Edition). CRC Press, New York. ISBN-13:978-1-4398-8972-5.
- Tilstone, W.J., Hastrup, M.L., Hald, C., Fisher's, C. (2013).Techniques of Crime Scene Investigation, CRC Press, Boca Raton .

Online Resources:

https://sites.google.com/site/introductiontoforensicscience/file-cabinet

https://study.com/academy/lesson/forensic-laboratories-description-services.html

https://www.who.int/health-topics/biological-weapons

https://www.unodc.org/documents/Wildlife/Wildlife_Forensics_Brochure.pdf

https://www.forensicsciencesimplified.org/tox/Toxicology.pdf

Course Designers:

1. **Dr. K. Renugadevi**
2. **Dr. A. Kanakalakshmi**

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DEPARTMENT OF MICROBIOLOGY
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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23ET121B	**Cell Structure and dynamics**	Core Elective-I	3	1	-	3

L - Lecture T - Tutorial P – Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble

Acquire knowledge on the fundamental concepts of cell structure and organization.
Elaborate the mechanism of cell division and its functions.

Prerequisite

Basic knowledge on cell, structure ,components, organization and its function..

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Understand the fundamentals of cell structures and organelles	**60**	**70**
CO2	Explore the role of cell organelles and transport of biomolecules	**60**	**70**
CO3	Become familiar with cell signaling and its regulations	**70**	**60**
CO4	Secure a wide knowledge on cell communication and quorum sensing	**70**	**60**
CO5	Gather an extempore knowledge on different phases of cell cycle	**60**	**70**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	M	L	L
CO2	S	S	M	M	M	L	L
CO3	S	S	M	M	L	M	L
CO4	S	S	M	M	M	M	M
CO5	S	S	S	S	S	L	L

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO 1	PSO2	PSO 3	PS O4	PSO 5
CO1	**S**	**L**	**M**	**L**	**L**
CO2	**S**	**M**	**L**	**M**	**L**
CO3	**S**	**M**	**M**	**M**	**M**
CO4	**M**	**S**	**L**	**L**	**M**
CO5	**S**	**M**	**M**	**M**	**M**

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15%(9)	15% (9)	20%(30)
Understand -K2	15%(9)	15% (9)	20%(30)
Apply-K3	30%(18)	30% (18)	20%(30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20%(30)
Total Marks	60	60	150

Title of the Paper: Cell Structure and Dynamics

Unit I

Discovery of cell and Cell theory. Ultrastructure of plant, bacterial and animal cells. Cell types epithelial cells, endothelial cells and Nerve cells. Specialization of cells into tissues and colonies. Structure, types and functions of: Mitochondria, Chloroplast, Ribosome, Peroxisomes, Endoplasmic reticulum (rough and smooth), Golgi apparatus, Lysosome, Nucleus – Nucleolus, Chromosome – Eukaryotic and prokaryotic, Histones and Plasmids

Unit II

Microfilaments, Microtubules, Cilia, Flagella, Pili, Capsule, Plasma membrane models - Davson-Danielli and Fluid mosaic model - chemical constituents of plasma membrane, lipid bilayer, Phospholipids, Membrane proteins, Hydropathy plot, Freeze – fracture technique, Transport proteins, cell coat or glycocalyx. ABO blood group antigens on plasma membrane, Transport of molecules across plasma membrane – Endocytosis – Macropinocytosis, clathrin mediated endocytosis, caveolae mediated endocytosis, Clathrin and caveolae independent endocytosis and Phagocytosis.

Unit III

Extra Cellular Matrix (ECM), Cell Adhesion, Cell migration, Cell junctions- gap junctions, tight junctions & anchoring junctions, & Cell-cell Communication, Vesicle formation- Transport of proteins from ER to Cis – golgi (Clathrin coated, COPI coated, COPII coated,) ER resident proteins often are retrieved from the cis – golgi, Quorum sensing, Intracellular signaling- calcium, receptors- G protein, MAPK.

Unit IV

Cell signalling- G-protein coupled and TGFβ receptor system JAK/STAT, Ras and MAP kinase pathway, Protein targeting and translocation, Endoplasmic reticulum – N linked glycosylation of dproteins, protein folding, Cell ageing, Cell death and its regulation.

Unit V

Cell cycle & its regulation- mitosis and Stages of cell cycle, regulation of cell cycle, Phases and significance of Mitotis, Meiosis, Apoptosis, Necrosis and Oncogenesis - meiosis Molecular and biochemical characteristics of cancer cells. Introduction to Stem cells.

Reference Books:

- De Roberties, E.D.P and De Roberties, E.M.F. 2011. Cell and Molecular Biology, Eighth edition, B.I. Publications Pvt. Ltd. India
- Allison, L.A. 2021. Fundamental Molecular Biology, Third edition, Blackwell Publishing Ltd, USA.
- Lodish, Berk, Zipursky, Matsudara, Baltimore and Darnell. 2021. Molecular Cell Biology, Ninth Edition, W. H. Freeman and Company, Newyork.
- Watson, J.D, Hopkins, Baker, T. A, Bell, S. P, Gann A, Levine, M, Losick R. 2014. Molecular Biology of the Gene, Seventh edition, The Benjamin / Cummings Publishing Company Inc.,Tokyo.
- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2008). Molecular Biology of the Cell (5th Ed.). New York: Garland Science.
- Krebs, J. E., Lewin, B., Kilpatrick, S. T., & Goldstein, E. S. (2014). Lewin's Genes XI. Burlington, MA: Jones & Bartlett Learning.
- Cooper, G. M., & Hausman, R. E. (2013). The Cell: a Molecular Approach (6th Ed.). Washington: ASM ; Sunderland.
- Hardin, J., Bertoni, G., Kleinsmith, L. J., & Becker, W. M. (2012). Becker's World of the Cell. Boston (8th Ed.). Benjamin Cummings.

Online Resources:

- https://education.nationalgeographic.org/resource/history-cell-discovering-cell/
- https://bio.libretexts.org/Bookshelves/Human_Biology/Human_Biology_(Wakim_and_Grewal)/05%3A_Cells/5.02%3A_Discovery_of_Cells_and_Cell_Theory
- https://www.toppr.com/guides/biology/cell-structure-and-function/cell-structure-and-functions/
- https://www.khanacademy.org/science/ap-biology/cell-communication-and-cell-cycle/cell-communication/a/introduction-to-cell-signaling
- https://alg.manifoldapp.org/read/fundamentals-of-cell-biology/section/78a4b49f-eb14-40a1-9ea7-196821b7d5de

Course Designers:

1. **Dr. K. Renugadevi**
2. **Dr. A. Kanakalakshmi**

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DEPARTMENT OF MICROBIOLOGY
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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23ET11C	**Bioinstrumentation**	Core Elective-I	3	1	-	3

L – Lecture T – Tutorial P – Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble

The course provide knowledge on elemental concepts and working principles of analytical instruments.

Prerequisite

Basic knowledge on microbiology and chemistry.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Demonstrate the principle and mechanism of basic laboratory equipments.	**60**	**70**
CO2	Apply chromatography in separation of biomolecules	**60**	**70**
CO3	Illustrate molecular techniques in biological applications	**70**	**60**
CO4	quire knowledge on spectroscopic techniques	**70**	**60**
CO5	Demonstrate the application of radioisotopes in biological research	**60**	**70**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**M**	**S**	**S**	**M**	**M**	**M**	**L**
CO2	**M**	**S**	**S**	**L**	**S**	**M**	**L**
CO3	**S**	**M**	**S**	**L**	**M**	**L**	**M**
CO4	**M**	**M**	**M**	**L**	**M**	**L**	**M**
CO5	**M**	**L**	**S**	**L**	**M**	**M**	**L**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**M**	**M**	**L**
CO2	**S**	**S**	**M**	**L**	**M**
CO3	**S**	**S**	**M**	**S**	**S**
CO4	**M**	**M**	**S**	**L**	**M**
CO5	**L**	**L**	**S**	**M**	**M**

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Total Marks	**60**	**60**	**130**

Title of the paper: Bioinstrumentation

Unit-I

Basic laboratory Instruments – Biosafety Cabinets - Fume Hood, 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

General principles of chromatography - Chromatographic Performance parameters; Types- Thin layerchromatography, Paper Chromatography, Liquid chromatography (LPLC &HPLC), Adsorption, ion exchange, Gel filtration, affinity, Gas liquid (GLC). Flash Chromatography and Ultra Performance convergence chromatography. Two dimensional chromatography. Stimulated moving bed chromatography (SEC).

Unit III

Electrophoresis: General principles - electrophoretic mobility – supportive materials – electro endosmosis – types (horizontal, vertical and two dimensional electrophoresis) - Principle and applications - paper electrophoresis, Serum electrophoresis, starch gel electrophoresis, Disc gel, Agarose gel, SDS – PAGE, Immuno electrophoresis. Blotting techniques -Southern, northern and western blotting.

Unit IV

Spectroscopic techniques: Principle, theory of absorption of light by molecules, electromagnetic spectrum, instrumentation and application of UV- visible, Raman, FTIR

spectrophotometer, spectrofluorimetry, Atomic Absorption Spectrophotometer, Flame spectrophotometer, NMR, and GC-MS. Detection of molecules in living cells - FISH and GISH. Biophysical methods: Analysis of biomolecules by Spectroscopy UV/visible.

Unit V

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. Commonly used isotopes in biology, labeling procedures and safety aspects.

Reference Books:

- Jayaraman J. (2011). Laboratory Manual in Biochemistry. (2nd Edition). Wiley Eastrn Ltd., New Delhi.
- Mitchell G. H. (2017). Gel Electrophoresis: Types, Applications and Research. Nova Science Publishers Inc.
- Chatwal G. R and Anand S. K. (2014.) Instrumental Methods of Chemical Analysis. Himalaya Publishing House.
- Ponmurugan P. and Gangathara P. B. (2012). Biotechniques. (1st Edition). MJP Publishers.
- Holme D. Peck H. (1998). Analytical Biochemistry. (3rd Edition). Prentice Hall.

E -Resources

- http://www.biologydiscussion.com/biochemistry/centrifugation/centrifuge-introduction- types-uses-and-other-details-with-diagram/12489
- https://www.watelectrical.com/biosensors-types-its-working-and-applications
- https://study.com/academy/lesson/what-is-chromatography-definition-types-uses
- https://norcaloa.com/BMIA

Course Designers:

1. **Dr. M. Karthikeyan**
2. **Dr. A. Kanakalakshmi**

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23ET12A	**Molecular Biology & Microbial Genetics**	Core Elect-II	3	1	-	3

L - Lecture **T - Tutorial** **P – Practicals**

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble

Introduce the core principles of molecular biology and microbial genetics. To emphasis the molecular aspects of DNA mutation, repair, recombination and gene expression strategies.

Prerequisite

Basic concepts of theoretical biology

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Illustrate the structure, types and functions of genetic material	**60**	**70**
CO2	Focus on the elemental concepts of prokaryotic, eukaryotic transcription and post modification systems	**60**	**70**
CO3	Classify the concepts of genetic code, mechanism of translational and post processing in prokaryotes and eukaryotes	**60**	**70**
CO4	Explain the mechanism of molecular and biochemical basis of DNA mutation and damage with repairing process	**60**	**70**
CO5	Compare the methods of gene transfer mechanism and its significance in gene mapping procedures	**70**	**70**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**S**	**M**	**M**	**L**
CO2	**S**	**S**	**M**	**S**	**M**	**M**	**M**
CO3	**S**	**S**	**S**	**M**	**S**	**M**	**M**
CO4	**S**	**S**	**S**	**M**	**M**	**M**	**L**
CO5	**S**	**S**	**S**	**M**	**S**	**M**	**M**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**L**	**S**	**S**	**S**	**M**
CO2	**L**	**L**	**S**	**S**	**S**
CO3	**S**	**M**	**S**	**M**	**M**
CO4	**M**	**L**	**S**	**S**	**S**
CO5	**L**	**L**	**L**	**M**	**M**

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Total Marks	**60**	**60**	**130**

Title of the paper: Molecular Biology and Microbial Genetics

Unit I

Discovery and Molecular basis of DNA as genetic material. Structure and forms of DNA. Properties of DNA - denaturation, renaturation, melting curve, hyperchromicity. Structure and types of RNA - tRNA, mRNA & rRNA. Epigenetics, Histone proteins. Replication of DNA - semi conservative mode, Meselson - Stahl experiment. Enzymology of DNA replication - DNA polymerase I, II &III, topoisomerase I & II, helicase, primase, gyrase. Molecular basis of DNA replication - replication fork, origin, Okazaki fragments. Types of replication - circular and theta.

Unit II

Transcription process in Prokaryotes and Eukaryotes: Initiation - promotors, upstream & downstream sequences, sigma and transcription factors. Elongation - RNA polymerase, sub units. Termination - Rho dependent and Rho independent, nus A, antitermination. RNA processing (post transcriptional modifications) – Structure and processing of m-RNA, r-RNA and t-RNA. Ribosomes. RNA degradation, inhibitors of transcription.Reversetranscription process.

Unit III

Genetic code: Elucidation of triplet code, code characteristics, codon dictionary. Reading frames, sense and nonsense code. Degeneracy - wobble hypothesis, universality of genetic code and exceptions. Process of translation in prokaryotes and eukaryotes: Initiation - initiation factors, initiator tRNA, amino acid activation, Shine Dalgarno (SD) sequences, initiation site. Elongation - elongation factors and translocation. Termination - termination factors. Post translational modifications - post translational transport, signal hypothesis. Post translational modification-Protein splicing, Chaperons.

Unit IV

Gene regulation and expression-positive and negative regulation-lac, trp, Ara operons. Gene regulation in eukaryotic systems - repetitive DNA, gene rearrangement, promoters, enhancer elements. Molecular basis of gene mutation - Types of mutations - base substitutions, frame shift, deletion insertion, duplication, inversion. Silent, conditional and lethal mutation. Chemical mutagenesis. Repair of DNA damage. Photoreactivation. SOS repair mechanism. Base excision repair. Nucleotide excision repair. Detection and analysis of mutations (Replica plating, Antibiotic enrichment, Ames test).

Unit V

Mechanism of genetic exchange: Types of plasmids (F Plasmid: Conjugate plasmid', Mobilization of Non-conjugative plasmid, R plasmid, Col plasmid Copy number and incompatibility), Episomes. Transposable elements (Insertion sequence and transposons, Integrons and Antibiotic-Resistance cassettes, Multiple Antibiotic Resistant bacteria, Mu– virus); Bacterial Genetics (Mutant phenotype, DNA mediated Transformation); Conjugation (Cointegrate formation and Hfr Cells, Time–of–Entry Mapping, F' Plasmid); Transduction (Generalized transduction, Specialized Transduction) - gene mapping.

Reference Books:

- Malacinski G.M. (2008). Freifelder's Essentials of Molecular Biology. (4th Edition). Narosa Publishing House, New Delhi.
- Primrose S.B. and Twyman R. M. (2006). Principles of Gene Manipulation and Genomics. (7th Edition). Blackwell Publishing.
- Maloy S. R. Cronan J.E. Jr. and Freifelder D. (2011). Microbial Genetics. (2nd Edition). Narosa Publishing House Pvt. Ltd.
- Brown T. A. (2016). Gene Cloning and DNA Analysis- An Introduction. (7th Edition). John Wiley and Sons, Ltd.
- 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.
- Freifelder,D.(2000).MolecularBiology,SecondEdition,NarosaPublishinghouse.NewDelhi,India.

Web Resources:

- Meselson&Stahlexperiment-https://www.youtube.com/watch?v=yDQg7uXShUs
- Transcriptioninprokaryotes-https://www.youtube.com/watch?v=nJK-l7ByQAs
- Differencesin translation between prokaryotes and eukaryotes:https://www.youtube.com/watch?v=WNZf4ip_R9s
- https://thebiologynotes.com/characteristic-of-genetic-code/

Course Designers:

1. **Dr. K. Renugadevi**
2. **Dr. M. Karthikeyan**

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DEPARTMENT OF MICROBIOLOGY
(For those joined M.Sc., Microbiology on or after June 2023)
Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23ET12B	**Essentials of Laboratory Management and Biosafety**	Core Elect-II	4	-	-	3

L - Lecture T - Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble

Provide comprehensive knowledge of biosafety level, risk assessment and maintain proper hygiene in the laboratory.

Prerequisite

Basic knowledge on biosafety regulations and guidelines and importance of first aid technique for various common lab accidents

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Employ skills on laboratory safety and avoid laboratory accidents.	**80**	**75**
CO2	Prevent laboratory hazards by practicing safety strategies.	**80**	**75**
CO3	Practice various first aid procedures during common laboratory accidents.	**80**	**75**
CO4	Ensure biosafety strategies in laboratory.	**80**	**75**
CO5	Recognize the importance of biosafety guidelines.	**80**	**75**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**M**	**L**	**-**	**L**	**M**	**L**
CO2	**S**	**S**	**S**	**-**	**M**	**M**	**-**
CO3	**S**	**M**	**S**	**L**	**L**	**L**	**M**
CO4	**S**	**S**	**M**	**M**	**M**	**M**	**M**
CO5	**S**	**M**	**S**	**L**	**M**	**M**	**S**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	L	S	L
CO2	S	S	S	-	L
CO3	S	S	M	-	M
CO4	S	S	L	-	S
CO5	S	S	M	M	S

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second (Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Title of the Paper: Essentials of Laboratory Management and Biosafety

Unit I

Introduction to the laboratory and laboratory hazards - General laboratory facilities – Occupational safety- Lab accidents - Fires, chemical burns, slips and falls, Animal bites. Cuts from broken glass. Toxic fume inhalation. General laboratory rules, Good laboratory practice (GLP). Laboratory plan.

Unit II

Common hazards in laboratory: Chemical hazards- Safe handling of chemicals and gases, hazard labels and symbols. Material safety datasheet (MSDS), Chemical handling - Fume hood, Storage of chemicals. Chemical Waste Disposal Guideline. Physical hazards - Physical agent data sheets (PADS), Electric hazards- Electrical shock, Electrical explosions, Electrical burns. Safe work practices. Potential ignition sources in the lab. Stages of Fire. Fire Extinguishers. Fire Response.

Unit III

Prevention and First aid for laboratory accidents. Personal protective equipment (PPE), Proper attire (Eye/Face Protection, laboratory coats, gloves, respirators. Disposal/Removal of PPE. Emergency equipment safety - Showers/ Eye Washes. Laboratory security and emergency response. First aid for - Injuries caused by broken glass, Acid/Alkali splashes on the skin, swallowing acid/alkali, burns caused by heat, electric shock.

Unit IV

Biosafety - Historical background. Blood borne pathogens (BBP) and laboratory - acquired infections. Introduction to biological safety cabinets. Primary containment for biohazards. Biosafety levels of specific microorganisms. Recommended biosafety. Levels for infectious agents and infected animals. Risk groups with examples - Risk assessment. Safety levels. Case studies - Safe working, hand hygiene. Laboratory instruments, packing, sending, transport, import and export of biological agents. Hygiene, disinfection, decontamination, sterilization.

Unit V

Biosafety regulations and guidelines. Centers for disease control and prevention and the National institutes of health. Occupational safety and health administration. Recombinant DNA advisory committee(RDAC), Institutional biosafety committee(IBSC), Review committee on genetic manipulation(RCGM), Genetic engineering approval committee (GEAC). Implementation of biosafety guidelines.

Reference Books:

- World Health Organization, Biosafety programme management. (2010). (4th Edition). WHO Publications.
- Rashid N. (2013). Manual of Laboratory Safety (Chemical, Radioactive, and Biosafety with Biocides) (1st Edition).
- Dayuan X. (2015). Biosafety and Regulation for Genetically Modified Organisms, Alpha Science International Ltd, ISBN-10 : 1842657917
- Ochei J. Kolhatkar(2000). A. (Medical Laboratory Science – Theory and Practice. ISBN; 13:978-0074632239.

Online Resource:

- https://ors.od.nih.gov/sr/dohs/safety/laboratory/Pages/student_goodlab.aspx
- https://portals.iucn.org/library/efiles/documents/pgc-001.pdf
- https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/med_lab_tech_students/LN_Hlth_Lab_Mgmnt_final.pdf

Course Designers:

1. Dr. A. Kanakalakshmi

2. Dr. M. Vijayasarathy

THIAGARAJAR COLLEGE, MADURAI:: 9
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DEPARTMENT OF MICROBIOLOGY
(For those joined M.Sc., Microbiology on or after June 2023)
Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23ET12 C	**Microalgal Technology**	Core Elect-II	4	-	-	2

L – Lecture T – Tutorial P – Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First/Second	First/Second/Third	25	75	100

Preamble

The course provide knowledge on elemental concepts of microalgal technology for commercial application in industrial sectors.

Prerequisite

Basic knowledge on microbiology and chemistry.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Characterize the different groups of algae	**60**	**70**
CO2	Appraise the techniques involved the cultivation and harvesting of algae	**60**	**70**
CO3	Summarize the commercial applications of various algal products.	**70**	**60**
CO4	ply microalgae for environmental applications.	**70**	**60**
CO5	Outline the application of microalgae as alternate fuels.	**60**	**70**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**L**	**S**	**M**	**L**	**M**	**S**	**S**
CO2	**M**	**S**	**S**	**L**	**S**	**S**	**M**
CO3	**L**	**M**	**S**	**L**	**M**	**S**	**M**
CO4	**M**	**M**	**M**	**L**	**S**	**S**	**M**
CO5	**M**	**M**	**S**	**L**	**M**	**S**	**M**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**M**	**M**	**S**	**L**	**L**
CO2	**S**	**S**	**S**	**L**	**M**
CO3	**L**	**S**	**M**	**L**	**M**
CO4	**M**	**S**	**S**	**L**	**M**
CO5	**L**	**S**	**S**	**M**	**M**

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Total Marks	**60**	**60**	**130**

Title of the paper: Microalgal Technology

Unit-I

Introduction to Algae - General characteristics. Classification of algae according to Fritsch. Salient features of different groups of algae. Distribution - Freshwater, brackish water and marine algae. Identification methods. An overview of applied Phycology. Economically important microalgae.

Unit-II

Cultivation of freshwater and marine cyanobacteria and microalgae - Growth media. Isolation and enumeration of microalgae. Laboratory cultivation and maintenance. Outdoor cultivation - Photobioreactors - construction, types and operation; raceway ponds - Heterotrophic and mixotrophic cultivation - Harvesting of microalgae biomass

Unit III

Microalgae in food and nutraceutical applications - Algal single cell proteins. Cultivation of *Spirulina* and *Dunaliella*. Microalgae as aquatic, poultry and cattle feed. Microalgal biofertilizers. Value-added products from microalgae. Pigments - Production of microalgal carotenoids and their uses. Phycobiliproteins - production and commercial applications. Polyunsaturated fatty acids as active nutraceuticals. Microalgal secondary metabolites - Pharmaceutical and cosmetic applications.

Unit IV

Microalgae in environmental applications. Phycoremediation - Domestic and industrial waste water treatment. High-rate algal ponds and surface-immobilized systems - Treatment of gaseous wastes by microalgae. Sequestration of carbon dioxide. Scavenging of heavy metals by microalgae. Negative effects of algae. Algal blooms, algicides for algal control.

Unit V

Microalgae as feed stock for production of biofuels - Carbon-neutral fuels. Lipid-rich algal strains - *Botryococcus braunii*. Drop-in fuels from algae - hydrocarbons and biodiesel, bioethanol, biomethane, biohydrogen and syngas from microalgae biomass. Biocrude synthesis from microalgae. Integrated biorefinery concept. Life cycle analysis of algae biofuels.

Reference Books:

- Bux F. (2013). Biotechnological Applications of Microalgae: Biodiesel and Value-added Products. CRC Press, UK
- Singh B., Bauddh K., Bux, F. (2015). Algae and Environmental Sustainability. Springer. Singapore
- Shekh A., Schenk P., Sarada R. (2021). Microalgal Biotechnology. Recent Advances, Market Potential and Sustainability. Royal Society of Chemistry.London
- Lele. S.S., Jyothi Kishen Kumar (2008). Algal bio process technology. New Age International P(Ltd), India

E -Resources

- https://www.classcentral.com/course/algae-10442
- https://onlinecourses.nptel.ac.in/noc19_bt16/preview
- https://freevideolectures.com/course/4678/nptel-industrial-biotechnology/46
- https://nptel.ac.in/courses/103103207
- https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microalgae

Course Designers:

1. **Dr. M. Karthikeyan**
2. **Dr. A. Kanakalakshmi**

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DEPARTMENT OF MICROBIOLOGY
(ForthosejoinedM.Sc.,Microbiologyonorafter June2023)
ProgrammeCode: PMB

Course Code	CourseTitle	Category	L	T	P	Credit
PMB23SL11	**Lab in Molecular Biology & Microbial Genetics**	SEC-I	4	-	-	2

L-Lecture T – Tutorial P–Practical

Year	Semester	Int.Marks	Ext.Marks	Total
First	First	25	75	100

Preamble

Appraise the hands on training of basic techniques in molecular biology and microbial genetics by enlightening with basic principles

Prerequisite

Basic knowledge on molecular biology

CourseOutcomes

On the completion of the course the student will be able to

#	CourseOutcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Elaborate the mechanism of isolation and estimation procedures in molecular biology	**70**	**80**
CO2	Demonstration of protocols for the basic electrophoretic separation techniques	**60**	**80**
CO3	Outline the most significant molecular and cell-based methods used to extend their knowledge of biology in cell survival mechanism	**70**	**80**
CO4	Simplify and explain the various methods used for genetic recombination and stability maintenance	**60**	**70**
CO5	Appraise the importance and analysis of genetic material	**60**	**80**

MappingofCOswithPOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**L**	**L**	**L**	**L**
CO2	**S**	**S**	**S**	**M**	**M**	**L**	**M**
CO3	**S**	**M**	**S**	**S**	**S**	**L**	**M**
CO4	**S**	**M**	**S**	**M**	**S**	**M**	**L**
CO5	**S**	**S**	**S**	**S**	**S**	**M**	**L**

S:Strong M:Medium L: Low

Mappingof COS withPSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	L	L
CO2	S	S	M	M	L
CO3	S	S	M	M	M
CO4	S	S	S	M	M
CO5	S	S	M	S	M

S:Strong M:Medium L: Low

Title of the Paper: Lab in Molecular Biology and Microbial Genetics

1. Isolation and estimation of genomic DNA from bacteria/yeast.
2. Isolation and estimation of RNA from bacteria/yeast.
3. Isolation and estimation of protein from bacteria/yeast.
4. Separation of Nucleic acids by agarose gel electrophoresis.
5. Determination of melting temperature of DNA
6. Detection of proteins by SDS-PAGE.
7. Determination percentage of killing of bacterial cells by UV rays.
8. Plotting of UV survival curve.
9. Plotting of dark repair mechanism.
10. UV sensitivity of RecA+ and RecA-.
11. Reversion of auxotroph.
12. Isolation of streptomycin resistant mutants using gradient plate technique.
13. Isolation of petitemutant.
14. Detection of mutagen-AMES test.
15. Isolation of auxotrophic mutant.
16. Isolation of bacteriophage from sewage sample.

ReferenceBooks

- Rajamanickam,C.2001,Experimental protocols in basic molecularbiology, Osho Scientific Publications, Madurai.
- Sambrook, I.,Fritsch, E.F.and Maniatis,T. 2001.Third Edition,MolecularCloning1,2,3 -A Laboratory Manual, ColdSpring Laboratory Press, USA.
- Brown,T.A. 1998. Molecular Biology LabFax11 Gene Analysis, Academic Press,London.
- Ausubel,F.M.,Roger,B.,RobertE.Kingston,DavidA.Moore,SeidmanJ.G.,John
- Miller,J.H.1992. A Short Course in Bacterial Genetics: A Lab Manual & Hand Book for *E.coli* and related Bacteria. Coldspring Harbor Labpress,Cole SpringHarbar.
- Malov,S.R.1990. Experimental Techniques in Bacterial Genetics, Jones and Bartlett Publishers, Boston.

Web Resources:

- IsolationofgenomicDNA -https://www.youtube.com/watch?v=8jVNcT5Dapk
- IsolationandestimationofRNA-https://www.youtube.com/watch?v=l5xlb8kkkt4
- Detectionofmutagen-AMEStest-https://www.youtube.com/watch?v=8fycieqsrq0

CourseDesigner

1. Dr. K.Renugadevi

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DEPARTMENT OF MICROBIOLOGY
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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23AT11	Bioentrepreneurship	AECC-1	2	-	-	2

L - Lecture T - Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble

Provides fundamental concepts on entrepreneurship practice and their role and significance in the biological discipline

Prerequisite

Basic knowledge on personal creativity and entrepreneurial initiative, adopting of the key steps in the elaboration of business idea.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Describe and apply several entrepreneurial ideas and business theories in practical framework.	**80**	**75**
CO2	Analyse the business environment in order to identify business opportunities, identify the elements of success of entrepreneurial ventures	**80**	**75**
CO3	Express the mass production of microbial inoculants used as Biofertilizers and Bioinsecticides	**80**	**75**
CO4	Analyze the application and commercial production of Monoclonal antibodies, Cytokines. TPH and teaching kits.	**80**	**75**
CO5	Integrate and apply knowledge of the regulation of biotechnology industries, utilize effective team work skills within an effective management team with a common objective	**80**	**75**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	L	-	L	M	L
CO2	S	S	S	-	M	M	-
CO3	S	M	S	L	L	L	M
CO4	S	S	M	M	M	M	M
CO5	S	M	S	L	M	M	S

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	L	S	L
CO2	S	S	S	-	L
CO3	S	S	M	-	M
CO4	S	S	L	-	S
CO5	S	S	M	M	S

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		**End of Semester (Marks)**
	First (Marks)	**Second (Marks)**	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Title of the Paper: Bioentrepreneurship

Unit I

Bio-Entrepreneurship - traits of an entrepreneur in bio-business. Copyright, Patents, trademark, plant breeders and farmers' rights, biodiversity-related issues. Biopiracy.

Unit II

Entrepreneurship opportunity in agricultural biotechnology – Essential requirement, marketing strategies, challenges and scope. Herbal source: drug compounds, nutraceuticals, value-added products, bioethanol production. Biosensor development in agri-management.

Unit III

Entrepreneurship opportunity in industrial biotechnology - Pollution monitoring and Bioremediation for Industrial pollutants. Integrated compost production - microbe enriched compost. Bio pesticide/ insecticide production. Biofertilizers. Single-cell protein.

Unit IV

Therapeutic and Fermented products - Stem cell bank, production of monoclonal antibodies, bioactive secondary metabolite - antibiotics, probiotic and prebiotics products.

Unit V

Project and Technology Management and Startup Schemes in India (BIRAC, DBT, Incubation centers. etc.,). Indian Company act for biobusiness - schemes and subsidies. Project proposal preparation, Successful start-ups-case study

Reference Books:

- Teng P. S. (2008). Bioscience Entrepreneurship in Asia. World Scientific Publishing Company. 2008.
- Agarwal S., Kumari S. and Khan S. (2021). Bioentrepreneurship and Transferring Technology into Product Development. Business Science Reference. ISBN-10 : 1799874125
- Anil Kumar (2020). Small Business and Entrepreneurship, Willey Distributions, Dream Tech Press.
- Shimasaki C. (2014). Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies- Academic Press. ISBN: 978-0-12-404730-3.

Online Resource:

- https://www.profitableventure.com/biotech-business-ideas/
- https://www.bio-rad.com/webroot/web/pdf/lse/literature/Biobusiness.pdf
- https://www.nature.com/articles/s41587-021-01110-3

Course Designers:

1. **Dr. M. Vijayasarathy**
2. **Dr. K. Renugadevi**

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23CT21	**Medical Microbiology**	Core-IV	4	-	-	4

L - Lecture T – Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble

To impart in-depth understanding on the route cause of various microbial diseases and its diagnostics procedures.

Prerequisite

Basic understanding of medically important pathogens.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected proficiency (%)	Expected Attainment (%)
CO1	Analyze the general characteristics, diagnosis, and control measures of Gram-positive bacteria	**70**	**70**
CO2	Appraise the epidemiology, diagnosis & control measures of Gram-negative bacterial diseases	**70**	**70**
CO3	Explain the general characteristics, pathogenesis, and laboratory diagnosis of fungi, and parasites	**65**	**70**
CO4	Apply the different microbiological methods for viral diagnosis and control measures	**65**	**70**
CO5	Classify various antibiotics used against disease based on their mode of actions	**60**	**70**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**M**	**L**	**M**	**S**	**L**
CO2	**S**	**M**	**M**	**-**	**M**	**S**	**M**
CO3	**S**	**S**	**M**	**-**	**L**	**S**	**S**
CO4	**S**	**M**	**M**	**L**	**M**	**S**	**S**
CO5	**S**	**M**	**M**	**-**	**S**	**S**	**L**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	L
CO2	S	S	M	M	L
CO3	S	S	M	M	L
CO4	S	S	S	M	L
CO5	S	M	L	L	M

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		**End of Semester (Marks)**
	First (Marks)	**Second (Marks)**	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Total Marks	**60**	**60**	**130**

Title of the paper: Medical Microbiology

Unit I

History and overview of medical Microbiology. Pathogenesis of microbial infections. General characters, virulence factors, antigenic structures, mode of transmission, pathogenesis, diagnosis, epidemiology, and control measures of Gram-positive aerobic bacteria– *Staphylococci, Streptococci, Corynebacteria, Bacillus. A*naerobic bacteria: *Clostridium.* Acid-fast bacteria – *M. tuberculosis, M. leprae,* Sexually transmitted diseases – *Treponema pallidum,* Spirochaetes –*Leptospira*and*Borrelia*

Unit II

General characters, antigenic structures, pathogenesis, diagnosis, mode of transmission, epidemiology control measures of Gram-negative non-spore-forming bacilli: Aerobic (*Bordetella,Haemophilus), Yersinia,* Enterobacteriaceae *(Vibrio, Pseudomonas, E. coli, Klebsiella pneumonia, Shigella, Salmonella)*Aerobic cocobacilli- *Neisseria gonorrhoeae,* Cell wall-less bacteria: *Mycoplasma pneumoniae*

Unit III

General characters, pathogenesis, diagnosis, control measures of superficial mycosis-*Tinea versicolor*. Systemic Mycoses – *Histoplasma capsulatum, Blastomyces dermatitidis,* Opportunistic mycoses: *Candidiasis*, and *Cryptococcus neoformans*. Sub-cutaneous mycoses – *Mycetoma*. Morphology, life cycle, pathogenesis, laboratory diagnosis and treatment of Amobea- *Entamoebahistolytica*, Flagellates- *Trichomonas vaginalis*, Apicomplexa-*Plasmodium falciparum, Toxoplasma gondii*, Ciliate-*Balantidium coli, Ascaris lumbricoides, Ancylostoma duodenale, Taeniasolium*

Unit IV

Principles and Pathogenesis of viral Disease.Morphology, pathogenesis, diagnosis, and treatment of: *Ebola virus, Adeno virus, Rhabdo virus, Picorna virus, Pox virus, Epstein Barr Virus, Herpes simplex virus, Hepatitis B virus. Flavi virus* (dengue), Retrovirus -HIV. Viral zoonosis - *Japanese encephalitis, Rabies, Corona virus*, Oncogenic virus.

Unit V

Classification of antibiotics based on the mode of action: antibacterial (Penicillin and Streptomycin), antiviral (Amantidine and Zidovudine), antifungal (Amphotericin and Nystatin) antiparasitic drugs (Quinine and Metronidazole) and anticancer drugs (Methotrexate and L asparaginase). Emerging and re-emerging infections (MRSA, NDMS), Beta-lactamase and types, Antifungal resistance (CDR and ERG), Superbugs, Beta lactamase producing bacteria and National programs in the prevention of infectious diseases.

Reference Books:

- Stefan Riedel, Stephen A. Morse, Timothy A. Mietzner, and Steve Miller (2019). Jawetz, Melnick & Adelberg's Medical microbiology. 28th Ed. McGraw-Hill LANGE.
- Ananthanarayanan and C.K. Jeyaram Paniker, (2022). Text Book of Microbiology, Twelfth Edition, Universities Press, Chennai.
- Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller., Tenover F.C., and Yolken R.H. (2020). Clinical Microbiology, Ninth Edition, Elsevier.
- David Greenwood, Richard Slack, John Pertherer and Mike Barer, (2012). Medical Microbiology - A Guide to Microbial infections, pathogenesis, immunity, lab diagnosis and control, 18th Edition, Elsevier Publications.
- Collee, J.G., A.G.Fraser, B. P. Marmion and A.Simmons, (2007). Mackie and McCartney, Practical Medical Microbiology, Fourteenth Edition, Churchill Lingstone.

Online Resources

- Antibiotics - https://www.youtube.com/watch?v=Cj9UADDIidI
- ELISA-https://www.youtube.com/watch?v=CWkrQrq0yxQ
- Mantox test- https://www.youtube.com/watch?v=9O0yDUktaLk

Course Designers:

1. **Dr. M.Vijayasarathy**
2. **Dr. M. Karthikeyan**

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credits
PMB23CT22	**Microbial Biochemistry and Physiology**	Core-V	4	-	-	4

L - Lecture **T - Tutorial** **P – Practical**

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble

Provides knowledge on the classification, structure and function of bio-molecules to elaborates the physiology of microorganisms

Prerequisites

Basics concepts of chemistry and Biology

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Define the chemistry, structure, function, and metabolism of carbohydrates	**70**	**60**
CO2	Summarize the structure, function, and metabolism of lipids and proteins	**70**	**60**
CO3	Interpret the importance, structure, and function of enzymes and highlight the significance of nucleic acid metabolism	**60**	**70**
CO4	Identify the structure, function, and metabolism of microbial pigments and photosynthetic pathways	**70**	**60**
CO5	Distinguish the elemental concepts of bioenergetic and physiological aspects of microbial stress responses.	**70**	**60**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**M**	**S**	**L**	**-**	**-**	**L**
CO2	**M**	**M**	**S**	**L**	**-**	**-**	**L**
CO3	**M**	**S**	**S**	**L**	**-**	**-**	**S**
CO4	**L**	**L**	**S**	**-**	**L**	**S**	**M**
CO5	**S**	**L**	**S**	**-**	**M**	**M**	**S**

S: Strong M: Medium L: Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	S	M	-	L
CO2	L	S	M	-	L
CO3	S	S	M	L	S
CO4	M	S	L	-	M
CO5	S	S	M	-	M

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second (Marks)	
Knowledge -K1	15%(9)	15% (9)	20%(30)
Understand -K2	15%(9)	15% (9)	20%(30)
Apply-K3	30%(18)	30% (18)	20%(30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20%(30)
Total Marks	**60**	**60**	**150**

Title of the paper: Microbial Biochemistry & Physiology

Unit I

Carbohydrates**:** Classification - structure and properties of monosaccharides (glucose, fructose) and disaccharides (lactose, sucrose), polysaccharides (starch, cellulose, and agar- agar). Metabolism: glycolysis, Krebs cycle, hexose monophosphate shunt, glyoxylate cycle, and Entner Doudroff pathway.

Unit II

Lipids**:** Classification and properties. Phospholipid and cholesterol synthesis in bacteria. Metabolism - α, β and ω oxidation of fatty acids and lipid peroxidation. Amino Acid: Classification based on structure, polarity, biological importance physical properties and chemical reactions, an overview of amino acid biosynthesis. Protein**:** Classification, physical and chemical properties. Structure – primary, secondary (Ramachandran plot), tertiary and quaternary structure of proteins.

Unit III

Enzymes**:** Classification, mechanism of enzyme action. Enzyme kinetics – Michaelis Menten equation, Lineweaver Burk plot. Factors influencing enzyme activity. Enzyme inhibition, active site, allosteric site. Isozyme, ribozyme, and abzyme. Nucleic acids: Conformation (helix (A, B, Z)), Synthesis, and degradation of purines and pyrimidines. Vitamins as cofactors and its importance

Unit IV

Microbial photosynthesis: - oxygenic and anoxygenic. Structure of photosynthetic pigments – chlorophylls, bacteriochlorophyll, carotenoids, and phycobilins. Photosynthetic bacteria - green sulfur and purple. Mechanism of photosynthesis - non-cyclic and cyclic electron transport and photophosphorylation. Carbon assimilation - Calvin, reverse citric acid cycle and hydroxy propionate cycle, Reverse TCA cycle, electron transport chain.

Unit V

Bioenergetics: Entropy, Enthalpy and Gibb's free energy. Principles and laws of thermodynamics. Chemiosmotic theory of Mitchell - efficiency of coupling. Endospore formation – characteristics of endospore-forming bacteria, life cycle of Bacillus- stages of sporulation. Physiological and genetic aspects of sporulation, and metabolic changes during germination. Life cycle of myxobacteria- aggregation and fruiting body formation, Physiological and genetic aspects of sporulation

Reference Books:

- Nelson, D.L. and Cox, M.M. (2021). Lehingers's Principles of Biochemistry, Eighth Edition, Macmillan Learning Publishers, USA.
- Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, Matthew W. Sattley, and David A. Stahl. (2020). Sixteenth Edition, Brock Biology of Microorganisms, Pearson Higher Ed Publishers.
- Albert G. Moat, John W. Foster, and Michael P. Spector (2002). Microbial Physiology, Fourth Edition, A John Wiley and Sons, USA.
- Srivastava, M.L. (2008). Microbial Biochemistry, Narosa Publishing House, New Delhi.

Web Resources:

- Fruiting body formation - https://www.youtube.com/watch?v=O1jPzhz1Qyc
- Bioenergitics &Thermodynamics -https://www.youtube.com/watch?v=PDgidel_Feo
- Bacterial Photosynthesis model - https://www.youtube.com/watch?v=J5Nz4cQJ2u8

Course Designers:

1. **Dr. M.Vijayasarathy**
2. **Dr. M. Karthikeyan**

THIAGARAJAR COLLEGE, MADURAI:: 9
An Autonomous Institution affiliated by Madurai Kamaraj University
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DEPARTMENT OF MICROBIOLOGY
(For those joined M.Sc., Microbiology on or after June 2023)
Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23CL21	**Lab in Medical Microbiology**	Core Lab-III	-	-	4	2

L - Lecture T – Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble

Provide hands on exposure to process the clinical specimens and laboratory diagnosis using different techniques

Prerequisite

Basic practical knowledge on microbiology

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected proficiency (%)	Expected Attainment (%)
CO1	Identify microorganisms of relevance to health care and the pharmaceutical industry and their sources	**60**	**80**
CO2	Perform microbiological laboratory procedures according to appropriate safety standards	**70**	**80**
CO3	Discuss various treatment methods for bacterial disease	**65**	**80**
CO4	Identify fungi in clinical samples and apply knowledge on antifungal agents.	**70**	**80**
CO5	Apply various immunodiagnostic method to detect fungal infections.	**70**	**80**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**M**	**S**	**L**	**M**	**L**	**-**
CO2	**S**	**M**	**M**	**L**	**M**	**L**	**-**
CO3	**S**	**M**	**M**	**-**	**M**	**-**	**-**
CO4	**S**	**S**	**M**	**L**	**S**	**L**	**L**
CO5	**S**	**S**	**M**	**L**	**S**	**L**	**L**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	L	M
CO2	S	S	M	L	M
CO3	S	S	L	-	M
CO4	S	L	M	L	L
CO5	S	M	M	L	L

S: Strong M: Medium L: Low

Title of the paper: Lab in Medical Microbiology

1. Staining techniques- Simple, Negative, Gram's, capsule, Spores
2. Staining of Acid fast Bacilli by Ziehl Nelson staining (Virtual).
3. Isolation and identification of pyogenic microorganisms.
4. Identification of *Staphylococci* and *Streptococci sp.* by hemolysis (α, β, and γ hemolysis)
5. Differentiation of *Streptococci sp.* by Bile solubility test.
6. Differentiation of *Staphylococci sp.* by coagulase test
7. Isolation and identification of microorganisms from a urine sample
8. Biochemical tests for identification of unknown bacteria (IMViC, Urease, TSI, Catalase & oxidase test)
9. Isolation and identification of Dermatophytic fungus (*Microsporum, Epidermophyton, Trichophyton)*
10. Lactophenol cotton blue staining and KOH mount for fungi *(Aspergillus, Mucor, Rhizopus, Penicillium).*
11. Germ tube test for identification of *Candida albicans*
12. Preparation of dried filter paper discs for susceptibility assay.
13. Antimicrobial activity by Kirby – Bauer disc diffusion technique.
14. Determination of MIC & MBC
15. Antimicrobial susceptibility test against filamentous and non- filamentous fungi.
16. Detection of β lactamase producing organisms
17. Detection of Azole resistance in *Candida albicans*

Reference Books:

1. Gary W. Procop, Deirdre L. Church, Geraldine S. Hall, William M. Janda, Elmer W. Koneman (2017). Koneman's Color Atlas and Textbook of Diagnostic Microbiology. Jones & Bartlett Learning, Burlington, MA
2. Betty A.F., Daniel F.S., Alice S. Bailey & Scott's Diagnostic Microbiology (2006), 12th Edition Diagnostic Microbiology, Mosby London.
3. Collee, J.C., Duguid, J.P., Fraser, A.C. and Marimon, B.P. (1996) Mackie and McCartney Practical Medical Microbiology, 14th Edn. Churchill Livingstone, London.
4. Wadhar B.H. and Boosreddy, G.L. 1995. Manual of Diagnostic Microbiology, Himalaya Publishing House, New Delhi.

Web Resources

1. Antibiotic resistance- Beta lactamase:https://www.youtube.com/watch?v=byLV2bESY4k
2. Azole resistance *Candida albicans*:https://www.youtube.com/watch?v=6GT11CiOykM
3. Determination of MIC and MBC: https://www.youtube.com/watch?v=jCShFlXPcmg

Course Designer:

1. Dr. M. Vijayasarathy – Assistant Professor

THIAGARAJAR COLLEGE, MADURAI:: 9
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DEPARTMENT OF MICROBIOLOGY
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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23CL22	**Lab in Microbial Biochemistry & Physiology**	Core Lab - IV	-	-	4	2

L - Lecture **T - Tutorial** **P – Practical**

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble

The course provides hands on training on analytical biochemical techniques for the separation, purification and characterization of biological molecules.

Prerequisites

Basics of analytical chemistry and biology.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Define the procedures involved in the preparation of buffers and solutions	**70**	**60**
CO2	Illustrate the conceptual knowledge of analysis of biomolecules	**70**	**60**
CO3	Categorize the protocols for the separation of biomolecules	**70**	**60**
CO4	Interpret the procedures involved in the purification of biomolecules	**70**	**60**
CO5	Distinguish the physiological features of microorganisms	**70**	**60**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**M**	**S**	**S**	**M**	**L**	**-**	**L**
CO2	**S**	**M**	**S**	**L**	**-**	**-**	**L**
CO3	**S**	**L**	**S**	**L**	**-**	**-**	**M**
CO4	**S**	**L**	**S**	**L**	**-**	**-**	**M**
CO5	**M**	**M**	**S**	**-**	**L**	**M**	**M**

S: Strong **M: Medium** **L: Low**

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	L	S	L
CO2	S	M	M	M	M
CO3	M	L	-	L	M
CO4	M	L	-	L	M
CO5	S	M	M	L	L

S: Strong M: Medium L: Low

Title of the Paper: Lab in Microbial Biochemistry & Physiology

1. Basic calculations in Biochemistry - Normality, Molarity, Molality percent solutions (v/v, w/v) & pH.
2. Transition interval of commonly used pH indicators
3. Preparation of buffers (Phosphate and Tris) and other chemicals
4. Extraction of Proteins from biological materials
5. Protein separation methods:-Ammonium sulphate Precipitation, and membrane dialysis
6. Qualitative and quantitative analysis of carbohydrate (mono, di and polysaccharides).
7. Qualitative and Quantitative analysis of proteins.
8. Determination of λ max (Wavelength scan) using UV visible spectrophotometry.
9. Separation of amino acids by Paper chromatography – circular.
10. Separation of amino acids and lipids by Thin layer chromatography.
11. Separation of pigments by column chromatography.
12. Separation of microbial secondary metabolites and pigments by Ultrasonication
13. Determination of functional groups by FTIR spectroscopy
14. Effect of temperature on bacterial growth.
15. Effect of pH on bacterial growth.
16. Extraction and estimation of photosynthetic pigments (bacterial and blue green algae)
17. Measurement of bacterial growth rate and generation time –Turbidity and biomass

Reference Books:

- David T. Plummer (2008). An introduction to practical Biochemistry, Third Edition, Tata Mc Graw Hill publishing Com. Ltd., New Delhi.
- Jayaraman, J. (1985). Laboratory Manual in Biochemistry, New Age International (Pvt.) Ltd. Publishers, New Delhi.
- Palanivel, P. (2000). Laboratory Manual for Analytical Biochemistry & Separation Techniques, School of Biotechnology, Madurai Kamaraj University, Madurai.
- Wilson, K. and Walker, J. (2008). Practical Biochemistry, Cambridge State University Press, UK

ICT Tutorials

- FT-IR Demonstration - https://www.youtube.com/watch?v=eALOKgRr3eI
- Ultra-sonicator Demonstration - https://www.youtube.com/watch?v=5rqv1uS2lIg

Course Designers:

1. **Dr. M. Vijayasarathy- Assistant Professor**

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DEPARTMENT OF MICROBIOLOGY
(For those joined M.Sc., Microbiology on or after June 2023)
Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23ET21 A	**Intellectual Property Rights, Bioethics & Biosafety**	Core Elective-III	3	1	-	3

L – Lecture T – Tutorial P – Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble

The course provides the elemental concepts of bioethics, IPR, patent filling and infringement of biotechnological process and products. Impart knowledge on regulations and guidelines for the ethical treatment of animals and clinical trials.

Prerequisite

Basic knowledge on biology.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Define the fundamental concepts of Patents, Trademarks and copyrights	**60**	**70**
CO2	Appraise the process of patent filing and licensing process	**60**	**70**
CO3	Categorize and implement the intellectual property law and policy.	**70**	**60**
CO4	plybioethics in GMO, food crops and its biodiversity	**70**	**60**
CO5	Outline the protocol for ethical and legal implications for GMOs	**60**	**70**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**M**	**S**	**L**	**M**	**M**	**S**	**L**
CO2	**S**	**L**	**M**	**S**	**L**	**M**	**L**
CO3	**S**	**S**	**M**	**L**	**M**	**S**	**L**
CO4	**S**	**S**	**L**	**M**	**M**	**S**	**M**
CO5	**S**	**S**	**L**	**M**	**M**	**L**	**M**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	L	L	L
CO2	L	L	M	L	L
CO3	L	L	L	L	M
CO4	M	L	L	L	L
CO5	M	M	S	M	M

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Total Marks	**60**	**60**	**130**

Title of the paper: Intellectual Property Rights, Bioethics and Biosafety

Unit-I

Intellectual Property Rights: Different forms of Intellectual Property Rights – their relevance, importance to industry, Academia. Role of IPR's in Biotechnology, Patent Terminology - Patents, trademarks, copyrights, industrial designs, geographical indications, trade secrets, non-disclosure agreements. Patent life and geographicalboundaries. International organizations and IPR - Overview of WTO, TRIPS, WIPO, GATT, International conventions, Trade agreements, Implication of TRIPS for developing countries.

Unit-II

Process involved in patenting. Patent Search - Procedural steps in patenting, process of filing, PCT application, pre-grant & post-grant opposition, PCT and patent harmonization including Sui-generis system, patent search methods, patent databases and libraries, online tools, Country-wise patent searches (USPTO, EPO, India etc.), patent mapping

Unit III

Patentability of biotechnology inventions - Patentability of biotechnology inventions in India, statutory provisions regarding biotechnological inventions under the current Patent Act 1970 (as Amended 2005). Biotechnological inventions as patentable subject matter, territorial nature of patents - from territorial to global patent regime, interpreting trips in the light of biotechnology inventions, feasibility of a uniform global patent system, merits and demerits of uniform patent law, relevance of the existing international patent, tentative harmonisation efforts, implications of setting up a uniform world patent system.

Unit IV

Introduction to bioethics - need of bioethics, applications and issues related to bioethics, social and cultural issues. Bioethics and biodiversity - conserving natural biodiversity, convention on protecting biodiversity, protocols in exchanging biological material across borders. Bioethics & GMO's - issues and concerns pertaining to genetically modified foods and food crops, organisms and their possible health implications and mixing up with the gene-pool.

Unit V

Bioethics in medicine - Protocols of ethical concerns related to prenatal diagnosis, gene therapy, organ transplantation, xeno transplantation, ethics in patient care, informed consent. bioethics and cloning - permissions and procedures in animal cloning, human cloning, risks and hopes. Bioethics in research: stem cell research, human genome project, use of animals in research, human volunteers for clinical research, studies on ethnic races. The Nuremberg code.

Reference Books:

- Jecker, N.S., Johnson, A.R., and Pearlman R.A. (2011). Bioethics: An Introduction to history, methods and practice, Jones and Barlett Publishers.
- Manomy V. (2009) Animal Experimentation: A guide to the issues, Second edition, - Cambridge university press.
- Goel, D., and Parashar, S. (2013). IPR, Biosafety and Bioethics, First edition, Pearson Education, India.
- BAREACT, Indian Patent Act (1970) Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007.

E -Resources

- http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf.
- https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf.
- https://bioethics.msu.edu/what-is-bioethics
- https://www.cdc.gov/training/quicklearns/biosafety/
- https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm

Course Designers:

1. **Dr. M. Karthikeyan**
2. **Dr. A. Kanakalakshmi**

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Microbiology
(For those joined MSc., Microbiology on or after June 2023)
Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23ET21B	**Herbal Technology**	Core Elective-III	3	1	-	3

L - Lecture T – Tutorial P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	25	75	100

Preamble

Provide fundamental concepts of Indian traditional medicine. Elaborate the core principles involved in the extraction of phytochemicals, formulation, standardization and processing of herbal medicines.

Prerequisite

Basic knowledge on plant science and biology

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Define and classify the Indian system of Medicine and its significance	**60**	**70**
CO2	Apply the fundamental principles for the identification of drug sources	**60**	**70**
CO3	Outline the role and importance herbal drugs for the treatment of Human ailments	**70**	**60**
CO4	Analyze the techniques involved in the extraction of herbal drugs	**70**	**60**
CO5	Appraise the procedures for the standardization and processing of herbal drugs.	**60**	**70**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**M**	**M**	**M**	**L**
CO2	**M**	**M**	**S**	**M**	**L**	**M**	**M**
CO3	**S**	**M**	**S**	**M**	**M**	**L**	**L**
CO4	**S**	**M**	**S**	**S**	**M**	**M**	**L**
CO5	**S**	**S**	**M**	**S**	**L**	**L**	**L**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**	**M**	**M**	**L**
CO2	**S**	**S**	**S**	**M**	**M**
CO3	**S**	**S**	**M**	**L**	**L**
CO4	**S**	**M**	**S**	**M**	**M**
CO5	**M**	**M**	**S**	**L**	**M**

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15%(9)	15% (9)	20%(30)
Understand -K2	15%(9)	15% (9)	20%(30)
Apply-K3	30%(18)	30% (18)	20%(30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20%(30)
Total Marks	**60**	**60**	**150**

Title of the Paper: Herbal Medicine

Unit I

History of Medicinal plants. Introduction of Indian systems of Medicine: Ayurvedha, Siddha, Unani, Naturopathy and foke medicine. Definition and classification of herbal raw materials, identification, authentication and standardization of medicinal plants as per WHO guidelines & different herbal pharmacopoeias. Activities of AYUSH ministry in promotion of Indian traditional medicine.

Unit II

Fundamental concepts in the identification of drug sources- Plants and mineral origins.Principle, methods, merits and demerits of single and poly-herbal formulations. Selection and evaluation of herbal ingredients, dosage forms and stability of herbal formulations.

Unit III

Herbal medicines for Human ailments Drugs: Antihypertensives-*Rauwolfia*, Antitumour-*Vinca*, Antileprotics-*Chaulmoogra* Oil, Antidysenterics - *Holarhaena*, Antiseptics and Disinfectants - Benzoin, Murraya, Neem, Curcuma, Antimalarials-*Cinchona*, *Andrographis.* Wound healing- *tridax procumbens* Immunity enhancers – kabasura kudineer.

Unit IV

Phytochemical investigations, Principles and different methods of extractions of different herbal drugs (maceration, Percolation, hot continuous extraction, pilot scale extraction and supercritical fluid extraction with their merits and demerits.

Unit V

Quality control and standardization of herbal drugs. Safety aspects- protocols for assessing acute, sub-acute and chronic toxicity studies, Indian Pharmacopeia, CDCSO, and OECD guidelines. Herbal drug - processing and packaging marketing - Intellectual property rights - Export laws.

Reference Books:

1. Dr.P.Mukherjee. (2005) Quality control herbal drugs, Business Horizons, New Delhi
2. W.C.Evans and Trease(2008) Pharmacognosy, 15th edition. W.B. Saunders &Co.Ltd., London.
3. Quality Control Methods for Medicinal Plant material, 1992, WHO Guidelines.
4. Indian Pharmacopoeia.(1996) Govt. of India, Ministry of Health and family welfare, Delhi.
5. R.D.Chaudhury, (2014)Herbal Drug Industry, Eastern Publishers, New Delhi.

E -Resources

- https://nptel.ac.in/courses/121106003
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5132387/
- https://www.who.int/health-topics/traditional-complementary-and-integrative-medicine

Course Designers:

1. **Dr. M. Karthikeyan**
2. **Dr. A. Kanakalakshmi**

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DEPARTMENT OF MICROBIOLOGY
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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23ET21 C	**Clinical Diagnostics Techniques**	Core Elective-III	3	1	-	3

L - Lecture T – Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble

The course provides an overview of diagnostic procedures required for performing clinical laboratory techniques. The coursework demonstrates technical skills, quality control parameters, and other health-related settings required for clinical lab technicians.

Prerequisite

Fundamental knowledge on diagnostic techniques

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected proficiency (%)	Expected Attainment (%)
CO1	Spell the basic lab safety methods and different clinical lab techniques	**60**	**70**
CO2	Summarize theoretical knowledge on blood sample analysis and grouping	**65**	**60**
CO3	Emphasize the scientific knowledge on urine sample processing and analysis	**70**	**60**
CO4	Interpret the importance of microscopic, macroscopic and culture sensitivity analyses of stool samples	**65**	**60**
CO5	Make use of scientific knowledge on specimen collection and examination of sputum and semen sample analyses	**65**	**60**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**M**	**S**	**-**	**L**	**-**	**L**
CO2	**L**	**M**	**S**	**L**	**L**	**-**	**M**
CO	**S**	**M**	**S**	**L**	**L**	**-**	**M**
CO4	**L**	**M**	**S**	**L**	**L**	**-**	**M**
CO5	**L**	**M**	**S**	**L**	**L**	**-**	**M**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	M	-	S
CO2	L	S	L	L	M
CO3	S	L	-	M	
CO4	L	S	L	-	M
CO5	L	S	L	-	M

S: Strong M: Medium L: Low

Blooms taxonomy

Blooms Taxanomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Total Marks	**60**	**60**	**130**

Title of the paper – Clinical Diagnostic Techniques

Unit I

Microbiology Laboratory Safety Practices – Biosafety in containment laboratory - Personal hygiene for Laboratory Technologists, National and International GLP, and GMP, Accidents - types and safety measures. Biomedical waste management. Emerging and Re-emerging infections. Hospital Infection Control Committee (HICC) – Functions.

Unit II

General concept of clinical specimen collection, transport, storage, and processing in Microbiology laboratory (urine, blood, sputum, and stool). - Specimen acceptance and rejection criteria. Specimen acceptance and rejection criteria. Antibiotic sensitivity tests - Disc diffusion, broth dilution - MBC/MIC - Quality control for antibiotics and standard strains.

Unit III

Diagnostic procedure for blood and urine samples – Physical, Chemical (sugar, albumin, bile salts & pigments, and ketone bodies), and Microscopic Examination (Cast, Crystals, and Cells) of blood and urine samples. Pregnancy Test (slide test and ELISA). Culture and sensitivity for blood and urine samples.

Unit IV

Diagnostic procedure for fluid and stool samples: Physical (CSF Pressure, Color, and appearance) and Microscopic examination (cells) of fluid. Synovial and Peritoneal fluid test. Physical, chemical, and microscopic examination of stool. Culture and Sensitivity. Occult Blood and its clinical significance

Unit V

Diagnostic procedure for sputum and semen samples: Macroscopic and Microscopic examination of sputum. AFB staining. Sputum culture and sensitivity. Collection of semen. Semen analysis – motility, total count and abnormality, Chemical examination of semen. Skin test- Tuberculin test, Schick test

Reference Books

- Frances Talaska Fischbach, Margaret Fischbach, Kate Stout, (2021). Fischbach's: A Manual Of Laboratory And Diagnostic Tests, Eleventh edition, Wolters Kluwer
- Sood, R, (2010). Medical Laboratory Technology – Methods and interpretations – Seventh edition, Jaypee, New Delhi.
- Mukherjee, L.K. (2022). Medical Laboratory Technology – 3 volumes – Fourth edition – CBS Publishers, New Delhi.
- Ochei, J and Kolkatkar, A. (2009). Medical Laboratory Science – Theory and Practice. Tata Mc Graw – Hill Publishing Company Ltd., New Delhi, India.
- David, S. Jacobs, Wayne R. Demott, Paul R. Finley, (2004). Laboratory Test Hand Book, third edition, Key word index, Laxi-Compinc, Hudson.

ICT Tools

- VDRL Test - https://www.youtube.com/watch?v=cFRk6CoupDs
- Urine analysis - https://www.youtube.com/watch?v=d8w5SICzzxc
- Analysis of Blood cells - https://www.youtube.com/watch?v=yKWQ_oLSXI8

Course Designers

1. **Dr. M.Vijayasarathy**
2. **Dr. A. Kanakalakshmi**

THIAGARAJAR COLLEGE, MADURAI:: 9
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DEPARTMENT OF MICROBIOLOGY
(For those joined M.Sc., Microbiology on or after June 2023)
Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23ET22 A	**Bioinformatics**	Core Elective IV	3	1	-	3

L – Lecture T – Tutorial P – Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble

Impart knowledge on computational tools and drug designing approaches for biological research.

Prerequisite

Basic knowledge on biology and chemistry.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Demonstrate biological data mining process	**60**	**70**
CO2	Summarize the algorithms for data retrieval and analysis	**60**	**70**
CO3	Demonstrate the methods of phylogenetic analysis	**70**	**60**
CO4	praise the role of software's in drug designing process	**70**	**60**
CO5	Outline the application computational tools in toxicity analysis	**60**	**70**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**M**	**S**	**S**	**L**	**S**	**L**	**M**
CO2	**M**	**S**	**S**	**L**	**S**	**L**	**M**
CO3	**L**	**S**	**S**	**L**	**S**	**M**	**L**
CO4	**M**	**L**	**S**	**L**	**S**	**M**	**M**
CO5	**M**	**L**	**S**	**L**	**S**	**M**	**M**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**M**	**S**	**M**
CO2	**S**	**S**	**M**	**S**	**M**
CO3	**S**	**S**	**L**	**M**	**L**
CO4	**M**	**M**	**M**	**S**	**S**
CO5	**M**	**M**	**M**	**S**	**S**

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Total Marks	**60**	**60**	**130**

Title of the paper: Bioinformatics

Unit-I

Introduction – Biological data mining and Biological databases – Types of database, PrimaryDatabasesNucleotidesequencedatabasesGenBank,EMBL,DDBJ.ProteinSequenceDatabases- UniProt, TrEMBL, Swiss Prot, UniProt Archive. Genome databases. Literature Databases- PubMed, PLOS, BioMed Central, structuredatabasePDB & domain, application and scope.

Unit-II

Data retrieval and analysis. Sequence alignment: Types - local and global alignment. Alignment methods pairwise sequencealignment: FASTA and BLAST. EXPASY Translate tools. Introduction to ORF and primer designing. Secondary structure prediction: GOR, Chou –Fasman.

Unit III

MUSCLE,ClustalW, Multalign. Phylogenetic analysis tools, construction and analysis of phylogenetic trees- Concept of Dendrograms. Evolutionary Trees - Distance Based Tree Reconstruction - Ultrametric trees and Ultrametric distances – Reconstructing Trees from Additive Matrices - Evolutionary Trees and Hierarchical Clustering - Character Based Tree Reconstruction - Maximum Parsimony Method, Maximum likelihood method.

Unit IV

Drug designing concepts Target identificationand validation, lead optimization and validation, Structure based drug design and ligand baseddrug design-Computational Protein Structure prediction – Secondary structure – Homology modelling- Fold recognition and ab

initio 3D structure prediction,Molecular docking of protein and target-small molecule interactions,Flexible - Rigid docking- Target- Ligand preparation- Solvent accessibility- Active site prediction- Docking algorithms- Genetic, Lamarckian , Molecular graphics - Visualization tools-Rasmol/Pymol. Molecular file formats

Unit V

Drug target prediction., Drug toxicity prediction and analysis, *Insilico* pharmacokinetics and pharmacodynmaics prediction (ADMET prediction), Quantitative structure property relation ships (QSAR)- Prediction of toxicity of compounds. Genome to drug discovery – Subtractive Genomics – Principles of Immunoinformatics and Vaccine Development. Artificial intelligence in drug discovery.

Reference Books:

- Rastogi S. C., Mendiratta N. and Rastogi P. (2014). Bioinformatics - Methods and Applications (Genomics, Proteomics and Drug Discovery) (4th Edition). Prentice-Hall of India Pvt.Ltd.
- Mount D.W., (2013).Bioinformatics sequence and genome analysis, 2nd Edition .CBS Publishers, New Delhi.
- Baxevanis A. D. and Ouellette F. (2004). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. (2nd Edition). John Wiley and Sons.
- Attwood, David W. M. (2001). Bioinformatics Sequence and Genome Analysis (2nd Edition). CBS Publishers and Distributors(Pvt.)Ltd.
- T.K. and Parry-Smith, D.J. (1999). Introduction to Bioinformatics. Addision Wesley Longman Limited, England

E -Resources

- Multiplesequencealignment:https://www.youtube.com/watch?v=TZaA_-4j19w
- Drug discovery process and target identification https://www.youtube.com/watch?v=6yqixEIJW10
- Toxicity and ADMET Prediction :https://www.youtube.com/watch?v=I6094_0dTtc

Course Designers:

1. **Dr. M. Karthikeyan**
2. **Dr. A. Kanakalakshmi**

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23ET22B	**Epidemiology**	Core Elective-IV	3	1	-	3

L - Lecture T - Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble
Provide comprehensive knowledge on the role of epidemiology in public health.

Prerequisite
Basics of communicable and non-communicable diseases.

Course Outcomes
On the completion of the course the student will be able to

	Course outcomes	Proficiency Expected%	Attainment Expected %
CO1	Apply the knowledge acquired on concepts of epidemiology to clinical and public health environment.	70	70
CO2	Plan various strategies to trace the epidemiology.	70	70
CO3	Plan the control of communicable and non-communicable diseases.	70	70
CO4	Analyze the implications of drug resistance in the society and design the control of antimicrobial resistance and its management.	70	70
CO5	Employ National control programs related to Communicable and Non-Communicable diseases with the public.	60	70

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	L	-	L	M	L
CO2	S	S	S	-	M	M	-
CO3	S	M	S	L	L	L	M
CO4	S	S	M	M	M	M	M
CO5	S	M	S	L	M	M	S

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	L	S	L
CO2	S	S	S	-	L
CO3	S	S	M	-	M
CO4	S	S	L	-	S
CO5	S	S	M	M	S

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		**End of Semester (Marks)**
	First (Marks)	**Second (Marks)**	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Title of the Paper: Epidemiology

Unit I

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

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

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, Monkey pox, 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

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

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.

Reference Books:

- 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.
- Celentano D. D. and Szklo M. (2018). Gordis Epidemiology. (6th Edition). Elseiver, USA.
- Cheesbrough, M. (2004). District Laboratory Practice in Tropical Countries - Part 2, (2nd Edition). Cambridge University Press.
- Ryan K. J. and Ray C. G. (2004). Sherris Medical Microbiology. (4th Edition), McGraw Hill, New York.

ICT Tutorials:

- https://www.scielo.br/j/rbca/a/mjDFGTtfWtBm786ZmR9TG9d/?lang=en
- https://hal.archives-ouvertes.fr/hal-00902711/document
- https://www.who.int/csr/resources/publications/whocdscsreph200212.pdf

Course Designers:

1. Dr. A. Kanakalakshmi

2. Dr. K. Renugadevi

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DEPARTMENT OF MICROBIOLOGY
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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23ET22 C	**Bioremediation**	Core Elective-IV	3	1	-	3

L - Lecture T - Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble
Provide comprehensive knowledge the nature and importance of bioremediation and its applications.

Prerequisite
Basics knowledge on chemistry and microbiology

Course Outcomes
On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Differentiate Ex-situ bioremediation and In-situ bioremediation. Assess the roles of organisms in bioremediation.	**70**	**60**
CO2	Distinguish microbial processes necessary for the design and optimization of biological processing unit operations.	**70**	**60**
CO3	Identify, formulate and design engineered solutions to environmental problems.	**70**	**60**
CO4	Explore microbes in degradation of toxic wastes and playing role on biological mechanisms.	**60**	**70**
CO5	Establish the mechanisms of Arbuscular mycorrhizal fungi and Plant growth promoting *Rhizobacteria* in phytoremediation.	**60**	**70**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**M**	**L**	**-**	**L**	**M**	**L**
CO2	**S**	**S**	**S**	**-**	**M**	**M**	**-**
CO3	**S**	**M**	**S**	**L**	**L**	**L**	**M**
CO4	**S**	**S**	**M**	**M**	**M**	**M**	**M**
CO5	**S**	**M**	**S**	**L**	**M**	**M**	**S**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**	**L**	**S**	**L**
CO2	**S**	**S**	**S**	**-**	**L**
CO3	**S**	**S**	**M**	**-**	**M**
CO4	**S**	**S**	**L**	**-**	**S**
CO5	**S**	**S**	**M**	**M**	**S**

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		**End of Semester (Marks)**
	First (Marks)	**Second (Marks)**	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Title of the Paper: Bioremediation

Unit I

Bioremediation - process and organisms involved. Bioaugmentation - Ex-situ and in-situ processes; Intrinsic and engineered bioremediation. Major pollutants and associated risks; organic pollutant degradation. Microbial aspects and metabolic aspects. Factors affecting the process. Recent developments and significance.

Unit II

Microbes involved in aerobic and anaerobic processes in nature. Water treatment - BOD, COD, dissolved gases, removal of heavy metals, total organic carbon removal. Secondary waste water treatments - use of membrane bioreactor. Aquaculture effluent treatment. Aerobic sludge and landfill leachate process. Aerobic digestion

Unit III

Composting of solid wastes, anaerobic digestion - methane production and important factors involved, Pros and cons of anaerobic process, sulphur, iron and nitrate reduction, hydrocarbon degradation, degradation of nitroaromatic compounds. Bioremediation of dyes, bioremediation in paper and pulp industries. Aerobic and anaerobic digesters – design. Various types of digester for bioremediation of industrial effluents.

Unit IV

Microbial leaching of ores - process, microorganisms involved and metal recovery with special reference to copper and iron. Biotransformation of heavy metals and xenobiotics.

Petroleum biodegradation - reductive and oxidative. Dechlorination. Biodegradable of plastics and super bug.

Unit V

Phytoremediation of heavy metals in soil - Basic principles of phytoremediation - Uptake and transport, Accumulation and sequestration. Phytoextraction. Phytodegradation. Phytovolatilization. Rhizodegradation. Phytostabilization – Organic and synthetic amendments in multi metal contaminated mine sites. Role of Arbuscular mycorrhizal fungi and plant growth promoting rhizobacteria in phytoremediation.

Reference Books:

- Sangeetha J., Thangadurai D., David M. and Abdullah M.A. (2016). Environmental Biotechnology: Biodegradation, Bioremediation, and Bioconversion of Xenobiotics for Sustainable Development. (1st Edition). Apple Academic Press.
- Rathoure, A.K. (Ed.). (2017). Bioremediation: Current Research and Applications. 1st edition. I.K. International Publishing House Pvt. Ltd.
- Singh A., Kuhad R. C., and Ward O. P. (2009). Advances in Applied Bioremediation (1st Edition). Springer-Verlag Berlin Heidelberg, Germany.
- Singh A. and Ward O. P. (2004). Biodegradation and Bioremediation. Soil Biology. Springer.

ICT Tutorials:

- Bioremediation- Objective, Principle, Categories, Types, Methods, Applications (microbenotes.com)
- https://agris.fao.org › agris-search
- https://www.sciencedirect.com/topics/earth-and-planetary-sciences/bioremediation
- https://microbiologysociety.org/blog/bioremediation-the-pollution-solution.html

Course Designers:

1. Dr. A. Kanakalakshmi
2. Dr. K. Renugadevi

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23SL21	**Lab in Bioinformatics**	SEC-II	4	-	-	2

L – Lecture T – Tutorial P – Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble

Impart practical knowledge on bioinformatics tools and drug designing softwares for biological data analyses

Prerequisite

Basic knowledge on biology and chemistry.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Demonstrate biological data mining tools	**60**	**70**
CO2	Appraise the algorithms for data retrieval and analysis	**60**	**70**
CO3	Demonstrate the methods of phylogenetic analysis	**70**	**60**
CO4	praise the role of software's in drug designing process	**70**	**60**
CO5	Outline the application computational tools in toxicity analysis	**60**	**70**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**M**	**S**	**S**	**L**	**S**	**L**	**M**
CO2	**M**	**S**	**S**	**L**	**S**	**L**	**M**
CO3	**L**	**S**	**S**	**L**	**S**	**M**	**L**
CO4	**M**	**L**	**S**	**L**	**S**	**M**	**M**
CO5	**M**	**L**	**S**	**L**	**S**	**M**	**M**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**M**	**S**	**M**
CO2	**S**	**S**	**M**	**S**	**M**
CO3	**S**	**S**	**L**	**M**	**L**
CO4	**M**	**M**	**M**	**S**	**S**
CO5	**M**	**M**	**M**	**S**	**S**

S: Strong M: Medium L: Low

Blooms Taxonomy

Blooms Taxonomy			
	CA		**End of Semester (Marks)**
	First (Marks)	**Second(Marks)**	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Total Marks	**60**	**60**	**130**

Title of the paper: Lab in Bioinformatics

1. Sequence retrieval analysis and file formats – ENTREZ, FASTA, EMBL, Genbank, Refseq.
2. Pair wise sequence analysis – BLAST and FASTA.
3. Multiple sequence analysis tools – Clustal-W, Multalin, Multialign
4. ORF prediction using ORF finder
5. Primer designing using Primer 3 tool
6. Identification of NEB cutter using NEB cutter tool
7. Phylogenetic tree construction – PHYLIP and MEGA
8. Homology modeling and protein structure prediction –Swiss Model Server
9. Molecular visualization tools – Rasmol, Chemdraw, VMD
10. Drug Target prediction – Swiss target server
11. ADMET prediction – pKCSM tool and Swiss ADMET server
12. Drug toxicity prediction – OSIRIS property explorer
13. Molecular docking studies – Arugus Lab and Autodock

Reference Books:

- Rastogi S. C., Mendiratta N. and Rastogi P. (2014). Bioinformatics - Methods and Applications (Genomics, Proteomics and Drug Discovery) (4th Edition). Prentice-Hall of India Pvt.Ltd.
- Mount D.W., (2013).Bioinformatics sequence and genome analysis, 2nd Edition .CBS Publishers, New Delhi.
- Baxevanis A. D. and Ouellette F. (2004). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. (2nd Edition). John Wiley and Sons.
- Attwood, David W. M. (2001). Bioinformatics Sequence and Genome Analysis (2nd Edition). CBS Publishers and Distributors(Pvt.)Ltd.
- T.K. and Parry-Smith, D.J. (1999). Introduction to Bioinformatics. Addision Wesley Longman Limited, England

Course Designers:

Dr. M. Karthikeyan- Assistant Professor

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB23AT21	**Vermitechnology**	AECC-II	2	-	-	2

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble

Vermitechnology includes the study and commercial application of technologies that utilise earthworms for degrading waste organic materials for sanitation and agricultural re-use

Prerequisite

Basic knowledge on earthworm biology and rearing.

Course Outcomes

On the completion of the course the student will be able to

#	Course outcomes	Expected Proficiency (%)	Expected Attainment (%)
CO1	Deliver the taxonomic position of earthworms	**80**	**75**
CO2	Categorise earthworms on the basis of ecology and the ecological role of earthworms	**80**	**75**
CO3	Characterize the earthworms used for vermiculture	**80**	**75**
CO4	Implement vermiculture process	**80**	**75**
CO5	Evaluate the conditions for vermiculture and its applications	**80**	**75**

Mapping of COS with POs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**L**	**M**	**S**	**L**
CO2	**S**	**M**	**M**	**S**	**M**
CO3	**S**	**L**	**S**	**L**	**L**
CO4	**S**	**L**	**S**	**M**	**L**
CO5	**S**	**M**	**S**	**L**	**L**

Mapping of COS with PSOs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**L**	**-**	**S**	**M**	**L**
CO2	**S**	**S**	**-**	**M**	**L**	**-**
CO3	**S**		**-**	**M**	**-**	**L**
CO4	**S**	**L**	**-**	**M**	**-**	**-**
CO5	**S**	**M**	**-**	**S**	**L**	**-**

Strong –S (+++) Medium-M (++) Low-L (+)

Blooms Taxonomy

Blooms Taxonomy			
	CA		**End of Semester (Marks)**
	First (Marks)	**Second (Marks)**	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Course Title: Vermitechnology

Unit I

Systematic position and life cycle of earth worm; ecological categories of earthworms - epigeic, endogeic and anecic; characteristics of earthworms used in vermiculture

Unit II

Common species used in vermiculture (*Perionyx excavates* and *Eisenia fetida*); mechanism of digestion in earthworm, ecological importance of earthworms

Unit III

Process of vermiculture: Collection of worms – Manual, migration and mechanical methods, materials required for vermiculture

Unit IV

Phases of vermiculture - preparation of vermibed, culture, harvesting, separation of earthworms

Unit V

Environmental factors - pH, temperature, moisture - transport of worms, applications of vermiculture in agriculture and waste management

Reference Books:

1. Edwards, C.A., Arancon, N.Q. and Sherman, R.L. (Eds). 2010. Vermiculture Technology. CRC Press, Florida, USA
2. Board, E. 2009. Hand book of Biofertilizers and Vermiculture. Engineers India Research Institute, New Delhi.
3. Sathe, T.V. 2022. Vermiculture and Organic Farming, Daya Publishing House, New Delhi.
4. Cremin, D. 2022. Vermiculture and Organic Farming, White Press Academic,

Online Resource:

- http://ecoursesonline.iasri.res.in/mod/page/view.php?id=108199
- https://prepp.in/news/e-492-vermiculture-environment-notes
- https://vikaspedia.in/agriculture/farm-based-enterprises/vermicomposting#:~:text=Local%20species%20used%20in%20India,concrete%20rings%20or%20any%20containers.

Course Designer:

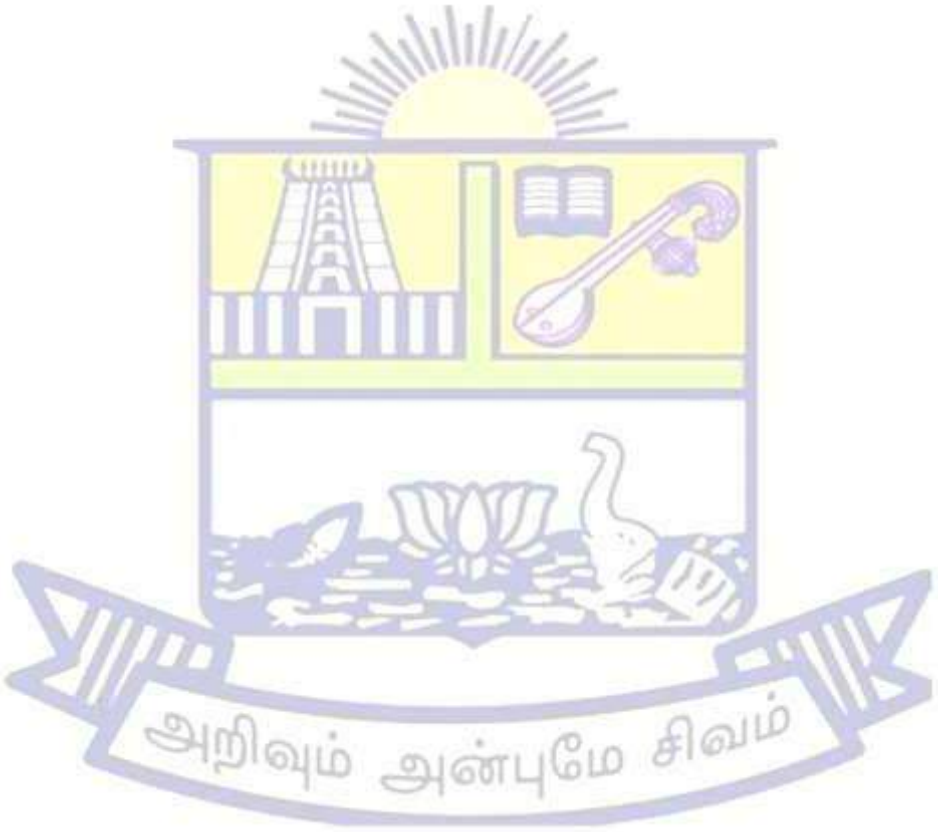
1. **Dr. A. Kanakalakshmi**
2. **Dr. K. Renugadevi**

Thiagarajar College

(An Autonomous Institution Affiliated to Madurai Kamaraj University)
Re-Accredited with "A" Grade by NAAC

Academic Council Meeting (ACM)

June-2023

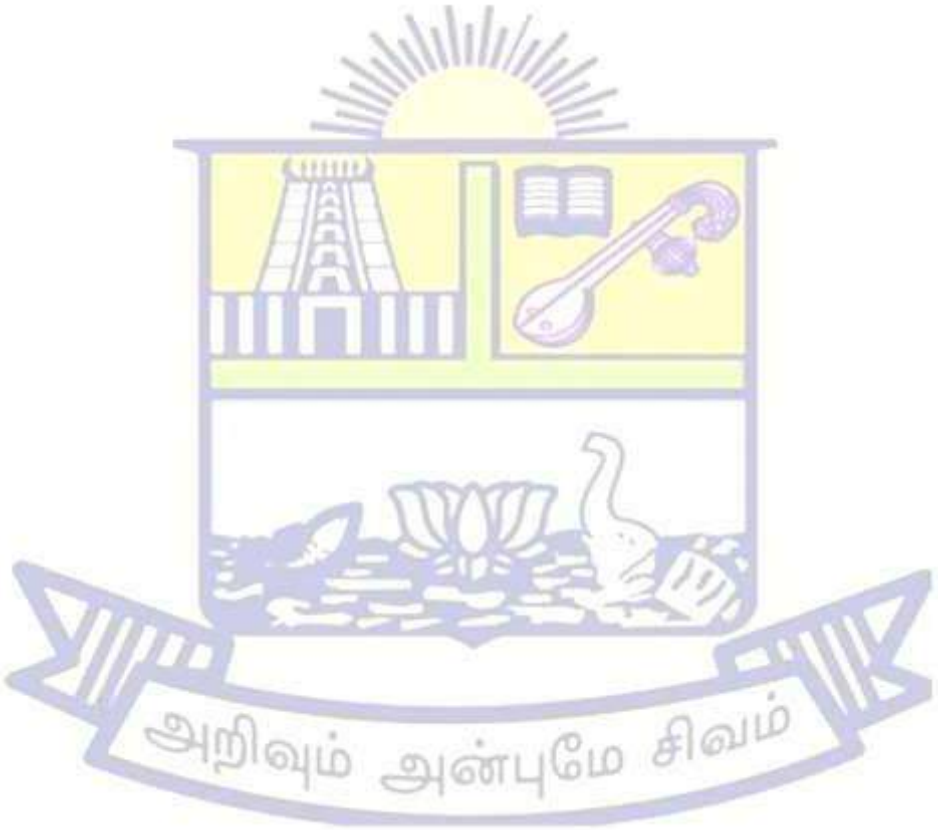


B.Sc., Microbiology

Syllabus 2023-2024

B.Sc., Microbiology

ProgrammeCode-UMB



PO1 Scientific Knowledge and Critical Thinking

Apply the knowledge of Life Science, Physical and Chemical Science, Mathematics, statistics, Computer science and humanities for the attainment of solutions to the problems that come across in our day-to-day life/activities.

PO2 Problem Solving

Identify and analyze the problem and formulate solutions for problems using the principles of mathematics, natural sciences with appropriate consideration for the public health, safety and environmental considerations.,

PO3 Communication and Computer Literacy

Communicate the fundamental and advanced concepts of their discipline in written and oral form. Able to make appropriate and effective use of information and information technology relevant to their discipline

PO4 Life-Long Learning

Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PO5 Ethical, Social and Professional Understanding

Commitment to principles, codes of conduct and social responsibility in order to behave consistently with personal respect. Acquire the responsibility to contribute for the personal development and for the development of the community. Respect the ethical values, social responsibilities and diversity.

PO6 Innovative, Leadership and Entrepreneur Skill Development

Function as an individual, and as a member or leader in diverse teams and in multidisciplinary settings. Become an entrepreneur by acquiring technical, communicative, problem solving, intellectual skills.

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with "A" Grade by NAAC)
Department of –Zoology and Microbiology

Vision

- To render exemplary quality education in Life Sciences and laboratory skills in order to produce generations of responsible, competent and employable graduates

Mission

- To provide a comprehensive set of courses in biological sciences that enhances the understanding, depth of knowledge and technical competency of the students.
- To prepare the students for entry-level research and teaching Positions in biological sciences.
- To provide an educational environment that fosters the development of appropriate scientific vocabulary, reasoning skills, and effective oral and written communication abilities for students.
- To create an holistic understanding of the allied subjects through interdisciplinary learning.

Programme Educational Objectives (PEO)

The objectives of this programme is to equip/prepare the students

PEO1	To prepare a new generation of microbiologists, capable of excelling in careers of their choosing.
PEO2	To equip the students to apply knowledge of prokaryotic and eukaryotic cellular processes, classification, interaction of microorganisms among themselves, with physical and chemical agents and higher order organisms
PEO3	To undertake research studies, collect relevant literature ,designexperiment, use experimental techniques, analysis the results statistically, report and publish the findings
PEO4	Job opportunities in pharmaceutical, food and bioprocess industries
PEO5	Basics and current updates in the areas of Microbiology, Biochemistry, Molecular Biology, Immunology, Genetic Engineering, Industrial Microbiology, Medical Microbiology, Agriculture & Environmental Microbiology are included to train the students and also sensitize them to scope for research.

Programme specific outcomes- B.Sc., Microbiology

On the successful completion of B.Sc., Microbiology the students will

PSO1	Comprehend the core concepts, methods & practices in life sciences especially Microbiology, Biotechnology etc.,
PSO2	Isolate, identify and characterize different types of microorganisms and their metabolites
PSO3	Interpret the etiology of infectious diseases, their transmission, treatment, control and prevention methods.
PSO4	Acquire theoretical basis and practical skills in the use of basic tools, technologies and methods common to different disciplines of life sciences.
PSO5	Be proficient in the fundamental knowledge and recent trends/updates of different disciplines in microbiology.

THIAGARAJAR COLLEGE, MADURAI – 9.
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Department of Microbiology
Bachelor of Science (B.Sc.,) Microbiology (w.e.f. 2023 batch onwards)
Programme Code-UMB

Semester – I

Course		Code No	Subject	Hrs/ Week	Cred.	Total Hrs	Max Mark CA	Max Marks SE	Total
Part - I	Tamil	U23P1TA11B	*பொதுத்தமிழ் - I*	6	3	90	25	75	100
Part - II	English	U23P2EN11	General English - I	4	3	60	25	75	100
Part - III	Core The 1	UMB23CT11	Fundamentals of Microbiology and Microbial Diversity	4	4	60	25	75	100
	Core The 2	UMB23CT12	Bioinstrumentation	3	3	45	25	75	100
	Core Lab 1	UMB 23CL11	Lab in Microbiology and Bioinstrumentation	2	1	30	25	75	100
	Generic Elec Theo Chem1	UCH23GT11Z	Ancillary Chemistry	3	2	30	25	75	100
	Generic Elec Lab Chem	UCH23GL21Z	Ancillary Chemistry Lab	2	-	30	-	-	-
Part - IV	NME 1	UMB 23NT11	Social Preventive and Medicine	2	2	30	25	75	100
	Foundation Course	UMB 23FT11	Good Laboratory Practices (GLP)	2	2	30	25	75	100
	AECC1	UEN23AT11	Introduction to Personality Development	2	2	30	25	75	100
TOTAL				**30**	**22**				

Semester – II

Course		Code No	Subject	Hrs/ Week	Cred.	Total Hrs	Max Mark CA	Max Marks SE	Total
Part - I	Tamil	U23P1TA21	*பொதுத்தமிழ் - II*	6	3	90	25	75	100
Part - II	English	U23P2EN21	General English - II	4	3	60	25	75	100
Part - III	Core The 3	UMB 23CT21	Biochemistry	4	4	60	25	75	100
	Core The 4	UMB 23CT22	Cell Biology	3	3	45	25	75	100
	Core Lab 2	UMB 23CL21	Lab in Biochemistry and Cell Biology	2	1	30	25	75	100
	Generic Elec Theo Chem2	UMB23GT21Z	Ancillary Chemistry	3	3	30	25	75	100
	Generic Elec Lab Chem1	UMB23GL21Z	Ancillary Chemistry Lab	2	2	30	25	75	100
Part-IV	NME 2	UMB 23NT21	Nutrition Health and Hygiene	2	2	30	25	75	100
	SEC1	UMB 23ST21	Disciplines of Microbiology	2	2	30	25	75	100
	AECC 2	UEN23AT21	Employability Skills	2	2	30	25	75	100
TOTAL				**30**	**24**	450			

Extra credit	**Naan MudhalvanScheme** Language Proficiency for Employability		**2**				

THIAGARAJAR COLLEGE, MADURAI – 9.
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Bachelor of Science (B.Sc.,) Microbiology (w.e.f. 2023 batch onwards)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB23CT11	Fundamentals of Microbiology and Microbial Diversity	Core	4	--	--	4

L - Lecture T - Tutorial P - Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble

The course explains the basic concepts, history and developments of microbiology. The course focuses on the classification and structural identification of microorganisms (bacteria, viruses, fungi and algae).

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency %	Proficiency Attainment %
CO1	Comprehend the contributions of scientists in the field of Microbiology	75	70
CO2	Outline the classification and analyze the structural organization of bacterial cell	75	70
CO3	Determine the methods to be adopted to cultivate and control microbes.	75	80
CO4	Outline the classification and analyze the structural organization of virus and fungi	70	65
CO5	Sketch the classification of algae, lichens and their significance.	70	65

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	L	M	L	L
CO2	S	L	L	M	L	L
CO3	M	M	L	S	M	S
CO4	S	L	L	M	L	L
CO5	S	L	L	M	L	S

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	L	S	S
CO2	S	S	L	S	S
CO3	S	S	L	S	S
CO4	M	S	M	M	S
CO5	S	S	S	M	M

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Fundamentals of Microbiology and Microbial Diversity

Unit I

History of Microbiology - Contributions of Robert Hooke, Leeuwenhoek, Francesco Redi, John Needham, Spallanzani, Louis Pasteur, Robert Koch, Edward Jenner, D' Herelle and Twort, Marshall and Waren, Alter and Rice. 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.

Unit II

Outline classification for bacteria as per the second edition of Bergey's Manual of Systematic Bacteriology. Structural organization of bacteria – Size, shape, and arrangement of bacterial cells -Ultrastructure of a bacterial cell - cell wall, cell membrane, nucleoid, capsule, flagella, fimbriae, mesosomes, chlorosomes, phycobilisomes, spores, cysts, and gas vesicles; Growth of bacterial culture – Physical & Chemical requirements for growth; Phases of growth.

Unit III

Types of growth media- natural, synthetic, complex, enriched, differential and anaerobic. Growth media - definition with example, pure culture methods (streak plate, spread plate, pour plate, stab culture, slant culture). Control of microbes- Sterilisation, disinfection, antiseptic, tyndallisation, pasteurization: Physical (- dry heat, moist heat, UV light, ionizing radiation, filtration, HEPA filter) and Chemical methods.

Unit IV

Classification of viruses, General characteristics of viruses. General Morphology – Helical, polyhedral, enveloped, complex. Morphology and structure of TMV and Influenza virus.Brief study of Viroids and Prions.Classification of Fungi (Alexopoulos and Mims).Distinguishing characteristics of Fungi – Filamentous, non-filamentous & dimorphic fungi; Morphology and structure of *Aspergillusniger*and*Saccharomyces cerevisiae*; Industrial uses of yeasts and molds.

Unit V

Classification of Algae (Chapman and Chapman); General Characteristics of Algae. Morphology and structure of *Chlorella &Anabaena.*Biological and economic importance of algae. General structure of Lichens.Biological and economic importance of Lichens. General characteristics of Protozoa.

Text Books:

1. Willey, J., Sandman, K. and Wood, D. 2023. Prescott's Microbiology 12th edition, McGraw Hill, New York.
2. Tortora, G.J., Funke, B.R. and Case, C.L., Weber, D. and Bair, W. B. 2021.Microbiology: An Introduction. 13thGlobal Edition, Pearson Education, UK.

References:

1. Ananthanarayan, R. and Paniker C. K. J. 2020. Ananthanarayan and Paniker's Textbook of Microbiology, 11th Edition, Universities Press (India) Pvt. Ltd. India.
2. Black, J. G. and Black, L. J. 2015. Microbiology: Principles and Explorations, 9th Edition. Wiley Publishers, US.
3. Madigan, M. T., Martinko, J. M., Bender, K. S., Buckley, D. H., Stahl, D. A. and Brock, T. (2014). Brock Biology of Microorganisms, 14th Edition Pearson Education, UK.
4. Pommerville, J. C. 2010. Alcamo's Fundamentals of Microbiology, 9th Edition. Jones and Bartlett learning, US.
5. Pelczar, M.J., E.C.S. Chan and N.R. Kreig. 2009. Microbiology, 5th edition. McGraw-Hill. Book Co., US.

Web Resources:

1. https://www.cliffsnotes.com/study-guides/biology/microbiology
2. https://www.keyence.com/ss/products/microscope/microscope_glossary/
3. https://www.coursehero.com/study-guides/boundless-microbiology/
4. https://microbenotes.com/
5. https://microbiologynote.com/

Course Designers:

Dr. B. Singaravelan
Dr. E. Kaarunya

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with "A" Grade by NAAC)
Department of Microbiology
Bachelor of Science (B.Sc.,) Microbiology (w.e.f. 2023 batch onwards)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB23CT12	Bioinstrumentation	Core	3	--	--	3

L - Lecture T - Tutorial P - Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble

The course is designed to understand the working principle of scientific instrumentsinvolved in biological studies. The course provides a theoretical background for the separation of biomolecules.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency %	Proficiency Attainment %
CO1	Comprehend the principles and applications of analytical techniques.	75	70
CO2	Familiarize with the principle and applications of microscopy.	75	70
CO3	Demonstrate the methodologies adopted for analyzing the biophysical and biochemical properties of compounds.	70	65
CO4	Appraise the role of chromatographic techniques for separation of biomolecules.	75	70
CO5	Outline the principles ofmolecular techniques for the	80	75

K1 - Knowledge K2 - Understand K3 - Appl y

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	M	S	L	M
CO2	M	S	M	S	L	M
CO3	M	M	L	M	M	M
CO4	L	S	L	M	M	M
CO5	L	S	S	S	S	S

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**L**	**S**	**S**	**S**
CO2	**S**	**S**	**M**	**S**	**S**
CO3	**S**	**S**	**S**	**S**	**M**
CO4	**S**	**S**	**S**	**S**	**S**
CO5	**M**	**M**	**M**	**L**	**L**

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge	**40%**	**40%**	**40%**
Understand	**40%**	**40%**	**40%**
Apply	**20%**	**20%**	**20%**

Bioinstrumentation

Unit I

pH meter, Centrifuge (Clinical, Density gradient and Ultra) – sedimentation coefficient, RCF, RPM; Micrometry, Quebec colony counter, GM counter, Liquid Scintillation counter, Sonicator, Lyophilizer, Laminar air flow and Biosafety cabinet.

Unit II

Compound (Dark and Light field) Microscopy, Phase Contrast Microscopy, Fluorescence Microscopy, Polarized Microscopy, Electron (Transmission and Scanning) Microscopy, Confocal Microscopy and Atomic Force Microscopy.

Unit III

Colorimeter – Beer & Lamberts law, Spectrophotometer (visible, ultraviolet, and infrared), Flame Photometer and Atomic Absorption Spectrophotometer.

Unit IV

Paper (Ascending, descending and circular), Thin layer, Column, gel filtration, ion exchange, Gas and High-Performance Liquid Chromatography.

Unit V

Agarose Gel Electrophoresis, SDS-PAGE, Gel Documentation, Southern, Northern and Western blotting, autoradiography, PCR - RT-PCR.

Text Books:

1. Veerakumari, L. 2021. Bioinstrumentation. MJP Publishers, Chennai.
2. Palanivelu. P. 2018. Analytical Biochemistry and Separation Techniques. Twenty first Century Publications, Madurai.

References:

1. Brown, T.A. 2020. Gene Cloning and DNA Analysis: An introduction. 8th Edition, Blackwell publishing, USA.

2. Reilly M J. 2018. Bioinstrumentation.CBS publishers and Distributors Pvt.Ltd, India.
3. Wilson, K. and Walker, J. 2018. Principles and Techniques of Practical Biochemistry, 8th Edition Cambridge University Press, New York.
4. M. H. Fulekar and Bhawana Pandey. 2013. Bioinstrumentation. I.K. International Publishing House Pvt. Limited, India.
5. M. Prakash. 2009. Understanding Bioinstrumentation. Discovery Publishing House, India.

Web Resources:

1. pH meter calibration https://www.youtube.com/watch?v=e1Ulu5ilU6s
2. Compound microscope https://www.youtube.com/watch?v=4x-2GHBel0A
3. Colorimeter principle https://www.youtube.com/watch?v=yTabfxvMdCM
4. Paper chromatography https://www.youtube.com/watch?v=23W5Z_redfs
5. Southern blotting https://www.youtube.com/watch?v=CSrUm-EgTK4

Course Designers:

Dr. C. M. Archana
Dr. A. Preeti

THIAGARAJAR COLLEGE, MADURAI – 9.

(Re-Accredited with "A" Grade by NAAC)
Department of Microbiology
Bachelor of Science (B.Sc.,) Microbiology (w.e.f. 2023 batch onwards)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB23CL11	Lab in Microbiology and Bioinstrumentation	Core	--	--	2	1

L - Lecture T - Tutorial P - Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	40	60	100

Preamble

Provide hands on training to perform basic Microbiology and analytical techniques. Demonstrate cultivation of microbes in laboratory conditions.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency %	Proficiency Attainment %
CO1	Define the standard operating procedures to be followed in the laboratory.	90	90
CO2	Demonstrate the methods for the isolation of bacteria, fungi and algae.	95	90
CO3	Appraise the staining techniques for identification of microbes.	90	85
CO4	Illustrate various biochemical techniques for microbial identification.	90	90
CO5	Sketch the structural organization of microbes (bacteria fungi, and algae).	95	95

K1 - Knowledge K2 - Understand K3 - Apply

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	L	M	S	M	S
CO2	S	S	M	S	S	S
CO3	M	S	M	S	L	S
CO4	S	S	M	S	S	S
CO5	S	S	L	M	L	L

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**L**	**S**	**S**	**S**
CO2	**S**	**S**	**M**	**S**	**S**
CO3	**S**	**S**	**S**	**S**	**M**
CO4	**S**	**S**	**S**	**S**	**S**
CO5	**M**	**M**	**M**	**L**	**L**

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge	**40%**	**40%**	**40%**
Understand	**40%**	**40%**	**40%**
Apply	**20%**	**20%**	**20%**

Lab in Microbiology and Bioinstrumentation

1. Laboratory safety and precautions according to GLP guidelines.
2. Preparation of media and pure culture techniques (Slant, Streak – simple and quadrant, subculture).
3. Enumeration of bacterial numbers by serial dilution and plating.
4. Isolation of bacteria and fungi from different sources (Skin, soil, leaves, air and water)
5. Simple staining.
6. Differential staining – Gram's staining.
7. Capsule and Spore staining.
8. Motility test (Hanging drop method)
9. Biochemical tests – IMViC, catalase and oxidase.
10. Fungal Staining.
11. Microscopic observation of Algae.
12. Micrometry.
13. Separation of molecules based on density gradient centrifugation principle.
14. Microscopy- working knowledge of light and electron microscopy.
15. pH meter, Quebec colony counter, centrifuge,colorimeter, UV spectrophotometer – working knowledge.

Text Books:

1. Cappuccino, J. G. and Welsh, C. T. 2023.Microbiology – A Laboratory Manual Global Edition, 11th Ed. Pearson Education Ltd., Global Edition, UK.
2. Brown, A. and Smith, H. 2015. Bensons Microbiological Application 13th Edition, McGraw Hill, US.

References:

1. Willey, J., Sandman, K. and Wood, D. 2023. Prescott's Microbiology 12th edition, McGraw Hill, New York.
2. Tortora, G.J., Funke, B.R. and Case, C.L., Weber, D. and Bair, W. B. 2021. Microbiology: An Introduction. 13th Global Edition, Pearson Education, UK.

3. Jain, A. Agarwal, J. and Venkatesh, V. 2018. Microbiology Practical Manual, 1st Edition. Elsevier, India.
4. Madigan, M. T., Martinko, J. M., Bender, K. S., Buckley, D. H., Stahl, D. A. and Brock, T. 2014. Brock Biology of Microorganisms, 14th Edition Pearson Education, UK.
5. Gunasekaran, P. 2008. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi

Web Resources:

1. https://serc.carleton.edu/microbelife/index.html
2. https://microbeonline.com/fungal-staining-methods-and-uses/
3. https://learn.chm.msu.edu/vibl/content/differential/
4. https://www.microbiologyinpictures.com/index.php
5. https://www.microscopyu.com/microscopy-basics/linear-measurements-micrometry

Course Designers:

Dr. B. Singaravelan
Dr. E. Kaarunya

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with "A" Grade by NAAC)
Department of Microbiology
Bachelor of Science (B.Sc.,) Microbiology (w.e.f. 2023 batch onwards)
Programme Code-UMB
(For those joined B.Sc. (other than Microbiology)/B.A/B.Com/BBA on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credit
UMB23NT11	Social and Preventive Medicine	SEC1	2	--	--	2

L - Lecture T - Tutorial P - Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble

Acquire knowledge on the importance of the health management system and preventive medicine.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency %	Proficiency Attainment %
CO1	Describe the concepts of health and disease and their social determinants	80	80
CO2	Summarize the health management system	85	80
CO3	Know about the various health care services	80	75
CO4	Outline the goals of preventive medicine	80	80
CO5	Gain knowledge about alternate medicine	85	85

K1 - Knowledge K2 - Understand K3 - Apply

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	L
CO2	S	M	M	S	S	M
CO3	S	M	M	S	M	L
CO4	S	M	L	S	M	L
CO5	S	S	L	S	M	S

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	S	M	L
CO2	S	L	S	M	M
CO3	L	L	M	S	L
CO4	M	L	S	M	L
CO5	M	L	S	M	M

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Social and Preventive Medicine

Unit I - 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 - Health Management:
Applications of behavioural sciences and psychology in health management- national programs for communicable and non-communicable diseases- environmental and occupational hazards and their control.

Unit III - 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.

Unit IV - 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 - Prevention through alternate medicine:
Unani, Ayurveda, Homeopathy, Naturopathy systems in epidemic and pandemic outbreaks. International health regulations. Infectious disease outbreak – Multidrug resistance; emerging and re-emerging diseases (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, India
2. Jain, V. 2020. Review of Preventive and Social Medicine: Including Biostatics. 12th Edition, Jaypee Brothers Medical Publishers, New Delhi, India.

References:

1. Waitzkin, H., Pérez, A. and Anderson, M. 2021. Social Medicine and the coming Transformation. 1st Edition. Routledge publishers, England, UK.
2. Roy. R. N. and Saha, I. 2013. Mahajan & Gupta Text book of preventive and social medicine, 4th Edition. Jaypee Brothers medical publishers, New Delhi, India.
3. Sunder, L. A. P. 2011. Textbook of Community Medicine: Preventive and Social Medicine, 3rd Edition, CBS publishers and Distributors Lts., New Delhi, India.
4. Prabhakara, G. N. 2010. Short Textbook of Preventive and Social Medicine. 2nd Edition. Jaypee publishers, New Delhi, India.

5. Suls, J. M., Davidson, K. W. and Kaplan, R. M. 2010. Handbook of Health Psychology and Behavioral Medicine. 1st Edition, Guilford Press, New York, USA.

Web Resources:

1. https://www.omicsonline.org/scholarly/social--preventive-medicine-journals-articles-ppts-list.php
2. https://www.teacheron.com/online-md_preventive_and_social_medicine-tutors
3. https://www.futurelearn.com
4. https://www.healthcare-management-degree.net
5. https://www.conestogac.on.health-care-administration-and-service-management

Course Designers:

Dr. E. Kaarunya
Dr. C. M. Archana

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with "A" Grade by NAAC)
Department of Microbiology
Bachelor of Science (B.Sc.,) Microbiology (w.e.f. 2023 batch onwards)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB23FT11	**Good Laboratory Practice**	**Foundation Course**	2	-	-	2

L - Lecture T - Tutorial P - Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	**First**	**25**	**75**	**100**

Preamble

Good Laboratory Practice (GLP) is a quality system covering the organizational process and conditions under which non-clinical laboratory studies are planned, performed, monitored, recorded, reported, and archived. GLP ensures the quality and integrity of safety test data submitted to the government for the issuance of research permits.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency %	Proficiency Attainment %
CO1	Evaluate the safety & efficacy of the drugs/ chemicals & devices.	60	60
CO2	Apply the data generated through clinical experiments and studies	60	60
CO3	Able to build the detailed understanding on the subject and eventually help them getting absorbed into industry.	60	60
CO4	Apply the principles of GLP to ensure that laboratory testing	60	60
CO5	Ensures the quality and integrity of safety test data submitted to the government for the issuance of research permits.	60	60

K1 - Knowledge K2 - Understand K3 - Apply

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**L**	**-**	**S**	**M**	**M**
CO2	**S**	**S**	**-**	**S**	**M**	**L**
CO3	**S**	**S**	**-**	**S**	**M**	**L**
CO4	**S**	**S**	**M**	**S**	**S**	**L**
CO5	**S**	**S**	**M**	**S**	**S**	**M**

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	---	M	---	M
CO2	M	L	S	L	L
CO3	M	L	L	M	M
CO4	M	---	M	M	M
CO5	---	M	S	S	M

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Good Laboratory Practices

Unit I

Introduction to GLP, History, Scope and fundamental points of GLP, WHO guidelines on GLP& GMP Concept of quality control & quality assurance.

Unit II

General rules/protocols for lab safety measures. Precautions and safety in handling: chemicals, reagents, solutions and solids. -Laboratory tools, Glass wares and instruments. Balances, ovens, desiccators, pipets, micropipettes, volumetric flask

Practicals

Unit III

Biosafety cabinets –Laminar hood andBiosafety levels 1 to 4. Laboratory associated hazards/infections, disposal of biohazard materials, fire prevention and safety.

Unit IV

Log Book Maintenance, Internal & external audit, Basic SOPs for instrument handling and Maintenance – Autoclave.

Unit V

Calibration of Instruments: weighing scale, microcentrifuge, pH meter, colorimeter, spectrophotometer, water bath, Distillation assembly. -Practicals.

Recommended text books

1. ISO 17025 General requirements for the competence of testing and calibration laboratories
2. FDA ORA Laboratory Manual of Quality Policies
3. FDA CFR GMP Regulations for Drug Products
4. Pharmacopoeias (BP / USP / EP / JP)
5. ICH Guidance QB4 Evaluation and Recommendation of Pharmacopoeial Texts for Use in the ICH Regions
6. ICH Q2(R1): Validation of Analytical Procedures: Text and Methodology
7. ICH Q5C: Quality of Biotechnological Products: Stability Testing of Biotechnological/Biological Products
8. WHO Guidelines for Sampling of Pharmaceutical and Related Materials

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with "A" Grade by NAAC)
Department of Microbiology
Bachelor of Science (B.Sc.,) Microbiology (w.e.f. 2023 batch onwards)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB23CT21	Biochemistry	Core	4	--	--	3

L - Lecture T - Tutorial P –Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble

The course elaborates the chemical and physical properties of biomolecules. To emphasis the classification, structure and metabolic pathways of biomolecules.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency %	Proficiency Attainment %
CO1	Elaborate the chemical and physical properties of biomolecules and their importance in biological systems	80	75
CO2	Explain the structure and classification of proteins, lipids, nucleic acids, and carbohydrates	75	80
CO3	Emphasis the role of metabolic pathways	80	75
CO4	Outline the structure and function oflipids and enzymes.	80	75
CO5	Sketch and analyse the structure and functions of nucleic acids and vitamins	75	80

K1 - Knowledge K2 - Understand K3 – Apply

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	M	M	L
CO2	M	M	M	L	M	S
CO3	S	L	M	M	S	M
CO4	S	M	S	M	S	S
CO5	S	M	M	S	M	S

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	L	M	M
CO2	M	L	M	M	S

CO3	**S**	**M**	**M**	**S**	**M**
CO4	**S**	**M**	**S**	**L**	**S**
CO5	**L**	**M**	**M**	**M**	**M**

Blooms taxonomy

	CA		End of
	First	**Second**	**Semester**
Knowledge	**40%**	**40%**	**40%**
Understand	**40%**	**40%**	**40%**
Apply	**20%**	**20%**	**20%**

Biochemistry

Unit I

Biomolecules - Interaction and bonding. Water – Molecular structure and properties (Thermal, solvent, colligative) dissociation and ionization of water, pH and buffers (bicarbonate, phosphate and acetate); Henderson-Hasselbach equation. pKa.

Unit II

Carbohydrates: Classification - Monosaccharides – glucose, fructose and galactose – structure and isomerism – biological importance. Disaccharides – Structure and biological importance of maltose, sucrose and lactose. Polysaccharides: Homo Polysaccharides- Starch and Glycogen. Hetero Polysaccharides: Structural characteristics and functions of peptidoglycan and agar.

Unit III

Proteins: classification, properties and biological importance. Structure and classification of aminoacids - based on Polarity - properties and chemical reactions-Zwitter ion – Isoelectric pI. Levels of organization: primary, secondary – Ramachandran Plot, tertiary and quaternary structure

Unit IV

Lipids: Classification, properties and biological importance. Structure and function of phospholipids, Biosynthesis of fatty acids and cholesterol, Beta oxidation and lipid peroxidation. Enzymes: Classification and mechanism of action (lock and key and induced fit theories). Enzyme kinetics – Michaels Menden equation, Factors influencing enzyme activity, Enzyme inhibition-competitive, non-competitive, uncompetitive and allosteric.

Unit V

Nucleic acids: Nucleoproteins, nucleosides, Nucleotides, chemical structure of DNA, synthesis of nucleic acids- Salvage and De-novo pathways. Catabolism of purine and pyrimidine. Fat and water soluble vitamins – source, significance and deficiency.

Text Books:

1. Satyanarayana, U. and Chakrapani, U. 2021. Biochemistry, 6th Edition. Books and Allied Pvt. Ltd., Kolkata.
2. Nelson, D. L. and Cox, M. 2021. Lehninger Principles of Biochemistry: International Edition, 8th Edition, W. H. Freeman and Co. Ltd., New York.

References:

1. Rastogi, S. C. 2019. Biochemistry, 4th Edition, New Age International Publishers, New Delhi.

2. Berg, J. M., Stryer, L., Tymoczko, J. and Gatto, G. 2019. Biochemistry, 9th Edition, W. H. Freeman and Co. Ltd., New York.
3. Rodwell, V. W., Bender, D., Botham, K. M., Kennelly, P. J. and Weil, P. A. 2018. Harper's Illustrated Biochemistry Thirty-First Edition (A & L LANGE SERIES), 31st Edition. McGraw Hill / Medical, New York.
4. Jain, J. L., Jain, S. and Jain, N. 2016. Fundamentals of Biochemistry, 7th Edition, S. Chand and Company Ltd, New Delhi.
5. Voet, D. and Voet, J. G. 2010. Biochemistry, 4th Edition, John Wiley and Sons, New York.

Web Resources:

1. https://chem.libretexts.org/Bookshelves/Biological_Chemistry
2. https://www.hsph.harvard.edu/nutritionsource/vitamins/
3. https://www.genome.gov/genetics-glossary/Nucleic-Acids
4. https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/lipids.htm
5. http://biochemical-pathways.com/#/map/1

Course Designers:

Dr. B. Singaravelan
Dr. A. Preeti

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with "A" Grade by NAAC)
Department of Microbiology
Bachelor of Science (B.Sc.,) Microbiology (w.e.f. 2023 batch onwards)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB23CT22	Cell Biology	Core	3	--	--	3

L - Lecture T - Tutorial P - Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble

Acquire knowledge on the structure,organization and function of prokaryotic and eukaryotic cells. Course enlightens the transport of molecules between cells, cell-cell adhesion and illustrates cell cycle and its regulation.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency %	Proficiency Attainment %
CO1	Explain the concepts of cell theory and cellular organization levels.	80	80
CO2	Appraise the role of biomolecules in cellular transport.	80	75
CO3	Depict the structure of various cell organelles and their functions.	85	80
CO4	Portray the various mechanisms of inter and intra cellular communication.	80	75
CO5	Outline the fundamentals and role of cell cycle.	85	85

K1 - Knowledge K2 - Understand K3 - Apply

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	L	M	M	L	L
CO2	M	S	M	M	L	M
CO3	M	S	S	M	L	L
CO4	M	S	L	L	L	M
CO5	M	M	M	L	L	M

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**M**	**M**	**M**	**M**	**M**
CO2	**S**	**L**	**S**	**M**	**S**
CO3	**S**	**L**	**M**	**L**	**M**
CO4	**S**	**L**	**S**	**L**	**M**
CO5	**S**	**L**	**M**	**S**	**S**

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge	**40%**	**40%**	**40%**
Understand	**40%**	**40%**	**40%**
Apply	**20%**	**20%**	**20%**

Cell Biology

Unit I

Discovery of cell and Cell Theory. Ultrastructure of animal, plant and bacterial cells. Cell types –epithelial cells, endothelial cells, Nerve cells. Specialization of cells into tissues and colonies.

Unit II

Cytoskeleton - Microfilaments, Microtubules; appendages - Cilia, Flagella, Pili; Plasma membrane models –Davson-Danielli and Fluid mosaic. Membrane Transport - active, passive and diffusion.

Unit III

Structure, types and functions sub cellular organelles - Mitochondria, chloroplast, Ribosome, Endoplasmic reticulum (rough and smooth), peroxisomes, Golgi apparatus, Lysosome; Organization of chromosomes in prokaryotes and eukaryotes - chromatin types, centromere, Telomere,Nucleus – Nucleolus, Histones and plasmids.

Unit IV

Extra Cellular Matrix (ECM) - Cell Adhesion, Cell migration; Cell Junctions, Cell-cell Communication; Cell signaling- calcium, receptors- G protein, mitogen-activated protein kinases (MAPK).

Unit V

Cell cycle - Stages & regulation of cell cycle; Cell division - Mitosis, Meiosis; cell death mechanisms -Apoptosis, Necrosis.

Text Books:

1. Alberts, B., Heald, R., Johnson, A., Morgan, D., Raff, M., Roberts, K. and Walter, P. 2022. Molecular Biology of the Cell, 7th edition. W. W. Norton & Company, New York
2. Berk, A., Kaiser, C. A., Lodish, H., Amon, A., Ploegh, H., Bretscher, A., Krieger, M. and Martin K. C. 2016. Molecular Cell Biology,8thEdition. W.H. Freeman & Co. New York.

References:

1. Power, C. B. 2019. Cell Biology, 3rd Edition. Himalayan Publishing House, New Delhi.
2. Hardin, J., Bertoni, G. and Kleinsmith, L. 2017. Becker's World of the Cell. Global Edition, 9th Edition.Pearson Education Ltd., UK.
3. Campbell, N. A., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V. and Reece, J. B. 2017. Biology: AGlobal Approach, Global Edition, 11th Edition. Pearson Education Ltd., UK.
4. Karp, G., Iwasa, J. and Marshall, W. 2015. Cell and Molecular Biology: Concepts and Experiments. 8th Edition. Wiley Publishers, US.
5. Cooper, G. M. and Hawman R. E. 2013. The Cell: A Molecular Approach, 6th Edition. Sinauer Associates, Inc, US.

Web Resources:

1. Structure of plant cell https://www.youtube.com/watch?v=URUJD5NEXC8
2. Structure of animal cell https://www.youtube.com/watch?v=sBHPwhBUxlQ
3. Cell membrane structure and function https://www.youtube.com/watch?v=fJfTDc3WzQ8
4. Cell division https://www.youtube.com/watch?v=XKZhcYetvsc
5. Cell junctions https://www.youtube.com/watch?v=vpYsjMDwsRk&t=16s

Course Designers:

Dr. E. Kaarunya
Dr. C. M. Archana

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with "A" Grade by NAAC)
Department of –Zoology and Microbiology
Bachelor of Science (B.Sc.,) Microbiology (w.e.f. 2023 batch onwards)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB23CL21	Lab in Biochemistry and Cell Biology	Core	--	--	2	1

L - Lecture T - Tutorial P - Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	40	60	100

Preamble

Provide hands on training to perform Biochemical and cytological techniques for identification and characterization of the biomolecules.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency %	Proficiency Attainment %
CO1	Prepare and analyze the buffers for biological reactions	90	95
CO2	Identify and quantify the amount of biomolecules in various samples.	90	90
CO3	Examine the separation of biomolecules by chromatography	95	95
CO4	Appraise the quantitative and qualitative measures of biomolecules.	90	95
CO5	Identify the different stages of cell division	95	90

K1 - Knowledge K2 - Understand K3 - Apply

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	S	S	L	S
CO2	L	S	M	L	L	M
CO3	L	S	M	L	L	M
CO4	M	M	S	L	L	M
CO5	L	L	L	L	L	L

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**L**	**L**	**S**	**S**
CO2	**S**	**S**	**M**	**S**	**S**
CO3	**S**	**M**	**L**	**S**	**S**
CO4	**S**	**M**	**M**	**S**	**S**
CO5	**M**	**L**	**L**	**M**	**L**

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge	**40%**	**40%**	**40%**
Understand	**40%**	**40%**	**40%**
Apply	**20%**	**20%**	**20%**

Lab in Biochemistry and Cell Biology

1. Preparation of buffers
2. Measurement of pH of various samples using pH meter.
3. Determination of pK_avalues of amino acid by titration curve method.
4. Verification of Beer-Lambert's law by calorimetric analysis using potassium dichromate.
5. Circular paper chromatography of amino acids and carbohydrates.
6. Thin layer chromatography of amino acids and carbohydrates.
7. Extraction and thin layer chromatography of lipids, microscopic observation of liposomes.
8. Qualitative analysis of carbohydrates and proteins
9. Quantitative estimation of carbohydrates (anthrone method), proteins (lowry method) and lipids (iodine value)
10. HPLC or GC-MS – Demonstration.
11. Study of chloroplast and stomata.
12. Study of divisional stages in mitosis using onion root tips.
13. Study of divisional stages in meiosis using flowers.
14. Observation of distinguishing features of prokaryotic and eukaryotic cells (Virtual Lab).
15. Animal cell culture techniques (virtual class).
16. Microtome – demonstration.

Text Books:

1. Chaitanya. K. V. 2013. Cell and Molecular Biology. A Lab manual. PHI learning Pvt. Ltd. India.
2. Palanivelu. P. 2009 Analytical Biochemistry and Separation Techniques. Twenty first Century Publications, Madurai.

References:

1. Hofmann, A. and Clokie, S. 2018. Wilson And Walker's Principles and Techniques of Biochemistry and Molecular Biology, 8th Edition. Cambridge University Press, UK.
2. Plummer, D. 2017. An Introduction to Practical Biochemistry, 3rd Edition. McGraw-Hill Publication, India.

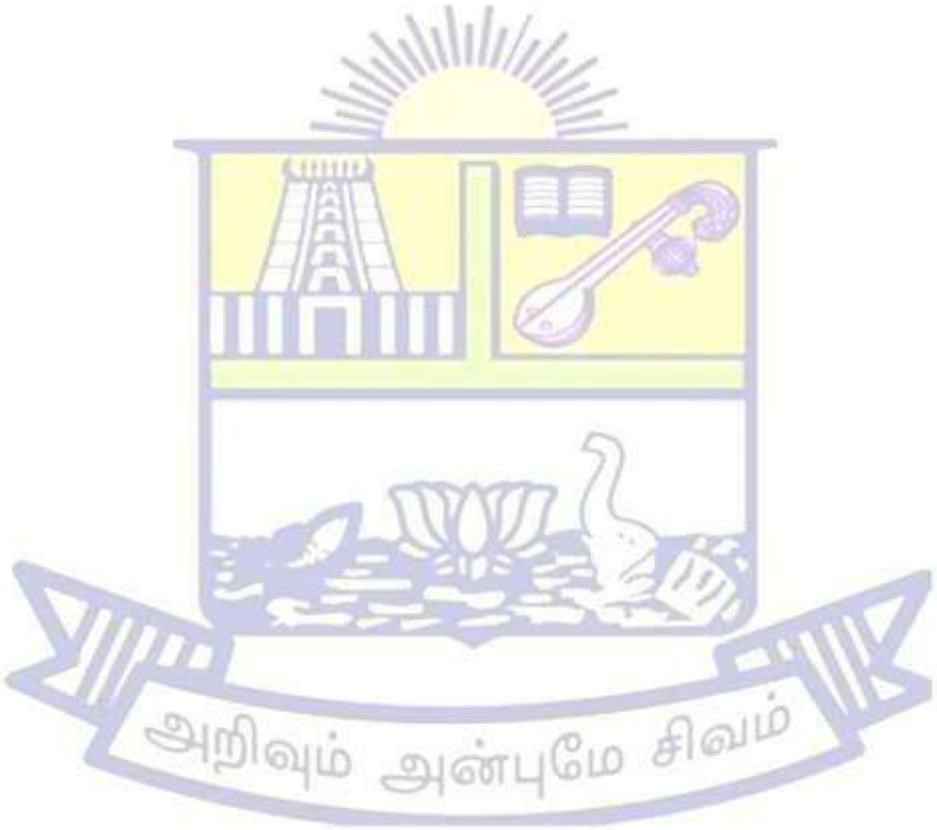
3. Jeyaraman, J. 2011. Laboratory Manual in Biochemistry, 2nd Edition. New Age International Pvt. Ltd. India.

Web Resources:

1. https://www.youtube.com/watch?v=RQ-SMCmWB1s
2. https://www.edinst.com/blog/the-beer-lambert-law/
3. https://www.thermofisher.com/blog/ask-a-scientist/what-is-chromatography/
4. https://microbiologynote.com/density-gradient-centrifugation/
5. https://www.microscopyu.com/microscopy-basics

Course Designers:

Dr. A. Preeti
Dr. B. Singaravelan



THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with "A" Grade by NAAC)
Department of Microbiology
Bachelor of Science (B.Sc.,) Microbiology (w.e.f. 2023 batch onwards)
Programme Code-UMB
(For those joined B.Sc. (other than Microbiology)/B.A/B.Com/BBA on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credit
UMB23NT21	Nutrition and Health Hygiene	SEC 2	2	--	--	2

L - Lecture T - Tutorial P - Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble

Acquire knowledge on the importance of nutrition and health hygiene.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency %	Proficiency Attainment %
CO1	Learn about nutrition and their importance	90	90
CO2	Understand the nutritional facts for a better life.	90	90
CO3	Emphasis on improper diet and associated disorders.	80	80
CO4	Impart knowledge on different national health care programs	80	75
CO5	Learn knowledge on different health	85	80

K1 - Knowledge K2 - Understand K3 - Apply

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	L	L
CO2	M	M	L	S	M	M
CO3	M	L	L	S	L	S
CO4	M	M	L	M	M	S
CO5	S	M	L	S	L	S

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	-	-	M	L
CO2	L	-	-	L	L
CO3	M	L	S	M	L
CO4	L	-	M	L	L
CO5	M	L	S	M	

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Nutrition Health and Hygiene

Unit I:

Nutrition – definition and importance; Carbohydrates, Lipids, Proteins and Vitamins – functions, dietary sources, effects of deficiency. Macro and micro minerals –functions, sources, effects of deficiency; Importance of water– functions, sources and effects of deficiency

Unit II:

Nutrition for Healthy life:Balanced Diet: Basics of Meal Planning; Diet Chart; Nutritive value of Indian foods.

Unit III:

Improper diets: Definition, Identification, Signs and Symptoms - malnutrition, under-nutrition, over-nutrition, Protein Energy Malnutrition, obesity; Nutritional Disease and Disorder - hypertension, diabetes, anemia, osteomalacia, cardiovascular disease.

Unit IV:

Health - Determinants of health, Key Health Indicators, Environment health & Public health; Functioning of various nutrition and health organizations in India.

Unit V:

Hygiene – Definition; Personal, Community, Medical and Culinary hygiene; WASH (Water, Sanitation and Hygiene) programme. Rural Community Health: Village health sanitation & Nutritional committee.

Text Books:

1. Revilla M. K. F., Titchenal A. and Draper J. (2020). Human Nutrition. University of Hawaii, Mānoa.
2. Bamji, M.S., Krishnaswamy, K. andBrahmam, G. N. V. 2019. Textbook of HumanNutrition, 4th Edition. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi

References:

1. Haldar, S. K. 2022. Occupational Health and Hygiene in Industry. CBS Publishers and Distributors Pvt. Ltd., India.
2. Das, R., Acharya, S. Kr. and Sen, M. 2021. Health Hygiene and Nutrition Perception and Practices, Satish Serial Publishing House, India.
3. Swaminathan, M. 2018. Handbook of Food and Nutrition (Vol I, Second Edition) The Bangalore Printing & Publishing Co Ltd., Bangalore
4. Sharma D. 2016. Textbook on Food Science and Human Nutrition for Under Graduates. Daya Publishing House, India.
5. Srilakshmi, B. 2010. Food Science, 5th Edition, New Age International Ltd., New Delhi

Web Resources:

1. National Rural Health Scheme - https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=969&lid=49
2. National Urban Health Scheme - https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=970&lid=137
3. Village health sanitation & Nutritional committee - https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=149&lid=225
4. Health Impact Assessment - https://www.who.int/hia/about/faq/en/
5. Healthy Living - https://www.nhp.gov.in/healthylivingViewall

Course Designers:

Dr. E. Kaarunya
Dr. C. M. Archana

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with "A" Grade by NAAC)
Department of Microbiology
Bachelor of Science (B.Sc.,) Microbiology (w.e.f. 2023 batch onwards)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB23ST21	Disciplines of Microbiology	SEC 3	2	--	--	2

L - Lecture T - Tutorial P - Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble

Students acquire knowledge on the various disciplines of Microbiology. Course enlightens the job opportunities and important methodologies employed in the various disciplines of Microbiology.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency %	Proficiency Attainment %
CO1	Learn about the importance of microbes in Ecology, Agricultural and Environmental Microbiology	90	90
CO2	Understand the necessity and position of microbes in Medicinal field	90	90
CO3	Impart the learnt knowledge and technical skills in Marine Microbiology and Microbial Biotechnology.	80	80
CO4	Gain the knowledge and scope of Food and Industrial Microbiology	80	75
CO5	Learn knowledge on the emerging fields	85	80

K1 - K owledge K2 - Understand K3 - Apply

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	--	S	M	S
CO2	S	S	--	S	M	M
CO3	M	S	--	S	L	S
CO4	M	S	--	S	L	S
CO5	S	S	--	M	M	S

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**M**	**S**
CO2	**S**	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**M**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge	**40%**	**40%**	**40%**
Understand	**40%**	**40%**	**40%**
Apply	**20%**	**20%**	**20%**

Disciplines of Microbiology

Unit I

Microbial Ecology: Introduction and Scope -Winogradsky experiment - culture and non-culture techniques. **Agriculture Microbiology**: Outline and Scope - interaction between plant and plant pathogens – substitutes for chemical pesticides- bio-controlling agents.**Environmental Microbiology**:outline and Scope - Microbes in controlling pollution - Microbial oil recovery - biomineralogy.

Unit II

Medical Microbiology: Introduction and Scope -human microbiota: skin, gut and oral - Communicable and non-communicable diseases.**Clinical and Diagnostic Microbiology**: Scope and applications. **Epidemiology:** Concepts of Endemic, epidemic, pandemic and sporadic diseases; mortality/ morbidity rates, incidence and prevalence.**Pharmaceutical Microbiology:**Scope and Applications - QC analyst – antimicrobial peptides, therapeuticproducts or drugs from plants/microbes.

Unit III

Aquatic Microbiology: Scope and Applications– fresh and marine water system – bioluminescence - ubiquitous source - **Microbial Biotechnology:**Scope and Applications - Recombinant vaccines – transgenic biology

Unit IV

Food and Diary Microbiology: Introduction and scope - bacteriocin- Quality control of food products:Milk – biopreservatives – food standard – FDA, WHO, FSSAI.**Industrial Microbiology:**Importance and Scope - biofuel – strain development

Unit V

Exomicrobiology: Introduction and Scope – origins of life – life in other planets **Aeromicrobiology:** Scope and Applications – microbiology in the clouds – aerial transmission (intramural and extramural)**. Geomicrobiology:**Scope and Applications - bioleaching – biomining.

Text Books:

1. Willey, J., Sandman, K. and Wood, D. 2023. Prescott's Microbiology 12th edition, McGraw Hill, New York.
2. Tortora, G.J., Funke, B.R. and Case, C.L., Weber, D. and Bair, W. B. 2021. Microbiology: An Introduction. 13th Global Edition, Pearson Education, UK.

References:

1. Ehrlich, H. L., Newman, D. K. and Kappler, A. 2021. Ehrlich's Geomicrobiology, 6th Edition. CRC Press, US.
2. Murray, P. R., Rosenthal, K. S. and Pfaller, M. A. 2020. Medical Microbiology, 9th Edition. Elsiever, US.
3. Black, J. G. and Black, L. J. 2015. Microbiology: Principles and Explorations, 9th Edition. Wiley Publishers, US.
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