MICROBIOLOGY

Syllabus

Program Code: UMB

2021- Onwards

MANNAR THIRUMALAI NAICKER COLLEGE(AUTONOMOUS)

Re-accredited with "A" Grade by NAAC

PASUMALAI, MADURAI – 625 004

Eligibility for Admission

Candidates should have passed the Higher Secondary Examination conducted by the board of Higher Secondary Education, Government of Tamil Nadu or equivalent examination conducted by other states of India with Science as one of the subjects in Higher Secondary Education.

Subjects of Study

Part I : Tamil / Company Secretarial Practice and Modern Office Management

Part II : English

Part III :

1. Core Subjects
2. Allied Subjects
3. Electives

Part IV :

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

Part V :

Extension Activities

Pattern of the question paper 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 x01= 04 Marks

Part –B

Three short answers questions (answer all) 3 x02= 06 Marks

Part –C

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

Part –D

Two questions out of three 1 x 10 =10 Marks

Total 30 Marks

The scheme of Examination for Part-I, II & III

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	--5 marks
Assignment	--5 marks

Total	25 Marks

Pattern of the question paper for the Summative Examinations:

Note: Duration- 3 hours

Part –A

Ten multiple choice questions 10 x01 = 10 Marks

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

Part –B

Short answer questions (one question from each unit) 5 x02 = 10 Marks

Part –C

Five Paragraph questions (‘either …. or ‘type) 5 x 05 = 25 Marks

(One question from each Unit)

Part –D

Three Essay questions out of five 3 x 10 =30 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)

Pattern of the questions paper for the continuous Internal Assessment

45 MCQs will be asked for each internal assessment tests (45 x 1=45 Marks**) and converted for 15 marks**

The components for continuous internal assessment are:

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

Total	25 Marks

Summative Examination Pattern

Pattern of the Question Paper for Skill Based Papers (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

The Scheme of Examination (Environmental Studies and Value Education)

Two tests and their average	--15 marks
Project Report	--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.

Question Paper Pattern

(Internal Assessment)

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

45 MCQs will be asked for each internal assessment tests (45 x 1=45 Marks**) and converted for 15 marks**

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

Total		25 Marks

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

Pattern of the Question Paper for (Internal Examination & Summative Examination)

Internal Examinations	- - 40 Marks
Summative Examinations	- - 60 Marks
	100

Minimum Marks for a Pass

40% of the aggregate (Internal +Summative Examinations).
No separate pass minimum for the Internal Examinations.
27 marks out of 75 is the pass minimum for the Summative Examinations

Vision

To provide excellent educational opportunities with quality and morality for eminent performance in laboratories and research centers in the discipline of microbiology.

Mission

1. To inculcate the fundamental concepts of microbiology in the student community.
2. To enhance the practical skills of the student in the various fields of microbiology.
3. To increase the competency potential of the students and to outshine in the competitive world.
4. To nurture budding entrepreneurs in the student community and to make them successful entrepreneurs.
5. To cater the requirements of the student's community in accomplishing their life goals.

The 12 Graduate Attributes*:

1. (KB) A knowledge base for engineering: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.
2. (PA) Problem analysis: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions
3. (Inv.) Investigation: An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data and synthesis of information in order to reach valid conclusions.
4. (Des.) Design: An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.
5. (Tools) Use of engineering tools: An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.
6. (Team) Individual and teamwork: An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
7. (Comm.) Communication skills: An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write

effective reports and design documentation, and to give and effectively respond to clear instructions.

8. (Prof.) Professionalism: An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
9. (Impacts) Impact of engineering on society and the environment: An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.
10. (Ethics) Ethics and equity: An ability to apply professional ethics, accountability, and equity.
11. (Econ.) Economics and project management: An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.
12. (LL) Life-long learning: An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge

WA	Graduate Attributes	Caption as
1	A knowledge base for engineering: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.	**Knowledge base**
2,3	Problem analysis: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions. Investigation: An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data and synthesis of information in order to reach valid conclusions	**Problem Analysis & Investigation**
7,4	Communication skills: An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions. Design: An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.	**Communication Skills & Design.**

6	Individual and teamwork: An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting	**Team**
8,10	Professionalism: An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest. Ethics and equity: An ability to apply professional ethics, accountability, and equity.	**Professionalism, Ethics and Equity**
12	Life-long learning: An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge	**Digital Literacy & Life-long Learning**

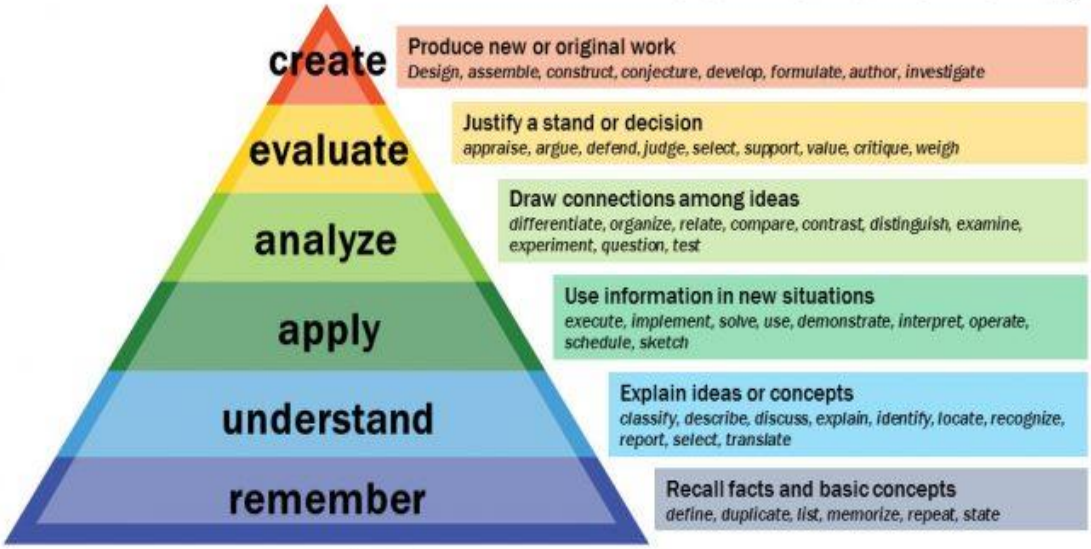
PROGRAM EDUCATIONAL OBJECTIVE (PEOs) are:	
PEO1:	Enable the students to pursue post- graduation in reputed National and International Institutes
PEO2:	Enable the students to carryout multidisciplinary research activities to execute national & international research projects
PEO3:	They can be placed in agriculture/ fertilizer sectors
PEO4:	They can also be employed in clinical research and hospital sector
PEO5:	Students can be placed in Biotech / Pharma industry
PEO6	To help the students in accomplishing their dream jobs.

PO NO	**PROGRAMME OUTCOMES (Pos)**	**Caption as**
At the end of the programme, the students will be able to		
PO – 1	Demonstrate the knowledge and understanding of science concepts and its relevant fields.	**Disciplinary Knowledge**
PO – 2	Identify, formulate, analyse complex problems and reach valid conclusions using the methodologies of science.	**Problem Solving**
PO – 3	Employ critical and analytical thinking in understanding the concepts and apply them in various problems appearing in different branches of science.	**Analytical Reasoning & Critical Thinking**
PO – 4	Communicate the known concepts effectively within the profession and with any forum	**Communication Skills**

PO – 5	Function successfully as a member / leader in any team and to apply ethics, accountability and equity in their life.	**Team Work and Moral/Ethical Awareness**
PO – 6	Use ICT tools in various learning situations, related information sources, suitable software to analyze data and furthermore participating in learning activities throughout life to meet the demands of work place through knowledge / up-skilling / re-skilling	**Digital Literacy & Life-long Learning**

PROGRAM SPECIFIC OUTCOME (PSOs)	
Students who graduate with a Bachelor of Science in Microbiology will	
PSO1:	Acquire knowledge on fundamentals of microbiology and understand on historical perspective of microbiology, different types and structure of microbes and scope of various branches of microbiology.
PSO2:	Gain Knowledge on growth of microbes and microbial metabolism and get to know about the microbes in food and environment.
PSO3:	Realize the application and productions of vermicompost and bioinoculants and understand the soil microorganisms and biogeochemical cycles prevail in environment.
PSO4:	Gain insight on cells and organs of the immune system and understand on various immunological reactions, techniques and autoimmune diseases.
PSO5:	Assimilate technical skills on microbial genetics. Realize the application-oriented aspects of microbiology in mushroom and spirulina cultivation. Understand the concepts on agriculture microbiology and able to know about global environmental problems.
PSO6:	Develop training in the safe handling of medically important microorganisms and microorganisms from different sources, to sharpen the microbiological skills as an entrepreneur.

Bloom's Taxonomy



MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS), MADURAI
MICROBIOLOGY CURRICULUM
(For the student admitted during the academic year 2021-2022 onwards)

Course Code	Title of the Course	Hrs	Credits	Maximum Marks		
				Int	Ext	Total
FIRST SEMESTER						
Part – I	**Tamil / Alternative Course**					
21UTAG11	இக்காலக் கவிதையும் நாடகமும்	6	3	25	75	100
Part – II	**English**					
21UENG11	Communicative English-I	6	3	25	75	100
Part – III	**Core Courses**					
21UMBC11	General Microbiology	5	5	25	75	100
21UMBCP1	General Microbiology - Practical	3	2	40	60	100
Part III	**Allied Course**					
21UCHA11	Chemistry I: Biochemistry	4	4	25	75	100
21UCHAP1	Chemistry Practical: Volumetric analysis	2	0	-	-	-
Part IV	**Skill Based Course**					
21UMBS11	Bioinstrumentation and Microbial techniques	2	2	25	75	100
Part IV	**Mandatory Subject**					
21UEVG11	Environmental Studies	2	2	25	75	100
	Total	**30**	**21**	**190**	**510**	**700**
SECOND SEMESTER						
Part – I	**Tamil / Alternative Course**					
21UTAG21	**இடைக்கால இலக்கியமும் சிறுகதையும்**	6	3	25	75	100
Part – II	**English**					
21UENG21	Communicative English -II	6	3	25	75	100
Part – III	**Core Courses**					
21UMBC21	Microbial Physiology	5	5	25	75	100
21UMBCP2	Microbial Physiology - Practical	3	2	40	60	100
Part III	**Allied Course**					
21UCHA21	Chemistry-II: Industrial chemistry	4	4	25	75	100
21UCHAP1	Chemistry Practical: Volumetric analysis	2	2	40	60	100
Part IV	**Skill Based Course**					
21UMBS21	Mushroom and Spirulina cultivation	2	2	25	75	100
Part IV	**Mandatory Subject**					
21UVLG21	Value Education	2	2	25	75	100
	Total	**30**	**23**	**230**	**570**	**800**

THIRD SEMESTER						
Part – I	**Tamil / Alternative Course**					
21UTAG31	காப்பிய இலக்கியமும் உரைநடையும்	6	3	25	75	100
Part – II	**English**					
21UENG31	Communicative English -III	6	3	25	75	100
Part – III	**Core Courses**					
21UMBC31	Microbial Genetics and Molecular biology	5	4	25	75	100
21UMBCP3	Microbial Genetics and Molecular biology – Practical	3	2	40	60	100
Part III	**Allied Course**					
21UMBA31	Biotechnology -I	4	4	25	75	100
21UMBAP3	Biotechnology – Practical	2	0	-	-	-
Part IV	**Skill Based Course**					
21UMBS31	Vermitechnology	2	2	25	75	100
Part IV	**Non-Major Elective**					
21UMBN31	Microbes in human welfare	2	2	25	75	100
	Total	**30**	**20**	**190**	**510**	**700**
FOURTH SEMESTER						
Part – I	**Tamil / Alternative Course**					
21UTAG41	பண்டைய இலக்கியமும் புதினமும்	6	3	25	75	100
Part – II	**English**					
21UENG41	Communicative English -IV	6	3	25	75	100
Part – III	**Core Courses**					
21UMBC41	Agriculture and Environmental Microbiology	5	4	25	75	100
21UMBCP4	Agriculture and Environmental Microbiology – Practical	3	2	40	60	100
Part III	**Allied Course**					
21UMBA41	Biotechnology -II	4	4	25	75	100
21UMBAP1	Biotechnology – Practical	2	2	40	60	100
Part IV	**Skill Based Course**					
21UMBS41	Immunology and Immunotechniques	2	2	25	75	100
Part IV	**Non-Major Elective**					
21UMBN41	Management of human microbial diseases	2	2	25	75	100
Part V	**Extension Activities**					
21UELAG40-21UELAG49	NSS, NCC, YRC	-	1	40	60	100
	Total	**30**	**23**	**270**	**630**	**900**

FIFTH SEMESTER						
Part – III	**Core Courses**					
21UMBC51	Industrial Microbiology	6	4	25	75	100
21UMBC52	Medical Microbiology	6	6	25	75	100
21UMBCP5	Industrial Microbiology-Practical	3	3	40	60	100
21UMBCP6	Medical Microbiology- Practical	3	3	40	60	100
21UMBIP1	In-Plant Training	5	5	40	60	100
	Core Elective					
21UMBE51 21UMBE52 21UMBE53	Fundamentals of Botany and Zoology Genetics and Biostatistics Cosmetic microbiology	5	5	25	75	100
21UMBE54 21UMBE55 21UMBE56	Genomics in forensic science Cell biology Public health microbiology					
Part IV	**Skill Based Subject**					
21UMBS51	Computer applications in biology	2	2	25	75	100
	Total	**30**	**28**	**220**	**480**	**700**
SIXTH SEMESTER						
Part – III	**Core Courses**					
21UMBC61	Food and Dairy Microbiology	6	5	25	75	100
21UMBC62	Virology	6	5	25	75	100
21UMBCP7	Food and Dairy Microbiology – Practical	5	4	40	60	100
21UMBPR1	Project and Viva - Voce	6	4	40	60	100
	Core Elective					
21UMBE61 21UMBE62 21UMBE63	Biosafety And Intellectual Property Rights Fundamentals of Algae, Fungi and Lichens Marine Microbiology	5	5	25	75	100
21UMBE64 21UMBE65 21UMBE66	Nanotechnology Parasitology Clinical Biochemistry					
Part IV	**Skill Based Subject**					
21UMBS61	Diagnostic Microbiology	2	2	25	75	100
	Total	**30**	**25**	**180**	**420**	**600**
	Grant Total	**180**	**140**	**1280**	**3120**	**4400**


FIRST SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**GENERAL MICROBIOLOGY**			
Course Code	**21UMBC11**	**L**	**P**	**C**
Category	**CORE**	5	-	5

Nature of course:	EMPLOYABILITY	**SKILL ORIENTED**	✓	ENTREPRENURSHIP

Course Objectives:

- To identify and differentiate bacteria and fungi using staining techniques.
- To describe basic concepts of microbiology and provide a foundation for later study in biological sciences.
- The main objective of this course is to give students an insight into the world of microorganisms and to become familiar with the foundation concepts of history of Microbiology.
- To understand the structure and functions of a typical prokaryotic cell.
- To know various Culture media and their applications.
- To demonstrate an understanding of bacterial, algal and fungal classifications, reproduction and significance.

Unit: I	**HISTORY AND DEVELOPMENT OF MICROBIOLOGY**	**15**

Definition - Origin and scope of Microbiology. Spontaneous generation – Biogenesis, Contributions of Leeuwenhoek, Joseph Lister, Louis Pasteur, Robert Koch, Edward Jenner, Sergei N. Winogradsky, Willem Beijerinck, S.A. Waksman and Alexander Fleming.

Unit: II	**SYSTEMS OF CLASSIFICATION**	**15**

Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems. Principles of Classification – morphological, physiological, biochemical, numerical, and molecular taxonomy, Classification of bacteria - Major groups (according to Bergey's manual of Determinative bacteriology- 9th edition).

Unit: III	**BACTERIOLOGY**	**15**

Bacteria: Cell size, shape and arrangement, slime, S layer, capsule, flagella, fimbriae and pili. Cell wall - Gram-positive and Gram-negative and its function. Cytoplasm - Ribosomes, mesosomes, inclusion bodies, Bacterial chromosomes. Endospore - Structure, formation and stages of sporulation. Culture media: liquid, semisolid, solid, natural, synthetic, Semi-synthetic, chemically defined, complex, selective, differential, indicator, enriched, enrichment and transport media.

Unit: IV	**PHYCOLOGY**	**15**

Classification of Algae (F.E. Fritsch and Smith), General Characteristics of Algae including occurrence, Ultrastructure of algae cell thallus organization, pigments, flagella, eyespot food reserves and reproduction (vegetative, asexual and sexual). Morphology and structure of *Chlorella* (Prokaryotes) & *Anabaena* (Eukaryotes). Biological and economic importance of algae.

Unit: V	**MYCOLOGY**	**15**

Classification of fungi (Saccardo and Ainsworth's). General characteristics of fungi including habitat, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, reproduction (sexual and asexual). Economic importance of fungi. Habitat, structure, reproduction and life cycle of fungi - Yeast, *Rhizopus stolonifer* and *Aspergillus niger*.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. Willey J. M, Sandman K and Wood D. **Prescott's Microbiology**, 11th edition, McGraw Hill Higher Education, 2019.
2. Tortora G.J, Funke B.R, Case C.L, Weber D and Bair W. **Microbiology: An Introduction**,13th edition, Pearson Education, 2019.

Books for reference:

1. Madigan M.T and Martinko J.M. **Brock Biology of Microorganisms**, 15th edition, Prentice Hall International Inc, 2017.
2. Lee R.E. **Phycology,** 4th edition, Cambridge University Press,2008.
3. Webster J and Weber R. **Introduction to fungi**, 3rd edition, Cambridge University Press, 2007.
4. Atlas R. M. 1997, **Principles of Microbiology**. 2nd edition. W.M.T. Brown Publishers, 1997.
5. Alexopoulus C.J, Mims C.W, Blackwell C.W. **Introductory Mycology**. 4th edition, Wiley and Sons, 1996.
6. Pelczar M. J, Chan E. C. S and Krieg N. R. **Microbiology** 5th edition. McGraw Hill, 1993.

Web Resources:

1. https://www.brainkart.com/article/Ultrastructure-of-a-Bacterial-cell_32841/
2. https://www.toppr.com/guides/biology/biological-classification/kingdom-fungi/
3. https://www.toppr.com/guides/biology/plant-kingdom/algae/

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Describe the terms of microbiology. Understand and list out the contributions of Microbiologist.	**Up to K2**
CO2:	Understanding the binomial nomenclature and classification of the organisms.	**Up to K3**
CO3:	Differentiate bacteria, prepare culture media and interpret the different cell structure.	**Up to K4**
CO4:	Classify algal structure, reproduction and analyze the biological and economical importance.	**Up to K4**
CO5:	Categorize fungi on its characteristics, reproduction, life cycle and evaluate the economic importance.	**Up to K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**1**	**1**	**3**	**3**	**2**
CO 2	**3**	**2**	**3**	**2**	**2**	**2**
CO 3	**2**	**1**	**1**	**1**	**1**	**2**
CO 4	**3**	**2**	**3**	**2**	**2**	**1**
CO 5	**3**	**2**	**3**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**History and development of Microbiology-** Definition - Origin and scope of Microbiology. Spontaneous generation – Biogenesis. Contributions of Leeuwenhoek, Joseph Lister, Louis Pasteur, Robert Koch, Edward Jenner, Sergei N. Winogradsky, Willem Beijerinck, S.A. Waksman and Alexander Fleming.	**15**	**Chalk & Talk, Power Point**
II	**Systems of classification-** Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems. Principles of Classification – morphological, physiological, biochemical, numerical, and molecular taxonomy, Classification of bacteria - Major groups (according to Bergey's manual of Determinative bacteriology- 9^{th} edition).	**15**	**Chalk & Talk, Power Point**
III	**Bacteriology-** Bacteria: Cell size, shape and arrangement, slime, S layer, capsule, flagella, fimbriae and pili. Cell wall - Gram-positive and Gram-negative and its function. Cytoplasm - Ribosomes, mesosomes, inclusion bodies, Bacterial chromosomes. Endospore - Structure, formation and stages of sporulation. Culture media: liquid, semisolid, solid, natural, synthetic, Semi-synthetic, chemically defined, complex, selective, differential, indicator, enriched, enrichment and transport media.	**15**	**Chalk & Talk, Power Point,**
IV	**Phycology -** Classification of Algae (F.E. Fritsch and Smith), General Characteristics of Algae including occurrence, Ultrastructure of algae cell thallus organization, pigments, flagella, eyespot food reserves and reproduction (vegetative, asexual and sexual). Morphology and structure of *Chlorella* (Prokaryotes) & *Anabaena* (Eukaryotes). Biological and economic importance of algae.	**15**	**Chalk & Talk, Power Point**
V	**Mycology -** Classification of fungi (Saccardo and Ainsworth's). General characteristics of fungi including habitat, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, reproduction (sexual and asexual). Economic importance of fungi. Habitat, structure, reproduction and life cycle of fungi - Yeast, *Rhizopus stolonifer* and *Aspergillus niger*.	**15**	**Chalk & Talk, Power Point, Assignment**

Course Designed by: **1.Dr. S. Rajesh Kannan, Assistant Professor & Head.**
2. Dr. N. Jayanthi, Assistant Professor.

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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1&K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	2(K3&K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	2(K4&K4)
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	3
	No. of Questions to be answered		4		3		2	2
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	3.33	50
	K2	2	6	10	10	28	46.6	
	K3	-	-	10	20	30	50	50
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	30	60	100	100
CIA II	K1	2	-	-	-	2	3.33	17
	K2	2	6	-	-	8	13.3	
	K3	-	-	20	-	20	33.3	33
	K4	-	-	-	30	30	50	50
	Marks	4	6	20	30	60	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 (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Up to K2**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
2	CO2	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
3	CO3	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K4)**
5	CO5	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(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 (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**GENERAL MICROBIOLOGY- PRACTICAL**			
Course Code	**21UMBCP1**	**L**	**P**	**C**
Category	**CORE – PRACTICAL**	-	3	2

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP

Course Objectives:

- To familiarize the students in general microbiology techniques
- To develop a sufficient background about the growth of microbes
- To give knowledge on ubiquitous nature and characteristics of microbes
- To prepare different types of media for culturing microorganisms
- To identify and differentiate bacteria and fungi using staining techniques

List of Experiments:

01. Safety practices in microbiological laboratory.
02. Cleaning of glasswares and sterilization technique.
03. Microscopy – Components and functions of a microscope.
04. Preparation of media: Nutrient broth, Nutrient agar, Potato dextrose agar.
05. Preparation of Differential and Selective media- EMB, MacConkey, SS agar and Blood agar.
06. Pure culture techniques - Spread plate, Pour plate and Streak plate.
07. Storage and revival of microorganisms using agar slant and agar deep (Glycerol stock preparation - theory only).
08. Simple staining, Gram staining and Negative staining.
09. Bacterial motility determination - Hanging drop method.
10. Fungal slide culture technique and Fungal staining: Lactophenol cotton blue mount.
11. Microscopic identification of algae.

	Total Hours	**45 Hrs**

Distribution of marks

Max marks : 100

Internal : 40 marks	**External : 60 marks**
Laboratory Performance : 30 marks	Vivo voce : 10 marks
Observation note book : 10 marks	Record note book : 10 marks
	Procedure and Result : 40 marks
Total : 40 marks	**Total : 60 marks**

Books for Study:

1. Dubey R.C and Maheswari D.K, **Practical Microbiology**, First edition, S. Chand and Company Ltd, New Delhi, 2004.
2. Rajan. S and Selvi Christy, **Experimental Procedures in Life Science** CBS Publishers and distributors, 2019.

Books for reference:

1. James G Cappuccino and Natalie Sherman, **Microbiology: A Laboratory Manual**, sixth

edition, published by Pearson Education, 2004.
2. Aneja K.R, **Experiments in Microbiology, Plant pathology and Biotechnology**, Fourth edition, New Age International Publishers, Chennai, 2005.
3. Reddy S.M, Ram Reddy S, **Microbiology: A Laboratory** Manual, BSC Publishers and Distributors, Hyderabad, 2007.

Web Resources:

https://www.researchgate.net/publication/306018042_Microbiology_Laboratory_Manual
https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC103J-lab-manual.pdf
https://www.researchgate.net/publication/257380059_Laboratory_Manual_in_General_Microbiology_For_Undergraduate_Students_Short_Version

Course Outcomes		K Level
On Successful Completion of Course the student will be able to		
CO1:	Explain the safety principles and working mechanism of instruments associated with microbiology	K2
CO2:	Describe the various methods of sterilization for microbial control.	K2
CO3:	Elaborate the concepts of media preparation, Pure culture techniques, cultivation of microorganism and motility	K2
CO4:	Apply the methods for the isolation of bacteria and Fungi, enumeration of bacteria and staining techniques.	K3
CO5:	Analyze the practical skills in the use of tools, technologies and methods common to microbiology.	K4

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	2	2	1	2	2
CO 2	1	2	2	1	2	3
CO 3	2	1	2	2	3	3
CO 4	2	2	1	1	1	2
CO 5	2	2	3	2	2	2

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Experiments	Topics	Hrs	Mode
1	Safety practices in microbiological laboratory	45 hrs	Demo/Practical/ Videos
2	Cleaning of glasswares and sterilization technique		
3	Microscopy - Components and functions of a microscope		
4	Preparation of media: Nutrient broth, Nutrient agar, Potato dextrose agar		
5	Preparation of Differential and Selective media- EMB, MacConkey, SS agar and Blood agar		
6	Pure culture techniques - Spread plate, Pour plate and Streak plate		
7	Storage and revival of microorganisms using agar slant and agar deep (Glycerol stock preparation theory only)		
8	Simple staining, Gram staining and Negative staining		
9	Bacterial motility determination - Hanging drop method		
10	Fungal slide culture technique and Fungal staining: Lactophenol cotton blue mount		
11	Microscopic identification of algae		

Course Designed by: 1. **Dr. N. Jayanthi, Assistant Professor.**

2. Dr.S. Rajesh Kannan, Assistant Professor & Head.

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**BIOCHEMISTRY**			
Course Code	**21UCHA11**	**L**	**P**	**C**
Category	**Allied**	4	-	4

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**		**ENTREPRENURSHIP**	✓

Course Objectives:

- To Recall the classification of carbohydrates and its structures.
- To Remember the basic properties of carbohydrates, colloids, proteins, enzymes and amino acids.
- To Compare the properties of proteins and amino acids.
- To Perform the structure and functions of dyes, vitamins and enzymes.
- To Determine the various preparation, properties of carbohydrates, colloids, amino acids, proteins, dyes and major constituents of chemistry in medicines.

Unit: I	**CARBOHYDRATES**	12

Carbohydrates: Definition – classification – monosaccharides – properties and uses of glucose and fructose – configuration of glucose and fructose – Haworth structure – conversion of glucose to fructose and vice versa. Disaccharides: Preparation, properties, constitution and configuration of sucrose. Poly saccharides: Preparation and properties of Starch. **Tests for Carbohydrates: Molish's test, Fehlings solution test, Barfoed's test and Benedict's test.**

Unit: II	**COLLOIDS**	12

Colloidal state of matter – various types – classification – Sols – dialysis – electro osmosis – electrophoresis – stability of colloids – protective action – Hardy Schulze law – gold number. Emulsion: Types of emulsions – emulsifier with examples. Gels - classification, preparation-swelling – syneresis – thixotropy – **Application of colloids in foods, medicines, industrial goods and sewage disposal.**

Unit: III	**AMINO ACIDS, PROTEINS AND DYES**	12

Amino acids: Definition – classification – General methods of preparation, properties and uses of amino acids – Glycine and Alanine. Proteins: Definition- Classification and general properties – colour reactions and the relation of amino acids to proteins – Some common proteins and their sources–Haemoglobin and Insulin. Dyes: Definition – theory of colour and constitution – classification based on structure and application – **preparation of methyl orange and bismark brown. Vat dye – Indigo.**

Unit: IV	**VITAMINS, ANTIBIOTICS AND ENZYMES**	12

Vitamins: Classification and biological function of vitamins A, B6, B12, C, D, E, K (structural elucidation not necessary). Antibiotics: Classification and biological function of antibiotics - penicillin, chloroamphenicol, streptomycin, tetracycline (structural elucidation not necessary). Enzymes: Classification and characteristics – biological functions of amylase and protease (structural elucidation not necessary).

Unit: V	**DRUG CHEMISTRY**	12

Different systems of medicine: Ayurveda, Siddha, Homeopathy and Allopathy – History of medicinal chemistry-Characteristics of a good drug. Sulpha drugs – Sulphadiazine, prontosil and prontosil-S (structural elucidation not necessary). Antimalarials – quinine and its derivatives

(structural elucidation not necessary). Arsenical drugs – Salvarasan-606 – Neosalvarsan (structural elucidation not necessary).	
Total Lecture Hours	**60 Hrs**

Books for Study:

1. P.L. Soni and H.M. Chawla, Textbook of Organic Chemistry, S. Chand & Sons, New Delhi, 2007.
2. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 46th Edition, Vishal Publishing Company, New Delhi, 2013.
3. S.C Rastogi, Biochemistry, 2nd Edition, Tata McGraw Hill Publishing Co., New Delhi, 2007.

Books for References:

1. G.T. Sustin, Shreve's Chemical Process Industries, 5th edition, Mc-Graw-Hill, 1984, New Delhi.
2. Jayashree Ghosh, A Textbook of Pharmaceutical Chemistry, 3rd Edition, S. Chand and Company Ltd., New Delhi, 1999.
3. Albert L Lehninger, David L Nelson and Michael M Cox, Lehninger Principles of Biochemistry, 2nd edition, Wiley publisher. 2010.

Web Resources:

1. https://youtu.be/uu_ehbKwADk
2. https://youtu.be/P_-JW-xU-84
3. https://youtu.be/JxK5rZxbyQY
4. https://youtu.be/BUhaP139_Ug

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Recall the general classification of biomolecules and colloids.	**[Up to K2]**
CO2:	Discuss the general methods of preparation, properties and uses of amino acids.	**[Up to K3]**
CO3:	Prepare the methyl orange, bismark brown, malachite green and vat dyes.	**[Up to K3]**
CO4:	Examine the medicinal plants and extraction of steam distillation.	**[Up to K4]**
CO5:	Apply the uses of carbohydrates, amino acids, dyes and enzymes in day today life.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**CARBOHYDRATES** Carbohydrates: Definition – classification – monosaccharides – properties and uses of glucose and fructose – configuration of glucose and fructose – Haworth structure – conversion of glucose to fructose and vice versa. Disaccharides: Preparation, properties, constitution and configuration of sucrose. Poly saccharides: Preparation and properties of Starch. Tests for Carbohydrates: Molish's test, Fehlings solution test , Barfoed's test and Benedict's test.	12	**Chalk, Talk & Power point**
II	**COLLOIDS** Colloidal state of matter – various types – classification – Sols – dialysis – electro osmosis – electrophoresis – stability of colloids – protective action – Hardy Schulze law – gold number. Emulsion: Types of emulsions – emulsifier with examples. Gels - classification, preparation-swelling – syneresis – thixotropy –Application of colloids in foods, medicines, industrial goods and sewage disposal.	12	**Chalk, Talk & Power point**
III	**AMINO ACIDS, PROTEINS AND DYES** Amino acids: Definition – classification – General methods of preparation, properties and uses of amino acids – Glycine and Alanine. Proteins: Definition- Classification and general properties – colour reactions and the relation of amino acids to proteins – Some common proteins and their sources–Haemoglobin and Insulin. Dyes: Definition – theory of colour and constitution – classification based on structure and application – preparation of methyl orange and bismark brown. Vat dye – Indigo.	12	**Chalk, Talk & Power point**
IV	**VITAMINS, ANTIBIOTICS AND ENZYMES** Vitamins: Classification and biological function of vitamins A, B_6, B_{12}, C, D, E, K (structural elucidation not necessary). Antibiotics: Classification and biological function of antibiotics - penicillin, chloroamphenicol, streptomycin, tetracycline (structural elucidation not necessary). Enzymes: Classification and characteristics – biological functions of amylase and protease (structural elucidation not necessary)	12	**Chalk, Talk & Power point**
V	**DRUG CHEMISTRY** Different systems of medicine: Ayurveda, Siddha, Homeopathy and Allopathy – History of medicinal chemistry-Characteristics of a good drug. Sulpha drugs – Sulphadiazine, prontosil and prontosil-S(structural elucidation not necessary). Antimalarials – quinine and its derivatives (structural elucidation not necessary). Arsenical drugs – Salvarasan – 606 – Neosalvarsan (structural elucidation not necessary).	12	**Chalk, Talk & Power point**

Course Designed by: **Dr. R. Satheesh & Dr. A. J. Sunija**

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**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K – Level**	**No. of. Questions**	**K - Level**		
CIA I	**CO1**	**Up to K2**	**2**	**K1&K2**	1	K1	2 (K2&K2)	1(K2)
	CO2	**Up to K3**	**2**	**K1&K2**	2	K2	2 (K3&K3)	2(K2 & K3)
CIA II	**CO3**	**Up to K2**	**2**	**K1&K2**	1	K2	2 (K2&K2)	1(K2)
	CO4	**Up to K4**	**2**	**K1&K2**	2	K2	2 (K3&K3)	2(K3 &K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**67**
	K2	**2**	**4**	**10**	**20**	**36**	**60**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**33**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**30**	**60**	**100**	**100**
CIA II	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**50**
	K2	**2**	**4**	**10**	**10**	**26**	**43.33**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**33**
	K4	**-**	**-**	**-**	**10**	**10**	**16.67**	**17**
	Marks	**4**	**6**	**20**	**30**	**60**	**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	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K 2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Upto K 3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K 3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	**5**	**4**	-	**-**	**9**	**7.5**	**33**
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**CHEMISTRY PRACTICAL: VOLUMETRIC ANALYSIS**				
Course Code	**21UCHAP1**			**L**	**P**	**C**
Category	**Allied Practical**			-	2	-
Nature of Course:	**EMPLOYABILITY**	✓	SKILL ORIENTED	ENTREPRENURSHIP		

Course Objectives:

- To Recollect the practical knowledge of chemistry.
- To Remember the theory of quantitative analysis and safety measures in laboratory.
- To Compare the concept of estimation of acids, bases and ions.
- To Execute the calculations on titrated values.
- To Determine the basic concepts in volumetric analysis

List of Experiments (Any 8)

1. Estimation of strong base.
2. Estimation of strong acid
3. Estimation of oxalic acid.
4. Estimation of ferrous ion
5. Estimation of Copper
6. Estimation of total hardness of water sample by EDTA.
7. Estimation of Dissolved Oxygen in water sample.
8. Estimation of Alkalinity in water sample.
9. Estimation of chloride in water sample
10. Estimation of Glycine.

Distribution of marks

Max marks: 100

Internal : 40 marks **External : 60 marks**

Laboratory Performance	:	30 marks	Vivo voce	:	5 marks
Observation note book	:	10 marks	Record note book	:	10 marks
			Procedure writing	:	15 marks
			Volumetric estimation	:	30 marks
Total	:	40 marks	Total	:	60 marks

For Volumetric Estimation if the student have

Less than 2% Error	-	30 marks
2-3% Error	-	25 marks
3-4% Error	-	20 marks
3-5% Error	-	15 marks
Greater than 5%	-	10 marks

Total Hours **30 Hrs**

Books for Study:

1. Vogel, Text book of Inorganic quantitative analysis, Longman Sc & Tech, 2008.

Books for References:

1. Jeyavathana Samuel, Chemistry Practical Book, G.G.Printers, Chennai, 2012.
2. Vickie.M.Williamson, M.Larry Peck, Lab manual for General Chemistry, Cengage Learning India Private Limited, New Delhi, 2009.

Web Resources:

1. https://youtu.be/xQDQNghs5dc
2. https://youtu.be/AdbK86BnXN8
3. https://youtu.be/dmnElKapQ00

Course Outcomes:		**K Level**
On the completion of the course the student will be able to		
CO1:	Discuss the theory of safety measures in chemistry laboratory.	**[Up to K2]**
CO2:	Understand the qualitative and quantitative analysis in practical chemistry.	**[Up to K3]**
CO3:	Apply the theory on quantitative titration methods.	**[Up to K3]**
CO4:	Analyze the titrated values in tabular format.	**[Up to K4]**
CO5:	Construct the estimated value of the given compounds.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**2**	**1**	**2**	**3**	**3**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**2**	**3**	**1**	**3**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	**List of Experiments (Any 8)**	**Hrs**	**Mode**
I	1. Estimation of strong base. 2. Estimation of strong acid 3. Estimation of oxalic acid. 4. Estimation of ferrous ion 5. Estimation of Copper 6. Estimation of total hardness of water sample by EDTA. 7. Estimation of Dissolved Oxygen in water sample. 8. Estimation of Alkalinity in water sample. 9. Estimation of chloride in water sample 10. Estimation of Glycine.	**30**	**Practical**

Course Designed by: **Dr. R. Satheesh & Dr. A. J. Sunija**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**BIOINSTRUMENTATION AND MICROBIAL TECHNIQUES**							
Course Code	**21UMBS11**					**L**	**P**	**C**
Category	**SKILL**					2	-	2
Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**			✓

Course Objectives:

- To gain knowledge in theoretical background and practical skills in microscopy
- To develop knowledge on principles and applications of various instruments used in biology
- To get idea the related to the methods for separation of biomolecules
- To understand characterize about the bacteriological technique.
- To familiarize the students about the staining technique in biology

Unit: I	**MICROSCOPY**	**6**
Principle and working mechanism of simple, compound, phase contrast and fluorescence microscope. Basics of Electron Microscopy.		
Unit: II	**BASIC LABORATORY INSTRUMENTS**	**6**
Principle, components and applications - pH meter, UV-Visible spectrophotometer Laminar air flow chamber.		
Unit: III	**SEPARATION TECHNIQUES**	**6**
Chromatography – principles, classification and applications - Paper Chromatography, Thin layer, HPLC; Centrifuge – basic principles, types and its applications		
Unit: IV	**BACTERIOLOGICAL TECHNIQUES**	**6**
Pure culture techniques – Serial dilution - Pour, Spread and Streak plate techniques, Sterilization techniques- Physical and Chemical methods, Preservation of microbial cultures – subculturing, lyophilization, slant cultures, storage at low temperature.		
Unit: V	**STAINING TECHNIQUES**	**6**
Principles of staining, simple staining, negative staining, differential staining, Gram's and Acid-Fast Bacillus staining, flagella staining, capsule and endospore staining.		
	Total Lecture Hours	**30 Hrs**

Text Books:

1. Wilson K and Walker J. **Principles and Techniques of Biochemistry and Molecular Biology**, 7th edition., Cambridge University Press, 2010.
2. Pelczar Jr M.J. Chan E.C.S, and Krieg N.R. **Microbiology**. 5th edition Tata McGraw Hill, 2004.
3. Willey J. M, Sandman K and Wood D. **Prescott's Microbiology**, 11thedition, McGraw Hill Higher Education, 2019.

Books for reference:

1. Karp G., **Cell and Molecular Biology: Concepts and Experiments**, 6th edition., John Wiley & Sons. Inc. 2010.
2. De Robertis and De Robertis, **Cell and Molecular Biology**, 8th edition., Wolters Kluwer Pvt. Ltd, 2017.
3. Nigam A and Ayyagari A, **Lab Manual in Biochemistry, Immunology and Biotechnology**, Tata McGraw Hill, 2008.
4. Palanivelu, P. **Laboratory Manual for Analytical Biochemistry & Separation Techniques**, 6th edition, Twenty First Century Publications, 2000.
5. Ghatak, K.L. **Techniques and Methods in Biology**, Kindle edition, PHI Learning Pvt. Ltd. New

Delhi, 2010.
Web Resources: **1.https://microbiologyinfo.com/category/basic-microbiology/** **2.https://microbenotes.com/category/instrumentation/** **3.https://www.biologydiscussion.com/biochemistry**

COURSE OUTCOME		**K Level**
On successful completion of the course, the learners should be able to		
CO1:	Describe the working mechanism and usage of different microscopes	**Up to K2**
CO2:	Apply the basic tools and usage of instruments in the laboratory	**Up to K3**
CO3:	Correlate chromatography principle and classify compounds by Separation techniques	**Up to K4**
CO4:	Demonstrate the Bacteriological techniques	**Up to K3**
CO5:	Outline the different staining techniques.	**Up to K2**

CO & PO Mapping:

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	3	3	1	1
CO 2	3	1	3	3	1	1
CO 3	3	3	3	3	2	2
CO 4	3	2	1	2	1	1
CO5	3	2	1	2	1	1

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Mode
I	**Microscope-** Principle and working mechanism of simple, compound, Phase contrast and Fluorescence microscope. Basics of Electron Microscopy.	**6**	**Chalk and talk, PPT**
II	**Basic laboratory Instruments-**Principle, components and applications - pH meter, Colorimeter, UV-Visible spectrophotometer.	**6**	**Chalk and talk, PPT**
III	**Separation technique-** Chromatography – principles, classification and applications - Paper Chromatography, Thin layer, HPLC; Centrifuge – basic principles, types and its applications.	**6**	**Chalk and talk, PPT**
IV	**Bacteriological techniques** -Pure culture techniques – Serial dilution - Pour, Spread and Streak plate techniques, Sterilization techniques- Physical and Chemical methods, Preservation of microbial cultures – subculturing, lyophilization, sand cultures, storage at low temperature.	**6**	**Chalk and talk, PPT**
V	**Staining technique-** Principles of staining, simple staining, negative staining, differential staining, Gram's and Acid-Fast Bacillus staining, flagella staining, capsule and endospore staining.	**6**	**Chalk and talk, PPT Assignment**

Course Designed by**: 1. Mrs. M. Kayalvizhi**, **Assistant Professor.**
2. Mrs. M.R.S. Saranya, Assistant Professor.


SECOND SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**MICROBIAL PHYSIOLOGY**			
Course Code	**21UMBC21**	**L**	**P**	**C**
Category	**CORE**	5	-	5

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To understand the nutritional requirements of microorganisms and their uptake.
- To elucidate the growth and growth factors of microorganisms.
- To provide knowledge about the metabolic pathways.
- To acquire the knowledge about anaerobic respiration and fermentation of microorganisms.
- To facilitate the understanding on microbial photosynthesis

Unit: I	**MICROBIAL NUTRITION**	**15**

Nutritional requirements of microorganisms – micro and macro elements; Nutritional types of microorganisms - Autotrophs, Heterotrophs, Photoautotrophs, chemoautotrophs, Lithotrophs, Oligotrophs; Transport of nutrients by active and passive transport mechanism.

Unit: II	**MICROBIAL GROWTH**	**15**

Different phases of growth curve - generation time; Nutrition - synchronous growth and continuous cultivation - diauxic growth. Measurement of cell number, Measurement of cell mass, Factors influencing microbial growth.

Unit: III	**AEROBIC RESPIRATION**	**15**

Metabolism - EMP, HMP Shunt, ED Pathway - ATP generation by Substrate level Phosphorylation - TCA cycle - Electron transport chain - ATP generation by Oxidative Phosphorylation.

Unit: IV	**ANAEROBIC RESPIRATION**	**15**

Anaerobic respiration- Nitrate, Methane and sulphur respiration, Fermentation - Alcoholic fermentation, Mixed acid fermentation, Lactic acid fermentation, Butanediol fermentation, Amino acid Fermentation.

Unit: V	**MICROBIAL PHOTO SYNTHESIS**	**15**

Bacterial photosynthesis - Characteristic of Photosynthetic bacteria, Photosynthetic pigments, metabolism in Photosynthetic bacteria, Photosynthetic electron transport system, mechanism of photosynthesis, Dark reaction (Calvin-Benson cycle)

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. Pelczar Jr. M.J. Chan. E.C.S and Kreig. N.R. **Microbiology** McGraw Hill Inc. 5th Edition., New York, 2006.
2. Rajan. S and Selvi Christy **Essentials of Microbiology** CBS Publishers and distributors, 2018.
3. Dubey RC and Maheswari DK. **A Text of Microbiology** Revised edition, S. Chand and Company Ltd., New Delhi, 2012.

Books for reference:

1. Moat A.G. and Foster S.W. **Microbial Physiology**, John Wiley and Sons, 4th Ed. New York, 2004
2. Prescott L.M, J. P Harley and D. A. Klein **Microbiology** International edition, McGraw Hill, Sixth edition, 2005.

3. GeetaSumbali and Mehrotra R.S. **Principles of Microbiology** Tata McGraw Hill P. Ltd., First edition, New Delhi, 2009	
Web Resources:	
https://youtu.be/OmJwEi9ZuL0 **https://youtu.be/05Fl-hSwCzw** **https://youtu.be/8Kn6BVGqKd8**	
Course Outcomes	**K Level**
On the completion of the course the student will be able to	
CO1: Describe about the requirement of microbial nutrition and outline the membrane transport for nutrient uptake of microorganisms.	**[Up to K2]**
CO2: Calculate the generation time as well as to identify the factors involved in growth of microorganisms.	**[Up to K3]**
CO3: Illustrate the metabolic pathway and electron transport chain involved in microbes.	**[Up to K4]**
CO4: Classify the anaerobic respiration and fermentation process involved in microbial cells.	**[Up to K4]**
CO5: Determine the ATP generation during light and dark reaction of bacterial photosynthesis.	**[Up to K3]**

CO & PO Mapping:

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	2	1	3	2	2
CO 2	2	3	3	2	2	3
CO 3	3	2	2	1	3	2
CO 4	2	1	1	2	1	2
CO5	2	2	1	2	1	2

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**MICROBIAL NUTRITION** - Nutritional requirements of microorganisms – micro and macro elements; Nutritional types of microorganisms - Autotrophs, Heterotrophs, Photoautotrophs, chemoautotrophs, Lithotrophs, Oligotrophs; Transport of nutrients by active and passive transport mechanism.	**15**	**Chalk & Talk, Power Point**
II	**MICROBIAL GROWTH** - Different phases of growth curve - generation time; Nutrition - synchronous growth and continuous cultivation - diauxic growth. Measurement of cell number, Measurement of cell mass, Factors influencing microbial growth.	**15**	**Chalk & Talk, Power Point**
III	**AEROBIC RESPIRATION** - Metabolism - EMP, HMP Shunt, ED Pathway - ATP generation by Substrate level Phosphorylation - TCA cycle - Electron transport chain - ATP generation by Oxidative Phosphorylation.	**15**	**Chalk & Talk, Power Point.**
IV	**ANAEROBIC RESPIRATION** - Anaerobic respiration- Nitrate, Methane and sulphur respiration, Fermentation - Alcoholic fermentation, Mixed acid fermentation, Lactic acid fermentation, Butanediol fermentation, Amino acid Fermentation.	**15**	**Chalk & Talk, Power Point**
V	**MICROBIAL PHOTO SYNTHESIS** - Bacterial photosynthesis - Characteristic of Photosynthetic bacteria, Photosynthetic pigments, metabolism in Photosynthetic bacteria, Photosynthetic electron transport system, mechanism of photosynthesis, Dark reaction (Calvin-Benson cycle).	**15**	**Chalk & Talk, Power Point, Assignment.**

Course Designed by: 1.**Mrs. M.R.S. Saranya, Assistant Professor.**
2. Ms. C. Thenmozhi, Assistant Professor.

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**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K – Level**	**No. of. Questions**	**K - Level**		
CIA I	**CO1**	**Up to K2**	**2**	**K1& K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
	CO2	**Up to K3**	**2**	**K1 & K2**	**2**	**K2**	**2(K3&K3)**	**2(K2&K3)**
CIA II	**CO3**	**Up to K4**	**2**	**K1 & K2**	**1**	**K2**	**2(K2&K2)**	**1(K4)**
	CO4	**Up to K4**	**2**	**K1 & K2**	**2**	**K2**	**2(K3&K3)**	**2(K3&K4)**
Question Pattern CIA I & II		No. of Questions to be asked	**4**		**3**		**4**	**3**
		No. of Questions to be answered	**4**		**3**		**2**	**2**
		Marks for each question	**1**		**2**		**5**	**10**
		Total Marks for each section	**4**		**6**		**10**	**20**

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**-**	**-**	**-**	**2**	**3.33**	**67**
	K2	**2**	**6**	**10**	**20**	**38**	**63.34**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**33**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**30**	**60**	**100**	**100**
CIA II	**K1**	**2**	**-**	**-**	**-**	**2**	**3.33**	**34**
	K2	**2**	**6**	**10**	**-**	**18**	**30**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**33**
	K4	**-**	**-**	**-**	**20**	**20**	**33.33**	**33**
	Marks	**4**	**6**	**20**	**30**	**60**	**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	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Up to K2**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
2	CO2	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
3	CO3	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K4)**
5	CO5	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	5	4.16	42
K2	5	10	20	10	45	37.5	
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K1	
16) b	CO1	K1	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**MICROBIAL PHYSIOLOGY - PRACTICAL**							
Course Code	**21UMBCP2**					**L**	**P**	**C**
Category	**CORE – PRACTICAL**					-	3	2
Nature of course:	EMPLOYABILITY	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**			✓

Course Objectives

- To learn the growth pattern of microorganisms.
- To demonstrate the effect of temperature, pH and salinity on the microbial growth.
- To acquire the knowledge about the physiological characteristics of microorganisms.
- To screen the enzymatic potential of microorganisms.
- To provide knowledge about biochemical characteristics of microorganisms.

List of Experiments

1. Determination of growth curve of Bacteria.
2. Effect of Temperature on bacterial growth.
3. Effect of pH on bacterial growth.
4. Effect of Salinity on bacterial growth.
5. Carbohydrate fermentation test.
6. Indole production test
7. Methyl red and Voges- Proskauer test.
8. Citrate utilization test.
9. Triple sugar iron agar test.
10. Catalase test.
11. Nitrate reduction test.
12. Oxidase test.

Total hours | **45**

Distribution of marks

Max marks: 100

Internal : 40 marks | **External : 60 marks**

Laboratory Performance : 30 marks	Vivo voce : 10 marks
Observation note book : 10 marks	Record note book : 10 marks
	Procedure and Result : 40 marks
Total : 40 marks	**Total : 60 marks**

Books for Study:

1. Rajan. S and Selvi Christy **Experimental Procedures in Life Science** CBS Publishers and distributors, 2019.
2. Dubey RC and Maheswari DK. **Practical Microbiology** Revised edition, S. Chand and Company Ltd., New Delhi, 2011.

Books For Reference:

1. James G Cappuccino and Natalie Sherman, **Microbiology: A Laboratory Manual**, tenth edition, published by Pearson Education, United Kingdom 2014
2. Aneja K.R, **Experiments in Microbiology, Plant pathology and Biotechnology**, Fourth edition, New Age International Publishers, Chennai, 2005.

Web Resources:

https://youtu.be/05Fl-hSwCzw
https://youtu.be/az0dXYmXgAg
https://youtu.be/Y3qoP_DtjhM
https://youtu.be/nQxJnI9c1X4
https://youtu.be/7zd2P9F7Vk4
https://youtu.be/7zd2P9F7Vk4
https://youtu.be/XTh4FcW32Ck

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Acquire knowledge on different types of enzymes produced by microbes on fermentation process.	**K2**
CO2:	Represent the factors affecting bacterial growth and methods adopted for microbial growth optimization.	**K2**
CO3:	Identify the microorganisms based on biochemical characteristics.	**K3**
CO4:	Determine the phases of growth of microorganisms.	**K3**
CO5:	Examine the process involved in metabolic activity of microorganisms.	**K4**

CO & PO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**1**	**1**	**2**	**2**
CO 2	**2**	**1**	**3**	**2**	**2**	**3**
CO 3	**2**	**2**	**2**	**3**	**2**	**1**
CO 4	**2**	**3**	**2**	**2**	**3**	**2**
CO5	**1**	**2**	**2**	**2**	**1**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Experiment	Topics	Hrs	Pedagogy
1.	Determination of growth curve of Bacteria.	**45**	**Chalk & Talk, PPT, Practical**
2.	Effect of Temperature on bacterial growth.		
3.	Effect of pH on bacterial growth.		
4.	Effect of Salinity on bacterial growth		
5.	Carbohydrate fermentation test		
6.	Indole Production test		
7.	Methyl red and Voges- Proskauer test.		
8.	Citrate Utilization test		
9.	Triple Sugar Iron Agar test		
10.	Catalase test		
11.	Nitrate Reduction test		
12.	Oxidase test		

Course Designed by: **1. Mrs. M.R.S. Saranya, Assistant Professor**
2. Mrs. M. Kayalvizhi, Assistant Professor

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**INDUSTRIAL CHEMISTRY**			
Course Code	**21UCHA21**	**L**	**P**	**C**
Category	**Allied**	4	-	4

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	**ENTREPRENURSHIP**	✓

Course Objectives:

- To Recall the structure of atom and also know the various model of an atom for the structure of the atoms.
- To Remember the basics of periodic table and atomic properties to relate their principles
- To compare the types of bonds to relate their relations between them.
- To perform the chemical bonding and VSEPR theory and their applications to find the geometry of molecules.
- To Determine the various concepts on Acids and Bases and also know the positions of hydrogen and its properties.

Unit: I	**LABORATORY SAFETY AND THE THEORY OF QUANTITATIVE ANALYSIS**	12

Handling of concentrated acids, bases and hazardous chemicals, Safety precautions, fire hazards, safety and first aid procedures for laboratory accidents - poisoning – universal antidote. Principle of Volumetric Analysis- introduction, standard solutions, indicators, end point, titration curves, Types of titrations-neutralization titration- principle, titration curves and selection of indicators- strong acid - strong base, strong acid –weak base, weak acid- strong base and weak acid –weak base.

Unit: II	**WATER ANALYSIS**	12

Water - Hardness of water - Types - Temporary and permanent hardness - removal of temporary hardness by boiling - removal of permanent hardness by Lime-Soda method and Reverse Osmosis method - – estimation by EDTA method – Domestic water treatment – Determination of Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).

Unit: III	**CHEMISTRY OF SUGAR AND FERMENTATION**	12

Details of manufacture of sucrose from cane sugar – extraction of juice, purification, concentration, crystallization, separation and refining of crystals, recovery of sucrose from molasses. Manufacture of sucrose from beetroot. Estimation of sucrose and inversion sugar by polarimetry. Preparation of alcohol from molasses-preparation of absolute alcohol-manufacture of wine, beer, methylated spirit – power alcohol-estimation of number of hydroxyl groups.

Unit: IV	**OILS, FATS AND WAXES**	12

Classification of oils, fats and waxes: distinction between oil, fats and waxes. Hydrogenation of oils-principle and manufacturing details. Definition and determination of saponification value, acid value, iodine value, RM value and Hehner value and their signification. Elaidin test for oils. Some common waxes like spermaceti, bees wax, bay beery wax and their uses.

Unit: V	**FOOD ADULTERATION AND TESTING METHODS**	12

Introduction-Legal aspects of food adulteration and prevention-Common food adulterants - Analysis of adulterants in Edible Oils, Ghee, Coffee powder, Chilli powder, Turmeric powder, Meat and Milk-Harmful effects of the adulterants – Food additives (Sweeteners, preservatives, flavours and colourants) - Pesticide contaminants (DDT, parathion and malathion) – Toxicants

(Lead, fluorine, cyanogenic compounds and antivitamins).		
	Total Lecture Hours	**60 Hrs**
Books for Study:		
1. Gurdeep R. Chatwal, Sham K. Anand, Instrumental Methods of Chemical Analysis, Himalaya Publishing House, New Delhi, 2013. 2. BK Sharma, Industrial chemistry including chemical engineering - Goel publishing house- 13th Revised and enlarged edition, New Delhi (2009) 3. Bamji MS, Rao NP, Reddy V. 1996, 5. Ed. Text Book of Human Nutrition. Oxford and 1BH publishing Co. Pvt. Ltd.		
Books for References:		
1. B.N. Chakrabarty, Industrial Chemistry, Oxford & IBH. Publishing Co, 198, New Delhi. 2. Jane Bowers, Food Theory and Applications. MacMillan Publishing Company, New Delhi.		
Web Resources:		
1. https://youtu.be/Q5_mNKVVDCc **2. https://youtu.be/O28J1ZmiWTY** **3. https://youtu.be/c07sSJLGF3w** **4. https://youtu.be/34IADhdkvKQ** **5. https://youtu.be/l0BthUI_MMA**		
Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Define the laboratory safety measures and types of water.	**[Up to K2]**
CO2:	Discuss the temporary, permanent hardness of water and its removal methods.	**[Up to K3]**
CO3:	Prepare the sucrose, oils and prevention of food adulterations.	**[Up to K3]**
CO4:	Examine the methods of water analysis and fermentation of sugar processes.	**[Up to K4]**
CO5:	Apply the theory of quantitative analysis in volumetric titrations and contamination process.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**LABORATORY SAFETY AND THE THEORY OF QUANTITATIVE ANALYSIS** Handling of concentrated acids, bases and hazardous chemicals, Safety precautions, fire hazards, safety and first aid procedures for laboratory accidents - poisoning – universal antidote. Principle of Volumetric Analysis- introduction, standard solutions, indicators, end point, titration curves, Types of titrations-neutralization titration- principle, titration curves and selection of indicators- strong acid - strong base, strong acid –weak base, weak acid- strong base and weak acid –weak base.	12	Chalk, Talk & Power point
II	**WATER ANALYSIS** Water - Hardness of water - Types - Temporary and permanent hardness - removal of temporary hardness by boiling - removal of permanent hardness by Lime-Soda method and Reverse Osmosis method - – estimation by EDTA method – Domestic water treatment – Determination of Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).	12	Chalk, Talk & Power point
III	**CHEMISTRY OF SUGAR AND FERMENTATION** Details of manufacture of sucrose from cane sugar – extraction of juice, purification, concentration, crystallization, separation and refining of crystals, recovery of sucrose from molasses. Manufacture of sucrose from beetroot. Estimation of sucrose and inversion sugar by polarimetry. Preparation of alcohol from molasses-preparation of absolute alcohol-manufacture of wine, beer, methylated spirit – power alcohol-estimation of number of hydroxyl groups.	12	Chalk, Talk & Power point
IV	**OILS, FATS AND WAXES** Classification of oils, fats and waxes: distinction between oil, fats and waxes. Hydrogenation of oils-principle and manufacturing details. Definition and determination of saponification value, acid value, iodine value, RM value and Hehner value and their signification. Elaidin test for oils. Some common waxes like spermaceti, bees wax, bay beery wax and their uses.	12	Chalk, Talk & Power point
V	**FOOD ADULTERATION AND TESTING METHODS** Introduction-Legal aspects of food adulteration and prevention-Common food adulterants - Analysis of adulterants in Edible Oils, Ghee, Coffee powder, Chilli powder, Turmeric powder, Meat and Milk-Harmful effects of the adulterants – Food additives (Sweeteners, preservatives, flavours and colourants) - Pesticide contaminants (DDT, parathion and malathion) – Toxicants (Lead, fluorine, cyanogenic compounds and antivitamins).	12	Chalk, Talk & Power point

Course Designed by: **Dr. A. J. Sunija & Dr. R. Satheesh**

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**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K – Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**Up to K2**	**2**	**K1&K2**	1	K1	2 (K2&K2)	1(K2)
	CO2	**Up to K3**	**2**	**K1&K2**	2	K2	2 (K3&K3)	2(K2 & K3)
CI AII	**CO3**	**Up to K2**	**2**	**K1&K2**	1	K2	2 (K2&K2)	1(K2)
	CO4	**Up to K4**	**2**	**K1&K2**	2	K2	2 (K3&K3)	2(K3 &K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**67**
	K2	**2**	**4**	**10**	**20**	**36**	**60**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**33**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**30**	**60**	**100**	**100**
CIA II	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**50**
	K2	**2**	**4**	**10**	**10**	**26**	**43.33**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**33**
	K4	**-**	**-**	**-**	**10**	**10**	**16.67**	**17**
	Marks	**4**	**6**	**20**	**30**	**60**	**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	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K 2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Upto K 3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K 3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	**5**	**4**	-	**-**	**9**	**7.5**	**33**
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**VOLUMETRIC ANALYSIS**				
Course Code	**21UCHAP2**			**L**	**P**	**C**
Category	**Allied Practical**			-	2	2
Nature of Course:	**EMPLOYABILITY**	✓	SKILL ORIENTED	ENTREPRENURSHIP	

Course Objectives:

- To recollect the practical knowledge of chemistry.
- To remember the theory of quantitative analysis and safety measures in laboratory.
- To compare the concept of estimation of acids, bases and ions.
- To execute the calculations on titrated values.
- To determine the basic concepts in volumetric analysis.

List of Experiments (Any 8)

1. Estimation of strong base.
2. Estimation of strong acid
3. Estimation of oxalic acid.
4. Estimation of ferrous ion
5. Estimation of Copper
6. Estimation of total hardness of water sample by EDTA.
7. Estimation of Dissolved Oxygen in water sample.
8. Estimation of Alkalinity in water sample.
9. Estimation of chloride in water sample
10. Estimation of Glycine.

Distribution of marks

Max marks: 100

Internal: 40 marks			External: 60 marks		
Laboratory Performance	:	30 marks	Vivo voce	:	5 marks
Observation note book	:	10 marks	Record note book	:	10 marks
			Procedure writing	:	15 marks
			Volumetric estimation	:	30 marks
Total	:	40 marks	Total	:	60 marks

For Volumetric Estimation if the student have

	Less than 2% Error	-	30 marks
	2-3% Error	-	25 marks
	3-4% Error	-	20 marks
	3-5% Error	-	15 marks
	Greater than 5%	-	10 marks

	Total Hours	**30 Hrs**

Books for Study:

1. Vogel, Text book of Inorganic quantitative analysis, Longman Sc & Tech, 2008.

Books for References:

1. Jeyavathana Samuel, Chemistry Practical Book, G.G.Printers, Chennai, 2012.
2. Vickie.M.Williamson, M.Larry Peck, Lab manual for General Chemistry, Cengage Learning India Private Limited, New Delhi, 2009.

Web Resources:

1. https://youtu.be/xQDQNghs5dc
2. https://youtu.be/AdbK86BnXN8
3. https://youtu.be/dmnElKapQ00

Course Outcomes:		**K Level**
On the completion of the course the student will be able to		
CO1:	Discuss the theory of safety measures in chemistry laboratory.	**[Up to K2]**
CO2:	Understand the qualitative and quantitative analysis in practical chemistry.	**[Up to K3]**
CO3:	Apply the theory on quantitative titration methods.	**[Up to K3]**
CO4:	Analyze the titrated values in tabular format.	**[Up to K4]**
CO5:	Construct the estimated value of the given compounds.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**2**	**1**	**2**	**3**	**3**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**2**	**3**	**1**	**3**	**2**	**1**
Weightage	**10**	**10**	**9**	**11**	**10**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	List of Experiments (Any 8)	Hrs	Mode
I	1. Estimation of strong base. 2. Estimation of strong acid 3. Estimation of oxalic acid. 4. Estimation of ferrous ion 5. Estimation of Copper 6. Estimation of total hardness of water sample by EDTA. 7. Estimation of Dissolved Oxygen in water sample. 8. Estimation of Alkalinity in water sample. 9. Estimation of chloride in water sample 10. Estimation of Glycine.	30	Practical

Course Designed by: **Dr. R. Satheesh & Dr. A. J. Sunija**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**MUSHROOM AND SPIRULINA CULTIVATION**							
Course Code	**21UMBS21**					**L**	**P**	**C**
Category	**SKILL**					2	-	2
Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**			✓

Course Objectives:

- To familiarize the students in edible, medicinal and poisonous mushroom
- To develop a sufficient background various properties of mushroom
- To gain knowledge on cultivation, harvest and preservation of mushroom
- To understand the importance and health benefits of spirulina
- To get idea related to commercial production of spirulina

Unit: I	**INTRODUCTION TO MUSHROOM**	**6**

Introduction and History of mushroom cultivation. Biology of mushroom. Nutritional Properties (Protein, Carbohydrates, Vitamins, Minerals and Fiber content) and medicinal properties of mushroom.

Unit: II	**TYPES AND MANAGEMENT OF MUSHROOM**	**6**

Cultivable edible mushrooms in India and world. Medicinal and Poisonous mushrooms. Management of fungal, viral and bacterial diseases in mushroom -Value added products (Mushroom soup and pickles)

Unit: III	**CULTIVATION AND POST HARVESTING TECHNIQUES OF MUSHROOM**	**6**

Principles and techniques of spawn production and composting - raising a pure culture. Cultivation techniques: White button mushroom - Oyster mushroom – Milky mushroom. Post harvesting techniques - freezing - dry freezing - drying – canning

Unit: IV	**INTRODUCTION TO SPIRULINA**	**6**

Introduction to SCP production – historical use and rediscovery of *Spirulina*, importance – morphology and habitat of *Spirulina* – biochemical composition including proximate composition – amino acids – unsaturated fatty acids – minerals and vitamins. Human health benefits of *Spirulina* - Value added products (Tablets and cookies)

Unit: V	**CULTIVATION OF SPIRULINA**	**6**

Natural production – laboratory cultivation – small scale and mass cultivation (tank construction, culture medium, strain selection, scaling up of the process) of Spirulina – importance of light and pH in *Spirulina* cultivation – harvesting, drying and packing

	Total Lecture Hours	**30 Hrs**

Books for Study:

1. Tripathi D.P, **Mushroom cultivation**, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi, 2005
2. Habib M.A.B., Parvin M., Huntington T.C. and Hasan M.R, **A review on culture, production and use of *Spirulina* as food for humans and feeds for domestic animals and fish.** FAO Fishers and Aquaculture Circular No. 1034, FAO, Rome, Italy, 2008.

Books For Reference:

1. Nita Bahl, **Hand book of mushroom**, fourth edition, Vijay Primlani for Oxford and IBH publishing Co.Pvt.Ltd, New Delhi, 2002.
2. Marimuthu T, Krishnamoorthy AS, Sivaprakasam K and Jayarajan R, **Oyster mushrooms**, Department of Plant pathology, Tamil Nadu Agricultural University, Coimbatore, 1991.
3. **Handbook of mushroom cultivation**,TNAU publications, 1991.

4. Selvendran D, **Large Scale Algal Biomass (*Spirulina*) Production in India**. In: D. Das (Ed.) Algal Biorefinery: An Integrated Approach, Springer, 2015.

Web Resources:

https://nios.ac.in/media/documents/vocational/mushroom_production_(revised)(618)/Lesson-01.pdf
https://www.academia.edu/11324578/Mushroom_Production_and_Processing_Teaching_Note
https://www.slideshare.net/Shashishekhar110/spirulina-cultivation

Course Outcomes		**K Level**
On Successful Completion of Course the student will be able to		
CO1:	Discuss historical aspect, biology, nutritional and medicinal values of mushroom	**Up to K2**
CO2:	Find different types of edible mushroom, medicinal and poisonous mushroom and management of mushroom	**Up to K3**
CO3:	Analyze cultivation techniques, preservation and packing of mushrooms	**Up to K4**
CO4:	Determine the historical aspect, composition and human health benefits of spirulina	**Up to K2**
CO5:	Illustrate cultivation technique, preservation and packing of spirulina	**Up to K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	3	2	2	2
CO 2	3	3	2	2	2	2
CO 3	2	3	2	3	2	3
CO 4	2	2	2	3	2	2
CO 5	3	3	2	2	3	2

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Mode
I	**Introduction to mushroom -** Introduction and History of mushroom cultivation. Biology of mushroom. Nutritional properties (Protein, Carbohydrates, Vitamins, Minerals and Fiber content) and medicinal properties of mushroom	6	**Chalk& talk**
II	**Types and management of mushroom** - Cultivable edible mushrooms in India and world. Medicinal and Poisonous mushrooms. Management of fungal, viral and bacterial diseases in mushroom - Value added products (Mushroom soup, pickles)	6	**Chalk & talk, PPT**
III	**Cultivation and Post harvesting techniques of mushroom -** Principles and techniques of spawn production and composting - raising a pure culture. Cultivation techniques: White button mushroom - Oyster mushroom - Milky mushroom. Post harvesting techniques - freezing - dry freezing - drying – canning	6	**Chalk & talk**
IV	**Introduction to SCP production** – Introduction to SCP production- historical use and rediscovery of *Spirulina* importance – morphology and habitat of *Spirulina* - biochemical composition including proximate composition - amino acids - unsaturated fatty acids - minerals and vitamins. Human health benefits of *Spirulina* - Value added products (Tablets and cookies)	6	**Chalk & talk, PPT**
V	**Cultivation of Spirulina** - Natural production – laboratory cultivation – small scale and mass cultivation (tank construction, culture medium, strain selection, scaling up of the process) of Spirulina – importance of light and pH in *Spirulina* cultivation – harvesting, drying and packing	6	**Chalk & talk, PPT Assignment**

Course Designed by: **1. Dr. N. Jayanthi, Assistant Professor.**
2. Dr. S. Rajesh Kannan, Assistant Professor & Head.


THIRD SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**MICROBIAL GENETICS AND MOLECULAR BIOLOGY**			
Course Code	**21UMBC31**	**L**	**P**	**C**
Category	**CORE**	5	-	4

Nature of course:	EMPLOYABILITY	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP	✓

Course Objectives:

On successful completion of the course, the learners should be able to

- To understand the structure and replication of DNA.
- To know about DNA damage and repair mechanism.
- To understand the central dogma of protein synthesis.
- To describe the basic concepts of codons and anticodons.
- To illustrate application of molecular biology in current research.

Unit: I	**NUCLEIC ACID STRUCTURE, FUNCTION & REPLICATION**	**15**

DNA Structure: Watson and Crick Model. DNA as genetic material-experimental evidence- Griffith experiment. Bidirectional and unidirectional replication, semi- conservative, semi-discontinuous replication. Enzymes involved in DNA replication. RNA structure- Types and its Function.

Unit: II	**DNA DAMAGE AND REPAIR**	**15**

Mutation- fluctuation test and its significance- complementation - Mutagens-chemical and physical mutagens – UV, NTG and hydroxylamine, Auxotrophic mutants. Types of DNA damage and repair.

Unit: III	**GENE TRANSFER MECHANISMS**	**15**

Genetic exchange in Prokaryotes– transformation, transduction (Generalized and Specialized), and conjugation - co-transduction and its use in genetic mapping. Transposons-Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon.

Unit: IV	**CENTRAL DOGMA AND GENE REGULATIONS**	**15**

Central Dogma of Cell- Transcription & Translation in prokaryotes - Post Transcription and Post Translational modification in Prokaryotes. Gene regulations in prokaryotes- Positive operon (Lac Operon) & Negative operon (Trp Operon).

Unit: V	**TECHNIQUES AND APPLICATIONS IN MOLECULAR BIOLOGY**	**15**

PCR : RT-PCR, Real time PCR, DNA Sequencing- Sanger's Sequencing, RFLP & RFPD and its Applications.

	Total Lecture Hours	**75Hrs**

Books for Study:

1.Gene VII. Benjamin Lewin, 2000: Oxford University Press.

2.Brown T. A (2021). Gene Cloning and DNA Analysis: An Introduction. 8th Edition. Wiley and Sons

Books for References:

1. Molecular biology of the Gene,4/e. Watson, Hopkins, Roserts. Steits and Weiner, 1987, The Benjamin/Cumming Publishing Company, Inc.

2. Molecular Genetics of Bacteria, 2/e, Larry Snyder and Wendy Champness, 2003, ASM press. Washington DC.
3. Microbial genetics. David Friefelder, 1987, Narosa Publishing Mouse.
4.Geoffrey Cooper (2018). The Cell: A Molecular Approach 8th Edition. Oxford University Press
5. Russell P. (2010). iGenetics: A Molecular Approach 3rd Edition. Pearson Publishlers

Web Resources:

1.https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/molecular-biology
2. https://www.ncbi.nlm.nih.gov/books/NBK21054/
3. https://open.oregonstate.education/generalmicrobiology/chapter/microbial-genetics/

Course Outcomes		K Level
On the completion of the course the student will be able to		
CO1:	Describe DNA structure and replication.	Up to K2
CO2:	Explain the experiment proving DNA as a genetic material and Types of Mutations.	Up to K3
CO3:	Illustrate gene transfer mechanisms in Prokaryotes	Up to K4
CO4:	Compare the gene expression in prokaryotes and Eukaryotes.	Up to K4
CO5:	Evaluate the genetic codes and protein synthesis.	Up to K3

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	1	2	1	2
CO 2	3	2	2	1	1	2
CO 3	2	3	3	1	1	2
CO 4	3	3	2	2	2	2
CO 5	2	3	2	3	2	2

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**DNA STRUCTURE & ITS REPLICATION-** DNA Structure: Miescher to Watson and Crick Model-Bidirectional and unidirectional replication, semi- conservative, semi- discontinuous replication. Enzymes involved in DNA replication. RNA- Types- Function.	**15**	**Chalk & Talk, Power Point**
II	**DNA AS GENETIC MATERIAL -** DNA as genetic material- experimental evidence- concept of gene and mutations- fluctuation test and its significance- complementation. Mutation-Mutagenes-chemical and physical mutagens – UV, NTG and hydroxylamine Prototrophs - Auxotrophs- DNA damage and repair.	**15**	**Chalk & Talk, Power Point, Assignment**
III	**GENETIC MAPPING -** Genetic exchange in Prokaryotes– transformation, transduction (Generalized and Specialized), and conjugation - co-transduction and its use in genetic mapping- chromosome transfer by Hfr strains. Transposons- Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon	**15**	**Chalk & Talk, Power Point,**
IV	**GENE REGULATIONS -** Central Dogma of Cell- Transcription & Translation in prokaryotes - Post Transcription and Post Translational modification in Eukaryotes. Gene regulations in prokaryotes- Positive operon (Lac Operon) & Negative operon (Trp Operon).	**15**	**Chalk & Talk, Power Point**
V	**PROTEIN SYNTHESIS -** Genetic code, Codons (Triplet codon concept) and Anticodons. Wobble hypothesis. Protein synthesis the process of translation in prokaryotes - factors involved in translation- an overview of comparisons with eukaryotic translation.	**15**	**Chalk & Talk, Power Point**

Course Designed by: **1.Dr. T. Rohini, Assistant Professor.**

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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Up to K2**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
2	CO2	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
3	CO3	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K4)**
5	CO5	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(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 (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**MICROBIAL GENETICS AND MOLECULAR BIOLOGY- PRACTICAL**			
Course Code	**21UMBCP3**	**L**	**P**	**C**
Category	**CORE – PRACTICAL**	-	3	2

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To isolate genomic and plasmid DNA from bacteria.
- To demonstrate spontaneous mutation by gradient plate method.
- To isolate Auxotrophs & Prototrophs by replica plating method.
- To calculate percentage killing of *E.coli* after UV irradiation.
- To Prepare Competent cell.

List of Experiments:

1. Isolation of Genomic DNA from Bacteria.
2. Isolation of Plasmid DNA from bacteria.
3. Demonstration of Electrophoresis
4. Isolation of spontaneous mutation by Gradient plate method.
5. Competent cell preparation.
6. Transformation- Chemical Mediated- Blue white selection.
7. Isolation phage and Phage titration.
8. UV Sensitivity of *E.coli.*
9. Isolation of Lac^- and Lac^+ colonies.
10. Percentage killing of *E.coli* after UV irradiation.

Total Hours | **45 Hrs**

Distribution of marks

Max marks : 100

Internal : 40 marks — **External : 60 marks**

Laboratory Performance : 30 marks
Observation note book : 10 marks

Vivo voce : 10 marks
Record note book : 10 marks
Procedure and Result : 40 marks

Total : 40 marks — **Total : 60 marks**

Books for Study:

1. Brown T.A.1998, Molecular Biology Lab; Gene Analysis, Academic Press, London.
2.Ausubel F.M, Roger B, Robert E. Kingston, David A. Moore, Seidman J.G, John A. Smith and Kelvin S. 1992. Short Protocols in Molecular Biology, Third Edition, John Wiley & Sons Inc., New York.

Books for reference:

1. Rajamanikam C. 2001, Experimental protocols in basic molecular biology, Osho Scientific Publications, Madurai.
2. Kannan N.1996, Laboratory Manual in General Microbiology, First edition, Palani Paramount Publications, Palani.

3. Maloy S.R, Cronan Jr. J.E, Freifelder D. 1994, Microbial genetics, Jones and Barlett publishers.
4. An Introduction to Genetic Analysis, (all editions) by A.J.F. Griffiths, J.H. Miller, D.T. Suzuki, R.C. Lewontin & W.M. Gelbart; W.H. Freeman & Co. Pub.
5. Microbial Genetics, 1994, 2nd Ed, by S.R. Maloy, J.E. Cronan & D. Freifelder; Jones and Bartlett Pub.

Web Resources:

1.https://www.studocu.com/en-gb/document/university-of-manchester/introduction-to-experimental-biology/lac-operon-induction-practical-manual/4831229
2.https://goldbio.com/documents/1031/Blue%20White%20Screening%20of%20Bacterial%20Colonies%20using%20X-Gal%20and%20IPTG%20Plates.pdf.
3. https://www.sciencedirect.com/science/article/pii/S221501611930305X.

Course Outcomes		**K Level**
On Successful Completion of Course the student will be able to		
CO1:	Isolate genomic and plasmid DNA from bacteria.	**K2**
CO2:	Discuss about Blue-white selection.	**K2**
CO3:	Preparation of competent cell.	**K3**
CO4:	Lac- and Lac+ colonies isolation.	**K2**
CO5:	Apply gradient plate method for spontaneous mutation.	**K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	3	2	2	1
CO 2	2	2	3	2	2	2
CO 3	2	3	2	2	1	2
CO 4	2	3	2	2	2	2
CO 5	2	2	2	2	2	2

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Experiments	Topics	Hrs	Mode
1	Isolation & Separation of Genomic DNA from Bacteria.	45 hrs	Demo/Practical/ Videos
2	Isolation & Separation of Plasmid DNA from bacteria.		
3	Isolation of spontaneous mutation by Gradient plate method.		
4	Isolation of Auxotrophs & Prototrophs by replica plating method.		
5	Transformation- Chemical Mediated- Blue white selection.		
6	Isolation phage and Phage titration.		
7	UV Sensitivity of *E.coli.*		
8	Isolation of Lac^- and Lac^+ colonies.		
9	Calculation of percentage killing of *E.coli* after UV irradiation.		
10	Competent cell preparation.		

Course Designed by: 1.**Dr.T.Rohini, ASSISTANT PROFESSO**R

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**BIOTECHNOLOGY - I**							
Course Code	**21UMBA31**						**L**	**P**	**C**
Category	**ALLIED**						4	-	4
Nature of course:	EMPLOYABILITY	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP	✓			

Course Objectives:

- To introduce the basic concepts in Biotechnology.
- To describe the fundamentals in the field of biotechnology and to prepare them for understanding advance concepts.
- To expose the students to the concept of Genetic Engineering.
- To understand the tools and techniques used in Gene Cloning.
- To illustrate the applications of DNA Vectors.

Unit: I	**INTRODUCTION TO BIOTECHNOLOGY**	**12**

Definition and history - Traditional and modern biotechnology, branches and applications of biotechnology, GMOs and LMOs, Pros and Cons of Biotechnology, Commercializing Biotechnology, Biotechnology Companies – International - Monsanto, Syngenta and Indian – Bharat Biotech and Serum Institute of India.

Unit: II	**MANIPULATION OF BIOMOLECULES**	**12**

DNA and proteins - properties, principles of electrophoresis, DNA– Isolation of plasmid and chromosomal DNA – Agarose Gel Electrophoresis, Protein isolation by SDS-PAGE.

Unit: III	**DNA MODIFYING ENZYMES**	**12**

DNA modifying Enzymes - Definition - Restriction Endonucleases – Nomenclature, types and properties - *EcoRI*, *BamHI*, *HindIII*, *AluI* and *ScaI*, Restriction Modification [R-M] system, Blunt-end and sticky end cuts, Exonuclease, Methylase, Ligase, Alkaline phosphatase, S_1/P_1 Nuclease, PNKase, Topoisomerase and Gyrase.

Unit: IV	**RECOMBINANT DNA CONSTRUCTION**	**12**

Vector DNA – Definition, properties of an ideal vector, Structure and properties of cloning vectors – pBR322, M13, plant-based [Ti plasmid], phage vectors [Lambda vectors], hybrid vectors [Cosmids and Phasmids], Shuttle vectors – YACs and BACs, Host cell types for recombinant construction – Prokaryotes [Bacteria] and Eukaryotes [fungi, plants and animals].

Unit: V	**GENE CLONING STRATEGIES**	**12**

Selection of desired DNA for cloning – Linkers, Adapters, Homopolymer tailing and terminal transferase, Steps in the construction of Recombinant DNA [rDNA], Transformation [Heat-shock, electroporation and microprojection] and transfection, Screening of Recombinants [Colony Hybridization, Antibiotic based, Blue-White screening and Immuno-based.

	Total Lecture Hours	**60 Hrs**

Books for Study:

1. **Sathyanarayana U**., 2020, Biotechnology, Books and Allied (P) Ltd.,
2. **Dubey R. C**., 2014, A Textbook of Biotechnology, 5th Ed., S. Chand and Company Ltd.

Books for reference:

1. **Julia Lodge, Pete Lund and Steve Minchin**, 2007, Gene Cloning- Principles and Applications, Library of Congress Cataloging in-Publication data.

2. **Colin Ratledge and Bjorn Kristiansen** – Editors, 2001, Basic Biotechnology, 2nd Ed., Cambridge University Press.
3. **Sandy B. Primrose, Richard Twyman and Bob Old**, 2001, Principles of Gene Manipulation: An Introduction to Genetic Engineering, 6th Ed., Wiley Blackwell Publications.
4. **Bernard R. Glick, Jack J. Pasternak and Cheryl L. Patten**, 2010, Molecular Biotechnology, Principles and Applications of Recombinant DNA, 4th Ed., ASM Press.
5. **Lee Yuan Kun**, 2006, Microbial Biotechnology – Principles and Applications, 2nd Ed., World Scientific Publishing Co.

Web Resources:

1. https://benchfly.com/video/1719/blue-white-screening-explained/
2. https://www.nagwa.com/en/videos/193194203641/
3. https://www.youtube.com/watch?v=bOaQzwHkr-s

Course Outcomes		K Level
On the completion of the course the student will be able to		
CO1:	Understand and appreciate the need for Biotechnology, along with the positive and negative outcomes and become aware of the steps in bringing biotechnology to real life.	**Up to K2**
CO2:	Grasp the fundamental principles involved in working with the elements of recombinant DNA technology	**Up to K3**
CO3:	Perceive the types, functions and importance of various enzymes used in Biotechnology.	**Up to K4**
CO4:	Classify the types of basic tools and steps involved in Gene cloning.	**Up to K4**
CO5:	Master the process of ascertaining the success of cloning.	**Up to K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**1**	**1**	**1**	**2**	**1**	**1**
CO 2	**2**	**3**	**3**	**3**	**3**	**2**
CO 3	**3**	**3**	**2**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**	**3**
CO 5	**3**	**3**	**3**	**3**	**3**	**3**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	Definition and history - Traditional and modern biotechnology, branches and applications of biotechnology, GMOs and LMOs, Pros and Cons of Biotechnology, Commercializing Biotechnology, Biotechnology Companies – International - Monsanto, Syngenta and Indian – Bharat Biotech and Serum Institute of India.	**5**	**Chalk & Talk,**
II	DNA and proteins - properties, principles of electrophoresis, DNA– Isolation of plasmid and chromosomal DNA – Agarose Gel Electrophoresis, Protein isolation by SDS-PAGE.	**10**	**Chalk & Talk, Power Point**
III	DNA modifying Enzymes - Definition - Restriction Endonucleases – Nomenclature, types and properties - *EcoRI*, *BamHI*, *HindIII*, *AluI* and *ScaI*, Restriction Modification [R-M] system, Blunt-end and sticky end cuts, Exonuclease, Methylase, Ligase, Alkaline phosphatase, S_1/P_1 Nuclease, PNKase, Topoisomerase and Gyrase.	**15**	**Chalk & Talk, Power Point,**
IV	Vector DNA – Definition, properties of an ideal vector, Structure and properties of cloning vectors – pBR322, M13, plant-based [Ti plasmid], phage vectors [Lambda vectors], hybrid vectors [Cosmids and Phasmids], Shuttle vectors – YACs and BACs, Host cell types for recombinant construction – Prokaryotes [Bacteria] and Eukaryotes [fungi, plants and animals].	**15**	**Chalk & Talk, Power Point**
V	Selection of desired DNA for cloning – Linkers, Adapters, Homopolymer tailing and terminal transferase, Steps in the construction of Recombinant DNA [rDNA], Transformation [Heat-shock, electroporation and microprojection] and transfection, Screening of Recombinants [Colony Hybridization, Antibiotic based, Blue-White screening and Immuno-based.	**15**	**Chalk & Talk, Power Point, Assignment**

Course Designed by: **1.Dr. S. Subramani, Assistant Professor.**

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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Up to K2**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
2	CO2	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
3	CO3	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K4)**
5	CO5	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions)
Answer All Questions **(10x1=10 marks)**

Q. No	CO	K Level	Questions
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	

Section B (Short Answers)
Answer All Questions **(5x2=10 marks)**

Q. No	CO	K Level	Questions
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	

Section C (Either/Or Type)
Answer All Questions **(5 x 5 = 25 marks)**

Q. No	CO	K Level	Questions
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	

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

Section D (Open Choice)
Answer Any Three questions **(3x10=30 marks)**

Q. No	CO	K Level	Questions
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**BIOTECHNOLOGY- PRACTICAL**			
Course Code	**21UMBAP1**	**L**	**P**	**C**
Category	**ALLIED – PRACTICAL**	-	2	-

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP	

Course Objectives:

- To identify the media preparation methods for plants and animal cell culture
- To understand the principle in plant tissue culture.
- To get acquainted with plant tissue culture medium.
- To construct callus induction and protoplast isolation
- To examine synthetic seeds

List of Experiments:

1. Preparation of MS Media for Plant Tissue Culture
2. Callus induction
3. Protoplast isolation
4. Shoot tip culture
5. Anther culture
6. Preparation of synthetic seeds
7. Preparation of Animal cell culture media
8. Gene transfer technique – Demonstration

Total Hours	**30 Hrs**

Distribution of marks

Max marks : 100

Internal : 40 marks **External : 60 marks**

Laboratory Performance : 30 marks	Vivo voce : 10 marks
Observation note book : 10 marks	Record note book : 10 marks
	Procedure and Result : 40 marks
Total : 40 marks	**Total : 60 marks**

Books for Study:

1.Ashishs verma *et al*., 2014. Laboratory manual for biotechnology, S. Chand & Company Ltd publications.

2.Lisa A. Seidman & Cynthia J. Moore, 1999. Basic Laboratory Methods for Biotechnology, Prentice Hall.

Books for reference:

1. Swami, P.M. 2009. Lab Manual of Biotechnology. Rastogi Publications, Meerut.

2.Anjana R & Joy P.P, 2014. A Plant Biotechnology Laboratory Manual, 1st Edition, Aromatic and Medicinal plants Research station.

Web Resources:

https://www.youtube.com/watch?v=vZ_fsXuENH8 https://www.youtube.com/watch?v=GIpvYMzo05U https://www.youtube.com/watch?v=eMv_PMNPYMc		
Course Outcomes		**K Level**
On Successful Completion of Course the student will be able to		
CO1:	Explain the principles of plant tissue culture.	**K2**
CO2:	Describe the various culture techniques.	**K2**
CO3:	Elaborate the concepts in tissue culture media preparation.	**K2**
CO4:	Apply the methods in synthetic seed development.	**K3**
CO5:	Analyze the practical skills in the use of tools, technologies and methods common to biotechnology.	**K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**2**	**2**	**2**	**1**	**2**	**2**
CO 2	**1**	**2**	**2**	**1**	**2**	**3**
CO 3	**2**	**1**	**2**	**2**	**3**	**3**
CO 4	**2**	**2**	**1**	**1**	**1**	**2**
CO 5	**2**	**2**	**3**	**2**	**2**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Experiments	Topics	Hrs	Mode
1	Preparation of MS Media for Plant Tissue Culture	30 hrs	Demo/Practical/ Videos
2	Callus induction		
3	Protoplast isolation		
4	Shoot tip culture		
5	Anther culture		
6	Preparation of synthetic seeds		
7	Preparation of Animal cell culture media		
8	Gene transfer technique – Demonstration		

Course Designed by:

1. Dr. S. Rajesh Kannan, Assistant Professor & Head.

2. Dr. S. Subramani, Assistant Professor

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**VERMITECHNOLOGY**			
Course Code	**21UMBS31**	**L**	**P**	**C**
Category	**SKILL**	2	-	2
Nature of course:	**EMPLOYABILITY** ✓	**SKILL ORIENTED** ✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To understand the biology of earthworms
- To conceptualize the role of earthworms in agriculture.
- To learn the basics of vermicompost and its applications.
- To get acquainted with the applications of Vermitechnology.
- To understand the factors that promote and suppress the growth of earthworms.

Unit: I	**INTRODUCTION TO VERMICULTURE**	**6**

Vermiculture – Definition and scope, Earthworm – Taxonomy, Morphology and Economic importance.

Unit: II	**HABITAT AND ECOLOGY OF EARTHWORM**	**6**

Habitat – Burrowers, Casts, Nocturnal, Poikilothermal, Ecological Grouping – Epigeic species, Endogeic species and Anecic, with their characteristics.

Unit: III	**ENEMIES OF EARTHWORMS**	**6**

Factors affecting the growth of earthworms – Abiotic – Nutrient content, Moisture, Temperature, pH and Soil texture; Biotic – Competition, Predation and Parasitism.

Unit: IV	**EARTHWORM AS TOOLS IN SUSTAINABLE AGRICULTURE**	**6**

Vermiwash - Definition, Composition, Preparation process and application, Effect of earthworms on soil microorganisms and soil fertility.

Unit: V	**VERMICOMPOSTING**	**6**

Definition, types of vermicomposting – Bed method and pit method, Nutrient profile of Vermicompost, Steps in vermicomposting, Factors affecting vermicomposting, advantages and disadvantages in vermicomposting.

	Total Lecture Hours	**30 Hrs**

Books for Study:

1. **Gupta P.K.**, 2008, Vermicompostingforsustainableagriculture,2nd Ed., Agrobios.
2. **Ismail S.A.**, 1997, Vermitechnology: The biology of Earthworm. Orient Longman.

Books for References:

1. **Bhatnagar & Patla**, 2007. Earthworm vermiculture and vermin-composting, Kalyani Publishers, New Delhi.
2. **Jordan & Verma**,2009, Invertebrate Zoology, Chand & Company Ltd.
3. **Aravind Kumar**, 2000, Verms & Vermitechnology, A.P.H. Publishing Corporation, New Delhi.
4. **Edwards C.A, and Bother, B**. 1996, Biology of Earthworms, Chapman Hall Publ. Co., London.
5. **Talashikar S.C**. 2008, Earthworms in Agriculture, Agrobios.

Web Resources:

COURSE OUTCOME		K Level
On successful completion of the course, the learners should be able to		
CO1:	Get introduced to vermiculture and understand the importance and advantages of Vermiculture.	**Up to K2**
CO2:	Understand the important features and lifestyle of earthworms.	**Up to K3**
CO3:	Get acquainted with the techniques of vermicomposting, its methods, along with its pros and cons.	**Up to K4**
CO4:	Appreciate the concept of applying earthworms as tools in improving agricultural yield.	**Up to K3**
CO5:	Aware of the various biotic and abiotic factors – that affect the growth of earthworms.	**Up to K2**

CO & PO Mapping:

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**1**	**1**	**2**	**1**
CO 2	**3**	**3**	**2**	**2**	**1**	**1**
CO 3	**3**	**3**	**3**	**3**	**3**	**2**
CO 4	**3**	**3**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Mode
I	Vermiculture – Definition and scope, Earthworm – Taxonomy, Morphology and Economic importance.	**6**	**Chalk and talk, PPT**
II	Habitat – Burrowers, Casts, Nocturnal, Poikilothermal, Ecological Grouping – Epigeic species, Endogeic species and Anecics, with their characteristics.	**6**	**Chalk and talk, PPT**
III	Definition, types of vermicomposting – Bed method and pit method, Nutrient profile of Vermicompost, Steps in vermicomposting, Factors affecting vermicomposting, advantages and disadvantages in vermicomposting.	**6**	**Chalk and talk, PPT**
IV	Vermiwash - Definition, Composition, Preparation process and application, Effect of earthworms on soil microorganisms and soil fertility.	**6**	**Chalk and talk, PPT**
V	Factors affecting the growth of earthworms – Abiotic – Nutrient content, Moisture, Temperature, pH and Soil texture; Biotic – Competition, Predation and Parasitism.	**6**	**Chalk and talk, PPT Assignment**

Course Designed by: **Dr. S. Subramani**, Asst. Professor

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**MICROBES IN HUMAN WELFARE**			
Course Code	**21UMBN31**	**L**	**P**	**C**
Category	**NME**	2	-	2

Nature of course:	EMPLOYABILITY	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP	✓

Course Objectives:

- To describe the history of microbiology and contributions to this field.
- To acquire knowledge about role of microbes in the field of agriculture.
- To enable the knowledge about production of antibiotics, vaccines, hormones and other useful products
- To gain an idea about importance of microbes in pharmaceutical field.
- To explain the role of microbes in human health- their sources, prevention and control measures.

Unit: I	**INTRODUCTION TO MICROBIOLOGY**	**6**

Introduction to Microorganisms and History – contributions of Anton Van Leeuwenhoek, Louis Pasteur, Robert Koch and Edward Jenner.

Unit: II	**MICROBES IN AGRICULTURE**	**6**

Role of microbes in Agriculture: Biofertilizer and Biopesticides, Beneficial microorganisms in agriculture- AM Fungi.

Unit: III	**INDUSTRIAL MICROBIOLOGY**	**6**

Role of microbes in industrial products- Food: Yeast, Mushroom, Microalgae and food spoilage organisms.

Unit: IV	**ROLE OF MICROBES IN PHARMACEUTICALS**	**6**

Pharmaceuticals: Production of antibiotics - Penicillin, Vaccines - IPV, Hormones - Steroids, Vitamins – Vitamin B12 , Enzymes – Amylase.

Unit: V	**MICROBES IN HUMAN HEALTH**	**6**

Microbes related to human health- Normal flora of human body and its significance. Source of infection, diseases, prevention and control.

	Total Lecture Hours	**30**

Books for Study:

1. Dubey R.C and Maheswari D.K. 2005, A Text book of Microbiology, S.Chand&Company Ltd, New Delhi.
2. Rangaswami G and Bagyaraj D.J. 2002, Agricultural Microbiology, Second edition, PHIL earning (P) Ltd., New Delhi.

Books for reference:

1. Frazies W.C and Westhoff D.C. 1988, Food microbiology, Fourth edition, McGraw Hill.
2. SubbaRao N.S. 1995, Soil Microorganisms and plant growth, Oxford and IBH publishing Co. Pvt. Ltd.
3. Hugo W.B, Russell A.D.Pharmaceutical Microbiology, Fourthedition, Blackwell scientific publications / Oxford.
4. Powar C.B and Daginawala H.F. 2005, General Microbiology, Volume I & II, Eighth edition, Himalaya Publishing House, Mumbai.
5. Subba Rao N.S. 2000, Soil Microorganisms and Plant Growth, Third Edition, Oxford &

IBH Publishing Co. Pvt. Ltd, New Delhi.
Web Resources:
1.https://byjus.com/neet/important-notes-of-biology-for-neet-microbes-in-human-welfare/ **2.https://www.learncbse.in/microbes-human-welfare-cbse-notes-class-12-biology/** **3.https://www.learncbse.in/microbes-human-welfare-cbse-notes-class-12-biology/**

COURSE OUTCOME		**K Level**
On successful completion of the course, the learners should be able to		
CO1:	Outline the contributions of Anton Van Leeuwenhoek, Louis Pasteur, Robert Koch and Edward Jenner.	**Up to K2**
CO2:	Discover the role of microbes in Agriculture	**Up to K4**
CO3:	Infer the microbial activity in Industrial products.	**Up to K4**
CO4:	Conceptual understanding of role of microbiology in production of pharmaceutical products.	**Up to K3**
CO5:	Acquaint with prevention and control strategies of Diseases.	**Up to K3**

CO & PO Mapping:

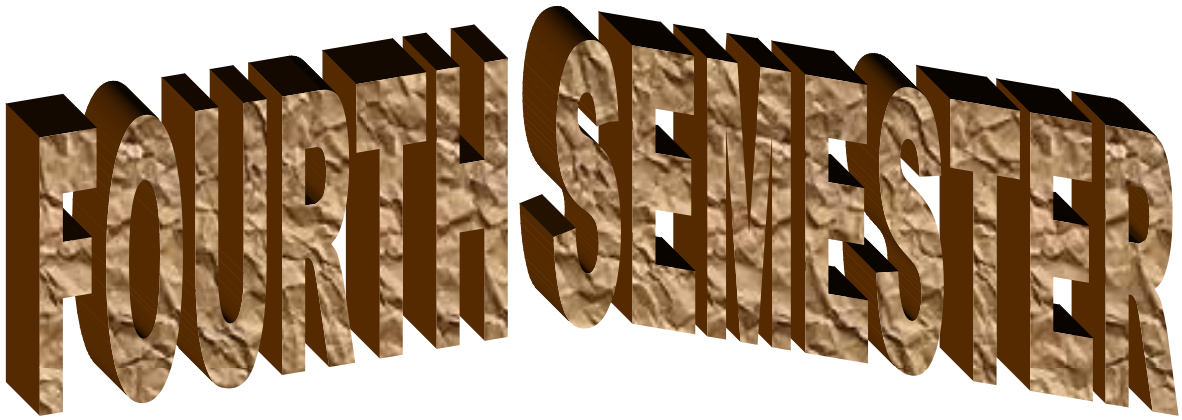
Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**1**	**2**	**2**	**1**	**1**
CO 2	**3**	**3**	**2**	**1**	**3**	**1**
CO 3	**3**	**3**	**2**	**1**	**2**	**2**
CO 4	**2**	**2**	**3**	**2**	**1**	**1**
CO5	**2**	**3**	**2**	**2**	**1**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Mode
I	**INTRODUCTION TO MICROBIOLOGY-** Introduction to Microorganisms and History – contributions of Anton Van Leeuwenhoek, Louis Pasteur and Edward Jenner.	**6**	**Chalk and talk, PPT**
II	**ROLE OF MICROBES IN PHARMACEUTICAL INDUSTRIES-** Pharmaceuticals: Production of antibiotics, Vaccines, Harmons, Vitamins, enzymes and aminoacids.	**6**	**Chalk and talk, PPT**
III	**INDUSTRIAL MICROBIOLOGY-** Role of microbes in industrial products- Food: Yeast, Mushroom, Microalgae and food spoilage organisms.	**6**	**Chalk and talk, PPT Assignment**
IV	**MICROBES IN AGRICULTURE-** Role of microbes in Agriculture: Biofertilizer and biopesticides, Beneficial microorganisms in agriculture- AM Fungi.	**6**	**Chalk and talk, PPT**
V	**MICROBES IN HUMAN HEALTH-** Microbes related to human health- Source of infection, diseases, prevention and control. Normal flora of human body and its significance.	**6**	**Chalk and talk, PPT**

Course Designed by: 1.**Dr.T.Rohini**, **Assistant Professor.**


FOURTH SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY**			
Course Code	**21UMBC41**	**L**	**P**	**C**
Category	**CORE**	5	-	4

Nature of course: **EMPLOYABILITY** ✓ **SKILL ORIENTED** ✓ **ENTREPRENURSHIP** ✓

Course Objectives:

- To study the importance of soil microorganisms and soil fertility and zones of soil microbes and its importance.
- To understand the nitrogen fixers and role of microorganisms in plants.
- To gain the knowledge about microbes present in soil.
- To understand how to isolate and identify microorganisms from the various water sources to check the Potability of water.
- To enable the students to explore knowledge about the treatment of sewage water.

Unit: I	**SOIL MICROBIOLOGY**	**15**

Soil microbiology: Soil - General properties -Soil micro flora - Microbes in soil surface and different zones of soil – Role of microbes in soil fertility – Soil and environmental influence on microbes - Decomposition of plant and animal residues by microorganisms in soil.

Unit: II	**BIOGEOCHEMICAL CYCLES**	**15**

Biogeochemical cycles- Carbon, Nitrogen, Phosphorus and Sulphur Cycle; Nitrogen fixers – Root nodule formation – Nitrogenase, Hydrogenase – Biochemistry of nitrogen fixation.

Unit: III	**PLANT PATHOLOGY**	**15**

Plant diseases - Mode of entry of pathogens, Symptoms, Disease cycle and Control Measures. Bacterial disease –Angular leaf spot of Cotton, Fungal disease - Blast disease of paddy and Viral disease- Bunchy top of banana.

Unit: IV	**MICROBIOLOGY OF AIR AND WATER**	**15**

Microbiology of air - Microbes in aerosol - Assessment of quality of air - Air sanitation - Air borne diseases and their control measures**. Microbiology of water** - Potability of water, Indicator organisms, Microbial assessment of water quality, MPN technique, Water purification, Water borne diseases and their control measures.

Unit: V	**SEWAGE TREATMENT**	**15**

Microbiology of sewage – Chemical and Biological characteristics of sewage – BOD and COD – Sewage treatment- Physical, Chemical and Biological – Aerobic and Anaerobic (Trickling filter, Activated sludge) Treatment- Disposable of wastes.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. Subba Rao N.S. 2000, Soil Microorganisms and Plant Growth, Third Edition, Oxford &

IBH Publishing Co. Pvt. Ltd, New Delhi.

2. Atlas R.A& Bartha R.2000, Microbial Ecology, Fundamentals and Application, Benjamin

Cummings, New York.

Books for References:

1. Rangaswami G and Bagyaraj D.J. 2002, Agricultural Microbiology, Second edition, PHIL earning

(P) Ltd., New Delhi.

2. Sharma, P.D. 2001, Plant Pathology, First edition. Rastogi Publications.

3. Mitchell R. 1974, Introduction to Environmental Microbiology, Prentice Gall Inc.,

Englewood Cliffs.

Web Resources:

1. Soil profile- **https://www.youtube.com/watch?v=nEShY_S_KGc**

2. Agriculture research institute **- https://www.icar.org.in/**

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

4.https://aem.asm.org/content/85/14/e00324-19

5.https://en.wikipedia.org/wiki/Bacteriological_water_analysis

6.https://aosts.com/role-microbes-microorganisms-used-wastewater-sewage-treatment/

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Describe the knowledge about types of microorganisms present in soil surface and soil fertility.	**Up to K2**
CO2:	Apply various role of microorganisms and fix nitrogen atmospheric fixation in soil.	**Up to K3**
CO3:	Distinguish plant diseases and how to isolate, identify and control measures.	**Up to K4**
CO4:	Analyze microorganisms in air and water samples.	**Up to K4**
CO5:	Determine the different treatment of sewage water.	**Up to K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**1**	**2**	**1**	**2**
CO 2	**3**	**2**	**2**	**1**	**1**	**2**
CO 3	**2**	**3**	**3**	**1**	**1**	**2**
CO 4	**3**	**3**	**2**	**2**	**2**	**2**
CO 5	**2**	**3**	**2**	**3**	**2**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**SOIL MICROBIOLOGY - Soil microbiology:** Soil - General properties -Soil micro flora - Microbes in soil surface and different zones of soil – Role of microbes in soil fertility – Soil and environmental influence on microbes - Decomposition of plant and animal residues by microorganisms in soil.	15	Chalk & Talk, Power Point
II	**BIOGEOCHEMICAL CYCLES - Biogeochemical cycles**- Carbon, Nitrogen, Phosphorus and Sulphur Cycle; Nitrogen fixers – Root nodule formation – Nitrogenase, Hydrogenase – Biochemistry of nitrogen fixation.	15	Chalk & Talk, Power Point
III	**PLANT PATHOLOGY - Plant diseases** - Mode of entry of pathogens, Symptoms, Disease cycle and Control Measures. Bacterial disease –Angular leaf spot of Cotton, Fungal disease - Blast disease of paddy and Viral disease- Bunchy top of banana.	15	Chalk & Talk, Power Point,
IV	**MICROBIOLOGY OF AIR AND WATER - Microbiology of air** - Microbes in aerosol - Assessment of quality of air - Air sanitation - Air borne diseases and their control measures**. Microbiology of water** - Potability of water, Indicator organisms, Microbial assessment of water quality, MPN technique, Water purification, Water borne diseases and their control measures.	15	Chalk & Talk, Power Point
V	**SEWAGE TREATMENT - Microbiology of sewage** – Chemical and Biological characteristics of sewage – BOD and COD – Sewage treatment- Physical, Chemical and Biological – Aerobic and Anaerobic (Trickling filter, Activated sludge) Treatment- Disposable of wastes.	15	Chalk & Talk, Power Point, Assignment

Course Designed by: **1.Ms.C.THENMOZHI, Assistant Professor.**

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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1&K2	1	K2	2(K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
3	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
4	CO4	Up to K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
5	CO5	Up to K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY-PRACTICAL**							
Course Code	**21UMBCP4**					**L**	**P**	**C**
Category	**CORE – PRACTICAL**					-	3	2
Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**			✓

Course Objectives:

- To enumerate bacteria from Soil, Water, Air, Leguminous plant and diseased plants.
- To gain the knowledge about.microbes present in environments.
- To learn to isolate the different types of microorganisms in soil sample.
- To deduct microbes from air and water.
- To acquire the basic knowledge about biofertilizer production.

List of Experiments:

1. Isolation of microorganisms from soil (Bacteria,Actinomycetes and Fungi).
2. Isolation of free-living nitrogen fixers –*Azotobacter*.
3. Isolation of *Rhizobium* from Legume nodule.
4. Isolation of Phosphate solubilizing microorganisms from soil.
5. Isolation of microbes from crops infected with bacterial diseases.
6. Isolation of microbes from crops infected with Fungal diseases.
7. Water analysis by MPN technique.
8. Microbial assessments of air quality – open plate method.
9. Demonstration on different biofertilizers types, formulation and application methods.
10. Visit to biofertilizers and biopesticides unit to understand about the Unit operation Procedures.

Total Hours | **45 Hrs**

Distribution of marks

Max marks : 100

Internal : 40 marks — **External : 60 marks**

Laboratory Performance : 30 marks
Observation note book : 10 marks

Vivo voce : 10 marks
Record note book : 10 marks
Procedure and Result : 40 marks

Total : 40 marks — **Total : 60 marks**

Books for Study:

1. Dubey R.C and Maheswari D.K. 2002, Practical Microbiology, S.Chand Ltd

Books for References:

1. Christon J. Hurst, Ronald L. Crawford, Manual of environmental microbiology, Second edition, ASM Press.
2. Aneja K.R. 2003, Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International.
3. Cappuccino J.G, Sherman S. 2002, Microbiology. A Laboratory Manual Benjamin Cummings Publishing Company.

Web Resources:		
1.**https://en.wikipedia.org/wiki/Bacteriological_water_analysis** 2.**https://aosts.com/role-microbes-microorganisms-used-wastewater-sewage-treatment/** 3. Bio fertilizers - **https://www.youtube.com/watch?v=KS95D3njzSo** 4. Carrier based inoculants - **https://www.youtube.com/watch?v=SlrfWALczXc** 5. Agriculture research institute - **https://www.icar.org.in/**		
Course Outcomes		**K Level**
On Successful Completion of Course the student will be able to		
CO1:	Recognize the beneficial microorganism in agriculture.	**K2**
CO2:	Indicate role of microorganisms from air and water samples.	**K2**
CO3:	Discuss about the isolation, mechanisms and applications of microorganims in soil.	**K2**
CO4:	Summarize the importance of microbes in agriculture field.	**K3**
CO5:	Catagorize Biofertilizer production in various crops.	**K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**3**	**2**	**2**	**2**
CO 2	**2**	**2**	**3**	**2**	**2**	**2**
CO 3	**2**	**3**	**2**	**3**	**2**	**2**
CO 4	**2**	**3**	**2**	**2**	**2**	**2**
CO 5	**2**	**2**	**2**	**2**	**2**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Experiments	Topics	Hrs	Mode
1	Isolation of microorganisms from soil (Bacteria,Actinomycetes and Fungi).	45 hrs	Demo/Practical/ Videos
2	Isolation of free-living nitrogen fixers *Azotobacter*.		
3	Isolation of *Rhizobium* from Legume nodule.		
4	Isolation of Phosphate solubilizing microorganisms from soil.		
5	Isolation of microbes from crops infected with bacterial diseases.		
6	Isolation of microbes from crops infected with Fungal diseases.		
7	Water analysis by MPN technique.		
8	Microbial assessments of air quality – open plate method.		
9	Demonstration on different biofertilizers types, formulation and application methods.		
10	Visit to biofertilizers and biopesticides unit to understand about the Unit operation procedures.		

Course Designed by: **1. Ms.C.THENMOZHI,ASSISTANT PROFESSOR**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**BIOTECHNOLOGY-II**							
Course Code	**21UMBA41**					**L**	**P**	**C**
Category	**ALLIED**					4	-	4
Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**			✓

Course Objectives:

- To describe the concepts of tissue culture.
- To outline the pathways of plant regeneration.
- To understand the methods of transformation in transgenic plants.
- To demonstrate various animal cell culture media.
- To identify the importance of transgenic plants and animals.

Unit: I	**BASIS OF PLANT TISSUE CULTURE**	**12**

Introduction-Concepts and principles. History of Plant tissue culture. Plant tissue culture media (composition, types and preparation), plant hormones and growth regulators in tissue culture. Preparation and sterilization of explants. Factors affecting plant tissue culture. Protoplast isolation, culture and protoplast fusion.

Unit: II	**PATHWAYS OF PLANT REGENERATION**	**12**

Morphogenesis – direct and indirect, organogenesis and somatic embryogenesis. Callus culture - initiation - establishment and maintenance. Suspension culture. Anther, pollen and ovary culture for production of haploid plants. Synthetic seeds and its applications.

Unit: III	**TRANSGENIC PLANTS**	**12**

Genetic engineering in plants: Introduction and applications. Methods of transformation, selectable markers, reporter genes and promoters used in plant vectors. Transgenic plants - Insect resistance - Herbicide resistant plants - virus free plants - disease resistance and stress tolerant plants. Golden rice. Plants as bioreactors.

Unit: IV	**ANIMAL CELL CULTURE AND ITS CULTURE TECHNIQUES**	**12**

Basic principles - Animal cell, tissues and organs culture. Animal cell culture media- definition, types - natural media, artificial media, serum media, serum free media. Physicochemical properties of media. Primary cell culture – definition, techniques - mechanical, enzymatic disaggregation, primary explants. Secondary culture. Cell lines - types, selection and maintenance. Biology of cultured cells, measurement of growth, cell synchronization, senescence and apoptosis.

Unit: V	**ANIMAL CLONING AND TRANSGENIC ANIMALS**	**12**

Cryopreservation of animal cells. Animal cloning – introduction, importance, methods - retroviral, micro injection. Transgenic animals - Dolly (nuclear transfer method), Mice and Fishes. Gene knockout and mice model for human genetic disorder. Ethical issues in animal biotechnology.

	Total Lecture Hours	**60 Hrs**

Books for Study:

1.Singh B.D, 2007. Plant Biotechnology. 1st Edition. Kalyani Publishers
2. Ranga M.M, 2000. Animal Biotechnology. Agrobios

Books for reference:

1. M.K. Sateesh. 2010. Biotechnology: V: (Including Animal Cell Biotechnology, Immunology and Plant Biotechnology. 2nd Edition. New Age International

2. Freshney, E. D. 2000. Animal Cell Culture: A practical approach. John Wiley Pub. New York.
3. Phundan Singh, 2013. Principles of Plant Biotechnology. Kalyani Publishers,India

Web Resources:
https://www.youtube.com/watch?v=vZ_fsXuENH8
https://www.youtube.com/watch?v=GIpvYMzo05U
https://www.youtube.com/watch?v=eMv_PMNPYMc

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Describe the concepts of Plant tissue culture, animal cell culture, Transgenic plant and animals.	**Up to K2**
CO2:	Understanding and preparing plant tissue culture media, synthetic seeds.	**Up to K3**
CO3:	Classify types of tissue culture, morphogenesis, transgenic plants and animals.	**Up to K4**
CO4:	Assess the factors affecting the growth of tissue culture, insect and disease resistance in plants,	**Up to K4**
CO5:	Identify the importance of plant and animal cell tissue culture.	**Up to K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	1	1	1	2	1	1
CO 2	2	3	3	3	3	2
CO 3	3	3	2	3	3	3
CO 4	3	3	3	3	3	3
CO 5	3	3	3	3	3	3

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**BASIS OF PLANT TISSUE CULTURE** Introduction-Concepts and principles. History of Plant tissue culture. Plant tissue culture media (composition, types and preparation), plant hormones and growth regulators in tissue culture. Preparation and sterilization of explants. Factors affecting plant tissue culture. Protoplast isolation, culture and protoplast fusion.	12	Chalk & Talk, Power Point
II	**PATHWAYS OF PLANT REGENERATION** Morphogenesis – direct and indirect, organogenesis and somatic embryogenesis. Callus culture - initiation - establishment and maintenance. Suspension culture. Anther, pollen and ovary culture for production of haploid plants. Synthetic seeds and its applications.	12	Chalk & Talk, Power Point
III	**TRANSGENIC PLANTS** Genetic engineering in plants: Introduction and applications. Methods of transformation, selectable markers, reporter genes and promoters used in plant vectors. Transgenic plants - Insect resistance - Herbicide resistant plants - virus free plants - disease resistance and stress tolerant plants. Golden rice. Plants as bioreactors.	12	Chalk & Talk, Power Point,
IV	**ANIMAL CELL CULTURE AND ITS CULTURE TECHNIQUES** Basic principles - Animal cell, tissues and organs culture. Animal cell culture media- definition, types - natural media, artificial media, serum media, serum free media. Physicochemical properties of media. Primary cell culture – definition, techniques - mechanical, enzymatic disaggregation, primary explants. Secondary culture. Cell lines - types, selection and maintenance. Biology of cultured cells, measurement of growth, cell synchronization, senescence and apoptosis.	12	Chalk & Talk, Power Point
V	**ANIMAL CLONING AND TRANSGENIC ANIMALS** Cryopreservation of animal cells. Animal cloning – introduction, importance, methods - retroviral, micro injection. Transgenic animals - Dolly (nuclear transfer method), Mice and Fishes. Gene knockout and mice model for human genetic disorder. Ethical issues in animal biotechnology.	12	Chalk & Talk, Power Point, Assignment

Course Designed by: **Dr. S. Rajesh Kannan Assistant Professor & HOD.**

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**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CIA I	**CO1**	**Up to K2**	**2**	**K1& K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
	CO2	**Up to K3**	**2**	**K1 &K2**	**2**	**K2**	**2(K3&K3)**	**1(K3)**
CIA II	**CO3**	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
	CO4	**Up to K4**	**2**	**K1&K2**	**2**	**K2**	**2(K3&K3)**	**1(K4)**
Question Pattern CIA I & II		No. of Questions to be asked	**4**		**3**		**4**	**2**
		No. of Questions to be answered	**4**		**3**		**2**	**1**
		Marks for each question	**1**		**2**		**5**	**10**
		Total Marks for each section	**4**		**6**		**10**	**10**

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**-**	**-**	**-**	**2**	**4**	**60**
	K2	**2**	**6**	**10**	**10**	**28**	**56**	
	K3	**-**	**-**	**10**	**10**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**
CIA II	**K1**	**2**	**-**	**-**	**-**	**2**	**4**	**20**
	K2	**2**	**6**	**-**	**-**	**8**	**16**	
	K3	**-**	**-**	**20**	**-**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**20**	**20**	**40**	**40**
	Marks	**4**	**6**	**20**	**20**	**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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1&K2	1	K2	2(K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
3	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
4	CO4	Up to K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
5	CO5	Up to K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**BIOTECHNOLOGY- PRACTICAL**							
Course Code	**21UMBAP3**					**L**	**P**	**C**
Category	**ALLIED – PRACTICAL**					-	2	2
Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP			

Course Objectives:

- To identify the media preparation methods for plants and animal cell culture
- To understand the principle in plant tissue culture.
- To get acquainted with plant tissue culture medium.
- To construct callus induction and protoplast isolation
- To examine synthetic seeds

List of Experiments:

1. Preparation of MS Media for Plant Tissue Culture
2.Callus induction
3.Protoplast isolation
4.Shoot tip culture
5.Anther culture
6.Peparation of synthetic seeds
7.Preparation of Animal cell culture media
8.Gene transfer technique – Demonstration

Total Hours | **30 Hrs**

Distribution of marks

Max marks : 100

Internal : 40 marks | **External : 60 marks**

Laboratory Performance : 30 marks	Vivo voce : 10 marks
Observation note book : 10 marks	Record note book : 10 marks
	Procedure and Result : 40 marks
Total : 40 marks	**Total : 60 marks**

Books for Study:

1.Ashishs verma *et al*., 2014. Laboratory manual for biotechnology, S. Chand &Company Ltd publications.

2.Lisa A. Seidman & Cynthia J. Moore, 1999. Basic Laboratory Methods for Biotechnology, Prentice Hall.

Books for References:

1. Swami, P.M. 2009. Lab Manual of Biotechnology. Rastogi Publications, Meerut.

2.Anjana R & Joy P.P, 2014. A Plant Biotechnology Laboratory Manual, 1st Edition,Aromatic and Medicinal plants Research station.

Web Resources:		
https://www.youtube.com/watch?v=vZ_fsXuENH8 https://www.youtube.com/watch?v=GIpvYMzo05U https://www.youtube.com/watch?v=eMv_PMNPYMc		
Course Outcomes		**K Level**
On Successful Completion of Course the student will be able to		
CO1:	Explain the principles of plant tissue culture.	**K2**
CO2:	Describe the various culture techniques.	**K2**
CO3:	Elaborate the concepts in tissue culture media preparation.	**K2**
CO4:	Apply the methods in synthetic seed development.	**K3**
CO5:	Analyze the practical skills in the use of tools, technologies and methods common to biotechnology.	**K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**2**	**2**	**2**	**1**	**2**	**2**
CO 2	**1**	**2**	**2**	**1**	**2**	**3**
CO 3	**2**	**1**	**2**	**2**	**3**	**3**
CO 4	**2**	**2**	**1**	**1**	**1**	**2**
CO 5	**2**	**2**	**3**	**2**	**2**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Experiments	Topics	Hrs	Mode
1	Preparation of MS Media for Plant Tissue Culture	30 hrs	Demo/Practical/ Videos
2	Callus induction		
3	Protoplast isolation		
4	Shoot tip culture		
5	Anther culture		
6	Preparation of synthetic seeds		
7	Preparation of Animal cell culture media		
8	Gene transfer technique – Demonstration		

Course Designed by:

1.Dr.S. Rajesh Kannan, Assistant Professor & Head.

2.Dr. S. Subramani, Assistant Professor

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**IMMUNOLOGY AND IMMUNOTECHNIQUES**							
Course Code	**21UMBS41**					**L**	**P**	**C**
Category	**SKILL**					2	-	2
Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**			✓

Course Objectives:

- To describe the history of immunology, immune organs and immune cells.
- To classify the types of immunity and immune response.
- To characterize the antigen and antibody types, structure and properties.
- To analyze the hypersensitivity reactions and autoimmune diseases.
- To detect the antigen - antibody reactions.

Unit: I	**HISTORY OF IMMUNOLOGY AND IMMUNE CELLS**	**6**

History of immunology: Immune organs – Bone marrow, Thymus, Lymph node, Spleen, GALT and MALT. Structure, function and properties of immune cells – T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell and Dendritic cell.

Unit: II	**TYPES OF IMMUNITY AND IMMUNE RESPONSE**	**6**

Immunity: Types: Active and passive immunity. Cell mediated immunity, Humoral immunity, **Immune response**: Primary and Secondary response.

Unit: III	**ANTIGEN- ANTIBODY**	**6**

Antigens: Properties – Chemical nature – Types – Immunogen – Hapten and Determinants of antigenicity. **Antibodies**: Immunoglobulins – Structure – Types and Properties- Adjuvants.

Unit: IV	**MONOCLONAL ANTIBODIES AND HYPERSENSITIVITY REACTIONS**	**6**

Hypersensitivity reactions – Antibody mediated (Type I, II). **Monoclonal antibodies** – Hybridoma technology.

Unit: V	**IMMUNO TECHNIQUES**	**6**

Immunological techniques: Principle, Methodology and applications :Precipitin reaction – Quchterlony double diffusion ,Agglutination reaction: Blood grouping, Widal test (Slide and Tube method). Radio immunoassay: ELISA

	Total Lecture Hours	**30 Hrs**

Books for Study:

1. Janis Kuby. 1993, Immunology,Second edition, W.H Frumen and company, New York.

Books for References:

1. Roitt, I.M. 1991, Essentials of Immunology, Seventh edition, Blackwell Scientific Publications.
2. Kannan I. 2007, Immunology, First edition, MJP Publishers, Chennai.
3. Ian R. Tizard. 1995, Immunology: An Introduction, Fourth edition, Saunders College.

Web Resources:

1. https://www.youtube.com/watch?v=vxWf-66lymg
2. https://www.youtube.com/watch?v=2tmw9x2Ot_Q
3. https://www.youtube.com/watch?v=NKnAXcM5Ly0
4. https://www.youtube.com/watch?v=KB980_rt8GI

5. https://www.youtube.com/watch?v=ki-3AOfmAZE **6. https://www.youtube.com/watch?v=ZuHdnTKBBKg** **7. https://www.webmd.com/a-to-z-guides/blood-transfusion-what-to-know#1** **8. https://www.google.co.in/intl/en/about/products?tab=wh** **9. https://www.youtube.com/watch?v=H6w-BRSgfMg** **10. https://www.youtube.com/watch?v=1dpw8yoggYY**	
COURSE OUTCOME	**K Level**
On successful completion of the course, the learners should be able to	
CO1: Explain the history of immunology and immune response and immune cells.	**Up to K2**
CO2: Find the types of immunity and immune response.	**Up to K3**
CO3: Differentiate the antigen and antibody types,structure and properties.	**Up to K4**
CO4: Classify hypersensitivity reactions.	**Up to K4**
CO5: Determine the antigen-antibody reactions.	**Up to K3**

CO & PO Mapping:

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**2**	**1**	**2**	**1**	**1**	**2**
CO 2	**2**	**2**	**3**	**2**	**1**	**2**
CO 3	**3**	**2**	**2**	**2**	**1**	**2**
CO 4	**2**	**2**	**2**	**2**	**1**	**2**
CO5	**3**	**3**	**3**	**2**	**1**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Mode
I	**HISTORY OF IMMUNOLOGY AND IMMUNE CELLS - History of immunology:** Immune organs – Bone marrow, Thymus, Lymph node, Spleen, GALT and MALT. Structure, function and properties of immune cells – T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell and Dendritic cell.	**6**	**Chalk and talk, PPT**
II	**TYPES OF IMMUNITY AND IMMUNE RESPONSE - Immunity**: Types: Active and passive immunity. Cell mediated immunity, Humoral immunity, Immune response: Primary and Secondary response.	**6**	**Chalk and talk, PPT**
III	**ANTIGEN AND ANTIBODY - Antigen**s: Properties – Chemical nature – Types – Immunogen – Hapten and Determinants of antigenicity. **Antibodies**: Immunoglobulins – Structure – Types and Properties- Adjuvants.	**6**	**Chalk and talk, PPT**
IV	**MONOCLONAL ANTIBODIES AND HYPERSENSITIVITY REACTIONS- Hypersensitivity reactions** – Antibody mediated (Type I, II). **Monoclonal antibodies** – Hybridoma technology.	**6**	**Chalk and talk, PPT**
V	**IMMUNO TECHNIQUES - Immunological techniques**: Principle, Methodology and applications: Precipitin reaction – Quchterlony double diffusion ,Agglutination reaction: Blood grouping, Widal test (Slide and Tube method). Radio immunoassay: ELISA	**6**	**Chalk and talk, PPT Assignment**

Course Designed by: **1. Ms.C.THENMOZHI**, **Assistant Professor.**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**MANAGEMENT OF HUMAN MICROBIAL DISEASES**							
Course Code	**21UMBN41**					**L**	**P**	**C**
Category	**NME**					2	-	2
Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP			

Course Objectives:

- To acquire knowledge on basics of Microbiology.
- To learn and differentiate on various microbial interactions.
- Outline on types of diseases and its mode of transmission.
- Examine common causes and treatment of microbial diseases.
- Summarize on management of Microbial diseases and its prevention

Unit: I	**INTRODUCTION TO MICROBIOLOGY**	**6**
Introduction to Microorganisms – Definition & Characteristics. Spontaneous generation theory. Structure of Bacterial Cells.		
Unit: II	**MICROBIAL INTERACTIONS**	**6**
Microbial Interaction – Types – Positive interaction Mutualisms, Proto corporation, Commensalism, Negative interaction – Ammensalisms, Predation, Parasitisms & Competition.		
Unit: III	**TYPES OF DISEASES**	**6**
Disease – Definition, Types Infectious Disease, Non - Infectious Disease. Mode of transmission of infectious diseases. Common Communicable diseases.		
Unit: IV	**COMMON MICROBIAL DISEASES**	**6**
Microbial Diseases – Causative agent, Symptoms, Mode of transmission & Treatment - Tuberculosis, Malaria, Scalp yeast infection and AIDS.		
Unit: V	**DISEASE MANAGEMENT**	**6**
Management of Microbial Diseases – Hygienic practices, Prevention of Infectious diseases: Vaccination and Immunization Schedule.		
	Total Lecture Hours	**30**

Books for Study:

1. Tortora G.J, Funke B.R, Case C.L, Weber D and Bair W. **Microbiology: An Introduction**,13th edition, Pearson Education, 2019.
2. Chakravarthy, A.K Immunology, Tata Mc Graw Hill Publishing Co Ltd., New Delhi.

Books for References:

1.Pelczar M. J, Chan E. C. S and Krieg N. R. **Microbiology** 5th edition. McGraw Hill, 1993.
2..Willey J. M, Sandman K and Wood D. **Prescott's Microbiology**, 11thedition, McGraw Hill Higher Education, 2019.
3.Kannan. I 2007, Immunology, First edition, MJP Publishers, Chennai.
4.Ananthanarayanan R & Jayaram Panicker, C.K., **Textbook of Microbiology**, Orient Longman, 2005.
5.Dubey RC and Maheswari DK. A textbook of Microbiology Revised edition, S. Chand and Company Ltd., New Delhi, 2012.

Web Resources:

1. https://www.worldbank.org/en/topic/infectiousdisease
2. https://my.clevelandclinic.org/health/diseases/17724-infectious-diseases
3. https://www.onlinebiologynotes.com/microbial-interaction-and-types-mutualism-syntropism-proto-cooperation-commensalism-antagonism-parasitism-predation-competition/

Course Outcomes		K Level
On the completion of the course the student will be able to		
CO1:	Describe the characteristics of microorganisms and classify on prokaryotic and eukaryotic cell and its organization.	K2
CO2:	Elaborate on various microbial interactions and differentiate among positive and negative bacterial interactions	K2
CO3:	Differentiate on types of infectious and non - infectious diseases and its mode of transmission	K4
CO4:	Classify the types of microbial diseases and to analyse the causes and treatment for the diseases.	K4
CO5:	Summarize on the management of microbial diseases.	K2

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	1	1	1	1	1	1
CO 2	1	2	2	2	1	1
CO 3	1	1	2	2	1	1
CO 4	2	2	2	2	1	1
CO 5	1	2	2	2	1	1

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**History of Microbiology-** Introduction to Microorganisms, Definition, Characteristics and History. Prokaryotes and Eukaryotes. Structure and organization of bacterial cell.	**6**	**Chalk & Talk, Power Point**
II	**Microbial Interactions** – Types – Positive interaction Mutualisms, Protocorporation, Commensalism, Negative interaction – Ammensalisms, Predation, Parasitisms & Competition.	**6**	**Chalk & Talk, Power Point**
III	**Types of Diseases** – Definition, Types Infectious Disease, Non - Infectious Disease. Mode of transmission of infectious diseases. Common Communicable diseases	**6**	**Chalk & Talk, Power Point,**
IV	**Common Microbial Diseases -** Introduction to Microbial Diseases - Causes, Symptom and mode of transmission- Mycobacterium Tuberculosis, Malaria, Scalp yeast infection and AIDS.	**6**	**Chalk & Talk, Power Point**
V	**Management of Microbial Diseases –** Hygienic practices, Treatment for Infectious diseases: Vaccination and preventable diseases and Immunization.	**6**	**Chalk & Talk, Power Point, Assignment**

Course Designed by: **1. Mrs. A. ABIRAMI,** Assistant professor.


FIFTH SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**INDUSTRIAL MICROBIOLOGY**							
Course Code	**21UMBC51**					**L**	**P**	**C**
Category	**CORE**					6	-	4
Nature of course:	EMPLOYABILITY	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP			✓

Course Objectives:

On successful completion of the course, the learners should be able to

- To know about Industrial Microbiology and its scope.
- To explain the fermentor and its types.
- To apply their knowledge in industrial use of Microorganisms.
- To get an exposure to different types of Preservation Methods.
- To become familiar with production process of Industrially important microbial products.

Unit: I	**INDUSTRIAL MICROBIOLOGY AND ITS SCOPE**	**18**

Industrial Microbiology: Scope of Industrial Microbiology. Fermentation types and functions: aerobic, anaerobic and solid-state fermentation.

Unit: II	**FERMENTOR AND ITS TYPES**	**18**

Fermentor. Types of fermentors: Air lift and CSTR, Tower fermentor and packed bed bioreactor. Control and monitoring of variables, temperature, pH, agitation, pressure, online measurement & PD control.

Unit: III	**FERMENTATION**	**18**

Media formulation and inoculum preparation- Strain improvement. Scale-up process of fermentation. Preservation Techniques.

Unit: IV	**DOWNSTREAM PROCESSING**	**18**

Downstream process of fermented products – Cell disruption-physical and chemical methods. Separation, Precipitation, filtration, centrifugation.

Unit: V	**PRODUCTION OF INDUSTRIALLY IMPORTANT PRODUCTS**	**18**

Production processes: Fermentation of Antibiotics - Penicillin, Acids – Citric Acid, and Vitamins- Vitamin B_{12}, Solvent – Ethanol. Detection and characterization assay of fermented products.

	Total Lecture Hours	**90Hrs**

Books for Study:

1. Patel A.H, 2005. Industrial Microbiology. Published by Macmillan India Ltd., New Delhi.
2. Crueger, W. and A. Crueger (2000), Biotechnology, A Text book of Industrial Microbiology. Panima Publishers, New Delhi.

Books for reference:

1. Flinger, M.C., and Drew, S.W., (1999), Encyclopedia of Bioprocess technology - Fermentation, Biocatalysis and Bioseparation (Volumes I - V), John Wiley and Sons, New York.
2. Nandari, H., (2005), Industrial Biotechnology, Dominant Publications and Distributors, New Delhi.
3. Reed, G. (1987), Prescott and Dunn's Industrial Microbiology, CBS Publishers and Distributors, New Delhi.

4. Rita Singh and Ghosh, S.K., (2004), Industrial Biotechnology, Global Vision Publishing House, New Delhi.
5. Stanbury, O.F., Whitakar, A., and Hall, S.J., (1997), Principles of Fermentation Technology, Aditya Books (P) Ltd.. New Delhi.

Web Resources:

1.https://www.nature.com/subjects/industrial-microbiology.
2.https://byjus.com/biology/microbes-in-industrial-products/.
3.https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/industrial-microbiology.

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Explain types of ferementor and its functions.	**Up to K2**
CO2:	Know the basic features of fermentation biology and fermenters.	**Up to K3**
CO3:	Apply their knowledge in industrial uses of microbes.	**Up to K4**
CO4:	Develop the fermentation process for industrially important by products.	**Up to K4**
CO5:	Understand the biosafety features, containment facilities and other quality parameter.	**Up to K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**2**	**2**	**1**	**3**	**2**	**2**
CO 2	**2**	**3**	**3**	**2**	**2**	**3**
CO 3	**3**	**2**	**2**	**1**	**3**	**2**
CO 4	**2**	**1**	**1**	**2**	**1**	**2**
CO 5	**2**	**2**	**1**	**2**	**1**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**INDUSTRIAL MICROBIOLOGY AND ITS SCOPE-** Industrial Microbiology: Scope of Industrial Microbiology. Fermentation types and functions: aerobic, anaerobic and solid-state fermentation.	18	Chalk & Talk, Power Point
II	**FERMENTOR AND ITS TYPES-** Fermentor. Types of fermentors: Air lift and CSTR tower fermentor and packed bed bioreactor. Control and monitoring of variables, temperature, pH, agitation, pressure, online measurement, PD control Computer applications in fermentation technology.	18	Chalk & Talk, Power Point,
III	**FERMENTATION-** Fermentation processes: Culture selection for fermentation, Media formulation and inoculum preparation- Strain improvement. Scale-up process of fermentation. Downstream process of fermented products – cell harvesting, purification methods and drying.	18	Chalk & Talk, Power Point,
IV	**PRODUCTION OF INDUSTRIAL IMPORTANT PRODUCTS-** Production processes: Aerobic fermentation of Penicillin, Glutamic acid, and Vitamin B_{12}. Anaerobic fermentation of Ethanol, and solid state of Gibberellic acid. Detection and characterization assay of fermentation products.	18	Chalk & Talk, Power Point, Assignment
V	**BIOSAFETY AND ITS LEVELS-** Biosafety: Types of Biosafety containment, personal hygienic practices, primary and secondary contaminant barriers, Risk assessment and Regulation, Biosafety levels, guidelines and regulations. Quality assurance and quality control of fermented products.	18	Chalk & Talk, Power Point

Course Designed by: **1.Dr. T. Rohini, Assistant Professor.**

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**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CIA I	**CO1**	**Up to K2**	**2**	**K1& K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
	CO2	**Up to K3**	**2**	**K1 &K2**	**2**	**K2**	**2(K3&K3)**	**1(K3)**
CIA II	**CO3**	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
	CO4	**Up to K4**	**2**	**K1&K2**	**2**	**K2**	**2(K3&K3)**	**1(K4)**
Question Pattern CIA I & II		No. of Questions to be asked	**4**		**3**		**4**	**2**
		No. of Questions to be answered	**4**		**3**		**2**	**1**
		Marks for each question	**1**		**2**		**5**	**10**
		Total Marks for each section	**4**		**6**		**10**	**10**

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**-**	**-**	**-**	**2**	**4**	**60**
	K2	**2**	**6**	**10**	**10**	**28**	**56**	
	K3	**-**	**-**	**10**	**10**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**
CIA II	**K1**	**2**	**-**	**-**	**-**	**2**	**4**	**20**
	K2	**2**	**6**	**-**	**-**	**8**	**16**	
	K3	**-**	**-**	**20**	**-**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**20**	**20**	**40**	**40**
	Marks	**4**	**6**	**20**	**20**	**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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Up to K2**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
2	CO2	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
3	CO3	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K4)**
5	CO5	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**MEDICAL MICROBIOLOGY**							
Course Code	**21UMBC52**					**L**	**P**	**C**
Category	**CORE**					6	-	6
Nature of course:	EMPLOYABILITY		**SKILL ORIENTED**	✓	ENTREPRENURSHIP			

Course Objectives:

- To get accustomed to the basics of Infectious diseases.
- To understand the concepts in diseases caused by microorganisms.
- To become aware of diseases caused by viruses along with their disease establishment and progression
- To become familiar with the seriousness of infectious diseases caused by fungi.
- To get an exposure to various antibiotic drugs by which infectious diseases can be cured.

Unit: I	**FUNDAMENTALS OF MEDICAL MICROBIOLOGY**	**18**

Epidemiology of Infectious diseases – Sporadic, Epidemic, Endemic, Pandemic and Prosodemic - Index case and Patient Zero, Portals of pathogen entry, Host-pathogen interaction, Virulence factors – Adhesins, aggresins, impedins, invasins, modulins and R-plasmids – *Path islands*.

Unit: II	**BACTERIOLOGY**	**18**

Cultural characteristics, pathology, pathogenesis, lab diagnosis, treatment and prophylaxis of *Staphylococcus, Streptococcus, Mycobacterium tuberculosis, E. coli* and *Pseudomonas*.

Unit: III	**VIROLOGY**	**18**

Aetiology, Mode of entry and disease cycle of Poxvirus, Rabies virus, HBV, Marburg and Ebola. Viruses and Cancer.

Unit: IV	**MYCOLOGY**	**18**

Mycosis – Classification – Superficial, cutaneous, subcutaneous, deep-seated / systemic mycosis and opportunistic mycoses with examples, *Tinea*, *Piedra*, Moniliasis, Madura foot and Coccidioidomycosis.

Unit: V	**ANTIMICROBIAL CHEMOTHERAPY**	**18**

Introduction – History – Paul Ehrlich – Magic Bullet – Salvarsan, Classification of antibiotics based on – Nature – Natural, Semi-synthetic and Synthetic, Spectrum of Activity – Broad spectrum and Narrow spectrum - Mechanism of Action – Static and Cidal, Kirby-Bauer methods of antimicrobial susceptibility testing – Disc Diffusion and Dilution susceptibility tests, Drug Resistance and Mechanisms of Drug Resistance in microorganisms.

	Total Lecture Hours	**90 Hrs**

Books for Study:

1. **Reba Kanungo** Ed., 2017, Ananthanarayanan and Paniker's Textbook of Microbiology, 10th Ed., The Orient Blackswan Publishers.
2. **David Greenwood *et al.,*** 2012, Medical Microbiology: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Investigation and Control, 18th Ed., Elsevier Publications.
3. **Kenneth J. Ryan** and **George Ray**, 2004, Sherry's Medical Microbiology – An Introduction to Infectious Diseases, 4th Ed., McGraw Hill Publications.
4. **Carey B. Roberta *et al.,*** 2008, Wiley Medical Microbiology for the New Curriculum – A Case Based Approach, Wiley Publications.
5. **Joanne Willey *at al.,*** 2020, Prescott's Microbiology, 11th Ed., McGraw Hill Publications.

6. **Neal R. Chamberlain**, The Big Picture Medical Microbiology, 2009, McGraw Hill Publications.

Books for References:

1. **Madigan M.T and Martinko J.M.**, 2017, Brock Biology of Microorganisms, 15th edition, Prentice Hall International Inc.
2. **Stefan Riedel *et al.,*** Jawetz, Melnick and Adelberg's Medical Microbiology, 2019, 28th Ed., McGraw Hill Publications.
3**. David O White and Frank J. Fenner**, 1994, Medical Virology, 4th Ed., Library of Congress In Publication Data.
4. **Edward K. Wagner *et al.,*** 2008, Basic Virology, 3rd Ed., Blackwell Publishing.
5. **Thomas J. Walsh *et al.,*** Larone's Medically Important Fungi – A Guide to Identification, 2018, 6th Ed., ASM Press.

Web Resources:

1. **https://www.youtube.com/watch?v=GgzRNwL3iKc**
2. **https://www.health.state.mn.us/diseases/staph/basics.html**
3. **https://www.youtube.com/watch?v=MyPvgio7BGE**
4. **https://www.cdc.gov/vhf/marburg/index.html**
5. **https://www.cdc.gov/drugresistance/about.html#:~:text=Antimicrobial%20resistance%20happens%20when%20germs,and%20sometimes%20impossible%2C%20to%20treat.**

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Learn the basic concepts and terminologies in Medical Microbiology.	**Up to K2**
CO2:	Understand the principles and mechanisms of bacterial infections.	**Up to K3**
CO3:	Explain the aetiology of common viral infections and the disease establishment and progression.	**Up to K4**
CO4:	Classify the types of fungal infection along with the antibiotics used to cure them.	**Up to K4**
CO5:	Categorize the different type of medications used to treat microbial infections.	**Up to K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**3**	**2**	**3**	**1**
CO 2	**3**	**3**	**3**	**3**	**3**	**3**
CO 3	**3**	**3**	**3**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**	**3**
CO 5	**3**	**3**	**3**	**3**	**3**	**3**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**FUNDAMENTALS OF MEDICAL MICROBIOLOGY -** Epidemiology of Infectious diseases – Sporadic, Epidemic, Endemic, Pandemic and Prosodemic - Index case and Patient Zero, Portals of pathogen entry, Host-pathogen interaction, Virulence factors – Adhesins, aggresins, impedins, invasins, modulins and R-plasmids – *Path islands*.	**18**	**Chalk & Talk, Power Point**
II	**BACTERIOLOGY -** Cultural characteristics, pathology, pathogenesis, lab diagnosis, treatment and prophylaxis of *Staphylococcus*, *Streptococcus*, *Mycobacterium tuberculosis*, *E. coli* and *Pseudomonas*.	**18**	**Chalk & Talk, Power Point**
III	**VIROLOGY -** Aetiology, Mode of entry and disease cycle of Poxvirus, Rabies virus, HBV, Marburg and Ebola. Viruses and Cancer.	**18**	**Chalk & Talk, Power Point,**
IV	MYCOLOGY - Mycosis – Classification – Superficial, cutaneous, subcutaneous, deep-seated / systemic mycosis and opportunistic mycoses with examples, *Tinea*, *Piedra*, Moniliasis, Madura foot and Coccidioidomycosis.	**18**	**Chalk & Talk, Power Point**
V	**ANTIMICROBIAL CHEMOTHERAPY -** Introduction – History – Paul Ehrlich – Magic Bullet – Salvarsan, Classification of antibiotics based on – Nature – Natural, Semi-synthetic and Synthetic, Spectrum of Activity – Broad spectrum and Narrow spectrum - Mechanism of Action – Static and Cidal, Kirby-Bauer methods of antimicrobial susceptibility testing – Disc Diffusion and Dilution susceptibility tests, Drug Resistance and Mechanisms of Drug Resistance in microorganisms.	**18**	**Chalk & Talk, Power Point, Assignment**

Course Designed by: **1.Dr. S. Subramani, Asst. Professor.**

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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1&K2	1	K2	2(K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
3	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
4	CO4	Up to K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
5	CO5	Up to K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions)
Answer All Questions **(10x1=10 marks)**

Q. No	CO	K Level	Questions
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	

Section B (Short Answers)
Answer All Questions **(5x2=10 marks)**

Q. No	CO	K Level	Questions
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	

Section C (Either/Or Type)
Answer All Questions **(5 x 5 = 25 marks)**

Q. No	CO	K Level	Questions
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	

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

Section D (Open Choice
Answer Any Three questions **(3x10=30 marks)**

Q. No	CO	K Level	Questions
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**INDUSTRIAL MICROBIOLOGY – PRACTICAL**			
Course Code	**21UMBCP5**	**L**	**P**	**C**
Category	**CORE – PRACTICAL**	-	3	3

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To screen the antibiotic producing microbes.
- To demonstrate the yeast cell and enzyme immobilization.
- To isolate amylase and protease producing bacteria from soil.
- To calculate the alcohol content using di-chromate method.
- To prepare glycerol stock to preserve industrially important microbes.

List of Experiments:

1. Screening of antibiotic producing microbes.
2. Isolation of amylase and protease producing bacteria and fungi from environment soil sample.
3. Crowded plate technique for antibiotics producing microbes.
4. Yeast Cell Immobilization.
5. Sudan black staining for screening of bacterial polymer producers
6. Alcohol Fermentation by Saccharomyces Cerevisiae
7. Estimation of alcohol using Potassium di-chromate method.
8. Methods of preservation of industrially important microbes (slant and glycerol).
9. Yeast biomass estimation by turbidity method.
10. Production of Citric acid by Aspergillus niger by Solid State fermentation.

	Total Hours	**45 Hrs**

Distribution of marks

Max marks : 100

Internal : 40 marks **External : 60 marks**

Laboratory Performance : 30 marks	Vivo voce : 10 marks
Observation note book : 10 marks	Record note book : 10 marks
	Procedure and Result : 40 marks
Total : 40 marks	**Total : 60 marks**

Books for Study:

1. Cappuccino J.G and Sherman N,2014. Microbiology - A laboratory manual, 10th edition. Benjamin Cummins, New York.
2. Goldman, Emanuel and Lorrence H, 2009. Green. Practical Handbook of Microbiology, Boca Raton, FL: CRC press, Francis.

Books for reference:

1. Richard H. Baltz*et al*., 2010. Manual of Industrial Microbiology and Biotechnology, 3rdedition, ASM press, Washington.

2. Gunasekaran P, 2008. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi.

3. Dr.S.Rajan and Mrs.R.Selvi Christy, Experimental procedures in Life Sciences, Anjana book house, Chennai.

4. Kulanthaivel, S and S. Janarthanan 2012. Practical Manual on Fermentation Technology. I.K. International publishing house. New Delhi

5. Ponmurugan, P., R.Nithya and M.Fredinose 2012. Experimental Procedure in Bioprocess Technology and Downstream Processing.Anjana Book House. Chennai

Web Resources:

1. **https://www.researchgate.net/publication/344465390_PRACTICAL_MANUAL_CUM_WORKBOOK_on_INDUSTRIAL_MICROBIOLOGY.**
2. **https://www.pdfdrive.com/manual-of-industrial-microbiology-and-biotechnology-e157635759.html.**

Course Outcomes		**K Level**
On Successful Completion of Course the student will be able to		
CO1:	Recognize antibiotic producing microbes.	**K2**
CO2:	Discuss preservation and purification of microbial products.	**K2**
CO3:	Describe crowded plate technique.	**K2**
CO4:	Demonstration of immobilization of yeast cell and enzyme.	**K3**
CO5:	Appraise the techniques and products of microbial production.	**K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**2**	**2**	**2**	**1**	**2**	**2**
CO 2	**1**	**2**	**2**	**1**	**2**	**3**
CO 3	**2**	**1**	**2**	**2**	**3**	**3**
CO 4	**2**	**2**	**1**	**1**	**1**	**2**
CO 5	**2**	**2**	**3**	**2**	**2**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Experiments	Topics	Hrs	Mode
1	Screening of antibiotic producing microbes.	**45 hrs**	**Demo/Practical/ Videos**
2	Isolation of amylase and protease producing bacteria and fungi from environment soil sample.		
3	Crowded plate technique for antibiotics producing microbes.		
4	Immobilization of yeast and enzymes.		
5	Alcohol (ethanol) production.		
6	Estimation of alcohol using Potassium di-chromate method.		
7	Methods of preservation of industrially important microbes (slant and glycerol).		
8	Yeast biomass estimation by turbidity method.		

Course Designed by: **1.Dr.T.Rohini, ASSISTANT PROFESSOR**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	MEDICAL MICROBIOLOGY- PRACTICAL			
Course Code	**21UMBCP6**	**L**	**P**	**C**
Category	**CORE – PRACTICAL**	-	3	3

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	

Course Objectives:

- To become aware of handling clinical samples.
- To develop skills in isolating pathogenic bacteria from clinical samples.
- To acquire the knowledge in plating culturing various bacterial pathogens.
- To become aware of the techniques to identify medically important microorganisms
- To identify and calculate the dose of antibiotics used to cure infectious diseases.
- To excel in the identification of various infectious diseases.

List of Experiments:

01. Isolation of Staphylococcus aureus from skin.
02. Differentiation of S. aureus from other Staphylococcus members by Coagulase test.
03. Isolation of α, β and γ haemolytic *Streptococcus* from throat swab.
04. Isolation and identification of *E. coli* from urine sample.
05. Serodiagnosis of bacterial infections – Widal Test.
06. Antimicrobial Susceptibility testing – Kirby-Bauer's disc diffusion test.
07. Determination of MIC and MLC.
08. Isolation of dermatophytic fungus – *Candida albicans*.
09. Identification of C. albicans by Reynold's-Braud phenomenon.
10. KOH observation of nails for the observation of fungal infections.
11. Egg Inoculation technique for the cultivation of viruses.

Total Hours	**45 Hrs**

Distribution of marks

Max marks : 100

Internal : 40 marks	**External : 60 marks**
Laboratory Performance : 30 marks	Vivo voce : 10 marks
Observation note book : 10 marks	Record note book : 10 marks
	Procedure and Result : 40 marks
Total : 40 marks	**Total : 60 marks**

Books for Study:

1. **Patrick R. Murray et al.,** Manual of Clinical Microbiology, 2017, 9th Ed., Library of Congress Cataloging -In Publication Data.
2. **Ronald M. Atlas and James W. Snyder**, 2019, 2nd Ed., Press.
3. **Edward J. Bottone**, Clinical Microbiology of Infectious Diseases – Volume-I – Bacterial Agents, 2008, The Parthenon Publishing Group, CRC Press.
4. **Thomas J. Walsh *et al.*,** Larone's Medically Important Fungi – A Guide to Identification, 2018, 6th Ed., ASM Press.
5. **Joanne Willey *at al.*,** 2020, Prescott's Microbiology, 11th Ed., McGraw Hill Publications.

Books for reference:

1. **Prince C. P.**, Practical Manual of Medical Microbiology for Medical, Dental and Paramedical Students, 2009, Jaypee Brothers Medical Publishers.
2. **Drew Provan** Ed., Oxford Handbook of Clinical and Laboratory Investigation, 4th Ed., 2018, Oxford University Press.
3. **Neal R. Chamberlain**, The Big Picture Medical Microbiology, 2009, McGraw Hill Publications.
4. **Karren C. Carroll *et al.*, , Melnick & Adelberg's Medical Microbiology**, 27th Ed., 2016, McGraw Hill Publications.

Web Resources:

1. **https://microbeonline.com/blood-agar-composition-preparation-uses-and-types-of-hemolysis/**
2. **https://courses.lumenlearning.com/suny-microbiology/chapter/testing-the-effectiveness-of-antimicrobials/**
3. **https://microbiologyinfo.com/germ-tube-test-principle-procedure-results-interpretation-and-limitations/**
4. **https://science.vla.gov.uk/flu-lab-net/docs/protocol_IsolationEmbryonatedEggs.pdf**
5. **https://labpedia.net/enteric-fever-part-2-typhoid-enteric-fever/**

Course Outcomes		**K Level**
On Successful Completion of Course the student will be able to		
CO1:	Acquire knowledge in handling common bacterial pathogens.	**K2**
CO2:	Identify the different culture techniques for isolating medically important microorganisms.	**K2**
CO3:	Elaborate the concepts of isolating microorganisms from various Clinical samples.	**K2**
CO4:	Apply and test the methods for confirming diseases caused by pathogenic microorganisms.	**K3**
CO5:	Analyze and decide the type and dose of antibiotics to cure infectious diseases.	**K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**3**	**3**	**3**	**3**	**2**
CO 2	**3**	**3**	**3**	**3**	**3**	**2**
CO 3	**3**	**3**	**3**	**3**	**3**	**2**
CO 4	**3**	**3**	**3**	**3**	**3**	**2**
CO 5	**3**	**3**	**3**	**3**	**3**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Experiments	Topics	Hrs	Mode
1	Isolation of Staphylococcus aureus from skin.	45 hrs	Demo/Practical/ Videos
2	Differentiation of S. aureus from other Staphylococcus members by Coagulase test.		
3	Isolation of α, β and γ haemolytic *Streptococcus* from throat swab.		
4	Demonstration of AFB staining of sputum by ZN method.		
5	Serodiagnosis of bacterial infections – Widal Test.		
6	Antimicrobial Susceptibility testing – Kirby-Bauer's disc diffusion test.		
7	Determination of MIC and MLC.		
8	Isolation of dermatophytic fungus – *Candida albicans*.		
9	Identification of C. albicans by Reynold's-Braud phenomenon.		
10	KOH observation of nails for the observation of fungal infections.		
11	Egg Inoculation technique for the cultivation of viruses.		

Course Designed by: 1. **Dr. S. Subramani**, Asst. Professor.

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**IN PLANT TRAINING**							
Course Code	**21UMBIP1**					**L**	**P**	**C**
Category	**Core**					**5**	**-**	**5**
Nature of course:	EMPLOYABILITY	✓	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP			✓

Course Objectives:

Course Content:

Each Group – 5 Students
Area of learning – Quality checking, production of beneficial microbes and entrepreneurship skills.
Record submission – A hard bound report to be submitted to the Department.
Evaluation – Project (oral) presentation followed by a brief Viva

Course Description

The In-Plant training is conducted by the following Course Pattern.

Internal
Presentation
Submission } **40**

External

In-plant training Report
Viva Voce } **60**

Total **100**

Course Outcomes		**K Level**
On Successful Completion of Course the student will be able to,		
CO1:	Acquire skills in different techniques in Microbiology.	**K1**
CO2:	Explore various job opportunities in the field.	**K2**
CO3:	Get accustomed to updated laboratory instruments.	**K3**
CO4:	Apply the learnt theory skills in practice.	**K4**
CO5:	Learn the SOPs followed in Microbiology-related labs.	**K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	1	2	2	1	2
CO 2	2	2	2	1	1	1
CO 3	1	1	1	1	2	2
CO 4	2	2	2	2	1	1
CO 5	1	1	1	1	2	1

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

Course Designed by: **1. Dr.S. Rajesh Kannan, ASSISTANT PROFESSOR**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**FUNDAMENTALS OF BOTANY AND ZOOLOGY**							
Course Code	**21UMBE51**					**L**	**P**	**C**
Category	**CORE ELECTIVE**					5	-	5
Nature of course:	EMPLOYABILITY		**SKILL ORIENTED**	✓	ENTREPRENURSHIP			

Course Objectives:

- To understand the Plant taxonomy - Nomenclature, Binomial system and classification of plants.
- To gain the knowledge about Plant physiology and Reproduction of plants.
- To study the features of plants,distribution and economic importance.
- To classify the introduction of animal Kingdom,Classification, Fertilization and Evolution theories .
- To enable the students to explore knowledge about human physiology.

Unit: I	**PLANT KINGDOM**	**15**

Introduction, Plant nomenclature- Binomial system, International code of Botanical Nomenclature (ICBN). Classification - Artificial and Natural system. Plant taxonomy.

Unit: II	**PHYSIOLOGY AND REPRODUCTION OF PLANTS**	**15**

Physiology and reproduction of angiosperms, Gymnosperms - Photosynthesis, Sexual and asexual reproduction.

Unit: III	**PLANTS AND LICHENS**	**15**

Salient features, Distribution and Economic importance of angiosperms, Gymnosperms, Pteridophytes, Bryophytes and Lichens.

Unit: IV	**ANIMAL KINGDOM**	**15**

Introduction to animal kingdom – General classification of invertebrates and vertebrates. Evolution: Theories of Lamarkism& Darwinism- Stages of Gametes- fertilization- development of chick embryo.

Unit: V	**HUMAN PHYSIOLOGY**	**15**

Human Physiology: Digestion, Respiratory system - blood components, structure & functions of heart. Excretion - structure of kidney and mechanism of urine formation.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. Ashok Bendre, A.K and Pandey P.C, 1975. Introductory Botany. Rastogi Publication Meerut.
2.EkambaranathaAyyar and Ananthakrishnan T.N, 1993. Outlines of Zoology, Vol I & II, Viswanathan and Co, Madras.

Books for References:

1. Ganguly A.K and Kumar N.C, 1971. General Botany Vol. I & Vol. II, Emkay Publication, Delhi.

2. Rev. Fr. Ignacimuthu, S.J, 1975. Basic Biotechnology – Tata Mccraw till publication co., New Delhi.

3. Rao, K.N, Krishnamoorthy, K.V and Rao G, 1975. Ancillary Botany. S. Viswanathan Private. Ltd., Chennai.
4. Sambasiviah I, KamalakaraRao A.P, Augustine Chellappa S, 1983. Text book of Animal Physiology, Chand S& Co., New Delhi.

Web Resources:

1. **https://www.youtube.com/watch?v=olLkneGDoJw**
2. **https://www.slideshare.net/rubasalah/reproduction-in-plants-32510559**
3. **https://www.youtube.com/watch?v=TKOv2XWxoeY**
4. **https://www.youtube.com/watch?v=If8DMdVT5tU**
5. **https://www.youtube.com/watch?v=5Mo1uuICho0**
6. **https://www.youtube.com/watch?v=yIoTRGfcMqM**

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Classify the plant kingdom and its classification.	**Up to K2**
CO2:	Utilize the plant physiology and reproduction.	**Up to K3**
CO3:	Illustrate the plant salient features, distribution and importance.	**Up to K4**
CO4:	Classify animal kingdom.	**Up to K4**
CO5:	Identify human physiology.	**Up to K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**2**	**1**	**2**	**2**	**1**	**2**
CO 2	**2**	**1**	**2**	**2**	**1**	**2**
CO 3	**2**	**1**	**2**	**3**	**1**	**2**
CO 4	**2**	**1**	**2**	**3**	**1**	**2**
CO 5	**2**	**1**	**2**	**2**	**1**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**PLANT KINGDOM-** Introduction, Plant nomenclature- Binomial system, International code of Botanical Nomenclature (ICBN). Classification - Artificial and Natural system. Plant taxonomy.	**15**	**Chalk & Talk, Power Point**
II	**PHYSIOLOGY AND REPRODUCTION OF PLANTS -** Physiology and reproduction of angiosperms, Gymnosperms - Photosynthesis, Sexual and asexual reproduction.	**15**	**Chalk & Talk, Power Point**
III	**PLANTS AND LICHENS -** Salient features, Distribution and Economic importance of angiosperms, Gymnosperms, Pteridophytes, Bryophytes and Lichens.	**15**	**Chalk & Talk, Power Point,**
IV	**ANIMAL KINGDOM -** Introduction to animal kingdom – General classification of invertebrates and vertebrates. Evolution: Theories of Lamarkism& Darwinism- Stages of Gametes- fertilization- development of chick embryo.	**15**	**Chalk & Talk, Power Point**
V	**HUMAN PHYSIOLOGY -** Human Physiology: Digestion, Respiratory system - blood components, structure & functions of heart. Excretion - structure of kidney and mechanism of urine formation.	**15**	**Chalk & Talk, Power Point, Assignment**

Course Designed by: **1.Ms.C.THENMOZHI, Assistant Professor.**

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**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CIA I	**CO1**	**Up to K2**	**2**	**K1& K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
	CO2	**Up to K3**	**2**	**K1 &K2**	**2**	**K2**	**2(K3&K3)**	**1(K3)**
CIA II	**CO3**	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
	CO4	**Up to K4**	**2**	**K1&K2**	**2**	**K2**	**2(K3&K3)**	**1(K4)**
Question Pattern CIA I & II		No. of Questions to be asked	**4**		**3**		**4**	**2**
		No. of Questions to be answered	**4**		**3**		**2**	**1**
		Marks for each question	**1**		**2**		**5**	**10**
		Total Marks for each section	**4**		**6**		**10**	**10**

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**-**	**-**	**-**	**2**	**4**	**60**
	K2	**2**	**6**	**10**	**10**	**28**	**56**	
	K3	**-**	**-**	**10**	**10**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**
CIA II	**K1**	**2**	**-**	**-**	**-**	**2**	**4**	**20**
	K2	**2**	**6**	**-**	**-**	**8**	**16**	
	K3	**-**	**-**	**20**	**-**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**20**	**20**	**40**	**40**
	Marks	**4**	**6**	**20**	**20**	**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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1&K2	1	K2	2(K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
3	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
4	CO4	Up to K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
5	CO5	Up to K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**GENETICS AND BIOSTATISTICS**							
Course Code	**21UMBE52**					**L**	**P**	**C**
Category	**CORE ELECTIVE**					5	-	5
Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP			

Course Objectives:

- To describe the genetics of microbes, Gene transfer mechanisms.
- To identify the genetic exchange Transduction,Conjugation.
- To understand the Mutation and its types.
- To interpret the Data collection, Validation and diagrammatic representation.
- To gain the knowledge to explore students in central tendency and dispersion.

Unit: I	**DNA AS A GENETIC MATERIAL**	**15**

DNA: Genetic material – experiment of Griffith, Avery, MacLeod and McCarty, Harshey and Chase; RNA: Genetic material – Gierer and Schramm experiments.

Unit: II	**GENETIC EXCHANGE**	**15**

Genetic exchange – Transduction (Specialized & Generalized), Transformation, Conjugation –Hfr mapping.

Unit: III	**MUTATION**	**15**

Mutation – spontaneous and induced – Mutagen & Mutagenesis – DNA repair mechanism.

Unit: IV	**DATA COLLECTION**	**15**

Collection of data – Primary data - Secondary data -Types of Variables-Tabulation and presentation of data - Kinds of biological data - Functions of statistics and limitation of statistics.

Unit: V	**CENTRAL TENDENCY AND DISPERSION**	**15**

Measures of central tendency- Mean, Median and Mode – Measures of dispersion – range, quartile deviation, standard deviation.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. David R Hyde. 2010, Genetics and Molecular biology. Special Indian edition, Tata McGraw Hill P.Ltd, New Delhi.
2. Gurumani N, 2004. An Introduction to Biostatistics. MJP publishers, Chennai.

Books for reference:

1.Daniel W.W, 2006. Biostatistics-A foundation for analysis in health sciences, John Wiley (Asia) & sons, Singapore.
2.Gupta S.P, 1987, Statistical Methods. Sultan Chand & Sons Publishers, New Delhi
3. SundarRao, P.S.S and Righard J, 2002. An Introduction to Biostatistics. III edn.

Web Resources:

1. **https://www.youtube.com/watch?v=0lZRAShqft0**
2. **https://www.youtube.com/watch?v=JQByjprj_mA**
3. **https://www.youtube.com/watch?v=QcBYTA7uVXk**
4. **https://www.youtube.com/watch?v=EMDuf_kBJcs**

5. https://www.youtube.com/watch?v=S_3C7R6UbAI 6. https://www.youtube.com/watch?v=TfBnfxm0Xyc 7. https://microbenotes.com/primary-data-and-secondary-data		
Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Classify DNA, RNA as a genetic material.	**Up to K2**
CO2:	Transfer DNA via mechanisms.	**Up to K3**
CO3:	Distinguish mutation and its types.	**Up to K4**
CO4:	Correlate Data collection and validation.	**Up to K4**
CO5:	Use central tendency and dispersion.	**Up to K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**1**	**3**	**3**	**1**	**2**
CO 2	**3**	**1**	**3**	**2**	**1**	**2**
CO 3	**3**	**1**	**3**	**2**	**1**	**2**
CO 4	**1**	**3**	**3**	**3**	**1**	**3**
CO 5	**1**	**3**	**3**	**3**	**1**	**3**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**DNA AS A GENETIC MATERIAL -** DNA: Genetic material – experiment of Griffith, Avery, MacLeod and McCarty, Harshey and Chase; RNA: Genetic material – Gierer and Schramm experiments.	15	Chalk & Talk, Power Point
II	**GENETIC EXCHANGE -** Genetic exchange – Transduction (Specialized & Generalized), Transformation, Conjugation –Hfr mapping.	15	Chalk & Talk, Power Point
III	**MUTATION -** Mutation – spontaneous and induced – Mutagen & Mutagenesis – DNA repair mechanism.	15	Chalk & Talk, Power Point,
IV	**DATA COLLECTION -** Collection of data – Primary data - Secondary data -Types of Variables-Tabulation and presentation of data - Kinds of biological data - Functions of statistics and limitation of statistics.	15	Chalk & Talk, Power Point
V	**CENTRAL TENDENCY AND DISPERSION -** Measures of central tendency- Mean, Median and Mode – Measures of dispersion – range, quartile deviation, standard deviation.	15	Chalk & Talk, Power Point, Assignment

Course Designed by: **1.Ms.C.THENMOZHI, Assistant Professor.**

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**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CIA I	**CO1**	**Up to K2**	**2**	**K1& K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
	CO2	**Up to K3**	**2**	**K1 &K2**	**2**	**K2**	**2(K3&K3)**	**1(K3)**
CIA II	**CO3**	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
	CO4	**Up to K4**	**2**	**K1&K2**	**2**	**K2**	**2(K3&K3)**	**1(K4)**
Question Pattern CIA I & II		No. of Questions to be asked	**4**		**3**		**4**	**2**
		No. of Questions to be answered	**4**		**3**		**2**	**1**
		Marks for each question	**1**		**2**		**5**	**10**
		Total Marks for each section	**4**		**6**		**10**	**10**

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**-**	**-**	**-**	**2**	**4**	**60**
	K2	**2**	**6**	**10**	**10**	**28**	**56**	
	K3	**-**	**-**	**10**	**10**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**
CIA II	**K1**	**2**	**-**	**-**	**-**	**2**	**4**	**20**
	K2	**2**	**6**	**-**	**-**	**8**	**16**	
	K3	**-**	**-**	**20**	**-**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**20**	**20**	**40**	**40**
	Marks	**4**	**6**	**20**	**20**	**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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1&K2	1	K2	2(K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
3	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
4	CO4	Up to K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
5	CO5	Up to K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	

25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**COSMETIC MICROBIOLOGY**							
Course Code	**21UMBE53**					**L**	**P**	**C**
Category	**CORE ELECTIVE**					5	-	5
Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**			✓

Course Objectives:

- To outline the History,scope and role of microbes in cosmetic microbiology.
- To apply the various products and development in cosmetics.
- To describe the microorganisms in food and preservatives .
- To determine the Validation in laboratory methods.
- To gain the knowledge about cosmetic product regulation.

Unit: I	**HISTORY AND SCOPE OF COSMETIC MICROBIOLOGY**	**15**

History and Scope of Cosmetic Microbiology - Definition of cosmetics- Role of microbes in cosmetics preparation - Significance of Cosmetic Microbiology.

Unit: II	**APPLICATION & PRODUCT DEVELOPMENT OF COSMETICS PRODUCTS**	**15**

Solutions, creams, lotions, ointment, paste, gels, sticks, tablets, capsules, powders and aerosols. Product Development: Defining the product, selection & sources of ingredients, formula optimization.

Unit: III	**MICROORGANISMS IN COSMETICS**	**15**

Microorganisms in cosmetics – Preservation of cosmetics – Mechanisms of action of Cosmetic preservatives – Enzymes in cosmetics.

Unit: IV	**VALIDATATON IN MICROBIOLOGY LAB**	**15**

Validation of Method – Equipment Cleansing and Sanitization – Validation in Microbiology Laboratory – Media, microbial Content Test, Identification, Sterilizers, Decontamination.

Unit: V	**COSMETIC PRODUCT REGULATION**	**15**

Cosmetic Product Regulation– Ingredients, Safety assessment, Efficacy data and Labeling requirements for cosmetic products. Environmental and safety concerns of cosmetic ingredients.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1.Philip, A.G. 2006. Cosmetic Microbiology. A Practical approach. 2nd Ed., Taylor & Francis group.

2. Daniel K. Brannan. 1997, Cosmetic Microbiology: A practical handbook, CRC Press.

Books for References:

1.Wilkinson J.B and Moore R.J. 2011. Harry's Cosmeticology.7th Ed., Chemical Publishing, New York,.

2. P.P. Sharma. 2014. Cosmetics – Formulation, Manufacturing and Quality Control, 4th Ed.,

Vandana Publications Pvt. Ltd., Delhi.

3. Hilda Butler and Poucher. W.A. (2000). Poucher's Perfumes, Cosmetics and Soaps. 10th Edition. Kluwer Academic Publishers, Boston.

4. André O. Barel, Marc Paye, Howard I. Maibach. (2009). Handbook of Cosmetic Science and

Technology. 3rd Edition. Marianne Mahieu Informa Healthcare, USA.

Web Resources:

1. https://www.fda.gov/cosmetics/resources-you-cosmetics/resources-industry-cosmetics
2. https://www.youtube.com/watch?v=Mgy9z-VvAdE
3. https://www.youtube.com/watch?v=-T0wxfWGKXw
4. https://www.youtube.com/watch?v=HA3iQbYDqt8
5. https://drive.google.com/file/d/1s-FzxcyhtaUIEtgi0zIjZZi0dw20HFs5/view?usp=share_link

Course Outcomes		K Level
On the completion of the course the student will be able to		
CO1:	Explain history,scope,significance of cosmetic microbiology.	Up to K2
CO2:	Apply the product development of cosmetic products and its applications.	Up to K3
CO3:	Examine the microorganisms in cosmetics.	Up to K4
CO4:	Classify validation methods in laboratory.	Up to K4
CO5:	Identify cosmetic product regulations.	Up to K3

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	1	1	1	1	1
CO 2	2	1	2	1	1	1
CO 3	2	1	2	3	1	1
CO 4	2	3	3	3	2	1
CO 5	2	1	2	2	1	1

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**HISTORY AND SCOPE OF COSMETIC MICROBIOLOGY -** History and Scope of Cosmetic Microbiology - Definition of cosmetics- Role of microbes in cosmetics preparation - Significance of Cosmetic Microbiology.	15	Chalk & Talk, Power Point
II	**APPLICATION & PRODUCT DEVELOPMENT OF COSMETICS PRODUCTS -** Solutions, creams, lotions, ointment, paste, gels, sticks, tablets, capsules, powders and aerosols. Product Development: Defining the product, selection & sources of ingredients, formula optimization.	15	Chalk & Talk, Power Point
III	**MICROORGANISMS IN COSMETICS -** Microorganisms in cosmetics – Preservation of cosmetics – Mechanisms of action of Cosmetic preservatives – Enzymes in cosmetics.	15	Chalk & Talk, Power Point,
IV	**VALIDATATON IN MICROBIOLOGY LAB -** Validation of Method – Equipment Cleansing and Sanitization – Validation in Microbiology Laboratory – Media, microbial Content Test, Identification, Sterilizers, Decontamination.	15	Chalk & Talk, Power Point
V	**COSMETIC PRODUCT REGULATION -** Cosmetic Product Regulation– Ingredients, Safety assessment, Efficacy data and Labeling requirements for cosmetic products. Environmental and safety concerns of cosmetic ingredients.	15	Chalk & Talk, Power Point, Assignment

Course Designed by: **1.Ms.C.THENMOZHI, Assistant Professor.**

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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1&K2	1	K2	2(K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
3	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
4	CO4	Up to K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
5	CO5	Up to K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**GENOMICS IN FORENSIC SCIENCE**							
Course Code	**21UMBE54**					**L**	**P**	**C**
Category	**Core-Elective**					5	-	5
Nature of course:	EMPLOYABILITY	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP			✓

Course Objectives:

On successful completion of the course, the learners should be able to

- To know about Basics and History of Forensic science.
- To understand about importance of DNA in identification of paternity test.
- To get idea about DNA typing and profiling.
- To gain knowledge on DNA Finger printing techniques.
- To aware of fake DNA evidences.

Unit: I	**History and types of Finger printing.**	**15**

History of Finger printing – Patterns – classification – uses of finger print in crime investigation – direct and latent prints – developments of powders – chemistry of powders –other methods of development, transfer of finger prints.

Unit: II	**Paternity DNA tests.**	**15**

Fundamentals and principles – computerized prints, blood stains, grouping and identification, disputed paternity and DNA tests.

Unit: III	**DNA typing and profiling.**	**15**

Genetic finger printing, DNA typing, DNA profiling, DNA finger printing methods– RFLP analysis, PCR analysis, AmpFLP.

Unit: IV	**DNA Finger printing methods.**	**15**

DNA structure, the process of DNA finger printing, DNA finger printing in agricultural genetics programs, plant DNA finger printing.

Unit: V	**Fake DNA evidences and case studies.**	**15**

Applications of DNA finger printing, Fake DNA evidences and case studies- Ted Bundy, The Lindberg Kidnapping, The Atlanta Child Murders.

	Total Lecture Hours	**75Hrs**

Books for Study:

1. Bernasol R. Glick and Jack J. Pasternak (2000), Molecular Biotechnology, Principles and applications of recombinant DNA, Panima Publishing Corporation,New Delhi.
2. Parik, CK (1999), Parik's Text Book of Medical Junrisprudence, Forensic Medicine and Toxicology, 6 th Eds. CBS Publishing, India.

Books for reference:

1. Encyclopedia of Forensic Sciences, 2nd edition, Siegel, Elsevier. ISBN: 9780123821669.
2. A Guide to Forensic DNA Profiling by Allan Jamieson, Scott Bader, ISBN: 9781118751527.
3. Forensic Science in Court by Donald E. Shelton, ISBN: 9781442201873.
Saferstein. R. (1978), Criminalistics, an introduction to Forensic Science, Pretice Hall of India.
4. The Poisoner's Handbook: Murder and the Birth of Forensic Medicine in Jazz Age New York.
5. Criminalistics : An Introduction to Forensic Science, 12th Edition. Richard Saferstein.

Web Resources:
1. https://suffolk.libguides.com/c.php?g=653940&p=4590945.
2. https://www.sanfoundry.com/best-reference-books-physical-evidence-forensic-science/.
3. https://bookauthority.org/books/beginner-forensic-science-books.

Course Outcomes		K Level
On the completion of the course the student will be able to		
CO1:	Describe the history and types of Finger printing.	Up to K2
CO2:	Understand the importance of DNA in paternity identification.	Up to K3
CO3:	Give awareness about DNA profiling and mapping.	Up to K4
CO4:	Have an idea about different DNA finger printing methods.	Up to K4
CO5:	Investigate fake DNA evidences with case studies.	Up to K3

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	1	3	3	2
CO 2	3	2	3	2	2	2
CO 3	2	1	1	1	1	2
CO 4	3	2	3	2	2	1
CO 5	3	2	3	2	2	1

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**History and types of Finger printing-** History of Finger printing – Patterns – classification – uses of finger print in crime investigation – direct and latent prints – developments of powders – chemistry of powders –other methods of development, transfer of finger prints.	**15**	**Chalk & Talk, Power Point**
II	**Paternity DNA tests-** Fundamentals and principles – computerized prints, blood stains, grouping and identification, disputed paternity and DNA tests.	**15**	**Chalk & Talk, Power Point,**
III	**DNA typing and profiling**- Genetic finger printing, DNA typing, DNA profiling, DNA finger printing methods– RFLP analysis, PCR analysis, AmpFLP.	**15**	**Chalk & Talk, Power Point,**
IV	**DNA Finger printing methods-** DNA structure, the process of DNA finger printing, DNA finger printing in agricultural genetics programs, plant DNA finger printing.	**15**	**Chalk & Talk, Power Point,**
V	**Fake DNA evidences and case studies-** Applications of DNA finger printing, Fake DNA evidences and case studies.	**15**	**Chalk & Talk, Power Point, Assignment**

Course Designed by: **1.Dr. T. Rohini, Assistant Professor.**

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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Up to K2**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
2	CO2	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
3	CO3	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K4)**
5	CO5	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**CELL BIOLOGY**							
Course Code	**21UMBE55**					**L**	**P**	**C**
Category	**CORE ELECTIVE**					5	-	5
Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**			✓

Course Objectives:

- To gain knowledge in diversity of microorganisms
- To learn in detail the structure of various cell organelles.
- To acquire knowledge on structural and functional knowledge of cells, tissues and organelles.
- To get familiarize with mechanisms of cell signaling.
- To identify the concept of cell in terms of growth and cell division.

Unit: I	**INRODUCTION TO CELL**	**15**

Cell Theory, Diversity of cell – shape and size, Ultra structure of plant and animal cell, Cell types – epithelial cells, endothelial cells, Muscle Cells and Connective tissue cells.

Unit: II	**ORGANELLES IN CELL**	**15**

Structure, types and functions of: Mitochondria, Chloroplast, Ribosome, Endoplasmic reticulum (rough and smooth), Golgi apparatus, Lysosome, Nucleus, Chromosome, Microfilaments, Microtubules, Cilia and, Flagella.

Unit: III	**TOOLS OF CELL MICROBIOLOGY**	**15**

Micrometry, subcellular fractionation- ultra centrifuge. Cytological techniques- Fixation & Sectioning, Staining- Gram Staining, Capsule & Giemsa Staining.

Unit: IV	**CELL SIGNALLLING**	**15**

Cell signaling, Importance and Types -Paracrine, Autocrine, Endocrine & Direct Contact, signal molecules-Surface membrane and cytoplasmic receptors; Cell-cell Communication, Intracellular signaling. Cell –Cell interactions: Extra Cellular Matrix (ECM), Cell Adhesion.

Unit: V	**CELL DIVISION**	**15**

Phases of cell cycle, regulation of cell cycle, Phases and significance of Mitosis, Meiosis, Apoptosis, Necrosis, Biology of cancer.

	Total Lecture Hours	**75 Hrs**

Books for Study: \

1. Power, C.B. 2009. Cell Biology. Himalayan Publishing House, New Delhi. 2. Paul, A. 2009. Cell and Molecular Biology. Books and Allied (P) ltd, India.
2. Paul, A. 2009. Cell and Molecular Biology. Books and Allied (P) ltd, India

Books for References:

1. Alberts, B. et al., 1994. Molecular Biology of the Cell (3rd edition). Garland Publishing, Inc., New York
2. Cooper, GM and Hawman RE. 2013. Cell a Molecular Approach (6th Edition). Sinauer Associates, Inc
3. De Roberties E.D.P and E.M.F.DeRoberties. 2011. Cell and Molecular Biology. 8th edition. B.I. Publicatons Pvt. Ltd., India
4. Karp G. 2013. Cell and Molecular Biology Concepts and Experiments. John Wiley & Sons, Inc
5. Alberts Bruce., etal., Essential Cell Biology, V International Student Edition.

Web Resources:		
1. https://www.britannica.com/science/cell-theory 2. https://askabiologist.asu.edu/cell-division 3. https://micro.magnet.fsu.edu/cells/animalcell.html 4. https://www.ncbi.nlm.nih.gov/books/NBK9851/#:~:text=Some%20cell%2Dcell%20interactions%20are,organization%20of%20cells%20in%20tissues.		
Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Classify, the diversity and similarity of different organisms at organization levels.	**Up to K2**
CO2:	Utilize the structure of various cell organelles.	**Up to K3**
CO3:	Illustrate the structural and functional properties of cells, tissues , organelles etc.	**Up to K4**
CO4:	Classify the various mechanisms of inter and intra cellular communication.	**Up to K4**
CO5:	Identifyconcepts of cells in terms of growth, division, specialisation, motility and interactions	**Up to K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**1**	**2**	**2**	**1**
CO 2	**2**	**2**	**2**	**2**	**1**	**1**
CO 3	**2**	**2**	**2**	**2**	**2**	**2**
CO 4	**3**	**1**	**1**	**2**	**1**	**1**
CO 5	**3**	**2**	**1**	**2**	**1**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**INTRODUCTION TO CELL** Cell Theory Cell Theory, Diversity of cell – shape and size, Ultra structure of plant and animal cell, Cell types –epithelial cells, endothelial cells, Muscle Cells and Connective tissue cells.	15	Chalk & Talk, Power Point
II	**ORGANELLES IN CELL** Structure, types and functions of: Mitochondria, Chloroplast, Ribosome, Endoplasmic reticulum (rough and smooth), Golgi apparatus, Lysosome, Nucleus, Chromosome, Microfilaments, Microtubules, Cilia and, Flagella.	15	Chalk & Talk, Power Point
III	**TOOLS OF CELL MIROBIOLOGY** Micrometry, subcellular fractionation- ultra centrifuge. Cytological techniques- Fixation & Sectioning, Staining- Gram Staining, Capsule &Giemsa Staining.	15	Chalk & Talk, Power Point,
IV	**CELL SIGNALLING** Cell signaling, Importance and Types -Paracrine, Autocrine, Endocrine & Direct Contact, signal molecules-Surface membrane and cytoplasmic receptors; Cell-cell Communication, Intracellular signaling. Cell –Cell interactions: Extra Cellular Matrix (ECM), Cell Adhesion.	15	Chalk & Talk, Power Point
V	**CELL DIVISION** Phases of cell cycle, regulation of cell cycle, Phases and significance of Mitosis, Meiosis, Apoptosis, Necrosis, Biology of cancer.	15	Chalk & Talk, Power Point, Assignment

Course Designed by: **1.Mrs. A. .Abirami, Assistant Professor.**

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**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CIA I	**CO1**	**Up to K2**	**2**	**K1& K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
	CO2	**Up to K3**	**2**	**K1 &K2**	**2**	**K2**	**2(K3&K3)**	**1(K3)**
CIA II	**CO3**	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
	CO4	**Up to K4**	**2**	**K1&K2**	**2**	**K2**	**2(K3&K3)**	**1(K4)**
Question Pattern CIA I & II		No. of Questions to be asked	**4**		**3**		**4**	**2**
		No. of Questions to be answered	**4**		**3**		**2**	**1**
		Marks for each question	**1**		**2**		**5**	**10**
		Total Marks for each section	**4**		**6**		**10**	**10**

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**-**	**-**	**-**	**2**	**4**	**60**
	K2	**2**	**6**	**10**	**10**	**28**	**56**	
	K3	**-**	**-**	**10**	**10**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**
CIA II	**K1**	**2**	**-**	**-**	**-**	**2**	**4**	**20**
	K2	**2**	**6**	**-**	**-**	**8**	**16**	
	K3	**-**	**-**	**20**	**-**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**20**	**20**	**40**	**40**
	Marks	**4**	**6**	**20**	**20**	**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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Up to K2**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
2	CO2	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
3	CO3	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K4)**
5	CO5	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**PUBLIC HEALTH MICROBIOLOGY**							
Course Code	**21UMBE56**					**L**	**P**	**C**
Category	**Core Elective**					5	-	5
Nature of course:	EMPLOYABILITY	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP			✓

Course Objectives:

On successful completion of the course, the learners should be able to

- To know about importance of Public Health Microbiology.
- To aware of infectious air borne diseases.
- To acquire knowledge about water treatment and water borne diseases.
- To recognize about food hygiene and food borne diseases.
- To understand about Hospital borne infections and biomedical waste management.

Unit: I	**Importance of Public Health Microbiology.**	**15**

Introduction to public health: definition, scope, concept and importance of public health microbiology – roles of microbiologist in public health.

Unit: II	**Air borne diseases.**	**15**

Types of Infection and Infectious agent – Methods to prevent airborne diseases (viral – H1N1 Influenza–) bacterial: Tuberculosis, Fungi - Aspergillosis).

Unit: III	**Water borne diseases.**	**15**

Water treatment- chlorination – Methods to prevent water borne diseases (viral – Hepatitis A, bacterial - Cholera, protozoan – Amoebiasis) – Public health organizations (Public Health Foundation of India).

Unit: IV	**Food borne diseases.**	**15**

Food borne infections: Definition and importance of food hygiene – role of microorganisms in food spoilage and poisoning - Aflotoxin – food borne diseases (Botulism) – types of food borne diseases.

Unit: V	**Nosocomial Infections.**	**15**

Hospital acquired infection: Prophylactic immunization – disposal of infective hospital and laboratory materials – monitoring of sanitation in community – techniques used for the diagnosis of hospital acquired infection and Vaccine – AMR- Anti Microbial Resistance & Siginificance, MDR – Multiple Drug Resistance.

	Total Lecture Hours	**75Hrs**

Books for Study:

1. Jacquelyn G. Black. 2001. Microbiology: Principles and Explorations (8th Edition),Willy Publications, UK.
2. Eugene Nester, Denise Anderson, Jr., Evans Roberts, C. and Martha Nester. 2007. Microbiology: A Human Perspective (8th Edition). McGraw-Hill Inc., US.

Books for References:

1. Jawetz, E., Melnic, J.L. and Adelberg, E.A. 2004. Medical Microbiology(22nd Edition). McGraw Hill companies, New Delhi.
2. Prescott, Harley and Klein. 2006. Microbiology (6th Edition). The McGraw-Hill Publishing

Co., Ltd., New Delhi.
3. Mims, C., Playfair, J., Roitt, Walkelin, D. and Williams, R. 2004. Medical Microbiology(3rd Edition). Mosby publications, US.
4. Greenwood, D. Richard C.B. Salk, John, F. and Peutherer. 2003. Medical Microbiology(5th Edition). Churchill Livingstone, USA.
5. Ananthanarayanan, R. and Jayaram Panicker, C.K. 2005. Text book of Microbiology, orient Long man, London

Web Resources:

1. http://www.careersinpublichealth.net/careers/public-health-microbiologist
2. https://www.mooc-list.com/tags/vaccines
3. https://www.mooc-list.com/course/vaccines-coursera.

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Describe the basic concepts of public health hygiene.	**Up to K2**
CO2:	To have an idea about the types of infection and diseases.	**Up to K3**
CO3:	Investigate the outbreaks of communicable diseases.	**Up to K4**
CO4:	Give awareness about Prevention of disease and promoting health among populations.	**Up to K4**
CO5:	Understand the pathogenicity of Hospital acquired infection.	**Up to K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	1	3	3	2
CO 2	3	2	3	2	2	2
CO 3	2	1	1	1	1	2
CO 4	3	2	3	2	2	1
CO 5	3	2	3	2	2	1

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**Importance of Public Health Microbiology-** Introduction to public health: definition, scope, concept and importance of public health microbiology – roles of microbiologist in public health.	**15**	**Chalk & Talk, Power Point**
II	**Air borne diseases-** Types of Infection and Infectious agent – Methods to prevent airborne diseases (viral – SARS – CoV2) bacterial: Tuberculosis, Fungi - Aspergillosis).	**15**	**Chalk & Talk, Power Point,**
III	**Water borne diseases-** Water treatment- chlorination – Methods to prevent water borne diseases (viral – Hepatitis A, bacterial - Cholera, protozoan – Amoebiasis) – Public health organizations (Public Health Foundation of India).	**15**	**Chalk & Talk, Power Point,**
IV	**Food borne diseases-** Food borne infections: Definition and importance of food hygiene – role of microorganisms in food spoilage and poisoning – food borne diseases (Botulism) – types of food borne diseases.	**15**	**Chalk & Talk, Power Point,**
V	**Nosocomial Infections-** Hospital acquired infection: Prophylactic immunization – disposal of infective hospital and laboratory materials – monitoring of sanitation in community – techniques used for the diagnosis of hospital acquired infection and Vaccine – Vaccination Schedule.	**15**	**Chalk & Talk, Power Point, Assignment**

Course Designed by: **1.Dr. T. Rohini, Assistant Professor.**

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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Up to K2**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
2	CO2	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
3	CO3	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K4)**
5	CO5	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**COMPUTER APPLICATIONS IN BIOLOGY**									
Course Code	**21UMBS51**							**L**	**P**	**C**
Category	**SKILL**							2	-	2
Nature of course:	EMPLOYABILITY			**SKILL ORIENTED**	✓	ENTREPRENURSHIP				

Course Objectives:

- To gain the knowledge about basics components of computer.
- To study in detail the the features of computer.
- To acquire knowledge on computer application in biology.
- To enable the students to explore knowledge about scope & applications of bioinformatics.
- To get familiarize with Sequence alignment in biological databases.

Unit: I	**Introduction to computers**	**6**
Introduction to computers: Definition, Components of computer Input and output devices, classification of Computers. Computer numbers system.		
Unit: II	**Basics in operating system**	**6**
MS Office – MS word – Data bases and graph generations, MS Excel, Project presentation -MS power point.		
Unit: III	**Application of Computer in biology.**	**6**
Introduction to Networking, internet – Email & File transfer protocol, Computer aided application in Fermentation technology & drug designing using software- Accelrys & Auto Dock.		
Unit: IV	**Introduction to Bioinformatics**	**6**
Bioinformatics: Scope & Definition, Brief idea about important software for microbiological studies. Applications of Bioinformatics, Statistical package for Sciences.		
Unit: V	**Biological databases.**	**6**
Introduction to biological databases – NCBI – Gen Bank, EMBL, DDBJ. Sequence alignment – BLAST, FASTA & CLUSTAL W.		
	Total Lecture Hours	**30 Hrs**

Books for Study:

1. Cory Althoff, The self- taught **Computer Scientist**- The Beginners guide to data structure.
2. John Pezzulo, Biostatistics for Dummies, III Edition

Books for References:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical learning, Springer science
2. William R. Hersh, Robert E. Hoyt Health Informatics, Practical guide 7th Edition.
3. Tore Samuelsson,(2007) **Genomics and Bioinformatics – An introduction to programming tools for Life scientist,** Cambridge University press.
4. P.M. Selzer, R.J. Marhofer & Rohwer (2003) **Applied Bioinformatics,** Springer.
5. K. Janardhan, P. Hanmanth Rao (2019) Fundamentals of Biostaistics.

Web Resources:

1.https://thebiologynotes.com/fasta-and-blast/ 2.https://www.w3schools.in/computer-fundamentals/components-of-computer 3https://www.sciencedirect.com/book/9781907568275/computer-aided-applications-in-pharmaceutical-technology	
Course Outcomes	**K Level**
On the completion of the course the student will be able to	
CO1: Explain the basics of computer in hardware and software aspects.	**Up to K1**
CO2: Outline the MS Windows applications.	**Up to K2**
CO3: Demonstrate the computer applications in bioinformatics.	**Up to K3**
CO4: Relate on the application of bioinformatics in clinical microbiology.	**Up to K3**
CO5: Illustrate the search and contributions in biological databases.	**Up to K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	2	2	2	2	2
CO 2	2	2	3	3	2	2
CO 3	2	1	2	2	2	2
CO 4	2	2	2	2	2	2
CO 5	2	2	3	2	2	3

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**Introduction to computers** Introduction to computers: Definition, Components of computer Input and output devices, classification of Computers. Computer numbers system	6	Chalk & Talk, Power Point
II	**Basics in operating system** MS Office – MS word – Data bases and graph generations, MS Excel, Project presentation -MS power point..	6	Chalk & Talk, Power Point
III	**Application of Computer in biology** Introduction to Networking, internet – Email & File transfer protocol, Computer application in Fermentation technology & drug designing using software- Accelrys & Auto Dock	6	Chalk & Talk, Power Point,
IV	**Introduction to Bioinformatics** Bioinformatics: Scope & Definition, Brief idea about important software for microbiological studies. Applications of Bioinformatics	6	Chalk & Talk, Power Point
V	**Biological databases** Introduction to biological databases – NCBI – Gen Bank, EMBL, DDBJ. Sequence alignment – BLAST, FASTA & CLUSTAL W.	6	Chalk & Talk, Power Point, Assignment

Course Designed by: **1.Mrs. A. ABIRAMI, Assistant Professor.**


SIXTH SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**FOOD AND DAIRY MICROBIOLOGY**							
Course Code	**21UMBC61**					**L**	**P**	**C**
Category	**CORE**					6	-	5
Nature of course:	EMPLOYABILITY	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP			✓

Course Objectives:

- The main objective of this course is to give students an insight into the world of Food and Dairy Microbiology.
- To understand various microbial interactions and role of microbes in spoilage of Food.
- To know the principles in traditional methods of preservation and modern preservation. techniques.
- To demonstrate an understanding of using Lactic acid bacteria as starter cultures and to learn more on microbes as source of food.
- To identify and differentiate microbes causing food intoxications and food infection.

Unit: I	**INTRODUCTION TO FOOD AND DAIRY MICROBIOLOGY**	**18**

Importance of food and dairy Microbiology-Natural flora and Sources of contamination of foods in general. Classification of food in relation to shelf life – Perishable food ,factors affecting the growth of microorganisms in food- feed and fodder.

Unit: II	**SPOILAGE OF FOOD AND MILK PRODUCTS**	**18**

Food Spoilage - Definition, intrinsic and extrinsic factors that affect growth and survival of microbes in food. Role of microorganisms in spoilage of milk. Spoilage of food - vegetables- eggs, milk and milk products- meat and meat products- fish and canned foods.

Unit: III	**PRINCIPLES OF AND METHODS OF FOOD PRESERVATION.**	**18**

Physical Methods of Food Preservation & Principles: Sterilization, Pasteurization-types, UHT, canning, drying and Irradiation. Chemical methods- salt, sugar, organic acids, SO_2 and antibiotics. Quality control, HACCP in dairy Industry, Principles and its Applications.

Unit: IV	**FERMENTED FOODS**	**18**

Fermented Foods – Definition and Characteristics of Lactic Acid Bacteria as starters-Fermented milk products-yogurt, butter, cheese & Kefir. Other fermented Food: Idly Pickle Cucumber. Microorganisms as food –Single Cell Protein, Edible Mushroom. Prebiotics, Probiotics & Synbiotics-Definition & uses.

Unit: V	**FOOD AND MILK BORNE DISEASES**	**18**

Food Poisoning, Food infections &intoxications– Definition, causative agent, Symptoms and preventive measures. Food Intoxication, Symptoms & Treatment – Staphylococcal poisoning & Botulisms. Food borne infections- Salmonellosis & Shigellosis .Milk borne disease – Brucellosis.

	Total Lecture Hours	**90 Hrs**

Books for Study:

1 Frazier W.C. and Westhoff D.C. (2008) **Food Microbiology,** 4th Edition. Tata McGraw Hill Publishing Co., New Delhi.
2. Bamforth C.W. (2005) **Food, Fermentation and Microorganisms**, Blackwell Science.

Books for References:
1Doyle M.P. and Buchanan R.L. (Ed.) (2013) **Food Microbiology**: Fundamentals and Frontiers, 4th Edition. ASM press. 2. Jay J.M., Loessner M.J. and Golden D.A. (2005) **Modern Food Microbiology,** 7th Edition. Springer Publishers. 3. Robinson R.K. (2002) **Dairy Microbiology:** Milk and Milk Products, 3rd Edition. Wiley Publishers. 4.Peter J. Taormina (2021)Food Safety and Quality – Based Shelf Life of perishable Foods, 1st Edition, Springer Publishers. 5. Adams (2001), Food Microbiology.
Web Resources:
1https://www.biotechnologynotes.com/food-biotechnology/microorganisms-in-food/growth-of-microorganisms-in-food-intrinsic-extrinsic-factors-biotechnology/14135 **2.https://www.agrimoon.com/wp-content/uploads/Starter-Cultures-and-Fermented-Milk-Products.pdf** **3. https://www.sciencedirect.com/food-microbiology**

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	To Recognize and relate on the classification of food in relation toshelf life and to relate ion the factors affecting the growth of Microorganisms.	**Up to K2**
CO2:	Understand and experiment the significance and activities of microorganismin spoilage of food.	**Up to K3**
CO3:	Analyze the principles in traditional and modern methods of Food preservation.	**Up to K4**
CO4:	Analyze types of starter cultures like Lactic acid bacteria and its application in Fermented food.	**Up to K4**
CO5:	Summarize on important food intoxications and food infections.	**Up to K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**2**	**3**	**2**	**2**
CO 2	**3**	**2**	**2**	**3**	**2**	**2**
CO 3	**2**	**3**	**2**	**3**	**1**	**2**
CO 4	**3**	**2**	**2**	**2**	**2**	**1**
CO 5	**3**	**2**	**3**	**2**	**2**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**INTRODUCTION TO FOOD AND DAIRY MICROBIOLOGY** Importanceof food and dairy Microbiology, Natural flora and Sources of contamination of foods in general. Classification of food in relation to shelf life.Factors affecting the growth of microorganisms in food, feed and fodder.	18	Chalk & Talk, Power Point
II	**SPOILAGE OF FOOD AND MILK PRODUCTS** Food Spoilage - Definition, intrinsic and extrinsic factors that affect growth and survivalofmicrobes in food. Role of microorganisms in spoilage of milk. Spoilage of food: vegetables, eggs, milk and milk products, Spoilage of food: meat and meat products, fish and canned foods.	18	Chalk & Talk, Power Point
III	**PRINCIPLES,PHYSICALMETHODSOFFOODPRESERVATION** Sterilization, Pasteurization-types, UHT, canning, drying and Irradiation. Chemical methods- salt, sugar ,organic acids,SO_2 and antibiotics. Quality control, HACCP in dairy Industry, Principles and its Applications.	18	Chalk & Talk, Power Point,
IV	**FERMENTED FOODS**– Definition and Characteristics of Lactic Acid Bacteria as starters. Fermented milk products-yogurt,butter, cheese & Kefir. Other fermented Food; Idly Pickle Cucumber. Microorganisms as food –Single Cell Protein, Edible Mushroom. Prebiotics, Probiotics &Synbiotics- uses.	18	Chalk & Talk, Power Point
V	**FOOD AND MILK BORNE DISEASES**Food Poisoning, Food infections & intoxications– Definition, causative agent, Symptoms and preventive measures. Food Intoxication, Symptoms & Treatment – Staphylococcal poisoning & Botulisms. Food borne infections- Salmonellosis & Shigellosis. Milk borne disease – Brucellosis.	18	Chalk & Talk, Power Point, Assignment

Course Designed by:

1. **Mrs. A. ABIRAMI, Assistant Professor**

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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1&K2	1	K2	2(K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
3	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
4	CO4	Up to K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
5	CO5	Up to K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**VIROLOGY**							
Course Code	**21UMBC62**					**L**	**P**	**C**
Category	**CORE**					6	-	5
Nature of course:	EMPLOYABILITY	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP			✓

Course Objectives:

On successful completion of the course, the learners should be able to

- To understand the basic characters and classification of virus.
- To know about different steps of virus multiplication.
- To gain knowledge about human viral diseases.
- To get idea about common plant viral diseases and their control measures.
- To recognize antiviral agents and antiviral therapy.

Unit: I	**INTRODUCTION AND CLASSIFICATION OF VIRUS.**	**18**

Introduction to Virus - History, Occurrence, Morphology of viruses - Helical, Icosahedral and Complex viruses - LHT and ICTV system of classification - Properties of viruses**.**

Unit: II	**VIRAL MULTIPICATION.**	**18**

Cultivation and quantification of viruses, Separation and characterization of viral components. Viral multiplication - Attachment, entry, un-coating, replication, assembly, release, Cell transformations. Virus like particles

Unit: III	**BACTERIOPHAGES AND ANIMAL VIRUSES.**	**18**

Bacteriophages -Introduction, Classification of bacteriophage- phage M13- phage lambda. Animal viruses- Introduction, Classification- Transmission, Multiplication, symptoms and control of following viral diseases: DNA containing viruses: Simion Virus 40 (SV-40), Adenoviruses, RNA containing viruses: Human Immuno Deficiency Virus (HIV), SARS (C0V-2).

Unit: IV	**PLANT VIRAL DISEASES.**	**18**

Introduction to Plant Viruses-Classification - Transmission, Multiplication, symptoms and control of following plant viral diseases: Cauliflower mosaic virus, Tobacco mosaic virus, Potato leaf roll virus, Sugarcane Mosaic virus, Tomato spotted wilt.

Unit: V	**ANTI VIRAL AGENTS.**	**18**

Host response and antiviral agents - Immune responses to viruses, Interferon and other cytokines, Antiviral therapy, Viral titre / assay methods.

	Total Lecture Hours	**90Hrs**

Books for Study:

1. Ananthanarayanan, R. and Jayaram Panicker, C.K. 2005. Text book of Microbiology, orient Long man, London.
2. Prescott, Harley and Klein. 2006. Microbiology (6th Edition). The McGraw-Hill Publishing Co., Ltd., New Delhi.

Books for References:

1. Villarreal L.P, 2005. Viruses and the Evolution of Life. A.S.M Press, Washington D.C.

2. Roger Hull, Mathews, 2002. Plant Virology, 4th edition, Academic press- A Harcourt Science

and technology company, New York.

3. Topley and Wilson, 2005. Principles of bacteriology, Virology and immunity. 11th edition, vol 4, Edward Arnold, London.

4. Robert I Krasner, 2002. The Microbial challenge: Human Microbe Interaction, American Society for Microbiology, 2nd edition, Washington.

5. Ann GiudiciFettner, 1990. The science of viruses, 2nd edition, Quill, William Marrow, New York.

Web Resources:

1. https://www.jfmed.uniba.sk/fileadmin/jlf/Pracoviska/ustav-mikrobiologie-a-imunologie/distancna_vyuka/ang_12_lect_viruses.pdf.
2. https://microbenotes.com/category/virology/
3. https://eazhar.kau.edu.sa/Files/0030203/files/19623_Lec-1%20General%20Virology_Medical%20Virology.pdf.

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Recognize history, morphology, multiplication, animal viral, plant viral diseases and host response.	**Up to K2**
CO2:	Classify properties of virus, components of viral multiplication, bacteriophages, plant viruses and antiviral therapy.	**Up to K3**
CO3:	Illustrate viral cell transformation, transmission, multiplication, symptoms and control of animal and plant viral diseases.	**Up to K4**
CO4:	Examine viral transmission.	**Up to K4**
CO5:	Summarize the immune responses to viruses, Interferon and other cytokines	**Up to K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**1**	**1**	**3**	**3**	**2**
CO 2	**3**	**2**	**3**	**2**	**2**	**2**
CO 3	**2**	**1**	**1**	**1**	**1**	**2**
CO 4	**3**	**2**	**3**	**2**	**2**	**1**
CO 5	**3**	**2**	**3**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**INTRODUCTION AND CLASSIFICATION OF VIRUS-** Introduction to Virus - History, Occurrence, Morphology of viruses - Helical, Icosahedral and Complex viruses - LHT and ICTV system of classification - Properties of viruses**.**	**18**	**Chalk & Talk, Power Point**
II	**VIRAL MULTIPICATION-** Cultivation and quantification of viruses, Separation and characterization of viral components. Viral multiplication - Attachment, entry, un-coating, replication, assembly, release, Cell transformations. Virus like particles.	**18**	**Chalk & Talk, Power Point,**
III	**BACTERIOPHAGES AND ANIMAL VIRUSES-** Bacteriophages - Introduction, Classification of bacteriophage- phage M13- phage lambda. Animal viruses- Introduction, Classification- Transmission, Multiplication, symptoms and control of following viral diseases: DNA containing viruses: Simion Virus 40 (SV-40), Adenoviruses, RNA containing viruses: Human Immuno Deficiency Virus (HIV), SARS (C0V-2).	**18**	**Chalk & Talk, Power Point,**
IV	**PLANT VIRAL DISEASES-** Introduction to Plant Viruses- Classification - Transmission, Multiplication, symptoms and control of following plant viral diseases: Cauliflower mosaic virus, Tobacco mosaic virus, Potato leaf roll virus, Sugarcane Mosaic virus, Tomato spotted wilt.	**18**	**Chalk & Talk, Power Point,**
V	**ANTI VIRAL AGENTS-** Host response and antiviral agents - Immune responses to viruses, Interferon and other cytokines, Antiviral therapy, Viral titre / assay methods.	**18**	**Chalk & Talk, Power Point, Assignment**

Course Designed by: **1.Dr. T. ROHINI, Assistant Professor.**

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**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CIA I	**CO1**	**Up to K2**	**2**	**K1& K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
	CO2	**Up to K3**	**2**	**K1 &K2**	**2**	**K2**	**2(K3&K3)**	**1(K3)**
CIA II	**CO3**	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
	CO4	**Up to K4**	**2**	**K1&K2**	**2**	**K2**	**2(K3&K3)**	**1(K4)**
Question Pattern CIA I & II		No. of Questions to be asked	**4**		**3**		**4**	**2**
		No. of Questions to be answered	**4**		**3**		**2**	**1**
		Marks for each question	**1**		**2**		**5**	**10**
		Total Marks for each section	**4**		**6**		**10**	**10**

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**-**	**-**	**-**	**2**	**4**	**60**
	K2	**2**	**6**	**10**	**10**	**28**	**56**	
	K3	**-**	**-**	**10**	**10**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**
CIA II	**K1**	**2**	**-**	**-**	**-**	**2**	**4**	**20**
	K2	**2**	**6**	**-**	**-**	**8**	**16**	
	K3	**-**	**-**	**20**	**-**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**20**	**20**	**40**	**40**
	Marks	**4**	**6**	**20**	**20**	**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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1&K2	1	K2	2(K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
3	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
4	CO4	Up to K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
5	CO5	Up to K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions)
Answer All Questions **(10x1=10 marks)**

Q.No	CO	K Level	Questions
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	

Section B (Short Answers)
Answer All Questions **(5x2=10 marks)**

Q.No	CO	K Level	Questions
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	

Section C (Either/Or Type)
Answer All Questions **(5 x 5 = 25 marks)**

Q.No	CO	K Level	Questions
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	

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

Section D (Open Choice)
Answer Any Three questions **(3x10=30 marks)**

Q. No	CO	K Level	Questions
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**FOOD AND DAIRY MICROBIOLOGY- PRACTICAL**							
Course Code	**21UMBCP7**					**L**	**P**	**C**
Category	**CORE PRACTICAL**					-	5	4
Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP			

Course Objectives:

- To develop basic skills in Food preparation.
- To gain basic understanding of principle behind milk testing.
- To acquire knowledge in various milk testing employed in industries.
- To get familiar with various plating techniques in raw milk.
- To develop skilled in tests followed in dairy and food processing industries.

List of Experiments

1. Preparation of Jam & Jelly.
2. Preparation of Pickle.
3. Preparation of Squash.
4. Preparation of Fruit and nuts based drink.
5. Clot on Boiling Test. & Phosphatase Test.
6. Methylene blue dye reduction Test in Raw and processed Milk
7. Determination Acidity in Raw and processed Milk
8. Determination of Fat & SNF in Raw Milk.
9. Determination of Alcohol / Heat stability in Milk
10. Coliform count in Raw Milk.

	Total Hours	**60 Hrs**

Distribution of marks

Max marks : 100

Internal : 40 marks **External : 60 marks**

Laboratory Performance : 30 marks
Observation note book : 10 marks

Vivo voce : 10 marks
Record note book : 10 marks
Procedure and Result : 40 marks

Total : 40 marks **Total : 60 marks**

Books for Study:

1 Frazier W.C. and Westhoff D.C. (2008) **Food Microbiology,** 4th Edition. Tata McGraw Hill Publishing Co., New Delhi.

2.Manual of Methods of Analysis of Foods, Milk & Milk Products, FSSAI.

Books for reference:

1.Doyle M.P. and Buchanan R.L. (Ed.) (2013) **Food Microbiology**: Fundamentals and Frontiers, 4th Edition. ASM press.

2.Jay J.M., Loessner M.J. and Golden D.A. (2005) **Modern Food Microbiology,** 7th Edition. Springer Publishers.

3.Robinson R.K. (2002) **Dairy Microbiology:** Milk and Milk Products, 3rd Edition. Wiley Publishers.

4. G.J. Banwart Basic Food Microbiology.

Web Resources:

1. https://www.youtube.com/watch?v=ms_yBSEfsWk
2. https://courseware.cutm.ac.in/wp-content/uploads/2020/06/Study-Material-Lecture-04-FSSAI-specification-for-Jam-Jelly-Marmalade-and-glazed-crystallised-fruits.pdf
3. https://www.sciencedirect.com/science/article/pii/S2211601X16000201/pdf?md5=19d18288aac9c46853730e591ab366ce&pid=1-s2.0-S2211601X16000201-main.pdf

Course Outcomes		K Level
On Successful Completion of Course the student will be able to		
CO1:	Remember the processing and preparation of Food products	K1
CO2:	Understand the principle behind food preservation.	K2
CO3:	Apply the different methods of milk testing.	K3
CO4:	Analyze the principle and application of testing employed in Milk Processing Industries.	K4
CO5:	Examine the normal and pathogenic microorganism in milk	K4

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**2**	**2**	**2**	**1**	**2**	**2**
CO 2	**1**	**2**	**2**	**2**	**2**	**3**
CO 3	**2**	**1**	**2**	**2**	**3**	**3**
CO 4	**2**	**2**	**1**	**1**	**1**	**2**
CO 5	**2**	**2**	**3**	**2**	**2**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Experiments	Topics	Hrs	Mode
1	Preparation of Jam.	45 hrs	Demo/Practical/ Videos
2	Preparation of Pickle.		
3	Preparation of Squash		
4	Preparation of Jelly		
5	Clot on Boiling Test		
6	Methylene blue dye reduction Test Raw and processed Milk		
7	Determination Acidity in Raw and processed Milk		
8	Determination of Fat & SNF in Raw Milk.		
9	Determination of Alcohol / Heat stability in Milk.		
10	Determination of Standard plate count and Coliform count in Raw Milk.		

Course Designed by:

1.. **Mrs. A. Abirami, Assistant Professor**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**PROJECT AND VIVA - VOCE**							
Course Code	**21UMBPR1**					**L**	**P**	**C**
Category	**Core**					**6**	**-**	**4**
Nature of course:	EMPLOYABILITY	✓	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP			✓

Course Objectives:

Course Content:

Group Project	–	Maximum 4 Students in a group
Record submission	–	A hard bound report to be submitted to the Department.
Evaluation	–	Project (oral) presentation followed by a brief Viva
Internal	–	40 Marks (Course Teacher)
External	–	60 Marks (Course teacher & External Examiner)

Course Description

The Project is conducted by the following Course Pattern.

Internal

Presentation
Submission } **40**

External

Project Report
Viva Voce } **60**

Total 100

Course Outcomes		K Level
On Successful Completion of Course the student will be able to		
CO1:	To get accustomed to research.	**K1**
CO2:	To get trained in microbiological techniques.	**K2**
CO3:	To be aware of common problems encountered during research activities,	**K3**
CO4:	To develop interest in result – oriented works.	**K4**
CO5:	To develop leadership skills by active participation in the group	**K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**2**	**1**	**2**	**2**	**1**	**2**
CO 2	**2**	**2**	**2**	**3**	**1**	**1**
CO 3	**3**	**1**	**1**	**1**	**2**	**1**
CO 4	**2**	**2**	**2**	**2**	**2**	**1**
CO 5	**1**	**1**	**1**	**1**	**1**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS**							
Course Code	**21UMBE61**					**L**	**P**	**C**
Category	**CORE ELECTIVE**					5	-	5
Nature of course	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**			✓

Course Objectives:

- To understand the basics and need for Biosafety procedures.
- To get accustomed to the Governing bodies of Biosafety guidelines
- To become aware of and manage biological risks.
- To acquire the knowledge about Intellectual property and its legal protection.
- To understanding the types of patents and patent filing procedures.

Unit: I	**BIOSAFETY**	**15**

Definition, History, Concepts in BioSafety and BioSecurity – Biohazard, Biocontainment & Bioprotection, Elements of Biosafety, Biosafety Levels – Risk Group classification of microorganisms, Biosafety Cabinets (BSCs) and Biosafety Level labs – High risk laboratories.

Unit: II	**RULES & REGULATIONS IN BIOSAFETY**	**15**

GMOs, LMOs, Select-Agents and Toxins – Concerns and challenges, rDNA research regulatory authorities in India – RDAC, IBSC, RCGM & GEAC, list of gene manipulation experiments that require permission and approval, SOP in Environmental release of GMOs, International Transborder movement control of LMOs/GMOs – The Cartagena Protocol.

Unit: III	**RISK MANAGEMENT**	**15**

Bio-incidents and Laboratory Acquired Infections [LAIs] – selection criteria for LAI agents, *Salmonella*, SARS-CoV2 & Ebola virus – short description, Bio-crime and Bioterrorism agents – categories with examples, Risk Analysis – Risk assessment, risk management and risk communication.

Unit: IV	**OVERVIEW OF IPR**	**15**

Introduction to intellectual property and Intellectual Property Rights – Importance – *Sui Generis* system of intellectual property protection – Types of Intellectual Property Rights in India, Patentable Rights and non-patentable inventions, patenting Life, Legal protection of Biotechnological inventions.

Unit: V	**PATENT FILING AND GRANT**	**15**

Patent types - Utility Patent Right, Plant Patent Right & Design Patent Right, Trademark and Copyright - Types of Patent applications – Provisional, Ordinary, Conventional, PCT – National Phase, PCT – International Phase, Patent of addition and Patent of Division, WIPO and its role, Patent filing procedures with timelines, Patent licensing and agreement, Rights and duties of a patentee.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. **Senthil Kumar S and Mohammed Jabir M.S.**, IPR, Biosafety and Biotechnology Management, 2009, Jasen Publication, India.
2. **Stephen Elias and Richard Stim**, Patent, Copyright and Trademark – An Intellectual Property

Desk Reference, 2004, 7th Ed., Nolo Publications, USA.

Books for References:

1. U. S. Department of Health and Human Services, Public Health Service, Centres for Disease Control and Prevention, National Institutes of Health, Biosafety in Microbiological and Biomedical Laboratories, 2020, 6th Ed.,
2. Bare Act , Indian Patent Act 1970 – Acts and Rules, 2007, Universal Law Publishing Co., Pvt., Ltd., New Delhi, India.
3. **Mittal D.P.,** Taxmann's Indian Patents Law: As amended by Patents (Amendment) Act-1999, 1999, Taxmann Publishers, India.
4. **Deepa Goel and Shomini Parashar S**., IPR, Biosafety and Bioethics, 2013, 1st Ed., Pearson Publications, India.
5. **Kshitij Kumar Singh**, Biotechnology and Intellectual Property Rights: Legal and Social Implications, 2016, 1st E., Springer Publications, India.

Web Resources:

1. **https://www.cdc.gov/safelabs/resources-tools/bio-risk-assessment.html**
2. **https://www.who.int/publications/i/item/9789240011458**
3. **https://www.phe.gov/s3/BioriskManagement/biosafety/Pages/Risk-Groups.aspx**
4. **https://www.wipo.int/about-ip/en/**
5. **https://www.youtube.com/watch?v=VzIgPfAd0Fs**

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Describe about the different biosafety levels containment systems.	**[Up to K2]**
CO2:	Understand and appreciate the need for Biosafety Governing Bodies	**[Up to K3]**
CO3:	Acquire skills regarding high-risk pathogens, to understand and manage the risks.	**[Up to K4]**
CO4:	Become aware of the importance in Intelligence Property Protection and the types of Patent Rights .	**[Up to K4]**
CO5:	Determine the types of Patent, Patent License Agreement and Patent filing procedures.	**[Up to K3]**

CO & PO Mapping:

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	3	2	3	3	2
CO 2	3	2	1	2	1	3
CO 3	3	2	2	3	2	3
CO 4	2	2	1	1	3	2
CO5	1	1	1	3	3	3

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**BIOSAFETY -** Definition, History, Concepts in BioSafety and BioSecurity – Biohazard, Biocontainment & Bioprotection, Elements of Biosafety, Biosafety Levels – Risk Group classification of microorganisms, Biosafety Cabinets (BSCs) and Biosafety Level labs – High risk laboratories.	**15**	**Chalk & Talk, Power Point**
II	**RULES & REGULATIONS IN BIOSAFETY -** GMOs, LMOs, Select agents and toxins – Concerns and challenges, rDNA research regulatory authorities in India – RDAC, IBSC, RCGM & GEAC, list of gene manipulation experiments that require permission and approval, SOP in Environmental release of GMOs, International Transborder movement control of LMOs/GMOs – The Cartagena Protocol.	**15**	**Chalk & Talk, Power Point**
III	**RISK MANAGEMENT -** Bio-incidents and Laboratory Acquired Infections [LAIs] – selection criteria for LAI agents, Salmonella, SARS-CoV2 & Ebola virus – short description, Bio-crime and Bioterrorism agents – categories with examples, Risk Analysis – Risk assessment, risk management and risk communication.	**15**	**Chalk & Talk, Power Point.**
IV	**OVERVIEW OF IPR -** Introduction to intellectual property and Intellectual Property Rights – Importance – *Sui Generis* system of intellectual property protection – Types of Intellectual Property Rights in India, Patentable Rights and non-patentable inventions, patenting Life, Legal protection of Biotechnological inventions.	**15**	**Chalk & Talk, Power Point**
V	**PATENT FILING AND GRANT –** Patent types - Utility Patent Right, Plant Patent Right & Design Patent Right, Trademark and Copyright - Types of Patent applications – Provisional, Ordinary, Conventional, PCT – National Phase, PCT – International Phase, Patent of addition and Patent of Division, WIPO and its role, Patent filing procedures with timelines, Patent licensing and agreement, Rights and duties of a patentee.	**15**	**Chalk & Talk, Power Point, Assignment.**

Course Designed by: 1. **Dr. S. Subramani**Asst. Prof.

,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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	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	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Up to K2**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
2	CO2	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
3	CO3	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K4)**
5	CO5	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	5	4.16	42
K2	5	10	20	10	45	37.5	
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K1	
16) b	CO1	K1	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**FUNDAMENTALS OF ALGAE, FUNGI AND LICHENS**							
Course Code	**21UMBE62**					**L**	**P**	**C**
Category	**CORE – ELECTIVE**					5	-	5
Nature of course:	EMPLOYABILITY	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP			✓

Course Objectives:

On successful completion of the course, the learners should be able to

- Describe general characteristics of algae, fungi and lichens.
- Become familiar with the concepts of the life cycle of algae, fungi and lichens.
- Know the life cycle of algae and fungi.
- Understand the sexual and asexual reproduction of algae and fungi..
- Demonstrate and understand economic importance of algae, fungi and lichens.

Unit: I	**Algae – Overview**	**15**

General account of Algae: distribution - range of thallus organization – pigmentation- flagellation- reserve food. Reproduction (vegetative, asexual and sexual). Classification (F.E.Fritsch and Smith). Economic importance (algae as food and fodder, algae in agriculture, pharmaceuticals and industries).

Unit: II	**Algae – Type study**	**15**

Habitat, structure, reproduction and life cycle of algae: Chlorophyceae – Volvox, Xanthophyceae – Vaucheria, Phaeophyceae – Ectocarpus and Rhodophyceae – Polysiphonia.

Unit: III	**Fungi – Overview**	**15**

General characteristics of fungi: Definition, Classification of fungi. (Saccardo and Ainsworth's), occurrence, thallus organization, asexual and sexual reproduction, biological and economic importance of fungi.

Unit: IV	**Fungi - Type study**	**15**

Habitat, structure, reproduction and life cycle of fungi: Yeast, Rhizopus, Aspergillus, Peziza and Agaricus.

Unit: V	**Lichens**	**15**

Lichens: General characters, habitat, structure, reproduction and economic importance of lichens, importance of lichens as colonizers and indicators of environment.

	Total Lecture Hours	**75Hrs**

Books for Study:

1. Sambamurty A.V.S.S, 2013. A Text book of Algae, I.K International publications.
2. Sharma O.P, 1989. A Text book of Fungi, Tata McGraw - Hill Education.

Books for reference:

1. Prescott, Harley and Klein. 2006. Microbiology (6th Edition). The McGraw-Hill Publishing Co., Ltd., New Delhi.
2. Alexopoulus C. J and Mims C. W, 2000. Introductory Mycology, 3rd Ed., Wiley Eastern Publications.
3. Geeta Sumbali and B.M. Johri, 2005. The Fungi, Alpha Science International Publications.

Web Resources:

1. https://www.plantscience4u.com/2014/04/fritsch-classification-of-algae.html
2. https://biologylearner.com/volvox-salient-features-occurrence-thallus-structure-reproduction/
3. https://www.onlinebiologynotes.com/yeast-morphology-life-cycle/

Course Outcomes		K Level
On the completion of the course the student will be able to		
CO1:	Describe the general characteristics of Algae, Fungi and Lichens	Up to K2
CO2:	Understanding the Habitat, and structure of Algae, Fungi and Lichens	Up to K3
CO3:	Differentiate life cycle of algae, fungi and Lichens	Up to K4
CO4:	Classify the reproduction of algae, fungi and Lichens	Up to K4
CO5:	Categorize economic importance of algae, fungi and Lichens	Up to K3

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	1	3	3	2
CO 2	3	2	3	2	2	2
CO 3	2	1	1	1	1	2
CO 4	3	2	3	2	2	1
CO 5	3	2	3	2	2	1

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**Algae – Overview:** General account of Algae: distribution - range of thallus organization – pigmentation- flagellation- reserve food. Reproduction (vegetative, asexual and sexual). Classification (F.E.Fritsch and Smith). Economic importance (algae as food and fodder, algae in agriculture, pharmaceuticals and industries).	**15**	**Chalk & Talk, Power Point.**
II	**Algae – Type study:** Habitat, structure, reproduction and life cycle of algae: Chlorophyceae – Volvox, Xanthophyte – Vaucheria, Phaeophyceae – Ectocarpus and Rhodophyceae – Polysiphonia.	**15**	**Chalk & Talk, Power Point.**
III	**Fungi – Overview:** General characteristics of fungi: Definition, Classification of fungi. (Saccardo and Ainsworth's), occurrence, thallus organization, asexual and sexual reproduction, biological and economic importance of fungi.	**15**	**Chalk & Talk, Power Point.**
IV	**Fungi - Type study:** Habitat, structure, reproduction and life cycle of fungi: Yeast, Rhizopus, Aspergillus, Peziza and Agaricus.	**15**	**Chalk & Talk, Power Point.**
V	**Lichens:** Lichens: General characters, habitat, structure, reproduction and economic importance of lichens, importance of lichens as colonizers and indicators of environment.	**15**	**Chalk & Talk, Power Point, Assignment.**

Course Designed by: **1**. **Dr. S. Rajesh kannan, Assistant Professor and Head.**

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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Up to K2**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
2	CO2	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
3	CO3	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K4)**
5	CO5	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(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 (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**MARINE MICROBIOLOGY**							
Course Code	**21UMBE63**					**L**	**P**	**C**
Category	**CORE – ELECTIVE**					5	-	5
Nature of course:	EMPLOYABILITY	✓	**SKILL ORIENTED**	✓	ENTREPRENURSHIP			✓

Course Objectives:

- To describe the diversity of marine microorganism
- To describe basic concepts of marine microbiology and provide a foundation for later studies.
- The main objective of this course is to give students an insight into the dynamics of marine microbes
- To become familiar with concepts of microbes of extreme environments
- To know various marine pollutants.
- To demonstrate and understand seafood microbiology.

Unit: I	**Introduction to Microbial Oceanography**	**15**

Marine ecosystem: benthic & littoral zone, saltpan, mangroves and estuarine microbes, microbial loop. Diversity of microorganism - planktons, bacteria, algae and fungi.

Unit: II	**Microbes of extreme environments**	**15**

Mechanism of extremophiles – halophiles – deep sea microbes. Microbes of hydrothermal vents - thermophilic, alkalophilic, osmophilic and barophilic, psychrophilic microorganisms – hyperthermophiles and halophiles.

Unit: III	**Dynamics of Marine Microbes**	**15**

Carbon cycle: Phototrophic microbes, the oceanic carbonate system and global warming. Nitrogen cycle: Nitrogen fixers – Iron limitation – ocean fertilization. Decomposition of organic matter. Bioleaching and biodeterioration of natural and synthetic materials.

Unit: IV	**Marine pollution**	**15**

Microorganisms responsible for bioluminescence in marine environment. Uses of bioluminescence. Microbial indicators of marine pollution and control, biofouling, biofilms, biodegradation and bioremediation of marine pollutants. Use of genetically engineered microorganisms in biodegradation.

Unit: V	**Sea food microbiology**	**15**

Normal genera associated with fish – fish spoilage – Human pathogens and contaminants. Zoonotic – Brief account on aquaculture pathogens - Vibriosis – shrimp diseases – White Spot Syndrome of Viral infection.

	Total Lecture Hours	**75Hrs**

Books for Study:

1. Colin Munn. 2009, Marine Microbiology: Ecology & Applications 2nd Edition. Garland Science, Taylor & Francis.
2. David L. Kirchman. 2008, Microbial Ecology of the Oceans, 2nd Edition, John Wiley & Sons.

Books for reference:

1. Madigan, M.T. and Martinko, J.M. 2006, Biology of Microorganisms, 11th Edition, Pearson Prentice Hall, USA.

2. Steffi. P. F. and Rajeswari Anburaj. R. 2020, A Text book on Marine Microbiology, Ryan Publishers.
3. Gasol, J.M. and Kirchman, D.L, 2018. Microbial ecology of the oceans. 3rd edition, John Wiley & Sons.

Web Resources:

1.https://geo.libretexts.org/Bookshelves/Oceanography/Book%3A_Oceanography_(Hill)/12%3A_Marine_Environments/12.1%3A_Zones_of_Marine_Environments.
2. http://www.marinebiotech.eu/wiki/Bioremediation_of_marine_ecosystems.
3.https://en.wikipedia.org/wiki/White_spot_syndrome#:~:text=White%20spot%20syndrome%20 (WSS)%20is,in%20places%20throughout%20the%20world.

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Explain marine ecosystem, deep sea microbes and marine pollution	**Up to K2**
CO2:	Outline the diversity of microorganism, mechanism of extremophiles, carbon cycle, nitrogen cycle and aquaculture pathogens.	**Up to K3**
CO3:	Categorise deep sea microbes, bioleaching and biodeterioration.	**Up to K4**
CO4:	Compare hydrothermal vents microbes, hyperthermophiles and halophiles.	**Up to K4**
CO5:	Illustrate decomposition, biodegradation, biofilms and bioremediation of marine pollutants	**Up to K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**1**	**1**	**3**	**3**	**2**
CO 2	**3**	**2**	**3**	**2**	**2**	**2**
CO 3	**2**	**1**	**1**	**1**	**1**	**2**
CO 4	**3**	**2**	**3**	**2**	**2**	**1**
CO 5	**3**	**2**	**3**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**Introduction to Microbial Oceanography -** Marine ecosystem: benthic & littoral zone, saltpan, mangroves and estuarine microbes, microbial loop. Diversity of microorganism - planktons, bacteria, algae and fungi.	**15**	**Chalk & Talk, Power Point.**
II	**Microbes of extreme environments -** Mechanism of extremophiles – halophiles – deep sea microbes. Microbes of hydrothermal vents - thermophilic, alkalophilic, osmophilic and barophilic, psychrophilic microorganisms – hyperthermophiles and halophiles.	**15**	**Chalk & Talk, Power Point.**
III	**Dynamics of Marine Microbes -** Carbon cycle: Phototrophic microbes, the oceanic carbonate system and global warming. Nitrogen cycle: Nitrogen fixers – Iron limitation – ocean fertilization. Decomposition of organic matter. Bioleaching and biodeterioration of natural and synthetic materials.	**15**	**Chalk & Talk, Power Point.**
IV	**Marine pollution -** Microorganisms responsible for bioluminescence in marine environment. Uses of bioluminescence. Microbial indicators of marine pollution and control, biofouling, biofilms, biodegradation and bioremediation of marine pollutants. Use of genetically engineered microorganisms in biodegradation.	**15**	**Chalk & Talk, Power Point.**
V	**Sea food microbiology -** Normal genera associated with fish – fish spoilage – Human pathogens and contaminants. Zoonotic – Brief account on aquaculture pathogens - Vibriosis – shrimp diseases – White Spot Syndrome of Viral infection.	**15**	**Chalk & Talk, Power Point, Assignment.**

Course Designed by: **1.Dr. S. Rajesh kannan, Assistant Professor and Head.**

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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Up to K2**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
2	CO2	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
3	CO3	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K4)**
5	CO5	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(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 (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**NANOTECHNOLOGY**			
Course Code	**21UMBE64**	**L**	**P**	**C**
Category	**CORE ELECTIVE**	5	-	5
Nature of course:	**EMPLOYABILITY** ✓	**SKILL ORIENTED** ✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To understand the basics and need for Biosafety procedures.
- To get accustomed to the Governing bodies of Biosafety guidelines
- To become aware of and manage biological risks.
- To acquire the knowledge about Intellectual property and its legal protection.
- To understanding the types of patents and patent filing procedures.

Unit: I	**ELEMENTS OF NANOTECHNOLOGY**	**15**

Introduction to Nanotechnology and Nanoscience, characteristics of nano materials, classification of nanomaterials based on dimensionality, nanostructured materials and applications of nanotechnology.

Unit: II	**NANOSTRUCTURE CHARACTERIZATION**	**15**

Nanostructure and nanomaterial characterization methods – Electron microscopy and other electron-based methods, Spectroscopic techniques, Scanning probe microscopy, Magnetic Resonance Techniques and ion-based techniques – RBS, PIXE, ERDA, SIMS & NRA.

Unit: III	**APPLICATION OF NANOMATERIALS**	**15**

Carbon Nanostructures – Fullerenes and Nanotubes, Porous nanomaterials – Porous silicon and other porous nanomaterials, Sculptured Thinfilms, Aerogels, Quantum Dots, Langmuir-Blodgett Films, Nanowires, Nanorods, Nanopillars and Polymer Nanocomposites.

Unit: IV	**NANOMEDICINE**	**15**

Proteins from non-natural aminoacids, Peptide nucleic acids, Personalized medicine, Immunotoxins as targeted cell killers – Liposome-mediated Drug delivery, Artificial blood, Cyclic peptides from nanotubes, Artificial Life and Biosensors.

Unit: V	**NANOMATERIAL SYNTHESIS**	**15**

Methods of Nanomaterial synthesis – Chemical – chmical precipitation and co-precipitation, metal nanocrystals by reduction, sol-gel synthesis, reverse micelles and myle formation – Self-assembly and catalysis – process o self-assembly, semiconductor island, monolayers, biometrics and colloids – Fabrication of nanomaterials by physical methods – Inert gas condensation, Molecular Beam Epitaxy and Deep-UV Lithography.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. **Raul J. Martin-Palma and Akhlesh Lakhtakia,** 2010, Nanotechnology – A Crash Course, Library of Congress Cataloging-in-Publication Data.
2. **David S. Goodsell,** 2004, Bionanotechnology – Lessons from Nature, John Wiley & Sons Inc. Publications.
3. **Jeremy Ramsden,** 2009, Essentials of Nanotechnology, Jeremy Ramsden and Ventus PublishingApS.
4. **Shah M. A and Shah K. A.,** 2019, Nanotechnology – The Science of Small, 2nd Ed., Wiley Publications.

5. **Shanmugam S.,** 2011, Nanotechnology, MJP Publishers.

Books for References:

1. **Guozhong Cao**, 2004, Nanostructures and Nanomaterials – Syntheis, Properties and Applications, Imperial College Press.
2. **Thomas Varghese and Balakkrishna K. M**., 2023, Nanotechnology – An introduction to Synthesis, Properties and Applications of Nanomaterials, Atlantic Publishers and Distributors Pvt. Ltd.
3. **Panda H,** 2010, Nanoscience and Nanotechnology Handbook, Asia Pacific Business Press Inc.,

Web Resources:

1. **https://www.nanowerk.com/what-are-nanomaterials.php**
2. **https://www.understandingnano.com/medicine.html**
3. **https://ccsuniversity.ac.in/bridge-library/pdf/L-3%20Synthesis%20of%20Nanostructured%20Materials%20Prof%20BPS.pdf**
4. **https://nanografi.com/blog/artificial-intelligence-integration-with-nanotechnology/**
5. **https://ieeexplore.ieee.org/document/9934704**

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Acquire knowledge in basic nanotechnology.	**[Up to K2]**
CO2:	Get accustomed to identification method of nanostructures.	**[Up to K3]**
CO3:	Understand the types of nanomaterials and their applications.	**[Up to K4]**
CO4:	Appreciate the applications of Nanotechnology in Medicine.	**[Up to K4]**
CO5:	Understand the various methods of producing Nanomaterials.	**[Up to K3]**

CO & PO Mapping:

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	3	2	3	3	1
CO 2	3	3	3	3	3	3
CO 3	3	3	3	3	3	3
CO 4	3	3	3	3	3	3
CO5	3	3	3	3	3	3

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**ELEMENTS OF NANOTECHNOLOGY -** Introduction to Nanotechnology and Nanoscience, characteristics of nano materials, classification of nanomaterials based on dimensionality, nanostructured materials and applications of nanotechnology.	15	Chalk & Talk, Power Point
II	**NANOSTRUCTURE CHARACTERIZATION -** Nanostructure and nanomaterial characterization methods – Electron microscopy and other electron-based methods, Spectroscopic techniques, Scanning probe microscopy, Magnetic Resonance Techniques and ion-based techniques – RBS, PIXE, ERDA, SIMS & NRA.	15	Chalk & Talk, Power Point
III	**APPLICATION OF NANOMATERIALS-** Carbon Nanostructures – Fullerenes and Nanotubes, Porous nanomaterials – Porous silicon and other porous nanomaterials, Sculptured Thinfilms, Aerogels, Quantum Dots, Langmuir-Blodgett Films, Nanowires, Nanorods, Nanopillars and Polymer Nanocomposites.	15	Chalk & Talk, Power Point.
IV	**NANOMEDICINE -** Proteins from non-natural aminoacids, Peptide nucleic acids, Personalized medicine, Immunotoxins as targeted cell killers – Liposome-mediated Drug delivery, Artificial blood, Cyclic peptides from nanotubes, Artificial Life and Biosensors.	15	Chalk & Talk, Power Point
V	**NANOMATERIAL SYNTHESIS -** Methods of Nanomaterial synthesis – Chemical – chmical precipitation and co-precipitation, metal nanocrystals by reduction, sol-gel synthesis, reverse micelles and myle formation – Self-assembly and catalysis – process o self-assembly, semiconductor island, monolayers, biometrics and colloids – Fabrication of nanomaterials by physical methods – Inert gas condensation, Molecular Beam Epitaxy and Deep-UV Lithography.	15	Chalk & Talk, Power Point, Assignment.

Course Designed by: 1. **Dr. S. Subramani**,
Asst. Prof.

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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	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	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Up to K2**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
2	CO2	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
3	CO3	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K4)**
5	CO5	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	5	4.16	42
K2	5	10	20	10	45	37.5	
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K1	
16) b	CO1	K1	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**PARASITOLOGY**							
Course Code	**21UMBE65**						**L**	**P**	**C**
Category	**CORE ELECTIVE**						5	-	5
Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓			

Course Objectives:

- To understand the basics and need for Biosafety procedures.
- To get accustomed to the Governing bodies of Biosafety guidelines
- To become aware of and manage biological risks.
- To acquire the knowledge about Intellectual property and its legal protection.
- To understanding the types of patents and patent filing procedures.

Unit: I	**PARASITOLOGY BASICS**	**15**

Parasites and hosts - Host-parasite relationships - Effects of parasitism in the host – Sources of parasitic infections, modes of infection, immunity to parasitic infections.

Unit: II	**PROTOZOAN PARASITES**	**15**

Habitat, morphology, antigenic variations, lifecycle, mode of transmission, reservoirs, pathogenicity clinical features and treatment of Sarcodina – *Entamoba*, *Giardia* and *Plasmodium*.

Unit: III	**PARASITIC NEMATODES**	**15**

Habitat, morphology, lifecycle, mode of transmission, reservoirs, pathogenicity clinical features, prophylaxis and treatment of *Enterobius*, *Ascaris* and hookworm.

Unit: IV	**PARASITIC TREMATODES**	**15**

Geographical distribution, epidemiology, causative agent, mode of transmission, disease signs and symptoms, diagnosis, treatment and prophylaxis of *Fasciola hepatica*, *Clonorchis* and intestinal nematodes.

Unit: V	**PARASITIC CESTODES**	**15**

Geographical distribution, transmission, lifecycle, signs and symptoms, treatment and prophylaxis of *Taenia*, *Diphyllobothrium* and *Hymenolepsis*.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1.Sougata Gosh, 2018, Paniker's Textbook of Medical Parasitology, 8th Ed., Jaypee Brothers Medical Publishers (P) Ltd.

2.Abhay R. Satoskar *et al.,* Ed., 2009, Medical Parasitology, Library of Congress Cataloging-In Publication Data.

3.Stephen H. Gillespie and Richard D. Pearson, 2001, Principles and Practice of Clinical Parasitology, John Wiley & Sons.

4.Cox F. E. G., 1993, Modern Parasitology, 2nd Ed., Blackwell Science.

Books for References:

1. **David T. John *et al.,*** 2006, Markell and Voges Medical Parasitology, 9th Ed., Elsevier

Publications.

2. Ichpujani R. L and Rajesh Bhatia, 2003, Medical Parasitology, 3rd Ed., Jaypee Brothers Medical Publishes.

3.Apurbba S. Sastry and Sandhya Bhat, 2018, Essentials of Medical Parasitology, 2nd Ed., Jaypee Brothers Medical Publishes.

Web Resources:

1.https://www.msdmanuals.com/en-in/professional/multimedia/figure/plasmodium-life-cycle
2. https://www.cdc.gov/parasites/pinworm/biology.html
3.https://gmch.gov.in/sites/default/files/documents/23%20Intestinal%20Nematodes.pdf
4.https://www.youtube.com/watch?v=ozO1oAbor-w

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Acquire knowledge in the fundamentals of Parasitic infections.	**[Up to K2]**
CO2:	Get accustomed to the most common protozoan parasitic infections.	**[Up to K3]**
CO3:	Illustrate life cycle, diagnosis, treatment and prevention of parasitic infections caused by nematode parasites.	**[Up to K4]**
CO4:	Get an in-depth understanding of the causative agent, disease mechanism, identification and treatment of trematode parasites.	**[Up to K4]**
CO5:	Determine the lifecycle of parasites in the group cestodes.	**[Up to K3]**

CO & PO Mapping:

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**3**	**2**	**3**	**3**	**2**
CO 2	**3**	**3**	**2**	**3**	**3**	**2**
CO 3	**3**	**3**	**2**	**3**	**3**	**2**
CO 4	**3**	**3**	**2**	**3**	**3**	**2**
CO5	**3**	**3**	**2**	**3**	**3**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit		Hrs	Pedagogy
I	**PARASITOLOGY BASICS -** Parasites and hosts - Host-parasite relationships - Effects of parasitism in the host – Sources of parasitic infections, modes of infection, immunity to parasitic infections.	**15**	**Chalk & Talk, Power Point**
II	**PROTOZOAN PARASITES -** Habitat, morphology, antigenic variations, lifecycle, mode of transmission, reservoirs, pathogenicity clinical features and treatment of Sarcodina – *Entamoba*, *Giardia* and *Plasmodium*.	**15**	**Chalk & Talk, Power Point**
III	**PARASITIC NEMATODES -** Habitat, morphology, lifecycle, mode of transmission, reservoirs, pathogenicity clinical features, prophylaxis and treatment of *Enterobius*, *Ascaris* and hookworm.	**15**	**Chalk & Talk, Power Point.**
IV	**PARASITIC TREMATODES -** Geographical distribution, epidemiology, causative agent, mode of transmission, disease signs and symptoms, diagnosis, treatment and prophylaxis of *Fasciola hepatica*, *Clonorchis* and intestinal nematodes.	**15**	**Chalk & Talk, Power Point**
V	**PARASITIC CESTODES -** Geographical distribution, transmission, lifecycle, signs and symptoms, treatment and prophylaxis of *Taenia*, *Diphyllobothrium* and *Hymenolepsis*.	**15**	**Chalk & Talk, Power Point, Assignment.**

Course Designed by: 1. **Dr. S. Subramani**, Asst. Prof.

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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	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	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1&K2	1	K2	2(K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
3	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
4	CO4	Up to K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
5	CO5	Up to K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	5	4.16	42
K2	5	10	20	10	45	37.5	
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K1	
16) b	CO1	K1	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**CLINICAL BIOCHEMISTRY**							
Course Code	**21UMBE66**					**L**	**P**	**C**
Category	**CORE ELECTIVE**					5	-	5
Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**			✓

Course Objectives:

- The main objective of this paper is to skill the students in procedures followed in biochemistry Laboratory..
- To acquire knowledge in the field of biochemistry.
- To get familiarize with the test protocols followed in Hospital Laboratory.
- To understand the principle and clinical significance behind various diseases.
- To learn and understand the methods of body fluid collection.

Unit: I	**Introduction to clinical biochemistry**	**15**

Biochemical specimen to perform qualitative & Quantitative analysis – Body fluids- Blood, Urine, faces, Cerebra spinal fluid, Gastric juices, amniotic fluid & other materials- Collection, Transport & Analysis. Laboratory safety & hygienic practices.

Unit: II	**Blood Testing**	**15**

Hematology – Introduction & Definition. Types and Functions of Blood. Blood collection & handling. Blood Test- CBC, ESR, GTT Clotting & Bleeding Time. Blood glucose test –hBA1C- Principle & Clinical significance. TSH & hCG.

Unit: III	**Lipid Profile.**	**15**

Determination of Lipid profile, procedure & clinical significances - Total cholesterol, Triglyceride TG, Lipoprotein analysis.

Unit: IV	**Non protein Nitrogen compounds.**	**15**

Kidney Function Test : Procedure, Principle & Clinical significance- (BUN) Blood urea, Serum-Creatinine, Uric Acid.

Unit: V	**Diagnosis of diseases.**	**15**

Principle & procedure - Liver Test – cell damage & Dysfunction test. GOT – Clinical Significance – CRP Heart, Liver & Muscular Diseases. Measurement of serum bilirubin, Albumin & Globulin– Method

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. R. Sood,(2018) **Tesxtbook of biochemistry**, CBS Publisher & Distributors.
2. Teiz, **Fundamentals of Clinical Biochemistry**, W.B-Saunders Company.

Books for References:

1. Harold Varley**, Pratical Clinical biochemistry,4th Edition.** CBC Publisher & Distributor
2. Practical Clinical Biochemistry, volume I and II, 5th edition – Varleyet.al.,CBS Publishers,.
3. Allan Gaw, Micheal Murphy, Robert Cowan, Denis O Reilly, Micheal Stewart

and James Shepherd. Churchill Livingtons, **Clinical Biochemistry: An illustrated color text 3rd Edition.**

4. Zubay, **Biochemistry** 4th Edition (WMC Brown Publishers)

Web Resources:

1.https://www.medicalnewstoday.com/articles/265443
2.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3894536/#:~:text=The%20levels%20of%20aspartate%20aminotransferase,liver%20are%20injured%20or%20not.
3.https://ors.od.nih.gov/sr/dohs/safety/laboratory/Pages/student_goodlab.aspx
4.https://my.clevelandclinic.org/health/diagnostics/17684-blood-urea-nitrogen-bun-test

Course Outcomes		K Level
On the completion of the course the student will be able to		
CO1:	Classify the methods and transport of Body Fluids	**Up to K2**
CO2:	Utilize the various methods of disease diagnosis in blood.	**Up to K3**
CO3:	Illustrate the procedure, procedure & Clinical significance of diseases.	**Up to K4**
CO4:	Classify the Non protein Nitrogenous compounds.	**Up to K4**
CO5:	Identify and learn the methods of body fluids testing and disease diagnosis.	**Up to K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**2**	**2**	**3**	**3**	**3**	**3**
CO 2	**2**	**2**	**2**	**3**	**3**	**2**
CO 3	**2**	**2**	**2**	**3**	**2**	**2**
CO 4	**3**	**2**	**3**	**2**	**2**	**1**
CO 5	**2**	**2**	**3**	**2**	**2**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**Introduction to clinical biochemistry** Biochemical specimen to perform qualitative & Quantitative analysis – Body fluids- Blood, Urine, faces, Cerebra spinal fluid, Gastric juices, amniotic fluid & other materials- Collection, Transport & Analysis.	15	Chalk & Talk, Power Point
II	**Blood Testing** Hematology – Introduction & Definition. Types and Functions of Blood. Blood collection & handling. Blood Test- CBC, ESR, Clotting & Bleeding Time. Blood glucose test –hBA1C- Principle & Clinical significance. TSH & hCG.	15	Chalk & Talk, Power Point
III	**Lipid Profile.** Determination of Lipid profile, procedure & clinical significances - Total cholesterol, Triglyceride TG, Lipoprotein analysis	15	Chalk & Talk, Power Point,
IV	**Non protein Nitrogen compounds.** Kidney Function Test : Procedure, Principle & Clinical significance- Blood urea, Serum- Creatinine, Uric Acid.	15	Chalk & Talk, Power Point
V	Liver Test – cell damage & Dysfunction test. GOT – Clinical Significance – Heart, Liver & Muscular Diseases. Measurement of serum bilirubin, Albumin & Globulin– Method, Principle & procedure.	15	Chalk & Talk, Power Point, Assignment

Course Designed by: **1.Mrs. A. ABIRAMI, Assistant Professor.**

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		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	4	60
	K2	2	6	10	10	28	56	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	-	-	-	2	4	20
	K2	2	6	-	-	8	16	
	K3	-	-	20	-	20	40	40
	K4	-	-	-	20	20	40	40
	Marks	4	6	20	20	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)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Up to K2**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
2	CO2	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
3	CO3	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K4)**
5	CO5	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(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 (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	05	4.1	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	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

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
(For those who joined in 2021-2022 and after)

Course Name	**DIAGNOSTIC MICROBIOLOGY**							
Course Code	**21UMBS61**					**L**	**P**	**C**
Category	**SKILL**					2	-	2
Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**			✓

Course Objectives:

- To outline the Diagnostic microbiology - Methods, Collection, Transport and Processing of clinical specimens.
- To categorize Culture media, Microscopic examination and Serological test of bacterial infections.
- To describe the Laboratory methods of mycology.
- To understand the Isolation, Identification of virus.
- To gain the knowledge about parasitology.

Unit: I	**DIAGNOSTIC MICROBIOLOGY**	**6**
Diagnostic Microbiology - Introduction -Methods of collection, Transport and Processing of clinical specimens - Blood, Urine,CSF.		
Unit: II	**DIAGNOSIS METHODS IN BACTERIOLOGY**	**6**
Diagnosis of Bacterial Infections: Microscopic examination Acid – fast staining, Culture media and Incubation, Serological test - Widal. Antimicrobial susceptibility testing- Disc diffusion – Kirby Bauer method.		
Unit: III	**DIAGNOSIS METHODS IN MYCOLOGY**	**6**
Laboratory methods in basic Mycology – Direct Microscopic examination of clinical specimens – Wet mount, Lactophenol cotton blue staining, culture media and incubation – Antifungal susceptibility testing.		
Unit: IV	**DIAGNOSIS METHODS IN VIROLOGY**	**6**
Isolation and Identification of viruses, Viral antigen detection: Fluorescent antibody and Solid phase immunoassays – RT PCR, PAGE TYPHING.		
Unit: V	**DIAGNOSIS METHODS IN PARASITOLOGY**	**6**
Laboratory methods for parasitic infections – Diagnostic techniques for faecal, Gastrointestinal and Urino-genital specimen Flotation method, Concentration method.		
	Total Lecture Hours	**30 Hrs**

Books for Study:

1. Bailey &Scott's (2014). Diagnostic Microbiology. 13th edition, The C.V. Mos by Company
2.Ranjan Kumar De, (2007). Diagnostic Microbiology, Jaypee Brothers publishing, New Delhi.

Books for References:

1.Gunasekaran, P. (1995). Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi.
2.Kannan, N. (1996). Laboratory Manual in General Microbiology, Palani Paramount Publication, Palani.
3.Rajan S and Selvi Christy R. 2015. Experiments in Microbiology. Anjana Books House, Chennai.

Web Resources: **1 https://www.youtube.com/watch?v=uAmTgVvTUNk** **2 https://www.youtube.com/watch?v=KrpooZv5juo** **3 https://www.youtube.com/watch?v=Oy5uixdzJ_c**		
COURSE OUTCOME		**K Level**
On successful completion of the course, the learners should be able to		
CO1:	Discuss about Collect, Transport and Transport of clinical specimens.	**Up to K2**
CO2:	Identify the Bacterial infections dignosis.	**Up to K3**
CO3:	Examine the Fungal infections microscopic and serological tests.	**Up to K4**
CO4:	Focus the Virus isolation, identification and processing.	**Up to K4**
CO5:	Determine the infections about parasites.	**Up to K3**

CO & PO Mapping:

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**2**	**2**	**1**	**2**
CO 2	**3**	**2**	**2**	**2**	**1**	**2**
CO 3	**3**	**2**	**2**	**2**	**1**	**2**
CO 4	**3**	**2**	**2**	**2**	**1**	**2**
CO5	**3**	**2**	**2**	**2**	**1**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Mode
I	**DIAGNOSTIC MICROBIOLOGY -** Diagnostic Microbiology - Introduction -Methods of collection, Transport and Processing of clinical specimens - Blood, Urine,CSF.	**6**	**Chalk and talk, PPT**
II	**DIAGNOSIS METHODS IN BACTERIOLOGY -** Diagnosis of Bacterial Infections: Microscopic examination Acid – fast staining, Culture media and Incubation, Serological test - Widal. Antimicrobial susceptibility testing- Disc diffusion – Kirby Bauer method.	**6**	**Chalk and talk, PPT**
III	**DIAGNOSIS METHODS IN MYCOLOGY -** Laboratory methods in basic Mycology – Direct Microscopic examination of clinical specimens – Wet mount, Lactophenol cotton blue staining, culture media and incubation – Antifungal susceptibility testing.	**6**	**Chalk and talk, PPT**
IV	**DIAGNOSIS METHODS IN VIROLOGY -** Isolation and Identification of viruses, Viral antigen detection: Fluorescent antibody and Solid phase immunoassays – RT PCR, PAGE TYPHING.	**6**	**Chalk and talk, PPT**
V	**DIAGNOSIS METHODS IN PARASITOLOGY -** Laboratory methods for parasitic infections – Diagnostic techniques for faecal, Gastrointestinal and Urino-genital specimen Flotation method, Concentration method.	**6**	**Chalk and talk, PPT Assignment**

Course Designed by: 1. **Ms.C.THENMOZHI**, **Assistant Professor.**