

B.Sc., MICROBIOLOGY

Syllabus

Program Code: UMB

2023 - Onwards



MANNAR THIRUMALAI NAICKER COLLEGE

(AUTONOMOUS)

Re-accredited with “A” Grade by NAAC

PASUMALAI, MADURAI – 625 004

**GUIDLINES FOR OUTCOME BASED EDUCATION WITH CHOICE BASED
CREDIT SYSTEM**

(FOR UG PROGRAM FROM 2023 -2024 ONWARDS)

ELIGIBILITY FOR ADMISSION

Candidates seeking admission to the UG Degree program must have passed the Higher Secondary Education (respective groups – Arts / Science) of the Government of Tamil Nadu or any other state or its equivalent qualification.

DURATION OF THE COURSE

The duration of the course shall be three academic years comprising six semesters with two semesters in each academic year.

Subjects of Study

Part I : Tamil / Hindi /

Part II : English

Part III:

- 1.Core Subjects
- 2.Allied Subjects
- 3.Electives

Part IV:

- 1.Non Major Electives (I Year)
- 2.Skill Based Subjects
- 3.Environmental Studies - Mandatory Subject
- 4.Value Education - Mandatory Subject

Part V :

Extension Activities

ARTS & SCIENCE

CBCS COURSE STRUCTURE FOR UG PROGRAMS

Sem I	Credit	Sem II	Credit	Sem III	Credit	Sem IV	Credit	Sem V	Credit	Sem VI	Credit
1.1. Language - Tamil	3	2.1. Language - Tamil	3	3.1. Language - Tamil	3	4.1. Language - Tamil	3	5.1 Core Course - \CC IX	4	6.1 Core Course - CC XIII	4
1.2 English	3	2.2 English	3	3.2 English	3	4.2 English	3	5.2 Core Course - CC X	4	6.2 Core Course - CC XIV	4
1.3 Core Course - CC I	4	2.3 Core Course - CC III	4	3.3 Core Course - CC V	4	4.3 Core Course - CC VII Core Industry Module	4	5.3. Core Course - CC -XI	4	6.3 Core Course - CC XV	4
1.4 Core Course - CC II	4	2.4 Core Course - CC IV	4	3.4 Core Course - CC VI	4	4.4 Core Course - CC VIII	4	5.3. Core Course - / Project with viva-voce CC - XII	4	6.4 Elective -VII Generic/ Discipline Specific	3
1.5 Elective I Generic/ Discipline Specific	3	2.5 Elective II Generic/ Discipline Specific	3	3.5 Elective III Generic/ Discipline Specific	3	4.5 Elective IV Generic/ Discipline Specific	3	5.4 Elective V Generic/ Discipline Specific	3	6.5 Elective VIII Generic/ Discipline Specific	3
1.6 Skill Enhancement Course SEC-1 (NME)	2	2.6 Skill Enhancement Course SEC-2 (NME)	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	4.6 Skill Enhancement Course SEC-6	2	5.5 Elective VI Generic/ Discipline Specific	3	6.6 Extension Activity	1
1.7 Ability Enhancement Compulsory Course (AECC) Soft Skill-1	2	2.7 Skill Enhancement Course - SEC-3(NME)	2	3.7 Skill Enhancement Course SEC-5	2	4.7 Skill Enhancement Course SEC-7	2	5.6 Value Education	2	6.7 Professional Competency Skill	2
1.8 Skill Enhancement - (Foundation Course)	2	2.8 Ability Enhancement Compulsory Course (AECC) Soft Skill-2	2	3.7 Ability Enhancement Compulsory Course (AECC) Soft Skill-3	2	4.7 Ability Enhancement Compulsory Course (AECC) Soft Skill-4	2	5.5 Summer Internship /Industrial Training	2		
				3.8 E.V.S	-	4.8 E.V.S	2				
	23		23		22		25		26		21
Total Credit Points											140

**QUESTION PAPER PATTERN FOR THE CONTINUOUS INTERNAL
ASSESSMENT**

Note: Duration – 1 hour

(FOR PART I, PART II & PART III)

The components for continuous internal assessment are:

Part –A

Four multiple choice questions (answer all) 4 x 01= 04 Marks

Part –B

Two questions (‘either or ‘type) 2 x 05= 10 Marks

Part –C

Two questions (‘either or ‘type) 2 x 08=16 Marks

Total 30 Marks

THE COMPONENTS FOR CONTINUOUS INTERNAL ASSESSMENT ARE:

(60 Marks of two continuous internal assessments will be converted to 15 marks)

Two tests and their average --15 marks

Seminar /Group discussion / Quiz Test --5 marks

Assignment --5 marks

Total 25 Marks

QUESTION PAPER PATTERN FOR THE SUMMATIVE EXAMINATIONS:

Note: Duration- 3 hours

Part –A

Ten multiple choice questions 10 x 01 = 10 Marks

No Unit shall be omitted: not more than two questions from each unit.)

Part –B

Five Paragraph questions ('either or 'type) 5 x 05 = 25 Marks

(One question from each Unit)

Part –C

Five Paragraph questions ('either or 'type) 5 x 08 = 40 Marks

(One question from each Unit)

Total -----
75 Marks

PART-IV- SKILL BASED PAPERS / NME:

The Scheme of Examination for Skill Based Papers: (Except Practical Lab Subjects)

QUESTION PAPER PATTERN FOR THE CONTINUOUS INTERNAL ASSESSMENT (SKILL BASED AND NME COURSES) DURATION – 1 HOUR

- ❖ 50 MCQs will be asked for each internal assessment tests (50 x 1=50 Marks) and converted for 15 marks

THE COMPONENTS FOR CONTINUOUS INTERNAL ASSESSMENT ARE:

Two tests and their average	--15 marks
Seminar /Group discussion / Quiz Test	-- 5 marks
Assignment	-- 5 marks

Total	25 Marks

SUMMATIVE EXAMINATION PATTERN (SKILL BASED AND NME COURSES) DURATION – 3 HOURS

Pattern of the Question Paper for Skill Based and Non-Major Elective courses
(External)

75 Multiple choice questions will be asked from five units (75 x 1=75 Marks)
(15MCQ's from each unit)

PART-IV- ENVIRONMENTAL STUDIES AND VALUE EDUCATION
QUESTION PAPER PATTERN (INTERNAL ASSESSMENT)

Pattern of the Question Paper for Environmental Studies & Value Education
(Internal)

50 MCQs will be asked for each internal assessment tests (50 x 1=50 Marks) and
converted for 15 marks

Two tests and their average	--	15 marks
Project	--	10 marks

Total		25 Marks

* The students as Individual or Group must visit a local area to document environmental assets – river / forest / grassland / hill / mountain – visit a local polluted site – urban / rural / industrial / agricultural – study of common plants, insects, birds – study of simple ecosystem – pond, river, hill slopes, etc.

SUMMATIVE EXAMINATION PATTERN

Pattern of the Question Paper for Environmental Studies & Value Education only) (External)

75 Multiple choice questions will be asked from five units (75 x 1=75 Marks)
(15MCQ's from each unit)

PART V EXTENSION ACTIVITIES: (MAXIMUM MARKS: 100)

1. NCC
2. NSS
3. Physical Education
4. YRC
5. RRC
6. Health & Fitness Club
7. Eco Club
8. Human Rights Club

Internal Examinations - - 25 Marks

Summative Examinations - - 75 Marks

100

OUTCOME BASED EDUCATION:

OBE starts with the identification and articulation of clear and measurable learning outcomes for each course or program. These outcomes describe the skills, knowledge, and abilities that students are expected to acquire. The curriculum, instructional methods, and assessments are aligned with the defined learning outcomes. This ensures that everything taught and evaluated is directly related to what students are expected to learn.

The Learning Outcomes-Based Approach to curriculum planning and transaction in our institution ensures whether the teaching-learning processes are oriented towards enabling students to attain the defined learning outcomes relating to the courses within a programme. The outcome based approach, particularly in the context of undergraduate studies, requires a significant shift from teacher-centric to learner-centric pedagogies and from passive to active/participatory pedagogies.

Assessment Method: The students are assessed with 2 internal examination and the summative examination which includes problem based assignments; practical assignment laboratory reports; observation of practical skills; individual project reports ,case-study reports; team project reports; oral presentations, including seminar presentation; viva voce interviews; computerized adaptive testing; etc. and any other pedagogic approaches as per the context.



INSTITUTIONAL VISION

To Mould the learners into accomplished individuals by providing them with a stimulus for social change through character, confidence and competence.

INSTITUTIONAL MISSION

1. Enlightening the learners on the ethical and environmental issues.
2. Extending holistic training to shape the learners in to committed and competent citizens.
3. Equipping them with soft skills for facing the competitive world.
4. Enriching their employability through career oriented courses.
5. Ensuring accessibility and opportunity to make education affordable to the underprivileged.

Highlights of the Revamped Curriculum:

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content wherever required.
- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising mathematical models and algorithms for providing solutions to industry / real life situations. The curriculum also facilitates peer learning with advanced mathematical topics in the final semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and Mathematics based problem solving skills are included as mandatory components in the 'Training for Competitive Examinations' course at the final semester, a first of its kind.
- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.

- The Industrial Statistics course is newly introduced in the fourth semester, to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
- The Internship during the second year vacation will help the students gain valuable work experience that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in conducting a Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.
- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective courses, covering conventional topics to the latest - Artificial Intelligence.

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B.SC MICROBIOLOGY CURRICULUM

(For the student admitted during the academic year 2023-2024 onwards)

Course Code	Title of the Course	Hrs	Credits	Maximum Marks		
				Int	Ext	Total
FIRST SEMESTER						
Part – I	Tamil / Alternative Course					
23UTAGT11	தமிழ் இலக்கிய வரலாறு - I	6	3	25	75	100
Part – II	English					
23UENGE11	GENERAL ENGLISH - I	6	3	25	75	100
Part - III	Core Courses					
23UMBCC11	FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY	5	5	25	75	100
23UMBPC11	FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY - PRACTICAL	5	5	25	75	100
Part - III	Elective Course					
23UMBEC11	BASIC AND CLINICAL BIOCHEMISTRY	4	3	25	75	100
Part IV	Non Major Elective					
23UMBNC11	SOCIAL AND PREVENTIVE MEDICINE	2	2	25	75	100
Part IV	Foundation Course					
23UMBFC11	MICROBIAL TAXONOMY	2	2	25	75	100
Total		30	23	175	525	700
SECOND SEMESTER						
Part – I	Tamil / Alternative Course					
23UTAGT21	தமிழ் இலக்கிய வரலாறு – II	6	3	25	75	100
Part – II	English					
23UENGE21	GENERAL ENGLISH - II	6	3	25	75	100
Part - III	Core Courses					
23UMBCC21	MICROBIAL PHYSIOLOGY AND METABOLISM	5	5	25	75	100
23UMBPC21	MICROBIAL PHYSIOLOGY AND METABOLISM - PRACTICAL	5	5	25	75	100
Part - III	Elective Course					
23UMBEC21	BIOINSTRUMENTATION	4	3	25	75	100
Part IV	Non Major Elective					
23UMBNC21	NUTRITION AND HEALTH HYGINE	2	2	25	75	100
Part IV	Skill Enhancement course					
23UMBSC21	SERICULTURE	2	2	25	75	100
Total		30	23	175	525	700

FIRST SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)



DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY			
Course Code	23UMBCC11	L	P	C
Category	CORE	5	-	5
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ Learn the fundamental principles about different aspects of Microbiology including recent developments in the area➤ Describe the structural organization, morphology and reproduction of microbes.➤ Explain the methods of cultivation of microbes and measurement of growth➤ Understand the microscopy and other basic laboratory techniques – culturing, disinfection and sterilization in Microbiology.➤ Compare and contrast the different methods of sterilization.				
UNIT - I HISTORY OF MICROBIOLOGY				12
History and Evolution of Microbiology, Classification – Three kingdom, five kingdom, six kingdom and eight kingdom. Microbial biodiversity: Introduction to microbial biodiversity- ecological niche. Basic concepts of Eubacteria, Archaeobacteria and Eucarya. Conservation of Biodiversity.				
UNIT - II GENERAL CHARACTERISTICS OF MICROORGANISMS				12
General characteristics of cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) and acellular microorganisms - (Viruses, Viroids, Prions), Differences between prokaryotic and eukaryotic microorganisms. Structure of Bacterial cell wall, cell membrane, capsule, flagella, pili, mesosomes, chlorosomes, phycobilisomes, spores, and gas vesicles. Structure of fungi (Mold and Yeast), Structure of microalgae.				
UNIT - III PURE CULTURE TECHNIQUES				12
Bacterial culture media and pure culture techniques. Mode of cell division, Quantitative measurement of growth. Anaerobic culture technique.				
UNIT - IV MICROSCOPY				12
Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM & SEM, Confocal microscopy, and Atomic Force Microscopy. Stains and staining methods.				
UNIT - V STERILIZATION				12
Sterilization–moist heat - autoclaving, dry heat – Hot air oven, radiation – UV, Ionization, filtration – membrane filter and disinfection, antiseptic; Antimicrobial agents.				
Total Lecture Hours				60

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

- Jeffrey C. Pommerville., Alcamo’s Fundamentals of Microbiology (9th Edition). Jones & Bartlett learning 2010
- Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5th Edition. MacMillan Press Ltd
- Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11th Edition., Benjamin Cummings
- Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5th Edition., McGraw Hill Publications.
- Microorganisms, 13th Edition Benjamin-Cummings Publishing Co.

WEB RESOURCES:

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

Nature of Course	EMPLOYABILITY		✓	SKILL ORIENTED		ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change			No Changes Made			New Course	✓

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:	K LEVEL
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After studying this course, the students will be able to:

CO1	Learn the fundamental principles about different aspects of Microbiology including recent developments in the area.	K1 to K4
CO2	Gain Knowledge of detailed structure and functions of prokaryotic cell organelles.	K1 to K4
CO3	Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.	K1 to K4
CO4	Explain the principles and working mechanism of different microscopes/Microscope, their function and scope of application	K1 to K4
CO5	Understand the concept of asepsis and modes of sterilization and disinfectants.	K1 to K4

MAPPING WITH PROGRAM OUTCOMES:										
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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	M	M	S	M			
CO2	M	S	M	M	S	M	M			
CO3	M	M	S	M	S	M	M			
CO4	M	M	S	M	M	M	S			
CO5	M	S	M	M	M	M	M			

S- STRONG

M – MEDIUM

L - LOW

CO / PO MAPPING:					
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COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	2	2	1	2	2
CO 2	2	1	2	2	1
CO 3	2	2	1	2	1
CO 4	2	2	1	2	2
CO 5	2	1	2	2	2
WEITAGE	10	8	7	10	8
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS					

LESSON PLAN:			
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UNIT	COURSE NAME	HRS	PEDAGOGY
I	History and Evolution of Microbiology: Classification – Three kingdom, five kingdom, six kingdom and eight kingdom. Microbial biodiversity: Introduction to microbial biodiversity- ecological niche.	12	Chalk & Talk, PPT

	Basic concepts of Eubacteria, Archaeobacteria and Eucarya. Conservation of Biodiversity.		
II	General characteristics of Microorganisms: General characteristics of cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) Acellular microorganisms - (Viruses, Viroids, Prions) Differences between prokaryotic and eukaryotic microorganisms. Structure of Bacterial cell wall, cell membrane, capsule, flagella, pili, mesosomes, chlorosomes, phycobilisomes, spores, and gas vesicles. Structure of fungi (Mold and Yeast), Structure of microalgae.	12	Chalk & Talk, PPT
III	Pure Culture Techniques: Bacterial culture media and pure culture techniques. Mode of cell division. Quantitative measurement of growth. Anaerobic culture techniques.	12	Chalk & Talk, PPT
IV	Microscopy: Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope. TEM & SEM, Confocal microscopy, and Atomic Force Microscopy. Stains and staining methods.	12	Chalk & Talk, PPT
V	Sterilization: Sterilization–moist heat - autoclaving, dry heat – Hot air oven, radiation – UV, Ionization, filtration – membrane filter and disinfection, antiseptic; Antimicrobial agents.	12	Chalk & Talk, PPT, Assignment

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)						
Internal	Cos	K Level	Section A		Section B Either or Choice	Section C Either or Choice
			MCQs			
			No. of Questions	K - Level		
CI	CO1	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AI	CO2	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
CI	CO3	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AII	CO4	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	Section A (Multiple Choice Questions)	Section B (Either / Or Choice)	Section C (Either / Or Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2			2	3.6	25
	K2	2	10		12	21.4	
	K3		10	16	26	46.4	46.4
	K4			16	16	28.6	28.6
	Marks	4	20	32	56	100	100
CIA II	K1	2			2	3.6	7.2
	K2	2	10		12	3.6	
	K3		10	16	26	46.4	46.4
	K4			16	16	46.4	46.4
	Marks	4	20	32	56	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
2	CO2	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
3	CO3	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
4	CO4	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
5	CO5	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	Section A (Multiple Choice Questions)	Section B (Either or Choice)	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.6	4
K2	5	20		25	17.8	18
K3		30	32	62	44.3	44
K4			48	48	34.3	34
Marks	10	50	80	140	100	100

NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.

Summative Examinations - Question Paper – Format

Q. No.	Unit	CO	K-level		
Answer ALL the questions				PART – A	
				(10 x 1 = 10 Marks)	
1.	Unit - I	CO1	K1	a)	b)
				c)	d)
2.	Unit - I	CO1	K2	a)	b)
				c)	d)
3.	Unit - II	CO2	K1	a)	b)
				c)	d)
4.	Unit - II	CO2	K2	a)	b)
				c)	d)
5.	Unit - III	CO3	K1	a)	b)
				c)	d)
6.	Unit - III	CO3	K2	a)	b)
				c)	d)
7.	Unit - IV	CO4	K1	a)	b)
				c)	d)
8.	Unit - IV	CO4	K2	a)	b)
				c)	d)
9.	Unit - V	CO5	K1	a)	b)
				c)	d)
10.	Unit - V	CO5	K2	a)	b)
				c)	d)

Answer ALL the questions				PART – B	(5 x 5 = 25 Marks)
11. a)	Unit - I	CO1	K2		
OR					
11. b)	Unit - I	CO1	K2		
12. a)	Unit - II	CO2	K3		
OR					
12. b)	Unit - II	CO2	K3		
13. a)	Unit - III	CO3	K2		
OR					
13. b)	Unit - III	CO3	K2		
14. a)	Unit - IV	CO4	K3		
OR					
14. b)	Unit - IV	CO4	K3		
15. a)	Unit - V	CO5	K3		
OR					
15. b)	Unit - V	CO5	K3		

Answer ALL the questions				PART – C	(5 x 8 = 40 Marks)
16. a)	Unit - I	CO1	K3		
OR					
16. b)	Unit - I	CO1	K3		
17. a)	Unit - II	CO2	K4		
OR					
17. b)	Unit - II	CO2	K4		
18. a)	Unit - III	CO3	K3		
OR					
18. b)	Unit - III	CO3	K3		
19. a)	Unit - IV	CO4	K4		
OR					
19. b)	Unit - IV	CO4	K4		
20. a)	Unit - V	CO5	K4		
OR					
20. b)	Unit - V	CO5	K4		

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)



DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY- PRACTICAL			
Course Code	23UMBPCP11	L	P	C
Category	CORE PRACTICAL	-	5	5
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ Learn the fundamental principles about different aspects of Microbiology including recent developments in the area.➤ Describe the structural organization, morphology and reproduction of microbes.➤ Explain the methods of cultivation of microbes and measurement of growth.➤ Understand the microscopy and other basic laboratory techniques – culturing, disinfection and sterilization in Microbiology.➤ Compare and contrast the different methods of sterilization.				
<ol style="list-style-type: none">1. Cleaning of glass wares, Microbiological good laboratory practice and safety.2. Sterilization and assessment of sterility– Autoclave, hot air oven, and membrane filtration3. Media preparation: liquid media, solid media, semi-solid media, agar slants, agar deeps, agar plates Preparation of basal, differential, enriched, enrichment, transport, and selective media preparation- quality control of media, growth supporting properties, sterility check of media.4. Pure culture techniques: streak plate, pour plate, decimal dilution5. Culture characteristics of microorganisms: growth on different media, growth characteristics, and description6. Demonstration of pigment production7. Microscopy: light microscopy and bright field microscopy.8. Staining techniques: smear preparation, simple staining.9. Gram's staining and endospore staining.10. Study on Microbial Diversity using Hay Infusion Broth – Wet mount, hanging drop.				
Total Lecture Hours				60

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

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

WEB RESOURCES:

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

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		✓	ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL	REGIONAL		NATIONAL		GLOBAL		✓
Changes Made in the Course	Percentage of Change		No Changes Made		New Course		✓	
* Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.								

COURSE OUTCOMES:										K LEVEL
After studying this course, the students will be able to:										
CO1	Practice sterilization methods; learn to prepare media and their quality control.									K1 to K4
CO2	Learn streak plate, pour plate and serial dilution and pigment production of microbes.									K1 to K4
CO3	Understand Microscopy methods, different Staining techniques and motility test.									K1 to K4
CO4	Observe culture characteristics of microorganisms.									K1 to K4
CO5	Study on Microbial Diversity using Hay Infusion Broth-Wet mount									K1 to K4

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	L	L	S	L	M	S	L	M
CO2	M	L	L	M	M	M	M	S	L	L
CO3	M	M	L	M	L	M	M	S	M	M
CO4	M	L	L	M	M	M	S	S	S	L
CO5	M	L	L	M	M	M	M	S	M	L
S- STRONG			M – MEDIUM					L - LOW		

CO / PO MAPPING					
COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	2	3	2	2	3
CO 2	2	2	2	2	2
CO 3	2	2	3	2	1
CO 4	2	2	3	2	2
CO 5	2	1	2	2	2
WEITAGE	10	10	12	10	10
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS					

LESSON PLAN:			
UNIT	COURSE NAME	HRS	PEDAGOGY
I	Cleaning of glass wares, Microbiological good laboratory practice and safety. Sterilization and assessment of sterility– Autoclave, hot air oven, and membrane filtration.	12	Chalk & Talk, PPT, Demonstration
II	Media preparation: liquid media, solid media, semi-solid media, agar slants, agar deeps, agar plates.	12	Chalk & Talk PPT, Demonstration

III	Preparation of basal, differential, enriched, enrichment, transport, and selective media preparation- quality control of media. Growth supporting properties, sterility check of media. Pure culture techniques: streak plate, pour plate, decimal dilution.	12	Chalk & Talk PPT, Demonstration
IV	Culture characteristics of microorganisms: growth on different media, growth characteristics, and description. Demonstration of pigment production. Microscopy: light microscopy and bright field microscopy.	12	Chalk & Talk PPT, Demonstration
V	Staining techniques: smear preparation, simple staining, Gram's staining and endospore staining. Study on Microbial Diversity using Hay Infusion Broth-Wet mount to show different types of microbes, hanging drop.	12	Chalk & Talk PPT, Demonstration

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)							
INTERNAL	COs	K LEVEL	MAJOR	MINOR	SPOTTERS	RECORDED	VIVA
CIAI	CO1	K1					5
	CO2	K2				5	
	CO3	K3			5		
	CO4	K4		5			
	CO5	K4	5				
Question Pattern	No. of Questions to be asked		2 (A-Written B- Practical Demo)	2 (A-Written B-Practical Demo)	2	1	5
	No. of Questions to be answered		2	2	4	1	5
	Marks for each question		A-3 B-2	A-3 B-2	5	10	1
	Total Marks for each section		5	5	5	5	5

Distribution of Marks with K Level

	K Level	Major	Minor	Spotters	Record	Viva	Total Marks	% of Marks without choice	Consolidated %
CIA	K1	-	-	-	-	5	5	6.66	6.66
	K2	-	-	-	5	-	5	6.66	6.66
	K3	-	-	5	-	-	5	6.66	6.66
	K4	-	5	-	-	-	5	6.66	6.66
	K4	5					5	6.66	6.66

**Summative Examination – Blue Print
Articulation Mapping – K Levels with Course Outcomes (COs)**

EXTERNA L	COs	K LEVEL	MAJOR	MINOR	SPOTTERS	RECORD	VIVA
CI AI	CO1	K1					5
	CO2	K2				5	
	CO3	K3			20		
	CO4	K4		20			
	CO5	K4	25				
Question Pattern	No. of Questions to be asked		2 (A-Written B-Practical Demo)	2 (A-Written B-Practical Demo)	2	1	5
	No. of Questions to be answered		2	2	4	1	5
	Marks for each question		A-20 B-5	A-15 B-5	5	10	1
	Total Marks for each section		25	20	20	5	5

Distribution of Marks with K Level CIA

	K Level	Major	Minor	Spotters	Record	Viva	Total Marks	% of Marks without choice	Consolidated %
CIA	K1					5	5	6.6	6.6
	K2				5		5	6.6	6.6
	K3			20			20	26.6	26.6
	K4		20				20	26.6	26.6
	K4	25					25	33.3	33.3
	Marks	25	20	20	5	5	75	100	100

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)



DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	BASIC AND CLINICAL BIOCHEMISTRY			
Course Code	23UMBEC11	L	P	C
Category	ELECTIVE	4	-	3
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ Attain thorough knowledge on carbohydrates and lipids, their characteristic properties and organization in carrying out all the living functions which constitute the life.➤ Explain the biological activity of amino acids and proteins.➤ Identify the metabolic errors in enzymes of carbohydrates and lipids.➤ Describe the disorders in amino acid metabolism.➤ Interpret the consequences, biochemical, clinical features, diagnosis and treatment of metabolic diseases of day today life.				
UNIT-I Biomolecules -Carbohydrate:				12
Biomolecules -Carbohydrate – General properties, function, structure, classification– monosaccharides (Glucose, Fructose, Galactose), Oligoaccharides (Sucrose, Maltose, Lactose) and polysaccharides (Starch, Glycogen,) and biological significance. Lipids – General properties, functions, structure, classification (Simple, Derived and Complex), Cholesterol, LDL, HDL – biological significance.				
UNIT-II Biomolecules - Amino acids:				12
General properties, functions, structure, classification and biological significance. Proteins– General structure, Properties, functions, classification and biological significance.				
UNIT-III Disorders of Metabolism - Disorders of carbohydrate metabolism:				12
Diabetes mellitus, ketoacidosis, hypoglycemia, glycogen storage diseases, galactosemia and lactose intolerance. Disorders of lipid metabolism: hyperlipidemia, hyperlipoproteinemia, hypercholesterolemia, hypertriglyceridemia, sphingolipidosis.				
UNIT- IV Disorders of Metabolism: Disorders of amino acid metabolism:				12
Alkaptonuria, phenylketonuria, phenylalaninemia, homocystineuria, tyrosinemia, aminoaciduria.				
UNIT - V Evaluation of organ function tests:				12
Assessment and clinical manifestations of renal, hepatic, pancreatic, gastric and intestinal functions. Diagnostic enzymes: Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase.				
Total Lecture Hours				60

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

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

WEB RESOURCES:

- ❖ www.abebooks.com
- ❖ www.kau.in/document/laboratory-manual-biochemistry
- ❖ www.metacyc.org
- ❖ www.medicalnewstoday.com
- ❖ www.journals.indexcopernicus.com

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		✓	ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change		No Changes Made			New Course		✓
* Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.								

COURSE OUTCOMES:	K LEVEL
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After studying this course, the students will be able to:

CO1	Explain the structure, classification, biochemical functions and significance of carbohydrates and lipids	K1 to K4
CO2	Differentiate essential and non-essential amino acids, biologically important modified amino acids and their functions, Illustrate the role, classification of Proteins and recognize the structural level organization of proteins, its functions and denaturation.	K1 to K4
CO3	Assess defective enzymes and Inborn errors. Recognize diseases related to carbohydrate and lipid metabolism.	K1 to K4
CO4	Discuss and evaluate the pathology of aminoacid metabolic disorders.	K1 to K4
CO5	Appraise the imbalances of enzymes in organ function and relate the role of Clinical Biochemistry in screening and diagnosis.	K1 to K4

MAPPING WITH PROGRAM OUTCOMES:										
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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M									
CO2	M									
CO3				S	S	S				
CO4				S	S	S				
CO5					S	S			S	
S- STRONG			M – MEDIUM				L - LOW			

CO / PO MAPPING:						
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COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	1	3	3	3	3
CO 4	3	2	3	2	3
CO 5	2	2	1	2	1
WEITAGE	12	13	13	13	13
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	3	3	3	3	3

LESSON PLAN:			
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UNIT	COURSE NAME	HRS	PEDAGOGY
I	Biomolecules -Carbohydrate – General properties, function, structure, classification– monosaccharides (Glucose, Fructose, Galactose), Oligoaccharides (Sucrose, Maltose, Lactose) and polysaccharides (Starch, Glycogen,) and biological significance. Lipids – General properties, functions, structure, classification (Simple, Derived and	12	Chalk & Talk

	Complex), Cholesterol, LDL, HDL – biological significance.		
II	General properties, functions, structure, classification and biological significance. Proteins– General structure, Properties, functions, classification and biological significance.	12	Chalk & Talk
III	Diabetes mellitus, ketoacidosis, hypoglycemia, glycogen storage diseases, galactosemia and lactose intolerance. Disorders of lipid metabolism: hyperlipidemia, hyperlipoproteinemia, hypercholesterolemia, hypertriglyceridemia, Sphingolipidosis.	12	Chalk & Talk
IV	Alkaptonuria, phenylketonuria, phenylalaninemia, homocystineuria, tyrosinemia, aminoacidurias.	12	Chalk & Talk
V	Assessment and clinical manifestations of renal, hepatic, pancreatic, gastric and intestinal functions. Diagnostic enzymes: Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase.	12	Chalk & Talk

Learning Outcome Based Education & Assessment (LOBE)						
Formative Examination - Blue Print						
Articulation Mapping – K Levels with Course Outcomes (COs)						
Internal	Cos	K Level	Section A		Section B Either or Choice	Section C Either or Choice
			MCQs			
			No. of Questions	K - Level		
CI	CO	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AI	CO	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
CI	CO	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AII	CO	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	Section A (Multiple Choice Questions)	Section B (Either / Or Choice)	Section C (Either / Or Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2			2	3.6	25
	K2	2	10		12	21.4	
	K3		10	16	26	46.4	46.4
	K4			16	16	28.6	28.6
	Marks	4	20	32	56	100	100
CIA II	K1	2			2	3.6	7.2
	K2	2	10		12	3.6	
	K3		10	16	26	46.4	46.4
	K4			16	16	46.4	46.4
	Marks	4	20	32	56	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
2	CO2	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
3	CO3	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
4	CO4	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
5	CO5	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	Section A (Multiple Choice Questions)	Section B (Either or Choice)	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.6	4
K2	5	20		25	17.8	18
K3		30	32	62	44.3	44
K4			48	48	34.3	34
Marks	10	50	80	140	100	100

NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.

Summative Examinations - Question Paper – Format

Q. No.	Unit	CO	K-level		
Answer ALL the questions PART – A (10 x 1 = 10 Marks)					
1.	Unit - I	CO1	K1	a)	b)
				c)	d)
2.	Unit - I	CO1	K2	a)	b)
				c)	d)
3.	Unit - II	CO2	K1	a)	b)
				c)	d)
4.	Unit - II	CO2	K2	a)	b)
				c)	d)
5.	Unit - III	CO3	K1	a)	b)
				c)	d)
6.	Unit - III	CO3	K2	a)	b)
				c)	d)
7.	Unit - IV	CO4	K1	a)	b)
				c)	d)
8.	Unit - IV	CO4	K2	a)	b)
				c)	d)
9.	Unit - V	CO5	K1	a)	b)
				c)	d)
10.	Unit - V	CO5	K2	a)	b)
				c)	d)

Answer ALL the questions				PART – B	(5 x 5 = 25 Marks)
11. a)	Unit - I	CO1	K2		
OR					
11. b)	Unit - I	CO1	K2		
12. a)	Unit - II	CO2	K3		
OR					
12. b)	Unit - II	CO2	K3		
13. a)	Unit - III	CO3	K2		
OR					
13. b)	Unit - III	CO3	K2		
14. a)	Unit - IV	CO4	K3		
OR					
14. b)	Unit - IV	CO4	K3		
15. a)	Unit - V	CO5	K3		
OR					
15. b)	Unit - V	CO5	K3		

Answer ALL the questions				PART – C	(5 x 8 = 40 Marks)
16. a)	Unit - I	CO1	K3		
OR					
16. b)	Unit - I	CO1	K3		
17. a)	Unit - II	CO2	K4		
OR					
17. b)	Unit - II	CO2	K4		
18. a)	Unit - III	CO3	K3		
OR					
18. b)	Unit - III	CO3	K3		
19. a)	Unit - IV	CO4	K4		
OR					
19. b)	Unit - IV	CO4	K4		
20. a)	Unit - V	CO5	K4		
OR					
20. b)	Unit - V	CO5	K4		



MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)

DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	SOCIAL AND PREVENTIVE MEDICINE			
Course Code	23UMBNM11	L	P	C
Category	SKILL ENHANCEMENT COURSE	2	-	2
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ To describe the concepts of health and disease and their social determinants.➤ To summarize the health management system➤ To know about the various health care services.➤ To outline the goals of preventive medicine.➤ To gain knowledge about alternate medicine.				
UNIT - I INTRODUCTION TO SOCIAL MEDICINE				6
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				6
Applications of behavioral sciences and psychology in health management- nutritional programs for health management-water and sanitation in human health-national programs for communicable and non-communicable diseases- environmental and occupational hazards and their control.				
UNIT -III HEALTH CARE AND SERVICES				6
Health care of the community-information, education, communication and training in health-maternal & child health-school health services- Geriatrics-care and welfare of the aged-mental health-health services through general practitioners.				
UNIT -IV PREVENTIVE MEDICINE				6
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				6
Unani, Ayurveda, Homeopathy, Naturopathy systems in epidemic and pandemic outbreaks. International health regulations. Infectious disease outbreak case studies and precautionary response during SARS and MERS coronavirus, Ebola and novel SARS-COV2 outbreaks.				
Total Lecture Hours				30

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

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

WEB RESOURCES:

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

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		✓	ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change		No Changes Made			New Course		✓

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:	K LEVEL
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After studying this course, the students will be able to:

CO1	Identify the health information system	K1 to K2
CO2	Associate various factors with health management system	K1 to K2
CO3	Choose the appropriate health care services	K1 to K2
CO4	Appraise the role of preventive medicine in community setting	K1 to K2
CO5	Recommend the usage of alternate medicine during outbreaks	K1 to K2

MAPPING WITH PROGRAM OUTCOMES:										
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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S				S	S				
CO2	S	S		M	S	S				
CO3				M	S	S			M	
CO4	S			S	S	M				
CO5	S				S	S				

S- STRONG

M – MEDIUM

L - LOW

CO / PO MAPPING:						
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COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	2	2	1	2	2
CO 2	2	1	1	2	1
CO 3	2	2	1	2	1
CO 4	2	2	1	2	2
CO 5	2	1	2	2	2
WEITAGE	10	8	6	10	8
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS					

LESSON PLAN:			
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UNIT	COURSE NAME	HRS	PEDAGOGY
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.	6	PPT/CHALK AND TALK
II	HEALTH MANAGEMENT: Applications of behavioral sciences and psychology in health management-nutritional programs for health management-water and sanitation in human health-national programs for communicable and non-communicable diseases-	6	PPT/CHALK AND TALK

	environmental and occupational hazards and their control.		
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-health services through general practitioners.	6	PPT/CHALK AND TALK
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.	6	PPT/CHALK AND TALK
V	PREVENTION THROUGH ALTERNATE MEDICINE: Unani, Ayurveda, Homeopathy, Naturopathy systems in epidemic and pandemic outbreaks. International health regulations. Infectious disease outbreak case studies and precautionary response during SARS and MERS coronavirus, Ebola and novel SARS-COV2 outbreaks.	6	PPT/CHALK AND TALK

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)				
Internal	Cos	K Level	Section A	
			MCQs	
			No. of. Questions	K - Level
CI	CO1	K1 – K2	25	K1,K2
AI	CO2	K1 – K2	25	K1,K2
CI	CO3	K1 – K2	25	K1,K2
AII	CO4	K1 – K2	25	K1,K2
Question Pattern CIA I & II		No. of Questions to be asked	50	
		No. of Questions to be answered	50	
		Marks for each question	1	
		Total Marks for each section	50	

* Two Formative examinations will be conducted as a part of Continuous Internal Assessment under which, 50 MCQ's will be asked [50X1=50 marks] from any 4 CO's. (Ist Test-2 CO's & IInd Test-2 CO's) in equal weightage

Distribution of Marks with K Level CIA I & CIA II					
	K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100
CIA II	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)				
S. No	COs	K - Level	Section A (MCQs)	
			No. of Questions	K – Level
1	CO1	K1-K2	15	K1,K2
2	CO2	K1-K2	15	K1,K2
3	CO3	K1-K2	15	K1,K2
4	CO4	K1-K2	15	K1,K2
5	CO5	K1-K2	15	K1,K2
No. of Questions to be Asked			75	
No. of Questions to be answered			75	
Marks for each question			1	
Total Marks for each section			75	
(Figures in parenthesis denotes, questions should be asked with the given K level)				

In summative examinations, 75 MCQ's will be asked [75X1=75 marks] from all 5 CO's in equal weightage.

Distribution of Marks with K Level				
K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidated %
K1	40	40	53	100
K2	35	35	47	
K3				
K4				
Marks		75	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.				



MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)

DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	MICROBIAL TAXONOMY			
Course Code	23UMBFC11	L	P	C
Category	FOUNDATION COURSE	2	-	2
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ To identify and discover the general methods in the classification of microorganisms.➤ To demonstrate the techniques involved in the classification of bacteria.➤ To illustrate the different factors that can be used for viral classification.➤ To analyze and distinguish the factors used in algal classification.➤ To design the taxonomy of Lichens.				
UNIT -I	BASICS OF TAXONOMY			06
Taxonomy-Definition, systematics, Identification, Classification and Nomenclature. Taxonomical hierarchy- Family, Genera, Species and Type strain. Basics of classification-physiological, Morphological and biochemical tests, Genetic basics of classification-definitions with brief descriptions only.				
UNIT -II	BACTERIAL CLASSIFICATION			06
General characteristics of bacteria, archaea and actinomycetes. Classification of bacteria based on - Nutrition, O ₂ requirement and Chemotaxonomy of bacterial cell wall (Gram positive and Gram negative), Bergey's manual - definition and difference between Systematic and Determinative bacteriology only – Bergey's Manual of Systematics of Archaea and Bacteria – Introduction only.				
UNIT -III	VIRAL CLASSIFICATION			06
General structure of a virus – T4, Classification of viruses based on life cycle -Lytic and lysogenic phages, capsid symmetry – Helical, Icosahedral and complex. Nucleic acids-DNA viruses and RNA viruses - (+) sense and (-) sense; segmented and non-segmented, ICTV - (Brief description only).				
UNIT -IV	ALGAL CLASSIFICATION			06
General characteristics of algae - Short notes on Classification of algae by Fritsch and Smith. Classification of algae based on habitats-Fresh water, marine water, aquatic and unusual habitat, Economic importance of algae.				
UNIT -V	LICHENS CLASSIFICATION			06
General characteristics of Lichens, classification based on fungal partners-Ascolichens, Basidiolichens & Hymenolichens. Classification based on growth (definition only), Economic importance of Lichens.				
Total Lecture Hours				30

BOOKS FOR STUDY:

- Michael T. Madigan, John M. Martinko, David A. Stahl and David P. Clark, 2012, Brock Biology of Microorganisms, Library of Congress Cataloging-In-publication data, NY.
- Trivedi P. C., Sonali Pandey and Seema Bhadauria, 2010, Textbook of Microbiology, Aavishkar Publishers, India.
- Joane M. Willey, Linda M. Sherwood and Christopher J. Woolverton, 2017, Prescott's Microbiology, 10th Ed., Library of Congress Cataloging-in-Publication Data, NY.
- Pommerville C., Jeffrey, 2011, Alcamo's Fundamentals of Microbiology, 9th Ed., Jones and Bartlett, Publishers, Massachusetts.
- Kathleen Park Talaro and Barry Chess, 2012, Foundations in Microbiology, 8th Ed., Library of Congress Cataloging-in-Publication Data, NY.

BOOKS FOR REFERENCES:

- Cindy H. Nakatsu, Robert V. Miller and Suresh D. Pillai, 2016, Ed., Manual of Environmental Microbiology, 4th Ed., Library of Congress Cataloging-In-publication data, NY.
- Tortora J. Gerard, Funke R. Berdell and Case L. Christine, 2016, Microbiology – An Introduction, 12th Ed., Library of Congress Cataloging-in-Publication Data, NY.
- Black G. Jacqueline and Black J. Laura, 2015, Microbiology – Principles and Explorations, 9th Ed., Library of Congress Cataloging-In-publication data, NY.
- Pelczar J. Michael, Chan E. C. S and Krieg R. Noel, 2008, Microbiology, 5th Ed., Tata McGraw-Hill Publishing Company Ltd., New Delhi.
- Marjorie Kelly Cowan and Heidi Smith, 2018, Microbiology – A Systems Approach, 5th Ed., Library of Congress Cataloging-in-Publication Data, NY.

WEB RESOURCES:

- ❖ <https://britishlichensociety.org.uk/learning/what-is-a-lichen>
- ❖ <https://www.bartleby.com/subject/science/biology/concepts/microbial-taxonomy>
- ❖ <https://www.biologydiscussion.com/microbial-taxonomy/notes-on-microbial-taxonomy-major-characteristics-and-principles/86773>
- ❖ http://web.biosci.utexas.edu/psaxena/bio226r/pdf/ch_19sp06.pdf
- ❖ https://cshperspectives.cshlp.org/site/misc/microbial_evolution.xhtml

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		✓	ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change		No Changes Made			New Course		✓
* Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.								

COURSE OUTCOMES:	K LEVEL
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After studying this course, the students will be able to:

CO1	Study the fundamentals for grouping of Microorganisms.	K1 to K2
CO2	Gain Knowledge of the divisions or groups in which microorganisms may be placed based on specific criteria.	K1 to K2
CO3	Understand the various methods of classifying microorganisms.	K1 to K2
CO4	Explain the principles for the taxonomic positioning of microorganisms.	K1 to K2
CO5	Understand the characteristic types and features of taxonomical groups of microorganisms.	K1 to K2

MAPPING WITH PROGRAM OUTCOMES:										
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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	M				
CO2	S	M	S	S	S	M				
CO3	S	L	S	S	L	S				
CO4	S	S	S	S	S	M				
CO5	S	S	S	S	S	M				

S- STRONG

M – MEDIUM

L - LOW

CO / PO MAPPING:						
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COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	2	3	3	3	2
CO 2	3	3	3	3	2
CO 3	3	3	3	3	2
CO 4	3	3	3	3	2
CO 5	2	3	3	3	2
WEITAGE	14	15	14	15	10
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS					

LESSON PLAN:			
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UNIT	COURSE NAME	HRS	PEDAGOGY
I	BASICS OF TAXONOMY Taxonomy-Definition, systematics, Identification, Classification and Nomenclature. Taxonomical hierarchy- Family, Genera, Species and Type strain. Basics of classification-physiological, Morphological and biochemical tests, Genetic basics of classification-definitions with brief descriptions only.	06	Chalk & Talk

II	BACTERIAL CLASSIFICATION General characteristics of bacteria, archaea and actinomycetes. Classification of bacteria based on - Nutrition, O ₂ requirement and Chemotaxonomy of bacterial cell wall (Gram positive and Gram negative), Bergey's manual - definition and difference between Systematic and Determinative bacteriology only – Bergey's Manual of Systematics of Archaea and Bacteria – Introduction only.	06	Chalk & Talk
III	VIRAL CLASSIFICATION General structure of a virus – T ₄ , Classification of viruses based on life cycle -Lytic and lysogenic phages, capsid symmetry – Helical, Icosahedral and complex. Nucleic acids-DNA viruses and RNA viruses - (+) sense and (-) sense; segmented and non-segmented, ICTV - (Brief description only).	06	Chalk & Talk
IV	ALGAL CLASSIFICATION General characteristics of algae - Short notes on Classification of algae by Fritsch and Smith. Classification of algae based on habitats-Fresh water, marine water, aquatic and unusual habitat, Economic importance of algae.	06	Chalk & Talk
V	LICHENS CLASSIFICATION General characteristics of Lichens, classification based on fungal partners-Ascolichens, Basidiolichens & Hymenolichens. Classification based on growth (definition only), Economic importance of Lichens.	06	Chalk & Talk

Learning Outcome Based Education & Assessment (LOBE)				
Formative Examination - Blue Print				
Articulation Mapping – K Levels with Course Outcomes (COs)				
Internal	Cos	K Level	Section A	
			MCQs	
			No. of. Questions	K - Level
CI	CO1	K1 – K2	25	K1,K2
AI	CO2	K1 – K2	25	K1,K2
CI	CO3	K1 – K2	25	K1,K2
AII	CO4	K1 – K2	25	K1,K2
Question Pattern CIA I & II		No. of Questions to be asked	50	
		No. of Questions to be answered	50	
		Marks for each question	1	
		Total Marks for each section	50	

* Two Formative examinations will be conducted as a part of Continuous Internal Assessment under which, 50 MCQ's will be asked [50X1=50 marks] from any 4 CO's. (Ist Test-2 CO's & IInd Test-2 CO's) in equal weightage

Distribution of Marks with K Level CIA I & CIA II					
	K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100
CIA II	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)				
S. No	COs	K - Level	Section A (MCQs)	
			No. of Questions	K – Level
1	CO1	K1-K2	15	K1,K2
2	CO2	K1-K2	15	K1,K2
3	CO3	K1-K2	15	K1,K2
4	CO4	K1-K2	15	K1,K2
5	CO5	K1-K2	15	K1,K2
No. of Questions to be Asked			75	
No. of Questions to be answered			75	
Marks for each question			1	
Total Marks for each section			75	
(Figures in parenthesis denotes, questions should be asked with the given K level)				

In summative examinations, 75 MCQ's will be asked [75X1=75 marks] from all 5 CO's in equal weightage.

Distribution of Marks with K Level				
K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidated %
K1	40	40	53	100
K2	35	35	47	
K3				
K4				
Marks		75	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.				

SECOND SEMESTER



MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)

DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	MICROBIAL PHYSIOLOGY AND METABOLISM			
Course Code	23UMBCC21	L	P	C
Category	CORE	5	-	5
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ Study the basic principles of microbial growth.➤ Understand the basic concepts of aerobic and anaerobic metabolic pathways.➤ Analyze the role of individual components in overall cell function.➤ Provide information on sources of energy and its utilization by microorganisms.➤ Study the different types of metabolic strategies.				
UNIT-I	PHYSIOLOGY OF MICROBIAL GROWTH	12		
Batch – continuous - synchronous cultures; Growth Curve and measurement method (turbidity, biomass, and cell count). Control of microbial growth.				
UNIT-II	NUTRITION REQUIREMENTS	12		
Photoautotrophs, Photoorganotrophs, Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria), Chemoorganotrophs. Nutrition transport mechanisms – Passive diffusion and Active transport. Factors affecting microbial growth.				
UNIT- III	AN OVERVIEW OF METABOLISM	12		
Embden Meyerhof Pathway, Entner-Doudoroff Pathway, Pentose Phosphate Pathway, Tricarboxylic Acid Cycle. Electron Transport Chain and Oxidative Phosphorylation. ATP synthesis. Fermentation- Homolactic Fermentation, Heterolactic Fermentation, Mixed Acid Fermentation, Butanediol Fermentation.				
UNIT - IV	PHOTOSYNTHESIS	12		
An Overview of chloroplast structure. Photosynthetic Pigments, Light Reaction-Cyclic and non-cyclic Photophosphorylation. Dark Reaction - Calvin Cycle.				
UNIT-V	MICROBIAL DIVISION	12		
Binary fission, Budding, Reproduction through conidia, cyst formation, endospore formation. Fungi asexual and sexual reproduction, Microalgae reproduction. Asexual and sexual reproduction of protozoa.				
Total Lecture Hours				60

BOOKS FOR STUDY:

- Schlegel, H.G. (1993). General Microbiology.,7th Edition, Press syndicate of the University of Cambridge.
- Rajapandian K. (2010). Microbial Physiology, Chennai: PBS Book Enterprises India.
- MeenaKumari. S. Microbial Physiology, Chennai 1st Edition MJP Publishers 2006.
- Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.
- Ram Reddy, S AND Reddy S.M., (2008). Microbial Physiology. Anmol Publications Pvt Ltd.

BOOKS FOR REFERENCES:

- Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
- Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
- Daniel R. Caldwell. (1995). Microbial Physiology & Metabolism Wm.C. Brown Communications, Inc. USA.
- Moat, A.G and J.W Foaster (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.
- BhanuShrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.

WEB RESOURCES:

- ❖ <https://sites.google.com/site/microbialphysiologyoddsem/teaching-contents>
- ❖ <https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition>
- ❖ https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
- ❖ http://web.iitd.ac.in/~amittal/2007_Addy_Enzymes_Chapter.pdf
- ❖ <https://www.frontiersin.org/microbial-physiology-and-metabolism>

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		✓	ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change		No Changes Made			New Course		✓

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:										K LEVEL
After studying this course, the students will be able to:										
CO1	Describe microorganisms based on nutrition.									K1 to K4
CO2	Know the concept of microbial growth and identify the factors affecting bacterial growth.									K1 to K4
CO3	Explain the methods of nutrient uptake.									K1 to K4
CO4	Describe anaerobic and aerobic energy production.									K1 to K4
CO5	Elaborate on the process of bacterial photosynthesis and reproduction.									K1 to K4

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1						M			M	
CO2						M	L		M	
CO3						M			M	
CO4						M			M	
CO5						M			M	
S- STRONG			M – MEDIUM				L - LOW			

CO / PO MAPPING:					
COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	2	2	1	1	3
CO 2	2	1	1	2	2
CO 3	2	2	1	2	1
CO 4	2	1	1	2	2
CO 5	2	1	1	2	2
WEITAGE	10	7	5	9	10
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	2	2	1	1	3

LESSON PLAN:			
UNIT	COURSE NAME	HRS	PEDAGOGY
I	Batch – continuous - synchronous cultures; Growth Curve and measurement method (turbidity, biomass, and cell count). Control of microbial growth.	12	Chalk & Talk, PPT
II	Photoautotrophs, Photoorganotrophs, Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria), Chemoorganotrophs. Nutrition transport mechanisms – Passive diffusion and Active transport. Factors affecting microbial growth.	12	Chalk & Talk, PPT

III	Embden Meyerhof Pathway, Entner-Doudoroff Pathway, Pentose Phosphate Pathway, Tricarboxylic Acid Cycle. Electron Transport Chain and Oxidative Phosphorylation. ATP synthesis. Fermentation- Homolactic Fermentation, Heterolactic Fermentation, Mixed Acid Fermentation, Butanediol Fermentation.	12	Chalk & Talk, PPT
IV	An Overview of chloroplast structure. Photosynthetic Pigments, Light Reaction-Cyclic and non-cyclic Photophosphorylation. Dark Reaction - Calvin Cycle.	12	Chalk & Talk, PPT
V	Binary fission, Budding, Reproduction through conidia, cyst formation, endospore formation. Fungi asexual and sexual reproduction, Microalgae reproduction. Asexual and sexual reproduction of protozoa.	12	Chalk & Talk, Ppt, Assignment

Learning Outcome Based Education & Assessment (LOBE)						
Formative Examination - Blue Print						
Articulation Mapping – K Levels with Course Outcomes (COs)						
Internal	Cos	K Level	Section A		Section B Either or Choice	Section C Either or Choice
			MCQs			
			No. of Questions	K - Level		
CI	CO	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AI	CO	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
CI	CO	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AII	CO	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	Section A (Multiple Choice Questions)	Section B (Either / Or Choice)	Section C (Either / Or Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2			2	3.6	25
	K2	2	10		12	21.4	
	K3		10	16	26	46.4	46.4
	K4			16	16	28.6	28.6
	Marks	4	20	32	56	100	100
CIA II	K1	2			2	3.6	7.2
	K2	2	10		12	3.6	
	K3		10	16	26	46.4	46.4
	K4			16	16	46.4	46.4
	Marks	4	20	32	56	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
2	CO2	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
3	CO3	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
4	CO4	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
5	CO5	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	Section A (Multiple Choice Questions)	Section B (Either or Choice)	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.6	4
K2	5	20		25	17.8	18
K3		30	32	62	44.3	44
K4			48	48	34.3	34
Marks	10	50	80	140	100	100

NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.

Summative Examinations - Question Paper – Format

Q. No.	Unit	CO	K-level		
Answer ALL the questions				PART – A	
				(10 x 1 = 10 Marks)	
1.	Unit - I	CO1	K1	a)	b)
				c)	d)
2.	Unit - I	CO1	K2	a)	b)
				c)	d)
3.	Unit - II	CO2	K1	a)	b)
				c)	d)
4.	Unit - II	CO2	K2	a)	b)
				c)	d)
5.	Unit - III	CO3	K1	a)	b)
				c)	d)
6.	Unit - III	CO3	K2	a)	b)
				c)	d)
7.	Unit - IV	CO4	K1	a)	b)
				c)	d)
8.	Unit - IV	CO4	K2	a)	b)
				c)	d)
9.	Unit - V	CO5	K1	a)	b)
				c)	d)
10.	Unit - V	CO5	K2	a)	b)
				c)	d)

Answer ALL the questions				PART – B	(5 x 5 = 25 Marks)
11. a)	Unit - I	CO1	K2		
OR					
11. b)	Unit - I	CO1	K2		
12. a)	Unit - II	CO2	K3		
OR					
12. b)	Unit - II	CO2	K3		
13. a)	Unit - III	CO3	K2		
OR					
13. b)	Unit - III	CO3	K2		
14. a)	Unit - IV	CO4	K3		
OR					
14. b)	Unit - IV	CO4	K3		
15. a)	Unit - V	CO5	K3		
OR					
15. b)	Unit - V	CO5	K3		

Answer ALL the questions				PART – C	(5 x 8 = 40 Marks)
16. a)	Unit - I	CO1	K3		
OR					
16. b)	Unit - I	CO1	K3		
17. a)	Unit - II	CO2	K4		
OR					
17. b)	Unit - II	CO2	K4		
18. a)	Unit - III	CO3	K3		
OR					
18. b)	Unit - III	CO3	K3		
19. a)	Unit - IV	CO4	K4		
OR					
19. b)	Unit - IV	CO4	K4		
20. a)	Unit - V	CO5	K4		
OR					
20. b)	Unit - V	CO5	K4		



MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)

DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	MICROBIAL PHYSIOLOGY AND METABOLISM - PRACTICAL			
Course Code	23UMBPCP21	L	P	C
Category	CORE PRACTICAL - II	-	5	5
COURSE OBJECTIVES				
<ul style="list-style-type: none">➤ To understand the principles of motility test.➤ To understand the basic concepts of staining methods.➤ To learn anaerobic culture and bacterial count using different methods.➤ To study the morphological demonstration of microorganisms and identification.➤ To study the biochemical identification of the bacteria.				
UNIT - I MOTILITY AND STAINING TECHNIQUES:				12
Hanging drop, Wet mount preparation, semi-solid agar, Craigie's tube method. Staining techniques: Gram's staining, spore and capsule staining.				
UNIT -II DIRECT COUNTS:				12
Direct cell count (Petroff-Hausser counting chamber), Turbidometry. Viable count - pour plate, spread plate. Bacterial growth curve.				
UNIT-III ANAEROBIC CULTURE METHODS:				12
Antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains.				
UNIT-IV SENSITIVITY TESTING AND FUNGAL IDENTIFICATION:				12
Antibiotic sensitivity testing, Demonstration of Stoke's method, Identification of different fungi by Lactophenol Cotton Blue and KOH mounting.				
UNIT- V SPOTTERS IDENTIFICATION:				12
Nostoc, Anabaena, Oscillatoria & Cyanobacteria, Entamoeba and Plasmodium.				
Total Lecture Hours				60

BOOKS FOR STUDY:

- James G Cappucino and N. Sherman MB (1996). A lab manual Benjamin Cummins, New York.
- Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
- Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
- Gunasekaran. P (2007). Laboratory manual in Microbiology. New age international publisher.
- Elsa Cooper (2018). Microbial Physiology: A Practical Approach. Callisto Reference publisher.

BOOKS FOR REFERENCES:

- David White., James Drummond., Clay Fuqua (2012) Physiology and Biochemistry of Prokaryotes. 4th Ed. Oxford University Press, New York.
- Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
- Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
- Dawes, I.W and Sutherland L.W (1992). Microbial Physiology (2nd edition), Oxford Blackwell Scientific Publications.
- 5. Moat, A.G and J.W Foaster, (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.

WEB RESOURCES:

- ❖ <https://sites.google.com/site/microbial-physiology-odd-sem/teaching-contents>
- ❖ <https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-nutrition>
- ❖ https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
- ❖ <https://www.studocu.com/microbial-physiology-practicals>
- ❖ <https://www.agr.hokudai.ac.jp/microbial-physiology>

Nature of Course	EMPLOYABILITY		✓	SKILL ORIENTED		ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change			No Changes Made		New Course		✓

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Describe hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method.	K1 to K4
CO2	Demonstrate Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining.	K1 to K4
CO3	Explain antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains.	K1 to K4
CO4	Describe demonstration of the size of yeast, fungal filaments and protozoa.	K1 to K4
CO5	Elaborate on the bacterial identification- morphological, physiological, and biochemical methods.	K1 to K4

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1						M	L	M	L	M
CO2						M	M	L	M	M
CO3						L	M	M	L	L
CO4						L	M	M	M	L
CO5						M	M	M	M	M
S- STRONG			M – MEDIUM				L - LOW			

CO / PO MAPPING:					
COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	1	3	3	1	3
CO 2	1	3	3	1	3
CO 3	1	3	3	2	3
CO 4	1	3	3	3	2
CO 5	1	3	3	1	3
WEITAGE	5	15	15	8	14
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	33	100	100	53	93

LESSON PLAN:			
UNIT	COURSE NAME	HRS	PEDAGOGY
I	Hanging drop, Wet mount preparation, semi-solid agar, Craigie's tube method. Staining techniques: Gram's staining, spore and capsule staining.	12	PPT/CHALK AND TALK DEMONSTRATION
II	Direct cell count (Petroff-Hausser counting chamber), Turbidometry.	12	PPT/CHALK

	Viabile count - pour plate, spread plate. Bacterial growth curve.		AND TALK DEMONSTRATION
III	Antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains.	12	PPT/CHALK AND TALK DEMONSTRATION
IV	Antibiotic sensitivity testing, Demonstration of Stoke's method, Identification of different fungi by Lactophenol Cotton Blue and KOH mounting.	12	PPT/CHALK AND TALK DEMONSTRATION
V	Nostoc, Anabaena, Oscillatoria & Cyanobacteria, Entamoeba and Plasmodium.	12	PPT/CHALK AND TALK DEMONSTRATION

Learning Outcome Based Education & Assessment (LOBE)							
Formative Examination - Blue Print							
Articulation Mapping – K Levels with Course Outcomes (COs)							
INTERNAL	COs	K LEVEL	MAJOR	MINOR	SPOTTERS	RECORD	VIVA
CIAI	CO1	K1					5
	CO2	K2				5	
	CO3	K3			5		
	CO4	K4		5			
	CO5	K4	5				
Question Pattern	No. of Questions to be asked		2 (A-Written B-Practical Demo)	2 (A-Written B-Practical Demo)	2	1	5
	No. of Questions to be answered		2	2	2	1	5
	Marks for each question		A-3 B-2	A-3 B-2	5	10	1
	Total Marks for each section		5	5	5	5	5

Distribution of Marks with K Level									
	K Level	Major	Minor	Spotters	Record	Viva	Total Marks	% of Marks without choice	Consolidated %
CIA	K1	-	-	-	-	5	5	6.66	6.66
	K2	-	-	-	5	-	5	6.66	6.66
	K3	-	-	5	-	-	5	6.66	6.66
	K4	-	5	-	-	-	5	6.66	6.66
	K4	5					5	6.66	6.66

Summative Examination – Blue Print							
Articulation Mapping – K Levels with Course Outcomes (COs)							
EXTERNAL	COs	K LEVEL	MAJOR	MINOR	SPOTTERS	RECORD	VIVA
CIAI	CO1	K1					5
	CO2	K2				5	
	CO3	K3			20		
	CO4	K4		20			
	CO5	K4	25				
Question Pattern		No. of Questions to be asked	2 (A-Written B-Practical Demo)	2 (A-Written B-Practical Demo)	2	1	5
		No. of Questions to be answered	2	2	2	1	5
		Marks for each question	A-20 B-5	A-15 B-5	5	10	1
		Total Marks for each section	25	20	20	5	5

Distribution of Marks with K Level CIA

	K Level	Major	Minor	Spotters	Record	Viva	Total Marks	% of Marks without choice	Consolidated %
CIA	K1					5	5	6.6	6.6
	K2				5		5	6.6	6.6
	K3			20			20	26.6	26.6
	K4		20				20	26.6	26.6
	K4	25					25	33.3	33.3
	Marks	25	20	20	20	5	5	75	100

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)



DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	BIOINSTRUMENTATION			
Course Code	23UMBEC21	L	P	C
Category	ELECTIVE	4	-	3
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ To gain knowledge about principles of spectroscopy➤ Understand the analytical techniques of Chromatography and electrophoresis➤ Understand the analytical instruments and study the basic principles in the field of sciences➤ To understand the principle of different types of scans used in medical diagnosis➤ To gain information about the principles of radioactivity and its measurements				
UNIT-I BASIC INSTRUMENT				12
pH meter, Buffer of biological importance, Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator. Biochemical calculations-preparations of Molar solutions - Buffers- Phosphate, Acetate, TE, TAE- calculation of Normality ,PPM- Ammonium sulphate precipitation.				
UNIT-II SPECTROSCOPIC TECHNIQUES				12
Colorimeter, Ultraviolet and visible, Infra red and Mass Spectroscopy.				
UNIT-III CHROMATOGRAPHIC AND ELECTROPHORESIS TECHNIQUES				12
Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC. Electrophoresis Techniques: Starch Gel, AGE, PAGE.				
UNIT-IV IMAGING TECHNIQUES				12
Principle, Instrumentation and application of ECG, EEG, EMG, MRI, CT and PET scan radioisotopes.				
UNIT-V FLUORESCENCE AND RADIATION BASED TECHNIQUES				12
Spectro fluorimeter, Flame photometer, Scintillation counter, Geiger Muller counter, Autoradiography				
Total Lecture Hours				60

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

- Rodney.F.Boyer (2000). Modern Experimental Biochemistry, 3rd Edition. Pearson Publication.
- Skoog A. and West M. (2014). Principles of Instrumental Analysis – 14th Edition W.B. Saunders Co., Philadelphia.
- N.Gurumani. (2006). Research Methodology for biological sciences- 1st Edition – MJP Publishers, New Delhi.
- Wilson K, and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Edition. Cambridge University Press .
- Webster, J.G. (2004). Bioinstrumentation- 4th Edition - John Wiley & Sons (Asia) Pvt. Ltd, Singapore.

WEB RESOURCES:

- ❖ <http://www.biologydiscussion.com/biochemistry/centrifugation/centrifuge-introduction-types-uses-and-other-details-with-diagram/12489>
- ❖ <https://www.watelectrical.com/biosensors-types-its-working-andapplications/>
- ❖ <http://www.wikiscales.com/articles/electronic-analytical-balance/> Page 24 of 75
- ❖ <https://study.com/academy/lesson/what-is-chromatography-definition-typesuses.html>
- ❖ <https://study.com/academy/lesson/what-is-chromatography-definition-typesuses.html>

Nature of Course	EMPLOYABILITY		SKILL ORIENTED			ENTREPRENEURSHIP		✓
Curriculum Relevance	LOCAL	REGIONAL	NATIONAL			GLOBAL	✓	
Changes Made in the Course	Percentage of Change		No Changes Made			New Course		✓

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:									K LEVEL		
After studying this course, the students will be able to:											
CO1	Gain knowledge about the basics of instrumentation.									K1 to K4	
CO2	Exemplify the structure of atoms and molecules by using the principles of spectroscopy.									K1 to K4	
CO3	Evaluate by separating and purifying the components.									K1 to K4	
CO4	Understand the need and applications of imaging techniques.									K1 to K4	
CO5	Categorize the working principle and applications of fluorescence and radiation.									K1 to K4	

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	M	S	M			
CO2	M	S	S	M	S	M	M			
CO3	M	M	S	M	S	M	M			
CO4	M	S	S	M	S	M	S			
CO5	S	S	S	M	S	M	M			
S- STRONG			M - MEDIUM				L - LOW			

CO / PO MAPPING:					
COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	2	2	2	1	2
CO 2	2	1	1	2	1
CO 3	2	2	1	2	1
CO 4	2	2	1	2	1
CO 5	3	1	1	2	1
WEITAGE	11	8	6	9	6
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS					

LESSON PLAN:			
UNIT	COURSE NAME	HRS	PEDAGOGY
I	BASIC INSTRUMENTS: pH meter, Buffer of biological importance. Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator. Biochemical calculations- preparations of Molar solutions - Buffers- Phosphate, Acetate, TE, TAE- calculation of Normality, PPM- Ammonium sulphate precipitation.	12	Chalk & Talk, Power point.
II	SPECTROSCOPIC TECHNIQUES: Spectroscopic Techniques:	12	Chalk &

	Colorimeter, Ultraviolet and visible, Infra-red and Mass Spectroscopy.		Talk, Power point.
III	CHROMATOGRAPHIC AND ELECTROPHORESIS TECHNIQUES: Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC. Electrophoresis Techniques: Starch Gel, AGE, PAGE.	12	Chalk & Talk, Power point.
IV	IMAGING TECHNIQUES: Principle, Instrumentation and application of ECG, EEG, EMG, MRI, CT and PET scan radioisotopes.	12	Chalk & Talk, Power point.
V	FLUORESCENCE AND RADIATION BASED TECHNIQUES: Spectro fluoro meter, Flame photometer, Scintillation counter, Geiger Muller counter, Autoradiography.	12	Chalk & Talk, Power point.

Learning Outcome Based Education & Assessment (LOBE)						
Formative Examination - Blue Print						
Articulation Mapping – K Levels with Course Outcomes (COs)						
Internal	Cos	K Level	Section A		Section B Either or Choice	Section C Either or Choice
			MCQs			
			No. of Questions	K - Level		
CI	CO1	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AI	CO2	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
CI	CO3	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AII	CO4	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	Section A (Multiple Choice Questions)	Section B (Either / Or Choice)	Section C (Either / Or Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2			2	3.6	25
	K2	2	10		12	21.4	
	K3		10	16	26	46.4	46.4
	K4			16	16	28.6	28.6
	Marks	4	20	32	56	100	100
CIA II	K1	2			2	3.6	7.2
	K2	2	10		12	3.6	
	K3		10	16	26	46.4	46.4
	K4			16	16	46.4	46.4
	Marks	4	20	32	56	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
2	CO2	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
3	CO3	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
4	CO4	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
5	CO5	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	Section A (Multiple Choice Questions)	Section B (Either or Choice)	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.6	4
K2	5	20		25	17.8	18
K3		30	32	62	44.3	44
K4			48	48	34.3	34
Marks	10	50	80	140	100	100

NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.

Summative Examinations - Question Paper – Format

Q. No.	Unit	CO	K-level		
Answer ALL the questions				PART – A	
				(10 x 1 = 10 Marks)	
1.	Unit - I	CO1	K1	a)	b)
				c)	d)
2.	Unit - I	CO1	K2	a)	b)
				c)	d)
3.	Unit - II	CO2	K1	a)	b)
				c)	d)
4.	Unit - II	CO2	K2	a)	b)
				c)	d)
5.	Unit - III	CO3	K1	a)	b)
				c)	d)
6.	Unit - III	CO3	K2	a)	b)
				c)	d)
7.	Unit - IV	CO4	K1	a)	b)
				c)	d)
8.	Unit - IV	CO4	K2	a)	b)
				c)	d)
9.	Unit - V	CO5	K1	a)	b)
				c)	d)
10.	Unit - V	CO5	K2	a)	b)
				c)	d)

Answer ALL the questions				PART – B	(5 x 5 = 25 Marks)
11. a)	Unit - I	CO1	K2		
OR					
11. b)	Unit - I	CO1	K2		
12. a)	Unit - II	CO2	K3		
OR					
12. b)	Unit - II	CO2	K3		
13. a)	Unit - III	CO3	K2		
OR					
13. b)	Unit - III	CO3	K2		
14. a)	Unit - IV	CO4	K3		
OR					
14. b)	Unit - IV	CO4	K3		
15. a)	Unit - V	CO5	K3		
OR					
15. b)	Unit - V	CO5	K3		

Answer ALL the questions				PART – C	(5 x 8 = 40 Marks)
16. a)	Unit - I	CO1	K3		
OR					
16. b)	Unit - I	CO1	K3		
17. a)	Unit - II	CO2	K4		
OR					
17. b)	Unit - II	CO2	K4		
18. a)	Unit - III	CO3	K3		
OR					
18. b)	Unit - III	CO3	K3		
19. a)	Unit - IV	CO4	K4		
OR					
19. b)	Unit - IV	CO4	K4		
20. a)	Unit - V	CO5	K4		
OR					
20. b)	Unit - V	CO5	K4		

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)



DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	NUTRITION AND HEALTH HYGIENE			
Course Code	23UMBNM21	L	P	C
Category	NME	2	-	2
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ Learn about nutrition and their importance.➤ Make student understand the nutritional facts for a better life.➤ Learn information to optimize our diet.➤ Impart knowledge on different health care programs taken up by India.➤ Learn knowledge on different health indicators and types of hygiene methods.				
UNIT - I NUTRITION AND ITS IMPORTANCE:				6
Nutrition – definition, importance, good nutrition, and mal nutrition; Balanced Diet: Basics of Meal Planning. Carbohydrates, Lipids, Proteins and Vitamins –functions, dietary sources, effects of deficiency. Macro and micro minerals –functions, effects of deficiency; food sources of Calcium, Potassium, and Sodium; food sources of Iron, Iodine, and Zinc. Importance of water– functions, sources, requirements and effects of deficiency.				
UNIT - II BALANCED DIET FOR HEALTHY LIFE:				6
Nutrition for Life Cycle: Balanced diet - Normal, Pregnant, lactating women, Infancy, young children Adolescents, Adults, and the Elderly; Diet Chart; Nutritive value of Indian foods.				
UNIT - III NUTRITIONAL DISEASES AND DISORDERS:				6
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 EDUCATION AND HEALTH ORGANIZATIONS IN INDIA:				6
Health - Determinants of health, Key Health Indicators, Environment health & Public health; Health-Education: Principles and Strategies. Health Policy & Health Organizations: Health Indicators and National Health Policy of Govt. of India; Functioning of various nutrition and health organizations in India.				
UNIT - V HYGIENE:				6
Hygiene – Definition; Personal, Community, Medical and Culinary hygiene; WASH (Water, Sanitation and Hygiene) programme. Rural Community Health: Village health sanitation & Nutritional committee. Community & Personal Hygiene: Environmental Sanitation and Sanitation in Public places.				
Total Lecture Hours				30

BOOKS FOR STUDY:

- Bamji, M.S., K. Krishnaswamy & G.N.V. Brahmam (2009) Textbook of Human Nutrition (3rd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- Swaminathan (1995) Food & Nutrition (Vol I, Second Edition) The Bangalore Printing & Publishing Co Ltd., Bangalore.
- SK. Haldar (2022). Occupational Health and Hygiene in Industry. CBS Publishers.
- Acharya, Sankar Kr, Rama Das, Minati Sen (2021). Health Hygiene and Nutrition Perception and Practices. Satish Serial Publishing House.
- Dass (2021). Public Health and Hygiene, Notion Press.

BOOKS FOR REFERENCES:

- Vijaya Khader (2000) Food, nutrition & health, Kalyan Publishers, New Delhi.
- Srilakshmi, B., (2010) Food Science, (5th Edition) New Age International Ltd., New Delhi.
- Arvind Kumar Goel (2005). A College Textbook of Health & Hygiene, ABD Publishers.
- Sharma D. (2015). Textbook on Food Science and Human Nutrition. Daya Publishing House.
- Revilla M. K. F., Titchenal A. and Draper J. (2020). Human Nutrition. University of Hawaii, Mānoa.

WEB RESOURCES:

- ❖ <https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=969&lid=49>
- ❖ <https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=970&lid=137>.
- ❖ <https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=149&lid=225>
- ❖ <https://www.who.int/hia/about/faq/en/>
- ❖ <https://www.nhp.gov.in/healthylivingViewall>.

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		✓	ENTREPRENEURSHIP	
Curriculum Relevance	LOCAL	REGIONAL	✓	NATIONAL		GLOBAL	
Changes Made in the Course	Percentage of Change		No Changes Made			New Course	✓
* Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.							

COURSE OUTCOMES:**K LEVEL**

After studying this course, the students will be able to:

CO1	Learn the importance of nutrition for a healthy life.	K1 to K2
CO2	Study the nutrition for life cycle.	K1 to K2
CO3	Know the health care programmers of India.	K1 to K2
CO4	Learn the importance of community and personal health & hygiene measures.	K1 to K2
CO5	Create awareness on community health and hygiene.	K1 to K2

MAPPING WITH PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	L	S	S	M	S	M		

CO2	S	M	S	M	M	M	M	L		
CO3	M	L	L	L	L	M	L	L		
CO4	S	M	M	M	M	S	L	L		
CO5	S	M	S	M	M	L	L	L		

S- STRONG

M – MEDIUM

L - LOW

CO / PO MAPPING:

COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	1	1	3	3
CO 2	3	2	3	2	2
CO 3	2	1	1	1	1
CO 4	3	2	2	2	2
CO 5	3	2	3	2	2
WEITAGE	14	8	10	10	10
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	93.3	53.3	66.6	66.6	66.6

LESSON PLAN:

UNIT	COURSE NAME	HRS	PEDAGOGY
I	Nutrition – Definition, importance, Good nutrition, and mal nutrition; Balanced Diet: Basics of Meal Planning. Carbohydrates, Lipids, Proteins and Vitamins –functions, dietary sources, effects of deficiency. Macro and micro minerals –functions, effects of deficiency; food sources of Calcium, Potassium, and Sodium; food sources of Iron, Iodine, and Zinc. Importance of water– functions, sources, requirements and effects of deficiency.	6	Chack & Talk and Power Point Presentation.
II	Nutrition for Life Cycle: Balanced diet - Normal, Pregnant, lactating women, Infancy, young children Adolescents, Adults, and the Elderly; Diet Chart; Nutritive value of Indian foods.	6	Chack & Talk and Power Point Presentation.
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.	6	Chack & Talk and Power Point Presentation.
IV	Health - Determinants of health, Key Health Indicators, Environment health & Public health; Health-Education: Principles and Strategies. Health Policy & Health Organizations: Health Indicators and National Health Policy of Govt. of India; Functioning of various nutrition and health organizations in India.	6	Chack & Talk and Power Point Presentation.

V	Hygiene – Definition; Personal, Community, Medical and Culinary hygiene; WASH (Water, Sanitation and Hygiene) programme. Rural Community Health: Village health sanitation & Nutritional committee. Community & Personal Hygiene: Environmental Sanitation and Sanitation in Public places.	6	Chack & Talk and Power Point Presentation.
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Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)				
Internal	Cos	K Level	Section A	
			MCQs	
			No. of. Questions	K - Level
CI	CO1	K1 – K2	25	K1,K2
AI	CO2	K1 – K2	25	K1,K2
CI	CO3	K1 – K2	25	K1,K2
AII	CO4	K1 – K2	25	K1,K2
Question Pattern CIA I & II		No. of Questions to be asked	50	
		No. of Questions to be answered	50	
		Marks for each question	1	
		Total Marks for each section	50	

* Two Formative examinations will be conducted as a part of Continuous Internal Assessment under which, 50 MCQ's will be asked [50X1=50 marks] from any 4 CO's. (Ist Test-2 CO's & IInd Test-2 CO's) in equal weightage

Distribution of Marks with K Level CIA I & CIA II					
	K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100
CIA II	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)				
S. No	COs	K - Level	Section A (MCQs)	
			No. of Questions	K – Level
1	CO1	K1-K2	15	K1,K2
2	CO2	K1-K2	15	K1,K2
3	CO3	K1-K2	15	K1,K2
4	CO4	K1-K2	15	K1,K2
5	CO5	K1-K2	15	K1,K2
No. of Questions to be Asked			75	
No. of Questions to be answered			75	
Marks for each question			1	
Total Marks for each section			75	
(Figures in parenthesis denotes, questions should be asked with the given K level)				

In summative examinations, 75 MCQ's will be asked [75X1=75 marks] from all 5 CO's in equal weightage.

Distribution of Marks with K Level				
K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidated %
K1	40	40	53	100
K2	35	35	47	
K3				
K4				
Marks		75	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.				



MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)

DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	SERICULTURE			
Course Code	23UMBSC21	L	P	C
Category	SKILL ENHANCEMENT COURSE	2	-	2
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ Acquire knowledge on the concepts of origin, growth and study of Sericulture as science and scientific approach of mulberry plant.➤ Describe the morphology and physiology of silkworm.➤ Discuss effective management of silkworm diseases.➤ Demonstrate field skills in mulberry cultivation and silkworm rearing with an emphasis on technological aspects.➤ Demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises.				
UNIT-I INTRODUCTION TO SERICULTURE				6
General introduction to Sericulture, its distribution in India. Botanical distribution and taxonomical characters of mulberry varieties and species. Biology of Mulberry plant and Mulberry crop cultivation and protection.				
UNIT-II SILKWORM MORPHOLOGY& LIFE CYCLE				6
Silkworm- biology-morphology of silkworm. Life cycle of silkworm- egg, larva, pupa, and moth.				
UNIT-III PATHOLOGY OF SILKWORM				6
Silkworm pathology: Introduction to Parasitism, Commensalism, Symbiosis and Parasite relationship - Mulberry Silkworm Diseases: Introduction, types, Pebrine, Grasserie, Muscardine, Flacherie, Symptoms and Pathogens, Mode of Infection, Prevention and Control -Non – mulberry silkworm diseases: Pebrine, Bacterial and viral diseases. Brief Account of Pests and Predators of Silkworms, Nature of damage and control measures.				
UNIT-IV SILKWORM REARING				6
Rearing of silkworm. Cocoon assessment and processing technologies. Value added products of mulberry and silkworms.				
UNIT-V ENTREPRENEURSHIP &RURAL DEVELOPMENT				6
Entrepreneurship and rural development in sericulture: Planning for EDP, Project formulation, Marketing, Insectary facilities and equipments: Location, building specification, air conditioning and environmental control, furnishings and equipment, sanitation and equipment, subsidiary facilities.				
Total Lecture Hours				30

BOOKS FOR STUDY:

- Ganga, G. and Sulochana Chetty (2010). Introduction to Sericulture,, J., Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
- Dr. R. K. Rajan&Dr. M. T. Himantharaj(2005). Silkworm Rearing Technology, Central Silk Board, Bangalore
- Dandin S B, Jayant Jayaswal and Giridhar K (2010). Handbook of Sericulture technologies, Central Silk Board, Bangalore.
- M. C. Devaiah, K. C. Narayanaswamy and V. G. Maribashetty (2010). Advances in Mulberry Sericulture, CVG Publications, Bangalore
- T. V. Sathe and Jadhav. A.D.(2021). *Sericulture and Pest Management*, Daya Publishing House.

BOOKS FOR REFERENCES:

- S. Morohoshi (2001). Development Physiology of Silkworms 2ndEdition, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi
- Hamamura, Y (2001). Silkworm rearing on Artificial Diet. Oxford & IBH publishing Co., Pvt. Ltd. NewDelhi.
- M.Johnson, M.Kesary (2019). Sericulture, 5th. Edition. Saras Publications.
- **Manisha Bhattacharyya (2019)**. Economics of Sericulture, Rajesh Publications.
- **Muzafar Ahmad Bhat, Suraksha Chanotra, Zafar Iqbal Buhroo, Abdul Aziz and Mohd. Azam (2020)**.

WEB RESOURCES:

- ❖ <https://egyankosh.ac.in> › [bitstream](#)
- ❖ <https://archive.org> › [details](#) › [Sericulture Handbook](#)
- ❖ <https://www.academic.oup.com>
- ❖ <https://www.sericulture.karnataka.gov.in>
- ❖ <https://www.silks.csb.gov.in>

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		ENTREPRENEURSHIP		✓
Curriculum Relevance	LOCAL	REGIONAL	NATIONAL		GLOBAL		✓
Changes Made in the Course	Percentage of Change		No Changes Made		New Course		✓

*** Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Discuss the overall aspects of Sericulture and the biology and varieties of mulberry plant. Create awareness among students about the economic importance and suitability of Sericulture in Indian conditions.	K1 to K2
CO2	Familiarize with the lifecycle of silk worm.	K1 to K2
CO3	Explain common diseases of silkworm encountered during rearing, sources of infection, disease symptoms, pre-disposing factors and their management practices.	K1 to K2
CO4	Attain thorough knowledge about the cultivation of mulberry, maintenance of the farm, seed technology, silkworm rearing, post cocoon techniques like stifling, reeling, and utilization of by-products.	K1 to K2
CO5	Competent to transfer the knowledge and technical skills to the Seri-farmers. Analyze the importance of sericulture in entrepreneurship development and emerge as potential entrepreneur.	K1 to K2

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S				S		S			
CO2	M				S					
CO3	S				S					
CO4							S	S		S
CO5					S		S	S		
S- STRONG			M – MEDIUM				L - LOW			

CO / PO MAPPING:						
COS	PSO1	PSO2	PSO3	PSO4	PSO5	
CO 1	2	2	2	2	1	
CO 2	2	1	1	2	1	
CO 3	2	2	1	2	1	
CO 4	2	2	1	2	2	
CO 5	23	1	1	2	2	
WEITAGE	10	8	6	10	8	
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS	66.6	53.33	40	66.6	53.33	

LESSON PLAN:			
UNIT	COURSE NAME	HRS	PEDAGOGY
I	General introduction to Sericulture, its distribution in India. Botanical distribution and taxonomical characters of mulberry varieties and species. Biology of Mulberry plant and Mulberry crop cultivation and protection.	6	Chalk & Talk

II	Silkworm- biology-morphology of silkworm. Life cycle of silkworm- egg, larva, pupa, and moth.	6	Chalk & Talk
III	Silkworm pathology: Introduction to Parasitism, Commensalism, Symbiosis and Parasite relationship - Mulberry Silkworm Diseases: Introduction, types, Pebrine, Grasserie, Muscardine, Flacherie, Symptoms and Pathogens, Mode of Infection, Prevention and Control -Non – mulberry silkworm diseases: Pebrine, Bacterial and viral diseases. Brief Account of Pests and Predators of Silkworms, Nature of damage and control measures.	6	Chalk & Talk
IV	Rearing of silkworm. Cocoon assessment and processing technologies. Value added products of mulberry and silkworms.	6	Chalk & Talk
V	Entrepreneurship and rural development in sericulture: Planning for EDP, Project formulation, Marketing, Insectary facilities and equipments: Location, building specification, air conditioning and environmental control, furnishings and equipment, sanitation and equipment, subsidiary facilities.	6	Chalk & Talk

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)				
Internal	Cos	K Level	Section A	
			MCQs	
			No. of. Questions	K - Level
CI	CO1	K1 – K2	25	K1,K2
AI	CO2	K1 – K2	25	K1,K2
CI	CO3	K1 – K2	25	K1,K2
AII	CO4	K1 – K2	25	K1,K2
Question Pattern CIA I & II		No. of Questions to be asked	50	
		No. of Questions to be answered	50	
		Marks for each question	1	
		Total Marks for each section	50	

* Two Formative examinations will be conducted as a part of Continuous Internal Assessment under which, 50 MCQ's will be asked [50X1=50 marks] from any 4 CO's. (Ist Test-2 CO's & IInd Test-2 CO's) in equal weightage

Distribution of Marks with K Level CIA I & CIA II					
	K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100
CIA II	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)				
S. No	COs	K - Level	Section A (MCQs)	
			No. of Questions	K – Level
1	CO1	K1-K2	15	K1,K2
2	CO2	K1-K2	15	K1,K2
3	CO3	K1-K2	15	K1,K2
4	CO4	K1-K2	15	K1,K2
5	CO5	K1-K2	15	K1,K2
No. of Questions to be Asked			75	
No. of Questions to be answered			75	
Marks for each question			1	
Total Marks for each section			75	
(Figures in parenthesis denotes, questions should be asked with the given K level)				

In summative examinations, 75 MCQ's will be asked [75X1=75 marks] from all 5 CO's in equal weightage.

Distribution of Marks with K Level				
K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidated %
K1	40	40	53	100
K2	35	35	47	
K3				
K4				
Marks		75	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.				

B.Sc., MICROBIOLOGY

Syllabus

Program Code: UMB

2023 - Onwards



MANNAR THIRUMALAI NAICKER COLLEGE

(AUTONOMOUS)

Re-accredited with “A” Grade by NAAC

PASUMALAI, MADURAI – 625 004

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS),

MADURAI – 625 004

B.SC MICROBIOLOGY CURRICULUM

(For the students admitted from the academic year 2023-2024 onwards)

Course Code	Title of the Course	Hrs	Credits	Maximum Marks		
				Int	Ext	Total
THIRD SEMESTER						
Part – I	Tamil / Alternative course					
23UTAGT31	தமிழக வரலாறும் பண்பாடும்	6	3	25	75	100
Part – II	English					
23UENGE31	GENERAL ENGLISH - III	6	3	25	75	100
Part - III	Core courses					
23UMBCC31	MOLECULAR BIOLOGY AND MICROBIAL GENETICS	5	5	25	75	100
23UMBPC31	MOLECULAR BIOLOGY AND MICROBIAL GENETICS PRACTICAL	4	4	40	60	100
Part - III	Elective / Allied course					
23UMBAC31	CLINICAL LABORATORY TECHNOLOGY	4	4	25	75	100
Part - IV	Skill Based courses					
23UMBSC31	ORGANIC FARMING AND BIOFERTILIZER TECHNOLOGY	2	2	25	75	100
23UMBSC32	AQUACULTURE	2	2	25	75	100
Part - IV	Mandatory course					
23UEVSG41	ENVIRONMENTAL STUDIES	1	-	-	-	-
Total		30	23	190	510	700
FOURTH SEMESTER						
Part – I	Tamil / Alternative course					
23UTAGT41	தமிழும் அறிவியலும்	6	3	25	75	100
Part – II	English					
23UENGE41	GENERAL ENGLISH - IV	6	3	25	75	100
Part - III	Core courses					
23UMBCC41	IMMUNOLOGY AND IMMUNOTECHNOLOGY	5	4	25	75	100
23UMBPC41	IMMUNOLOGY AND IMMUNOTECHNOLOGY PRACTICAL	4	4	40	60	100
Part - III	Elective / Allied course					
23UMBAC41	FOOD PROCESSING TECHNOLOGY	4	3	25	75	100
Part - IV	Skill Based courses					
23UMBSC41	VACCINE TECHNOLOGY	2	2	25	75	100
23UMBSC42	APICULTURE	2	2	25	75	100
Part - IV	Mandatory course					
23UEVSG41	ENVIRONMENTAL STUDIES	1	2	25	75	100
Total		30	23	215	585	800

THIRD SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)



DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	MOLECULAR BIOLOGY AND MICROBIAL GENETICS			
Course Code	23UMBCC31	L	P	C
Category	CORE	5	-	5
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ Provide knowledge on structure and replication of DNA.➤ Illustrate the significance and functions of RNA in protein synthesis.➤ Explain the cause and types of DNA mutation and DNA repair mechanisms.➤ Outline the role of plasmids and phages in genetics.➤ Examine mechanisms of gene transfer and recombination.				
UNIT - I DNA STRUCTURE:				15
Salient features of double helix, forms of DNA. Denaturation and renaturation. DNA topology – Supercoiling, linking number, DNA organization in prokaryotes, viruses, eukaryotes. Replication of DNA in prokaryotes and eukaryotes - Bidirectional and unidirectional replication, Mechanism of DNA replication – enzymes involved – DNA polymerases, DNA ligase. DNA replication modes – Conservative and semi-conservative, rolling circle & D-loop modes.				
UNIT - II TRANSCRIPTION AND TRANSLATION IN PROKARYOTES:				15
Concept of transcription. RNA Polymerases - prokaryotic and eukaryotic. General transcription factors in eukaryotes. Distinction between transcription processes in prokaryotes versus eukaryotes. Translation in prokaryotes and eukaryotes - Translational machinery - ribosome structure in prokaryotes and eukaryotes, tRNA structure and processing. Inhibitors of protein synthesis in prokaryotes and eukaryotes. Overview of regulation of gene expression - <i>lac</i> , and <i>trp</i> as examples.				
UNIT - III MUTATION:				15
Mutation - Definition and types - base substitutions, frame shifts, deletions, insertions, duplications, inversions. Silent, conditional, and lethal mutations. Physical and chemical mutagens. Reversion and suppression. Uses of mutations. Repair Mechanisms - Photoreactivation, Nucleotide Repair, Base Excision Repair, Mismatch Repair.				
UNIT - IV PLASMID REPLICATION:				15
Plasmid replication and partitioning, host range, plasmid incompatibility, regulation of plasmid copy number, curing of plasmids. Types of plasmids – R Plasmids, F plasmids, Ti plasmid, linear plasmids, yeast 2 μ plasmid. Bacteriophage-T4, Virulent Phage – Structure and lifecycle. Lambda phage-Structure, Lytic and Lysogenic cycle. Applications of Phages in Microbial Genetics.				
UNIT - V GENE TRANSFER MECHANISMS:				15
Conjugation and its uses. Transduction - Generalized and Specialized, Transformation - Natural Competence and Transformation. Transposition and Types of Transposition reactions. Transposable elements - Prokaryotic transposable elements – insertion sequences, composite, and non-composite transposons. Uses of transposons.				
Total Lecture Hours				75

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

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

WEB RESOURCES:

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

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		✓	ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change		35	No Changes Made			New Course	

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:										K LEVEL
After studying this course, the students will be able to:										
CO1	Analyze the significance of DNA and elucidate the replication mechanism									K1 to K4
CO2	Illustrate the types of RNA and protein synthesis machinery									K1 to K4
CO3	Infer the causes and types of DNA mutation and summarize the DNA repair mechanisms.									K1 to K4
CO4	Evaluate the importance of plasmids and phages in genetics.									K1 to K4
CO5	Analyze gene transfer and recombination methods.									K1 to K4

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	M	S	S	S	M	S	M	M
CO3	S	M	S	S	S	S	M	S	M	S
CO4	S	M	S	S	M	S	S	S	M	M
CO5	S	S	M	S	M	S	M	S	M	M
S- STRONG			M – MEDIUM				L - LOW			

CO / PO MAPPING:					
COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3
CO 2	2	2	2	2	2
CO 3	3	2	1	2	2
CO 4	3	2	1	2	2
CO 5	2	1	2	3	2
WEITAGE	11	10	9	12	11
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS					

LESSON PLAN:			
UNIT	COURSE NAME	HRS	PEDAGOGY
I	CHARACTERISTICS OF DOUBLE HELICAL DNA DNA Structure - Salient features of double helix, forms of DNA. Denaturation and renaturation. DNA topology – Supercoiling, linking number, topoisomerases. DNA organization in prokaryotes, viruses, eukaryotes. Replication of DNA in prokaryotes and eukaryotes - Bidirectional and unidirectional replication, Mechanism of DNA replication – enzymes involved – DNA polymerases, DNA ligase - DNA replication modes – Conservative and semi-conservative, rolling circle & D-loop modes.	15	Chalk & Talk, PPT
II	TRANSCRIPTION AND TRANSLATION IN PROKARYOTES. Transcription in Prokaryotes. Concept of transcription. RNA	15	Chalk & Talk,

	<p>Polymerases - prokaryotic and eukaryotic. General transcription factors in eukaryotes. Distinction between transcription processes in prokaryotes versus eukaryotes. Translation in prokaryotes and eukaryotes - Translational machinery - ribosome structure in prokaryotes and eukaryotes, tRNA structure and processing. Inhibitors of protein synthesis in prokaryotes and eukaryotes. Overview of regulation of gene expression - <i>lac</i>, and <i>trp</i> as examples.</p>		PPT
III	<p>MUTATION Mutation - Definition and types - base substitutions, frame shifts, deletions, insertions, duplications, inversions. Silent, conditional, and lethal mutations. Physical and chemical mutagens. Reversion and suppression. Uses of mutations. Repair Mechanisms - Photoreactivation, Nucleotide Repair, Base Excision Repair, Mismatch Repair.</p>	15	Chalk & Talk, PPT
IV	<p>PLASMID REPLICATION Plasmid replication and partitioning, host range, plasmid incompatibility, regulation of plasmid copy number, curing of plasmids. Types of plasmids – R Plasmids, F plasmids, colicinogenic plasmids, metal resistance plasmids, Ti plasmid, linear plasmids, yeast 2μ plasmid. Bacteriophage-T4, Virulent Phage – Structure and lifecycle. Lambda phage-Structure, Lytic and Lysogenic cycle. Applications of Phages in Microbial Genetics</p>	15	Chalk & Talk, PPT
V	<p>GENE TRANSFER MECHANISMS Gene Transfer Mechanisms- Conjugation and its uses. Transduction - Generalized and Specialized, Transformation - Natural Competence and Transformation. Transposition and Types of Transposition reactions. Transposable genetic elements - Prokaryotic transposable elements – insertion sequences, composite, and non-composite transposons. Uses of transposons.</p>	15	Chalk & Talk, PPT

**Learning Outcome Based Education & Assessment (LOBE)
Formative Examination - Blue Print
Articulation Mapping – K Levels with Course Outcomes (COs)**

Internal	Cos	K Level	Section A		Section B Either or Choice	Section C Either or Choice
			MCQs			
			No. of Questions	K - Level		
CI	CO1	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AI	CO2	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
CI	CO3	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AII	CO4	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II

	K Level	Section A (Multiple Choice Questions)	Section B (Either / Or Choice)	Section C (Either / Or Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2			2	3.6	25
	K2	2	10		12	21.4	
	K3		10	16	26	46.4	46.4
	K4			16	16	28.6	28.6
	Marks	4	20	32	56	100	100
CIA II	K1	2			2	3.6	7.2
	K2	2	10		12	3.6	
	K3		10	16	26	46.4	46.4
	K4			16	16	46.4	46.4
	Marks	4	20	32	56	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
2	CO2	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
3	CO3	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
4	CO4	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
5	CO5	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	Section A (Multiple Choice Questions)	Section B (Either or Choice)	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.6	4
K2	5	20		25	17.8	18
K3		30	32	62	44.3	44
K4			48	48	34.3	34
Marks	10	50	80	140	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.						

Summative Examinations - Question Paper – Format

Q. No.	Unit	CO	K-level		
Answer ALL the questions				PART – A	(10 x 1 = 10 Marks)
1.	Unit - I	CO1	K1		
				a)	b)
				c)	d)
2.	Unit - I	CO1	K2		
				a)	b)
				c)	d)
3.	Unit - II	CO2	K1		
				a)	b)
				c)	d)
4.	Unit - II	CO2	K2		
				a)	b)
				c)	d)
5.	Unit - III	CO3	K1		
				a)	b)
				c)	d)
6.	Unit - III	CO3	K2		
				a)	b)
				c)	d)
7.	Unit - IV	CO4	K1		
				a)	b)
				c)	d)
8.	Unit - IV	CO4	K2		
				a)	b)
				c)	d)
9.	Unit - V	CO5	K1		
				a)	b)
				c)	d)
10.	Unit - V	CO5	K2		
				a)	b)
				c)	d)

Answer ALL the questions				PART – B	(5 x 5 = 25 Marks)
11. a)	Unit - I	CO1	K2		
OR					
11. b)	Unit - I	CO1	K2		
12. a)	Unit - II	CO2	K3		
OR					
12. b)	Unit - II	CO2	K3		
13. a)	Unit - III	CO3	K2		
OR					
13. b)	Unit - III	CO3	K2		
14. a)	Unit - IV	CO4	K3		
OR					
14. b)	Unit - IV	CO4	K3		
15. a)	Unit - V	CO5	K3		
OR					
15. b)	Unit - V	CO5	K3		

Answer ALL the questions				PART – C	(5 x 8 = 40 Marks)
16. a)	Unit - I	CO1	K3		
OR					
16. b)	Unit - I	CO1	K3		
17. a)	Unit - II	CO2	K4		
OR					
17. b)	Unit - II	CO2	K4		
18. a)	Unit - III	CO3	K3		
OR					
18. b)	Unit - III	CO3	K3		
19. a)	Unit - IV	CO4	K4		
OR					
19. b)	Unit - IV	CO4	K4		
20. a)	Unit - V	CO5	K4		
OR					
20. b)	Unit - V	CO5	K4		



MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)

DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	MOLECULAR BIOLOGY AND MICROBIAL GENETICS PRACTICAL			
Course Code	23UMB31	L	P	C
Category	CORE	-	4	4
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ Provide knowledge on structure and replication of DNA.➤ Elucidate the methods of Genomic and Plasmid DNA isolation➤ Explain methods of protein separation.➤ Explain artificial transformation method.➤ Outline the role of phages in genetics.				
UNIT - I Study of DNA & RNA				15
Study of different types of DNA and RNA using micrographs and model / schematic representations. Study of semi-conservative replication of DNA through micrographs / schematic representations.				
UNIT - II Electrophoresis				15
Isolation of Genomic and Plasmid DNA from <i>E. coli</i> and Analysis by Agarose gel electrophoresis. Estimation of DNA using colorimeter (diphenylamine reagent), UV spectrophotometer (A260 measurement).				
UNIT - III SDS – PAGE				15
Resolution and visualization of proteins by polyacrylamide gel electrophoresis (SDS-PAGE) – Demonstration. UV induced auxotrophic mutant production and isolation of mutants by replica plating technique – Demonstration.				
UNIT - IV Artificial Transformation				15
Isolation of antibiotic resistant mutants by gradient plate method. - Demonstration				
UNIT - V Screening and isolation of RNA				15
Screening and isolation of phages from sewage. Perform RNA isolation. Estimate RNA– Orcinol method.				
Total Lecture Hours				75

BOOKS FOR STUDY:

- Rajan S and Selvi Christy, (2019), Experimental Procedures in Life Sciences, CBS Publishers and Distributors.
- Crichton. M. (2014). Essentials of Biotechnology. Scientific International Pvt Ltd. New Delhi
- Sambrook J. and Russell D.W. (2001). Molecular Cloning - A Laboratory Manual – 7th Edition. Cold Spring Harbor, N.Y: Cold Spring Harbor Laboratory Press
- Dale J. W., Schantz M. V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd.
- Gunasekaran P. (2007). Laboratory Manual in Microbiology. New Age International
- James G Cappucino. and Natalie Sherman. (2016). Microbiology – A laboratory manual. (5th Edition). The Benjamin publishing company. New York.

BOOKS FOR REFERENCES:

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

WEB RESOURCES:

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

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		✓	ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change		60	No Changes Made			New Course	

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:										K LEVEL
After studying this course, the students will be able to:										
CO1	Illustrate different types of DNA and RNA.									K1 to K4
CO2	Utilize hands-on training in isolation of genomic and plasmid DNA.									K1 to K4
CO3	Analyze importance of experimental microbial genetics.									K1 to K4
CO4	Apply the knowledge of molecular techniques in various fields.									K1 to K4
CO5	Investigate the significance of Phages.									K1 to K4

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	S	S	S	M	S	S	M
CO2	M	S	S	M	M	M	M	S	S	S
CO3	M	M	S	M	S	M	M	S	M	M
CO4	M	S	S	M	M	M	S	S	S	S
CO5	M	S	S	M	M	M	M	S	M	S
S- STRONG			M – MEDIUM				L - LOW			

CO / PO MAPPING:						
COS	PSO1	PSO2	PSO3	PSO4	PSO5	
CO 1	2	2	1	1	3	
CO 2	2	1	1	2	2	
CO 3	2	2	1	2	1	
CO 4	2	1	1	2	2	
CO 5	2	1	1	2	2	
WEITAGE	10	7	5	9	10	
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS						

LESSON PLAN:			
UNIT	COURSE NAME	HRS	PEDAGOGY
I	Study of different types of DNA and RNA using micrographs and model / schematic representations. Study of semi-conservative replication of DNA through micrographs / schematic representations.	15	Chalk & Talk, PPT, Demonstration
II	Isolation of Genomic and Plasmid DNA from <i>E. coli</i> and Analysis by Agarose gel electrophoresis. Estimation of DNA using colorimeter (diphenylamine reagent), UV spectrophotometer (A260 measurement).	15	Chalk & Talk PPT, Demonstration
III	Resolution and visualization of proteins by polyacrylamide gel electrophoresis (SDS-PAGE) – Demonstration. UV induced auxotrophic mutant production and isolation of mutants by replica plating technique – Demonstration.	15	Chalk & Talk PPT, Demonstration

IV	Perform artificial Transformation in <i>E. coli</i> . Isolation of antibiotic resistant mutants by gradient plate method - Demonstration	15	Chalk & Talk PPT, Demonstration
V	Screening and isolation of phages from sewage. Perform RNA isolation. Estimate RNA – Orcinol method.	15	Chalk & Talk PPT, Demonstration

**Learning Outcome Based Education & Assessment (LOBE)
Formative Examination - Blue Print
Articulation Mapping – K Levels with Course Outcomes (COs)**

INTE RNA L	COs	K LEVEL	MAJOR	MINOR	SPOTTERS	RECORD	VIVA
CI AI	CO1	K1					5
	CO2	K2				5	
	CO3	K3			5		
	CO4	K4		5			
	CO5	K4	5				
Question Pattern	No. of Questions to be asked	2 (A-Written B-Practical Demo)	2 (A- Written B- Practical Demo)	2	1	5	
	No. of Questions to be answered	2	2	2	1	5	
	Marks for each question	A-10 B-5	A-5 B-5	2.5	10	1	
	Total Marks for each section	15	10	5	5	5	

Distribution of Marks with K Level									
	K Level	Major	Minor	Spotters	Record	Viva	Total Marks	% of Marks without choice	Consolidated %
CIA	K1	-	-	-	-	5	5	12.5	12.5
	K2	-	-	-	5	-	5	12.5	12.5
	K3	-	-	5	-	-	5	12.5	12.5
	K4	-	10	-	-	-	10	25	25
	K4	15					15	37.5	37.5
	Marks	15	10	5	5	5	40	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)							
EXTERNAL	COs	K LEVEL	MAJOR	MINOR	SPOTTERS	RECORD	VIVA
CIAI	CO1	K1					5
	CO2	K2				10	
	CO3	K3			20		
	CO4	K4		20			
	CO5	K4	25				
Question Pattern	No. of Questions to be asked		2 (A-Written B-Practical Demo)	2 (A-Written B-Practical Demo)	2	1	5
	No. of Questions to be answered		2	2	2	1	5
	Marks for each question		A-15 B-5	A-10 B-5	5	10	1
	Total Marks for each section		20	15	10	10	5

Distribution of Marks with K Level CIA

	K Level	Major	Minor	Spotters	Record	Viva	Total Marks	% of Marks without choice	Consolidated %
CIA	K1					5	5	8.33	8.33
	K2				10		10	16.66	16.66
	K3			10			10	16.66	16.66
	K4		15				15	25	25
	K4	20					20	33.33	33.33
	Marks	20	15	10	10	5	60	100	100

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)



DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	CLINICAL LABORATORY TECHNOLOGY			
Course Code	23UMBAC31	L	P	C
Category	ELECTIVE GENERIC/DISCIPLINE SPECIFIC ELECTIVE - III	4	-	4
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ Demonstrate ethical and professional conduct with patients, laboratory personnel, health-care professionals, and the public.➤ Explain how accurate and reliable information might be obtained about proper procurement, storage, and <i>handling</i> of laboratory <i>specimens</i>.➤ Develop a sound scientific knowledge foundation that prepares them to interpret, analyze and evaluate scientific knowledge in clinical practice.➤ Perform a full range of laboratory tests with accuracy and precision.➤ Establish quality assurance principles and practices to ensure the accuracy and reliability of laboratory information.				
UNIT - I INTRODUCTION TO CLINICAL LABORATORY SCIENCE				12
Basic laboratory principles - Code of conduct for medical laboratory personnel -Organization of clinical laboratory and role of medical laboratory technician - Safety measures. Maintenance of Hygiene & Infection Control Practices, Lab wastes management.				
UNIT - II SPECIMEN COLLECTION AND PROCESSING				12
Blood, urine, stool, sputum CSF, amniotic fluid and bile. Separation of serum and plasma, Handling of specimens for testing, preservation of specimens, transport of specimens.				
UNIT - III INTRODUCTION TO HISTOPATHOLOGY				12
Methods of examination of tissues and cells, Fixation of tissues: Classification and properties of fixatives. Tissue processing - Collection of specimens, Labeling and fixation, Dehydration, Clearing, Impregnation, Embedding - Paraffin block making, Section Cutting, Staining of specimen for histopathology, Microtomes – types.				
UNIT - IV INTRODUCTION TO HAEMATOLOGY				12
Laboratory methods used in the investigation of coagulation disorders - coagulation tests, Routine coagulation tests, (prothrombin time, plasma recalcification time, partial thromboplastin time, activated partial thromboplastin time, thrombin time), Assay of coagulation factors, HCG test.				
UNIT - V QUALITY STANDARDS IN HEALTH LABORATORIES				12
GLP, Development and implementation of standards, Accreditation Boards –NABL, ISO, CAP, COLA, Performing quality assessment - pre-analytical, analytical, and post-analytical phases of testing.				
Total Lecture Hours				60

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

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

WEB RESOURCES:

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

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		✓	ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change		No Changes Made			New Course		✓
*Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.								

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Impart knowledge about the significance of organic farming and strategies to increase the yield to conserve environment.	K1 to K4
CO2	To encourage organic farming in urban areas.	K1 to K4
CO3	Comprehensive knowledge about bacterial bio fertilizers, its advantages and future perspective.	K1 to K4
CO4	Structure and characteristic features of Cyanobacterial and fungal bio fertilizer.	K1 to K4
CO5	Develop the knowledge and skill to produce, analyze the quality of packaging, storage and assess the shelf life and bio efficacy of bio fertilizers.	K1 to K4

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	S	S	S	S
CO2	S	S	M	S	M	S	M	S	M	M
CO3	S	M	S	S	S	S	M	S	M	S
CO4	S	M	S	S	M	S	S	S	S	M
CO5	M	S	S	M	S	M	S	M	M	M
S- STRONG			M - MEDIUM				L - LOW			

CO / PO MAPPING:					
COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	2	3	3
CO 2	3	3	2	3	2
CO 3	3	2	3	1	2
CO 4	3	2	1	1	1
CO 5	2	3	3	2	2
WEITAGE	14	13	11	10	10
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS					

LESSON PLAN:			
UNIT	COURSE NAME	HRS	PEDAGOGY
I	Introduction to Clinical Laboratory Science: Basic laboratory principles - Code of conduct for medical laboratory personnel - Organization of clinical laboratory and role of medical laboratory technician - Safety measures. Maintenance of Hygiene & Infection Control Practices, Lab wastes management.	12	Chalk & Talk, PPT, Demonstration
II	Specimen collection and processing: Blood, urine, stool, sputum CSF, amniotic fluid and bile. Separation of serum and plasma, Handling of specimens for testing, preservation of specimens, transport of specimens	12	Chalk & Talk, PPT, Demonstration

III	Introduction to histopathology: Methods of examination of tissues and cells, Fixation of tissues: Classification and properties of fixatives. Tissue processing -Collection of specimens, Labelling and fixation, Dehydration, Clearing, Impregnation, Embedding - Paraffin block making, Section Cutting, Staining of specimen for histopathology, Microtome – types.	12	Chalk & Talk, PPT, Demonstration
IV	Introduction to Haematology: Laboratory methods used in the investigation of coagulation disorders - coagulation tests , Routine coagulation tests, (prothrombin time , plasma recalcification time, partial thromboplastin time , activated partial thromboplastin time, thrombin time), Assay of coagulation factors, HCG test.	12	Chalk & Talk, PPT, Demonstration
V	Quality Standards in Health Laboratories: GLP, Development and implementation of standards, Accreditation Boards –NABL, ISO, CAP, COLA, Performing quality assessment - pre-analytical, analytical, and post-analytical phases of testing.	12	Chalk & Talk, PPT, Demonstration

Learning Outcome Based Education & Assessment (LOBE)						
Formative Examination - Blue Print						
Articulation Mapping – K Levels with Course Outcomes (COs)						
Internal	Cos	K Level	Section A		Section B Either or Choice	Section C Either or Choice
			MCQs			
			No. of Questions	K - Level		
CI	CO1	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AI	CO2	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
CI	CO3	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AII	CO4	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	Section A (Multiple Choice Questions)	Section B (Either / Or Choice)	Section C (Either / Or Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2			2	3.6	25
	K2	2	10		12	21.4	
	K3		10	16	26	46.4	46.4
	K4			16	16	28.6	28.6
	Marks	4	20	32	56	100	100
CIA II	K1	2			2	3.6	7.2
	K2	2	10		12	3.6	
	K3		10	16	26	46.4	46.4
	K4			16	16	46.4	46.4
	Marks	4	20	32	56	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
2	CO2	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
3	CO3	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
4	CO4	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
5	CO5	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	Section A (Multiple Choice Questions)	Section B (Either or Choice)	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.6	4
K2	5	20		25	17.8	18
K3		30	32	62	44.3	44
K4			48	48	34.3	34
Marks	10	50	80	140	100	100

NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.

Summative Examinations - Question Paper – Format

Q. No.	Unit	CO	K-level		
Answer ALL the questions				PART – A	
				(10 x 1 = 10 Marks)	
1.	Unit - I	CO1	K1	a)	b)
				c)	d)
2.	Unit - I	CO1	K2	a)	b)
				c)	d)
3.	Unit - II	CO2	K1	a)	b)
				c)	d)
4.	Unit - II	CO2	K2	a)	b)
				c)	d)
5.	Unit - III	CO3	K1	a)	b)
				c)	d)
6.	Unit - III	CO3	K2	a)	b)
				c)	d)
7.	Unit - IV	CO4	K1	a)	b)
				c)	d)
8.	Unit - IV	CO4	K2	a)	b)
				c)	d)
9.	Unit - V	CO5	K1	a)	b)
				c)	d)
10.	Unit - V	CO5	K2	a)	b)
				c)	d)

Answer ALL the questions				PART – B	(5 x 5 = 25 Marks)
11. a)	Unit - I	CO1	K2		
OR					
11. b)	Unit - I	CO1	K2		
12. a)	Unit - II	CO2	K3		
OR					
12. b)	Unit - II	CO2	K3		
13. a)	Unit - III	CO3	K2		
OR					
13. b)	Unit - III	CO3	K2		
14. a)	Unit - IV	CO4	K3		
OR					
14. b)	Unit - IV	CO4	K3		
15. a)	Unit - V	CO5	K3		
OR					
15. b)	Unit - V	CO5	K3		

Answer ALL the questions				PART – C	(5 x 8 = 40 Marks)
16. a)	Unit - I	CO1	K3		
OR					
16. b)	Unit - I	CO1	K3		
17. a)	Unit - II	CO2	K4		
OR					
17. b)	Unit - II	CO2	K4		
18. a)	Unit - III	CO3	K3		
OR					
18. b)	Unit - III	CO3	K3		
19. a)	Unit - IV	CO4	K4		
OR					
19. b)	Unit - IV	CO4	K4		
20. a)	Unit - V	CO5	K4		
OR					
20. b)	Unit - V	CO5	K4		



MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)

DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	ORGANIC FARMING AND BIOFERTILIZER TECHNOLOGY			
Course Code	23UMBSC31	L	P	C
Category	SKILL	2	-	2
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ Impart knowledge about the significance of organic farming and strategies to increase the yield to conserve environment.➤ To encourage organic farming in urban areas.➤ Comprehensive knowledge about bacterial biofertilizers, its advantages and future perspective.➤ Structure and characteristic features of Cyanobacterial and fungal biofertilizer➤ Develop the knowledge and skill to produce, analyse the quality of packaging, storage and assess the shelf life and bioefficacy of biofertilizers.				
UNIT - I PRINCIPLE OF ORGANIC FARMING				12
Principles of health, fairness, ecological balance, and care. Environmental benefits of organic farming: sustainability- reduces non-renewable energy by decreasing agrochemical need. Biodiversity-crop rotation, inter-cropping. Ecological services – biological control, soil formation and nutrient cycling.				
UNIT - II GARDENING				12
Organic farming for urban space; Create a Sustainable Organic Garden (Backyard- Square Foot Gardening, Small Space Gardening, Mini Farming), Composting, Vermicomposting.				
UNIT - III BIOFERTILIZERS				12
Biofertilizers: Introduction, advantages and future perspective. PSBs, Structure and characteristic features of bacterial biofertilizers- Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium and Frankia				
UNIT - IV CHARACTERISTICS OF BIOFERTILIZER				12
Structure and characteristic features of Cyanobacterial biofertilizers- <i>Anabaena</i> , <i>Nostoc</i> ; Structure and characteristic features of fungal biofertilizers- AM mycorrhiza				
UNIT - V BIOFERTILIZER MASS PRODUCTION				12
Production of <i>Rhizobium</i> , <i>Azotobacter</i> , <i>Anabena</i> ; Biofertilizers - Storage, shelf life, quality control and marketing				
Total Lecture Hours				60

BOOKS FOR STUDY:

- A.K. Sharma (2006). Hand book of Organic Farming
- A.C.Gaur (2017). Hand book of Organic Farming and Biofertilizers
- N.S. Subbarao (2017). Bio-fertilizers in Agriculture and Forestry (4th Edition) Med tech publisher
- SubbaRao, N. S. (2002). Soil Microbiology. Soil Microorganisms and Plant Growth. (4th Edition), Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Dubey, R. C. (2008). A Textbook of Biotechnology. S. Chand & Co., New Delhi.

BOOKS FOR REFERENCES:

- Masanobu Fukuoka, Frances Moore Lappe Wendell Berry (2009). The One-Straw Revolution: An Introduction to Natural Farming, 1st edition, YRB Classics.
- SujitChakrabarty(2018). Organic Home Gardening Made Easy1st Edition
- Singh and Purohit (2008). Biofertilizer technology. Agrobios, India.
- Bansal M (2019). Basics of Organic Farming CBS Publisher.
- Hurst, C.J., Crawford R.L., Garland J.L., Lipson D.A., Mills A.L. and Stetzenbach

WEB RESOURCES:

- ❖ https://agritech.tnau.ac.in/org_farm/orgfarm_introduction.html
- ❖ <https://www.fao.org/organicag/oa-faq/oa-faq6/en/>
- ❖ <https://www.india.gov.in/topics/agriculture/organic-farming>
- ❖ <https://agriculture.nagaland.gov.in/bio-fertilizer/>
- ❖ <https://vlab.amrita.edu/index.php?sub=3&brch=272>

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		✓	ENTREPRENEURSHIP	
Curriculum Relevance	LOCAL	REGIONAL	NATIONAL			GLOBAL	✓
Changes Made in the Course	Percentage of Change		5	No Changes Made		New Course	

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:	K LEVEL
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After studying this course, the students will be able to:

CO1	Become an entrepreneur with wide knowledge about farming and sustainable resources.	K1 & K2
CO2	Implement organic farming in urban areas with knowledge on compost.	K1 & K2
CO3	Gain knowledge about the bacterial biofertilizers and its advantages	K1 & K2
CO4	Understand the significance about Cyanobacterial and fungal biofertilizers	K1 & K2
CO5	Understand and implement the use of bio fertilizers.	K1 & K2

MAPPING WITH PROGRAM OUTCOMES:										
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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	S	M	M
CO2	S	M	M	S	M	M	S	S	S	S
CO3	M	S	M	M	M	S	M	M	S	M
CO4	S	M	S	M	S	S	S	S	M	S
CO5	M	S	S	S	S	S	S	S	S	S

S- STRONG

M – MEDIUM

L - LOW

CO / PO MAPPING:					
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COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	2	2	2	2	1
CO 2	2	1	1	1	2
CO 3	1	1	2	1	1
CO 4	2	2	1	2	1
CO 5	2	1	2	1	2
WEITAGE	9	7	8	7	7
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS					

LESSON PLAN:			
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UNIT	COURSE NAME	HRS	PEDAGOGY
I	Principle of organic farming Principle of organic farming: principles of health, fairness, ecological balance, and care. Environmental benefits of organic farming: sustainability- reduces non-renewable energy by decreasing agrochemical need. Biodiversity-crop rotation, inter-cropping. Ecological services – biological control, soil formation and nutrient cycling.	12	Chalk & Talk, PPT, Demonstration
II	Gardening Organic farming for urban space; Create a Sustainable Organic Garden (Backyard- Square Foot Gardening, Small Space Gardening, Mini	12	Chalk & Talk, PPT, Demonstration

	Farming), Composting, Vermicomposting.		on
III	Biofertilizers Biofertilizers: Introduction, advantages and future perspective. PSBs Structure and characteristic features of bacterial biofertilizers <i>Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium</i> and <i>Frankia</i> .	12	Chalk & Talk, PPT, Demonstration
IV	Characteristics of Biofertilizer Structure and characteristic features of Cyanobacterial biofertilizers Anabaena, Nostoc; Structure and characteristic features of fungal biofertilizers- AM mycorrhiza.	12	Chalk & Talk, PPT, Demonstration
V	Biofertilizer Mass production Production of <i>Rhizobium, Azotobacter, Anabena</i> ; Biofertilizers -Storage, shelf life, quality control and marketing.	12	Chalk & Talk, PPT, Demonstration

Learning Outcome Based Education & Assessment (LOBE)				
Formative Examination - Blue Print				
Articulation Mapping – K Levels with Course Outcomes (COs)				
Internal	Cos	K Level	Section A	
			MCQs	
			No. of. Questions	K - Level
CI	CO1	K1 – K2	25	K1,K2
AI	CO2	K1 – K2	25	K1,K2
CI	CO3	K1 – K2	25	K1,K2
AII	CO4	K1 – K2	25	K1,K2
Question Pattern CIA I & II		No. of Questions to be asked	50	
		No. of Questions to be answered	50	
		Marks for each question	1	
		Total Marks for each section	50	

* Two Formative examinations will be conducted as a part of Continuous Internal Assessment under which, 50 MCQ's will be asked [50X1=50 marks] from any 4 CO's. (Ist Test-2 CO's & IInd Test-2 CO's) in equal weightage

Distribution of Marks with K Level CIA I & CIA II					
	K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100
CIA II	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)				
S. No	COs	K - Level	Section A (MCQs)	
			No. of Questions	K – Level
1	CO1	K1-K2	15	K1,K2
2	CO2	K1-K2	15	K1,K2
3	CO3	K1-K2	15	K1,K2
4	CO4	K1-K2	15	K1,K2
5	CO5	K1-K2	15	K1,K2
No. of Questions to be Asked			75	
No. of Questions to be answered			75	
Marks for each question			1	
Total Marks for each section			75	
(Figures in parenthesis denotes, questions should be asked with the given K level)				

In summative examinations, 75 MCQ's will be asked [75X1=75 marks] from all 5 CO's in equal weightage.

Distribution of Marks with K Level				
K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidated %
K1	40	40	53	100
K2	35	35	47	
K3				
K4				
Marks		75	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.				

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)



DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	AQUACULTURE			
Course Code	23UMBSC32	L	P	C
Category	SKILL ENHANCEMENT COURSE	2	-	2
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ Provide a deeper knowledge in aquaculture systems and methods.➤ Explain the significance and functions of design, types and construction of aquaculture ponds.➤ Demonstrate the biological characteristics of various aquaculture species.➤ Discuss the methods involved in post stocking management.➤ Illustrate major cultivatable species for aquaculture.				
UNIT - I AQUACULTURE SYSTEMS AND METHODS:				12
Scope and definition. Traditional, extensive, semi - intensive and intensive culture. Monoculture, polyculture, composite culture, mixed culture, mono-sex culture, cage culture, pen culture, raft culture, race way culture.				
UNIT - II AQUACULTURE ENGINEERING:				12
Design and construction of pond, Pond management, lay-out and design of aquaculture farm, construction, water intake system, drainage system - aeration and aerators. Ponds - Types of ponds.				
UNIT - III SELECTION OF SPECIES:				12
Biological characteristics of aquaculture species; economic and market considerations; seed resources collection and transportation. Pre-Stocking Management-Sun drying, ploughing / tilling, desilting, liming and fertilization, eradication of weed fishes. Types of feeds – Live, artificial and probiotic, Stocking Acclimatization of seed and release - species combinations - stocking density and ratio.				
UNIT - IV POST STOCKING MANAGEMENT:				12
Water and soil quality parameters required for optimum production, control of aquatic weeds and aquatic insects, algal blooms and microorganisms. Food conversion ratio (FCR). Growth - Measurement of growth, length - weight relationship.				
UNIT - V MAJOR CULTIVABLE SPECIES FOR AQUACULTURE:				12
Culture of Indian Major Carps. Culture of Giant fresh water prawn, Macrobrachium rosenbergii - seed collection formation sources. Hatchery management. Culture of tiger shrimp, Penaeusmonodon and LitopenaeusVannamei. Culture of pearl oysters. Culture of sea weeds. Methods of Crab culture. Culture of ornamental fishes. Culture of Molluscs.				
Total Lecture Hours				60

BOOKS FOR STUDY:

- Santhanam, R. Velayutham, P. Jegatheesan, G. A (2019). Manual of Freshwater Ecology: An Aspect of Fishery Environment. Daya Publishing House, New Delhi
- Stickney, R.R. (2016). Aquaculture: An Introductory Text. 3rd Edition. Centre for Agriculture and Bioscience International Publishing.
- Ackefors H., Huner J and Konikoff M. (2009). Introduction to the General Principles of Aquaculture. CRC Press.
- Mushlisin Z. A. (2012). Aquaculture. In Tech.
- Akpaniteaku R.C. (2018). Basic Handbook of Fisheries and Aquaculture. AkiNik Publications.

BOOKS FOR REFERENCES:

- Arumugam N. (2014). Aquaculture. Saras Publication.
- Pillay T. V. R. and Kutty M.N. (2005). Aquaculture: Principles and Practices. 2nd Edition. Wiley India Pvt. Ltd.
- Tripathi S. D., Lakra W.S. and Chadha N.K. (2018). Aquaculture in India. Narendra Publishing House.
- Rath R.K.(2011). Fresh Water Aquaculture. 3rd Edition. Scientific Publishers.
- Lucas J. S., Southgate P.C. and Tucker C.S. (2019). Aquaculture: Farming Aquatic Animals and Plants. Wiley Blackwell.

WEB RESOURCES:

- ❖ [Aquaculture: Types, Benefits and Importance \(Fish Farming\) - Conserve Energy Future \(conserve-energy-future.com\)](http://conserve-energy-future.com).
- ❖ [Fisheries Department - Tamil Nadu \(tn.gov.in\)](http://tn.gov.in).
- ❖ [Aquaculture - Google Books](https://books.google.com).
- ❖ [aquaculture | Definition, Industry, Farming, Benefits, Types, Facts, & Methods | Britannica](https://www.britannica.com).
- ❖ [Fisheries & Aquaculture \(investindia.gov.in\)](http://investindia.gov.in).

Nature of Course	EMPLOYABILITY		✓	SKILL ORIENTED		ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change		10	No Changes Made		New Course		

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:										K LEVEL
After studying this course, the students will be able to:										
CO1	Analyze the significance and importance of aquaculture.									K1 & K2
CO2	Illustrate the types and construction of aquaculture ponds.									K1 & K2
CO3	Analyze the biological characteristics of species and choose the best species for aquaculture.									K1 & K2
CO4	Follow methods involved for optimal growth of aquaculture species.									K1 & K2
CO5	Summarize major species suitable for aquaculture in a particular environment.									K1 & K2

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	S	M	S	M	S	M
CO2	S	S	M	S	M	M	S	M	S	L
CO3	M	S	M	M	S	M	S	M	S	L
CO4	S	S	M	M	M	M	S	M	S	L
CO5	M	S	M	M	S	S	S	M	S	L
S- STRONG			M - MEDIUM				L - LOW			

CO / PO MAPPING:						
COS	PSO1	PSO2	PSO3	PSO4	PSO5	
CO 1	3	2	3	3	3	
CO 2	3	2	2	2	1	
CO 3	2	1	1	2	2	
CO 4	2	3	1	2	1	
CO 5	2	3	2	2	1	
WEITAGE	12	11	9	11	8	
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS						

LESSON PLAN:			
UNIT	COURSE NAME	HRS	PEDAGOGY
I	Aquaculture Systems and Methods - Scope and definition. Traditional, extensive, semi - intensive and intensive culture. Monoculture, polyculture, composite culture, mixed culture, mono-sex culture, cage culture, pen culture, raft culture, race way culture.	6	Chalk & Talk, PPT, Demonstration
II	Aquaculture Engineering - Design and construction of pond, Pond management, lay-out and design of aquaculture farm, construction, water intake system, drainage system - aeration and aerators. Ponds - Types of ponds.	6	Chalk & Talk, PPT, Demonstration
III	Selection of Species - Biological characteristics of aquaculture species; economic and market considerations; seed resources, collection and transportation. Pre-Stocking Management-Sun drying, ploughing /	6	Chalk & Talk, PPT, Demonstration

	tilling, desilting, liming and fertilization, eradication of weed fishes. Types of feeds – Live, artificial and probiotic, Stocking - Acclimatization of seed and release - species combinations - stocking density and ratio.		on
IV	Post Stocking Management - Water and soil quality parameters required for optimum production, control of aquatic weeds and aquatic insects, algal blooms and microorganisms. Food conversion ratio (FCR). Growth - Measurement of growth, length - weight relationship.	6	Chalk & Talk, PPT, Demonstration
V	Major cultivable species for aquaculture – Culture of Indian Major Carps. Culture of Giant fresh water prawn, <i>Macrobrachium rosenbergii</i> - seed collection formation sources. Hatchery management. Culture of tiger shrimp, <i>Penaeus monodon</i> and <i>Litopenaeus vannamei</i> . Culture of pearl oysters. Culture of sea weeds. Methods of Crab culture. Culture of ornamental fishes. Culture of Molluscs.	6	Chalk & Talk, PPT, Demonstration

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)				
Internal	Cos	K Level	Section A	
			MCQs	
			No. of. Questions	K - Level
CI	CO1	K1 – K2	25	K1,K2
AI	CO2	K1 – K2	25	K1,K2
CI	CO3	K1 – K2	25	K1,K2
AII	CO4	K1 – K2	25	K1,K2
Question Pattern CIA I & II		No. of Questions to be asked	50	
		No. of Questions to be answered	50	
		Marks for each question	1	
		Total Marks for each section	50	

* Two Formative examinations will be conducted as a part of Continuous Internal Assessment under which, 50 MCQ's will be asked [50X1=50 marks] from any 4 CO's. (Ist Test-2 CO's & IInd Test-2 CO's) in equal weightage

Distribution of Marks with K Level CIA I & CIA II					
	K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100
CIA II	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)				
S. No	COs	K - Level	Section A (MCQs)	
			No. of Questions	K – Level
1	CO1	K1-K2	15	K1,K2
2	CO2	K1-K2	15	K1,K2
3	CO3	K1-K2	15	K1,K2
4	CO4	K1-K2	15	K1,K2
5	CO5	K1-K2	15	K1,K2
No. of Questions to be Asked			75	
No. of Questions to be answered			75	
Marks for each question			1	
Total Marks for each section			75	
(Figures in parenthesis denotes, questions should be asked with the given K level)				

In summative examinations, 75 MCQ's will be asked [75X1=75 marks] from all 5 CO's in equal weightage.

Distribution of Marks with K Level				
K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidated %
K1	40	40	53	100
K2	35	35	47	
K3				
K4				
Marks		75	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.				

FOURTH SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)



DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	IMMUNOLOGY AND IMMUNOTECHNOLOGY			
Course Code	23UMBCC41	L	P	C
Category	CORE COURSE – VII	5	-	4
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ To gain knowledge about immune system, organs of immunity and cells involved.➤ To distinguish the types of antigens and antibodies; their properties.➤ To provide in-depth knowledge on immuno-techniques.➤ To discuss the role of MHC system in transplantation; functions of Tumor specific antigens.➤ To impart knowledge on immunological disorders.				
UNIT - I Organs And Cells in Immune System And Immune Response				12
Primary Lymphoid Organs, Secondary Lymphoid Organs, And Lymphoid Tissues; T – Cell And B –Cell Membrane Bound Receptors – Apoptosis; T - Cell Processing, Physiology Of Immune Response- Innate, Humoral And Cell Mediated Immunity.				
UNIT - II Antigen and Antibody				12
Antigens - Properties of haptens, epitopes, adjuvants, and cross reactivity; Antibodies- structure, properties, classes; Antigen and Antibody Reactions: precipitation, agglutination, complement fixation, opsonization, Vaccines – active and passive immunization; Classification of vaccines; Types of vaccine - antibacterial, antiviral; Vaccination schedule.				
UNIT - III Immunoassay and Immunotechniques				12
Complement system – Classical and Alternate pathways, Raising of monoclonal and polyclonal antibodies; Purification of antibodies. Immunotechniques - RIA, RAST, ELISA, Immuno fluorescence techniques.				
UNIT - IV Transplantation and Tumor Immunology				12
MHC Antigens - structure and function; Transplantation immunology - tissue transplantation and grafting; Mechanism of graft acceptance and rejection; HLA typing; Tumor specific antigens; Immune response to tumors.				
UNIT - V Immunological disorders and diseases				12
Hypersensitivity reactions (Type I, II, III and IV); Acquired Immunodeficiency Syndrome; Auto immune disorders and diseases. organ specific and non-organ specific.				
Total Lecture Hours				60

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

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

WEB RESOURCES:

- ❖ <https://www.ncbi.nlm.nih.gov/books/NBK279395/>
- ❖ <https://med.stanford.edu/immunol/phd-program/ebook.html>
- ❖ <https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/pages/lecture-notes/>
- ❖ [Immunology Overview - Medical Microbiology - NCBI Bookshelf \(nih.gov\)](#)
- ❖ [Immunology - an overview | ScienceDirect Topics](#)

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		✓	ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL	REGIONAL		NATIONAL		GLOBAL		✓
Changes Made in the Course	Percentage of Change		35	No Changes Made		New Course		

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Assess the fundamental concepts of immunity, contributions of the organs and cells in immune responses.	K1 to K4
CO2	Investigate the structures of Ag and Ab; Immunization.	K1 to K4
CO3	Justify the Immunoassay and Immunotechniques.	K1 to K4
CO4	Explain about the immunologic processes governing graft rejection and therapeutic modalities for immunosuppression in transplantation	K1 to K4
CO5	Analyze the overreaction by our immune system leading to hypersensitive conditions and its consequences.	K1 to K4

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	L	M	L	S	L	M	M	L
CO2	M	L	L	M	M	L	L	L	M	L
CO3	S	M	L	S	S	L	S	L	L	M
CO4	S	L	M	S	S	L	L	S	M	M
CO5	S	S	L	S	M	M	L	L	L	M
S- STRONG			M - MEDIUM				L - LOW			

CO / PO MAPPING:					
COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	1	1	1	2	3
CO 2	1	2	1	2	2
CO 3	3	1	2	3	3
CO 4	1	2	1	1	3
CO 5	2	1	1	1	2
WEITAGE	8	7	6	9	13
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS					

LESSON PLAN:			
UNIT	COURSE NAME	HRS	PEDAGOGY
I	Organs and Cells in Immune System and Immune Response: Primary lymphoid organs, secondary lymphoid organs, and lymphoid tissues; T – cell and B –cell membrane bound receptors – apoptosis; T - cell processing, presentation and regulation; T –cell subpopulation, properties, functions and T – cell suppression; Physiology of immune response- innate, humoral and cell mediated immunity; Immunohematology.	12	Chalk & Talk, PPT
II	Antigen and Antibody: Antigens - Properties of haptens, epitopes, adjuvants, and cross reactivity; Antibodies- structure, properties, classes; Antigen and Antibody Reactions: precipitation, agglutination,	12	Chalk & Talk,

	complement fixation, opsonization, Vaccines – active and passive immunization; Classification of vaccines; Types of vaccine - antibacterial, antiviral; Vaccination schedule.		PPT
III	Immunoassay and Immunotechniques - Complement system – Classical and Alternate pathways, Raising of monoclonal and polyclonal antibodies; Purification of antibodies. Immunotechniques - RIA, ELISA, Immuno fluorescence techniques.	12	Chalk & Talk, PPT
IV	Transplantation and Tumor Immunology - MHC Antigens - structure and function; Transplantation immunology - tissue transplantation and grafting; Mechanism of graft acceptance and rejection; HLA typing; Tumor specific antigens; Immune response to tumors	12	Chalk & Talk, PPT
V	Immunological disorders and diseases. Hypersensitivity reactions (Type I, II, III and IV); acquired immunodeficiency syndrome; Auto immune disorders and diseases	12	Chalk & Talk, PPT

Learning Outcome Based Education & Assessment (LOBE)						
Formative Examination - Blue Print						
Articulation Mapping – K Levels with Course Outcomes (COs)						
Internal	Cos	K Level	Section A		Section B Either or Choice	Section C Either or Choice
			MCQs			
			No. of Questions	K - Level		
CI	CO1	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AI	CO2	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
CI	CO3	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AII	CO4	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	Section A (Multiple Choice Questions)	Section B (Either / Or Choice)	Section C (Either / Or Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2			2	3.6	25
	K2	2	10		12	21.4	
	K3		10	16	26	46.4	46.4
	K4			16	16	28.6	28.6
	Marks	4	20	32	56	100	100
CIA II	K1	2			2	3.6	7.2
	K2	2	10		12	3.6	
	K3		10	16	26	46.4	46.4
	K4			16	16	46.4	46.4
	Marks	4	20	32	56	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
2	CO2	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
3	CO3	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
4	CO4	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
5	CO5	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	Section A (Multiple Choice Questions)	Section B (Either or Choice)	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.6	4
K2	5	20		25	17.8	18
K3		30	32	62	44.3	44
K4			48	48	34.3	34
Marks	10	50	80	140	100	100

NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.

Summative Examinations - Question Paper – Format

Q. No.	Unit	CO	K-level		
Answer ALL the questions			PART – A		(10 x 1 = 10 Marks)
1.	Unit - I	CO1	K1	a)	b)
				c)	d)
2.	Unit - I	CO1	K2	a)	b)
				c)	d)
3.	Unit - II	CO2	K1	a)	b)
				c)	d)
4.	Unit - II	CO2	K2	a)	b)
				c)	d)
5.	Unit - III	CO3	K1	a)	b)
				c)	d)
6.	Unit - III	CO3	K2	a)	b)
				c)	d)
7.	Unit - IV	CO4	K1	a)	b)
				c)	d)
8.	Unit - IV	CO4	K2	a)	b)
				c)	d)
9.	Unit - V	CO5	K1	a)	b)
				c)	d)
10.	Unit - V	CO5	K2	a)	b)
				c)	d)

Answer ALL the questions				PART – B	(5 x 5 = 25 Marks)
11. a)	Unit - I	CO1	K2		
OR					
11. b)	Unit - I	CO1	K2		
12. a)	Unit - II	CO2	K3		
OR					
12. b)	Unit - II	CO2	K3		
13. a)	Unit - III	CO3	K2		
OR					
13. b)	Unit - III	CO3	K2		
14. a)	Unit - IV	CO4	K3		
OR					
14. b)	Unit - IV	CO4	K3		
15. a)	Unit - V	CO5	K3		
OR					
15. b)	Unit - V	CO5	K3		

Answer ALL the questions				PART – C	(5 x 8 = 40 Marks)
16. a)	Unit - I	CO1	K3		
OR					
16. b)	Unit - I	CO1	K3		
17. a)	Unit - II	CO2	K4		
OR					
17. b)	Unit - II	CO2	K4		
18. a)	Unit - III	CO3	K3		
OR					
18. b)	Unit - III	CO3	K3		
19. a)	Unit - IV	CO4	K4		
OR					
19. b)	Unit - IV	CO4	K4		
20. a)	Unit - V	CO5	K4		
OR					
20. b)	Unit - V	CO5	K4		



MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)

DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	IMMUNOLOGY AND IMMUNOTECHNOLOGY PRACTICAL			
Course Code	23UMB41	L	P	C
Category	CORE COURSE –VIII- PRACTICAL IV	-	4	4
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ To gain hands-on knowledge to identify Blood group and typing.➤ To acquire adequate skill to perform latex agglutination reactions.➤ To analyze precipitation reactions in gels.➤ To investigate the antigen & antibody reactions in electrophoresis.➤ To familiarize with Separation of Lymphocytes.				
UNIT - I Blood Grouping				12
Identification of blood group and typing.				
UNIT - II Antiglobulin Test				12
Coomb's test. Latex Agglutination reactions- RF, ASO, CRP				
UNIT - III Ouchterlony's Double Diffusion Method				12
Ouchterlony's Double Diffusion Method (antigen pattern).				
UNIT - IV Electrophoresis				12
Serum, Counter and Immuno.				
UNIT - V ELISA:				12
Hepatitis/ HIV				
Total Lecture Hours				60

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

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

WEB RESOURCES:

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

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		✓	ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change		No Changes Made		✓	New Course		
*Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.								

COURSE OUTCOMES:										K LEVEL
After studying this course, the students will be able to:										
CO1	Assess the blood groups and types									K1 to K4
CO2	Competently perform serological diagnostic tests such as RF, ASO, CRP									K1 to K4
CO3	Illustrate the antigen antibody reactions in gel.									K1 to K4
CO4	Compare & contrast antigens and antibodies in electrophoresis									K1 to K4
CO5	Examine the concept of ELISA.									K1 to K4

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	L	M	L	S	S	S	M	L	M
CO2	L	L	M	S	M	M	S	M	L	L
CO3	L	M	L	L	M	S	M	S	M	L
CO4	L	L	L	L	M	M	M	S	M	L
CO5	L	L	L	L	M	M	S	S	M	M
S- STRONG			M – MEDIUM				L - LOW			

CO / PO MAPPING:					
COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	2	1	3	3
CO 2	1	2	1	2	2
CO 3	2	2	1	2	1
CO 4	1	2	2	3	3
CO 5	3	2	3	2	2
WEITAGE	10	10	8	12	11
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS					

LESSON PLAN:			
UNIT	COURSE NAME	HRS	PEDAGOGY
I	Identification of blood group and typing.	12	Chalk & Talk, PPT, Demonstration
II	Coomb's test. Latex Agglutination reactions- RF, ASO, CRP	12	Chalk & Talk PPT, Demonstration
III	Ouchterlony's Double Diffusion Method (antigen pattern).	12	Chalk & Talk PPT, Demonstration
IV	Electrophoresis - Serum, Counter and Immuno.	12	Chalk & Talk PPT, Demonstration
V	ELISA: Hepatitis/ HIV	12	Chalk & Talk PPT, Demonstration

**Learning Outcome Based Education & Assessment (LOBE)
Formative Examination - Blue Print
Articulation Mapping – K Levels with Course Outcomes (COs)**

INTE RNA L	COs	K LEVEL	MAJOR	MINOR	SPOTTERS	RECORD	VIVA
CI AI	CO1	K1					5
	CO2	K2				5	
	CO3	K3			5		
	CO4	K4		5			
	CO5	K4	5				
Question Pattern	No. of Questions to be asked	2 (A-Written B-Practical Demo)	2 (A- Written B- Practical Demo)	2	1	5	
	No. of Questions to be answered	2	2	2	1	5	
	Marks for each question	A-10 B-5	A-5 B-5	2.5	10	1	
	Total Marks for each section	15	10	5	5	5	

Distribution of Marks with K Level

	K Level	Major	Minor	Spotters	Record	Viva	Total Marks	% of Marks without choice	Consolidated %
CIA	K1	-	-	-	-	5	5	12.5	12.5
	K2	-	-	-	5	-	5	12.5	12.5
	K3	-	-	5	-	-	5	12.5	12.5
	K4	-	10	-	-	-	10	25	25
	K4	15					15	37.5	37.5
	Marks	15	10	5	5	5	40	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)							
EXTERNAL	COs	K LEVEL	MAJOR	MINOR	SPOTTERS	RECORD	VIVA
CI AI	CO1	K1					5
	CO2	K2				10	
	CO3	K3			20		
	CO4	K4		20			
	CO5	K4	25				
Question Pattern	No. of Questions to be asked	2 (A-Written B-Practical Demo)	2 (A-Written B-Practical Demo)	2	1	5	
	No. of Questions to be answered	2	2	2	1	5	
	Marks for each question	A-15 B-5	A-10 B-5	5	10	1	
	Total Marks for each section	20	15	10	10	5	

Distribution of Marks with K Level CIA									
	K Level	Major	Minor	Spotters	Record	Viva	Total Marks	% of Marks without choice	Consolidated %
CIA	K1					5	5	8.33	8.33
	K2				10		10	16.66	16.66
	K3			10			10	16.66	16.66
	K4		15				15	25	25
	K4	20					20	33.33	33.33
	Marks	20	15	10	10	5	60	100	100

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)



DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	FOOD PROCESSING TECHNOLOGY			
Course Code	23UMBAC41	L	P	C
Category	ALLIED	4	-	3
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ To provide knowledge on objectives of food preservation.➤ To explain the freshness criteria and quality assessment of meat and fish.➤ To outline the methods of milk processing and fermented milk products.➤ To explain the importance of fat and oil processing.➤ To discuss the methods of microbiological examination of foods.				
UNIT - I FOOD PRESERVATION METHODS				12
Introduction to food preservation, Intrinsic and extrinsic factors influencing microbial growth in foods, objectives and techniques of food preservation. Preservation: principles of high temperature, low temperature, radiation, chemical preservatives and bio preservatives.				
UNIT - II PACKAGING METHODS				12
Freshness criteria and quality assessment of meat and fish –spoilage and methods of preservation. Production of by-products after processing waste and their utilization. Role of packaging material, types of packaging material.				
UNIT - III FERMENTATION TECHNOLOGY				12
Composition of milk; assessment of milk, thermal processing of fluid milk-pasteurization (LTH, HTST&UHT techniques). Fermented milk products-cheese, Butter milk, Yogurt, Kumis, Kefir and Acidophilus milk. Hygiene and sanitation requirement in food processing and fermentation industries.				
UNIT - IV NUTRITION				12
Importance of fats and oils in Food-Extraction of fats and Oils-Rendering, pressing, solvent extraction, pressing of oil-degumming, refining, bleaching, deodorization, fractionation, pyrolysis of fats, toxicity of frying oil.				
UNIT - V FOOD BORNE DISEASES				12
Methods for the microbiological examination of foods. Food borne infections and intoxications. Microbial cultures for food fermentation. Indian Factories Act on safety, HACCP, Safety from adulteration of food.				
Total Lecture Hours				60

BOOKS FOR STUDY:

- Avantina Sharma. (2006). Text Book of Food Science and Technology, International Book Distributing Co, Lucknow, UP.
- Sivasankar. (2005). Food Processing and Preservation, 3rd Edition.,Prentice hall of India Pvt Ltd,NewDelhi.
- Ramaswamy H & Marcotte M. (2006). Food Processing: Principles & Applications. Taylor & Francis.
- NIIR Board of Food and Technologist. (2005). Modern Technology of Food Processing and Agrobased industries, National Institute of Industrial Research, Delhi.
- Adams M.R. and Moss M. O (2007). Food Microbiology. New Age International.

BOOKS FOR REFERENCES:

- Fellos P. J. (2005). Food Processing Technology: Principle &Practice 2ndEdition. CRC.
- Peter Zeuthen and Leif Bogh-Sorenson. (2005). Food Preservation Techniques, Woodland Publishing Ltd, Cambridge, England.1
- Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Pilar Cano. (2004). Novel Food Processing Technologies, CRC.
- Suman Bhatti, Uma Varma. (1995). Fruit and vegetable processing organizations and institutions, 1st Edition., CBS Publishing, New Delhi.
- Mirdula Mirajkar, Sreelatha Menon. (2002). Food Science and Processing Technology Vol-2, Commercial processing and packaging, Kanishka publishers, New Delhi.

WEB RESOURCES:

- ❖ <https://sites.google.com/a/uasd.in/ecourse/food-processing-technology>
- ❖ <https://nptel.ac.in/courses/126105015>
- ❖ <https://engineeringinterviewquestions.com/biology-notes-on-food-adulteration/>
- ❖ [food processing | Definition, Purpose, Examples, & Facts | Britannica](#)
- ❖ [Food Processing Technology | Food News & Views Updated Daily \(foodprocessing-technology.com\)](#)

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		✓	ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL	REGIONAL		NATIONAL		GLOBAL		✓
Changes Made in the Course	Percentage of Change		No Changes Made		New Course		✓	

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:										K LEVEL
After studying this course, the students will be able to:										
CO1	Assess the fundamental concepts of food preservation.									K1 to K4
CO2	Investigate the quality assessment of meat and fish.									K1 to K4
CO3	Design the processing of milk and milk quality assessment.									K1 to K4
CO4	Explain about the importance of fats and oils.									K1 to K4
CO5	Plan the food safety and adulteration detection.									K1 to K4

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	M	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S
S- STRONG			M - MEDIUM				L - LOW			

CO / PO MAPPING:					
COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	1	2	2	2	2
CO 2	2	2	2	1	2
CO 3	2	2	3	2	1
CO 4	1	2	2	1	1
CO 5	1	1	2	2	1
WEITAGE	7	9	11	8	8
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS					

LESSON PLAN:			
UNIT	COURSE NAME	HRS	PEDAGOGY
I	Food Preservation method - Introduction to food preservation - Intrinsic and extrinsic factors influencing microbial growth in foods – objectives and techniques of food preservation. Preservation: principles of high temperature, low temperature, radiation, chemical preservatives and bio preservatives.	12	Chalk & Talk, PPT, Demonstration
II	Packaging Method - Freshness criteria and quality assessment of meat and fish –spoilage and methods of preservation. Production of byproducts after processing waste and their utilization. Role of packaging material, types of packaging material.	12	Chalk & Talk, PPT, Demonstration
III	Fermentation Technology - Composition of milk; assessment of milk, thermal processing of fluid milk-pasteurization (LTH, HTST&UHT techniques). Fermented milk products-cheese, Butter milk, Yogurt, Kumis, Kefir and Acidophilus milk. Hygiene and sanitation requirement	12	Chalk & Talk, PPT, Demonstration

	in food processing and fermentation industries.		
IV	Nutrition - Importance of fats and oils in Food-Extraction of fats and Oils-Rendering, pressing, solvent extraction, pressing of oil-degumming, refining, bleaching, deodorization, fractionation, pyrolysis of fats, toxicity of frying oil.	12	Chalk & Talk, PPT, Demonstration
V	Methods for the microbiological examination of foods. Food borne infections and intoxications. Microbial cultures for food fermentation. Indian Factories Act on safety, HACCP, Safety from adulteration of food.	12	Chalk & Talk, PPT, Demonstration

Learning Outcome Based Education & Assessment (LOBE)						
Formative Examination - Blue Print						
Articulation Mapping – K Levels with Course Outcomes (COs)						
Internal	Cos	K Level	Section A		Section B Either or Choice	Section C Either or Choice
			MCQs			
			No. of Questions	K - Level		
CI	CO1	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AI	CO2	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
CI	CO3	K1 – K4	2	K1, K2	2(K2, K2)	2(K3, K3)
AII	CO4	K1 – K4	2	K1, K2	2(K3, K3)	2(K4, K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		4	4
		No. of Questions to be answered	4		2	2
		Marks for each question	1		5	8
		Total Marks for each section	4		10	16

Distribution of Marks with K Level CIA I & CIA II							
	K Level	Section A (Multiple Choice Questions)	Section B (Either / Or Choice)	Section C (Either / Or Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2			2	3.6	25
	K2	2	10		12	21.4	
	K3		10	16	26	46.4	46.4
	K4			16	16	28.6	28.6
	Marks	4	20	32	56	100	100
CIA II	K1	2			2	3.6	7.2
	K2	2	10		12	3.6	
	K3		10	16	26	46.4	46.4
	K4			16	16	46.4	46.4
	Marks	4	20	32	56	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)						
S. No	COs	K - Level	Section A (MCQs)		Section B (Either / or Choice) With K - LEVEL	Section C (Either / or Choice) With K - LEVEL
			No. of Questions	K – Level		
1	CO1	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
2	CO2	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
3	CO3	K1-K4	2	K1, K2	2(K2, K2)	2(K3, K3)
4	CO4	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
5	CO5	K1-K4	2	K1, K2	2(K3, K3)	2(K4, K4)
No. of Questions to be Asked			10		10	10
No. of Questions to be answered			10		5	5
Marks for each question			1		5	8
Total Marks for each section			10		25	40
(Figures in parenthesis denotes, questions should be asked with the given K level)						

Distribution of Marks with K Level						
K Level	Section A (Multiple Choice Questions)	Section B (Either or Choice)	Section C (Either/ or Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5			5	3.6	4
K2	5	20		25	17.8	18
K3		30	32	62	44.3	44
K4			48	48	34.3	34
Marks	10	50	80	140	100	100

NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.

Summative Examinations - Question Paper – Format

Q. No.	Unit	CO	K-level		
Answer ALL the questions			PART – A		(10 x 1 = 10 Marks)
1.	Unit - I	CO1	K1	a)	b)
				c)	d)
2.	Unit - I	CO1	K2	a)	b)
				c)	d)
3.	Unit - II	CO2	K1	a)	b)
				c)	d)
4.	Unit - II	CO2	K2	a)	b)
				c)	d)
5.	Unit - III	CO3	K1	a)	b)
				c)	d)
6.	Unit - III	CO3	K2	a)	b)
				c)	d)
7.	Unit - IV	CO4	K1	a)	b)
				c)	d)
8.	Unit - IV	CO4	K2	a)	b)
				c)	d)
9.	Unit - V	CO5	K1	a)	b)
				c)	d)
10.	Unit - V	CO5	K2	a)	b)
				c)	d)

Answer ALL the questions				PART – B	(5 x 5 = 25 Marks)
11. a)	Unit - I	CO1	K2		
OR					
11. b)	Unit - I	CO1	K2		
12. a)	Unit - II	CO2	K3		
OR					
12. b)	Unit - II	CO2	K3		
13. a)	Unit - III	CO3	K2		
OR					
13. b)	Unit - III	CO3	K2		
14. a)	Unit - IV	CO4	K3		
OR					
14. b)	Unit - IV	CO4	K3		
15. a)	Unit - V	CO5	K3		
OR					
15. b)	Unit - V	CO5	K3		

Answer ALL the questions				PART – C	(5 x 8 = 40 Marks)
16. a)	Unit - I	CO1	K3		
OR					
16. b)	Unit - I	CO1	K3		
17. a)	Unit - II	CO2	K4		
OR					
17. b)	Unit - II	CO2	K4		
18. a)	Unit - III	CO3	K3		
OR					
18. b)	Unit - III	CO3	K3		
19. a)	Unit - IV	CO4	K4		
OR					
19. b)	Unit - IV	CO4	K4		
20. a)	Unit - V	CO5	K4		
OR					
20. b)	Unit - V	CO5	K4		



MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)

DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	VACCINE TECHNOLOGY			
Course Code	23UMBSC41	L	P	C
Category	SKILL ENHANCEMENT COURSE	2	-	2
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ To provide knowledge on the basics of immunization and induction of immunity.➤ To learn the types of vaccines, its immunological effects and regulatory guidelines.➤ To learn the role of rDNA in vaccine technology.➤ To provide the knowledge on conventional to recent technology of vaccine production.➤ To learn about ethical issues and regulations in vaccine production and clinical trials.				
UNIT - I FUNDAMENTALS OF VACCINE TECHNOLOGY:				12
History of vaccination, Active and passive immunization; requirements for induction of immunity, Epitopes, characterization and location of APC, MHC and immunogenicity.				
UNIT - II INACTIVATED VACCINES:				12
Vaccine and its types: Live, attenuated vaccines, Inactivated vaccines, Subunit Vaccines, Toxoid vaccines, Conjugate vaccines, DNA vaccines, Recombinant Vector vaccines. Methods of vaccine preparation. Bacterial Vaccines- Anthrax, Cholera and Diphtheria vaccines, Viral vaccines- Polio, Rabies and Hepatitis A & B vaccines, Parasitic Vaccine- Malaria vaccine.				
UNIT - III VACCINE TECHNOLOGY				12
Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein-based vaccines, plant-based vaccines, Peptide vaccines, conjugate vaccines. Recent advances in Malaria, Tuberculosis, HIV.				
UNIT - IV VACCINE DESIGNING:				12
Fundamental research to rational vaccine design. Antigen identification and delivery, Rationale vaccine design based on clinical requirements: Scope of future vaccine strategies.				
UNIT - V REGULATIONS IN VACCINE TECHNOLOGY:				12
Vaccine additives, Regulation and testing of vaccines, Regulation of vaccines in developing countries, Quality control and regulations in vaccine research, Animal testing, Rational design to clinical trials, large scale production, Commercialization. Vaccine safety ethics and Legal issues.				
Total Lecture Hours				60

BOOKS FOR STUDY:

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

BOOKS FOR REFERENCES:

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

WEB RESOURCES:

- ❖ <https://www.bio.fiocruz.br/en/images/stories/pdfs/mpti/2013/selecao/vaccine-processtechnology.pdf>
- ❖ https://www.dcvmn.org/IMG/pdf/ge_healthcare_dcvmn_introduction_to_pd_for_vaccine_production_29256323aa_10mar2017.pdf
- ❖ <https://www.sciencedirect.com/science/article/pii/B9780128021743000059>
- ❖ https://www.researchgate.net/publication/313470959_Vaccine_Scaleup_and_Manufacturing

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		✓	ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change		40	No Changes Made			New Course	

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Explain the significance of critical antigens, immunogens and adjuvants in developing effective vaccines.	K1 & K2
CO2	Understand the types of vaccines.	K1 & K2
CO3	Construct vaccine applying rDNA technology.	K1 & K2
CO4	Formulate the strategies for developing an innovative vaccine technology with different mode of vaccine delivery.	K1 & K2
CO5	Evaluate the regulatory issues and guidelines for the management of vaccine production.	K1 & K2

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	S	M	M	M	S	M	M
CO2	S	S	S	S	S	M	S	M	M	M
CO3	M	S	S	S	S	S	M	S	S	M
CO4	L	S	S	S	S	S	S	M	L	M
CO5	L	M	L	L	M	L	M	M	M	L
S- STRONG			M – MEDIUM				L - LOW			

CO / PO MAPPING:					
COS	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	2	3	2
CO 2	3	3	3	3	1
CO 3	1	3	3	3	2
CO 4	1	3	3	2	2
CO 5	1	2	1	2	1
WEITAGE	9	14	12	13	8
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS					

LESSON PLAN:			
UNIT	COURSE NAME	HRS	PEDAGOGY
I	History of vaccination, Active and passive immunization; requirements for induction of immunity, Epitopes, characterization and location of APC, MHC and immunogenicity.	6	Chalk & Talk
II	Vaccine and its types: Live, attenuated vaccines, Inactivated vaccines, Subunit Vaccines, Toxoid vaccines, Conjugate vaccines, DNA vaccines, Recombinant Vector vaccines. Methods of vaccine preparation. Bacterial Vaccines- Anthrax, Cholera and Diphtheria vaccines, Viral vaccines- Polio, Rabies and Hepatitis A & B vaccines, Parasitic Vaccine- Malaria vaccine.	6	Chalk & Talk
III	Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein-based vaccines, plant-based vaccines, Peptide	6	Chalk & Talk

	vaccines, conjugate vaccines. Recent advances in Malaria, Tuberculosis, HIV		
IV	Fundamental research to rational vaccine design. Antigen identification and delivery, Rationale vaccine design based on clinical requirements: Scope of future vaccine strategies.	6	Chalk & Talk
V	Vaccine additives, Regulation and testing of vaccines, Regulation of vaccines in developing countries, Quality control and regulations in vaccine research, Animal testing, Rational design to clinical trials, Large scale production, Commercialization. Vaccine safety ethics and Legal issues.	6	Chalk & Talk

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)				
Internal	Cos	K Level	Section A	
			MCQs	
			No. of. Questions	K - Level
CI	CO1	K1 – K2	25	K1,K2
AI	CO2	K1 – K2	25	K1,K2
CI	CO3	K1 – K2	25	K1,K2
AII	CO4	K1 – K2	25	K1,K2
Question Pattern CIA I & II		No. of Questions to be asked	50	
		No. of Questions to be answered	50	
		Marks for each question	1	
		Total Marks for each section	50	

* Two Formative examinations will be conducted as a part of Continuous Internal Assessment under which, 50 MCQ's will be asked [50X1=50 marks] from any 4 CO's. (Ist Test-2 CO's & IInd Test-2 CO's) in equal weightage

Distribution of Marks with K Level CIA I & CIA II					
	K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100
CIA II	K1	30	30	60	100
	K2	20	20	40	
	K3				
	K4				
	Marks	50	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)				
S. No	COs	K - Level	Section A (MCQs)	
			No. of Questions	K – Level
1	CO1	K1-K2	15	K1,K2
2	CO2	K1-K2	15	K1,K2
3	CO3	K1-K2	15	K1,K2
4	CO4	K1-K2	15	K1,K2
5	CO5	K1-K2	15	K1,K2
No. of Questions to be Asked			75	
No. of Questions to be answered			75	
Marks for each question			1	
Total Marks for each section			75	
(Figures in parenthesis denotes, questions should be asked with the given K level)				

In summative examinations, 75 MCQ's will be asked [75X1=75 marks] from all 5 CO's in equal weightage.

Distribution of Marks with K Level				
K Level	Section A (Multiple Choice Questions)	Total Marks	% of (Marks without choice)	Consolidated %
K1	40	40	53	100
K2	35	35	47	
K3				
K4				
Marks		75	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.				



MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)

DEPARTMENT OF MICROBIOLOGY

FOR THOSE WHO JOINED IN 2023-2024 AND AFTER

Course Name	APICULTURE			
Course Code	23UMBSC42	L	P	C
Category	SKILL ENHANCEMENT COURSE	2	-	2
COURSE OBJECTIVES:				
<ul style="list-style-type: none">➤ To understand the biology of honey bees.➤ To study on honey bee colony establishment.➤ To develop knowledge on honey extraction.➤ To understand the diseases of honey bees and their control.➤ To gain information on financial assistance and funding agencies for bee keeping industry.				
UNIT - I BIOLOGY OF BEES:				6
Honeybee – Systematic position – Species of Honey bees – Life history of Honey bee – behaviour – swarming – Pheromone.				
UNIT - II SOCIAL LIFE IN BEES:				6
Bee colony – Castes – natural colonies and their yield – Types of bee hives – Structure – location, care and management.				
UNIT - III BEE REARING:				6
Apiary – Care and Management – Artificial bee hives – types – construction of spaceframes – Selection of sites – Handling – Maintenance – Instruments employed in Apiary – Extraction instruments.				
UNIT - IV BEE ECONOMY:				6
Honey – Composition – uses – Bee wax and its uses – yield in national and international market – Diseases of honey bees and their control methods. Economics of bee culture.				
UNIT - V ENTREPRENEURSHIP:				6
Venture – Preparing proposals for financial assistance and funding agencies – Bee Keeping Industry, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens.				
Total Lecture Hours				60

BOOKS FOR STUDY:

- Dewey M. Caron. (2013). Honey Bee Biology and Beekeeping. Revised Edition. Wicwas Press, Kalamazoo. ISBN 10: 1878075292
- R. A. Morse. (1993). Rearing queen honey bees. Wicwas press, NY. ISBN-10 : **1878075055**
- Ted Hooper. (2010). Guide to Bees & Honey: The World's Best Selling Guide to Beekeeping. Northern Bee Books. Oxford. ISBN 10: 1904846513.
- Jayashree K. V., Tharadevi C.S. and Arumugam N. (2014) Apiculture. Saras Publication.
- Raj H. (2020). Vinesh Text Book of Apiculture. S. Vinesh and Co.

BOOKS FOR REFERENCES:

- Dewey M. Caron. (2020). The Complete Bee Handbook: History, Recipes, Beekeeping Basics, and More, Rockridge Press. ISBN-10 : 1646119878
- Joachim Petterson. (2016). Beekeeping: A Handbook on Honey, Hives & Helping the Bees, Weldon Owen.
- Eva Crane. (1999). The World History of Beekeeping and Honey Hunting. Routledge. India. ISBN-10 : 0415924677
- Pagar B. S. (2016). Textbook Of Apiculture. Sahitya Sagar.
- Sehgal P.K. (2018). Text Book of Sericulture, Apiculture and Entomology. Kalyani.

WEB RESOURCES:

- ❖ **Bee Keeping Basics. Retrieved from:**
<https://denton.agrilife.org/files/2013/08/beekeeping-basics.pdf>
- ❖ **Beekeeping as an Entrepreneurship, Retrieved from:**
<https://lupinepublishers.com/agriculture-journal/pdf/CIACR.MS.ID.000270.pdf>
- ❖ **Raising Bumble Bees at Home: A Guide to Getting Started. Retrieved from:**
<https://www.ars.usda.gov/ARSUserFiles/20800500/BumbleBeeRearingGuide.pdf>
- ❖ **Apiculture – Biology for Everybody (homeomagnet.com)**
- ❖ **Apiculture: Introduction to Apiculture (iasri.res.in)**

Nature of Course	EMPLOYABILITY		SKILL ORIENTED		✓	ENTREPRENEURSHIP		
Curriculum Relevance	LOCAL		REGIONAL		NATIONAL		GLOBAL	✓
Changes Made in the Course	Percentage of Change		40	No Changes Made			New Course	

***Treat 20% as each unit (20*5=100%) and calculate the percentage of change for the course.**

COURSE OUTCOMES:		K LEVEL
After studying this course, the students will be able to:		
CO1	Understand the systematic position and life history of honey bee.	K1 & K2
CO2	Reveal the different stages and types of bees and discuss about the care and management of apiculture.	K1 & K2
CO3	Describe the practice of bee rearing process and analyze instruments employed in apiary.	K1 & K2
CO4	Compare and contrast the composition of honey and bee wax and interpret the yield in National and International markets.	K1 & K2
CO5	Clarify the proposal for financial assistance and funding agencies and reveal the modern methods employed in artificial bee hives.	K1 & K2

MAPPING WITH PROGRAM OUTCOMES:										
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S								S
CO2	S	S		S	S					
CO3		S		S	M					S
CO4				S	M		S	S		M
CO5					S			S	S	S
S- STRONG			M - MEDIUM				L - LOW			

CO / PO MAPPING:						
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WEITAGE	11	13	10	11	10	
WEIGHTED PERCENTAGE OF COURSE CONTRIBUTION TO POS						

LESSON PLAN:			
UNIT	COURSE NAME	HRS	PEDAGOGY
I	Biology of Bees: Honeybee – Systematic position – Species of Honey bees – Life history of Honey bee – behaviour – swarming – Pheromone.	6	Chalk & Talk
II	Social life in Bees: Bee colony – Castes – natural colonies and their yield – Types of bee hives – Structure – location, care and management.	6	Chalk & Talk
III	Bee Rearing: Apiary – Care and Management – Artificial bee hives – types – construction of space frames – Selection of sites – Handling – Maintenance – Instruments employed in Apiary – Extraction instruments.	6	Chalk & Talk
IV	Bee Economy: Honey – Composition – uses – Bee wax and its uses – yield in national and international market – Diseases of honey bees and their control methods. Economics of bee culture.	6	Chalk & Talk

V	Entrepreneurship: venture – Preparing proposals for financial assistance and funding agencies – Bee Keeping Industry, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens.	6	Chalk & Talk
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