MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE

(An Autonomous College)

Affiliated to Periyar University, Salem | Accredited by **NAAC** with '**A**' Grade

Recognized by **UGC** under Section 2(f) & 12 (B)

ESTD-1994

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE (Autonomous)

A UNIT OF VANETRA GROUP

Learn. Lead

DEGREE OF MASTER OF SCIENCE

Learning Outcomes - Based Curriculum Framework

- Choice Based Credit System

Syllabus for M.Sc., Microbiology

(Semester Pattern)

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

Regulation and Syllabus for

M.Sc., Microbiology

(With effect from the Academic Year 2023-24)

Vision:

To redefine the scope of higher education by infusing into each of our pursuits, initiatives that will encourage intellectual, emotional, social and spiritual growth, thereby nurturing a generation of committed, Knowledgeable and socially responsible citizens.

Mission:

*To Ensure State of the world learning experience

*To Espouse value based Education

*To Empower rural education

*To Instill the sprite of entrepreneurship and enterprise

*To create a resource pool of socially responsible world citizens

QUALITY POLICY

To Seek – To Strive – To Achieve greater heights in Arts and Science, Engineering, Technological and Management Education without compromising on the Quality of Education.

DEPARTMENT OF MICROBIOLOGY

Vision:

*To provide education that gives self-employment and build a strong academic industry

Mission:

* To provide value and need based education.

PREAMBLE

Master of Science in Microbiology (M.Sc) programme can be attained within two years of study. This programme typically focuses on imparting comprehensive knowledge and competency in various aspects of microbiology, including microbial physiology, genetics, immunology, and biotechnology. The degree programme serves as a foundational programme, enabling learners to either pursue higher studies or seek employment in diverse fields such as healthcare, research, pharmaceuticals, and environmental science. The learning outcomes are designed to help learners understand the objectives of studying M.Sc in Microbiology, that is, to analyze, appreciate, understand, and critically engage with microbiological concepts and practices, approaching them from various scientific perspectives and with a clear understanding of their applications in real-world scenarios.

PROGRAMME LEARNING OUTCOME

NATURE AND EXTENT OF THE PROGRAMME

The M.Sc Microbiology Programme is designed to provide an in-depth understanding of microbial life, encompassing a range of core courses that progressively build knowledge from fundamental principles to advanced topics. Students will explore the diversity of microorganisms, their physiology, genetics, and the roles they play in various environments, including their applications in biotechnology, medicine and industry. Allied courses in chemistry, biochemistry, and molecular biology will provide essential background knowledge to support the core microbiology courses. Courses on immunology, virology, and microbial pathogenesis are included to highlight the importance of microorganisms in health and disease. Elective courses allow students to specialize in areas of interest and align their studies with career aspirations, research, clinical microbiology, environmental microbiology, or industrial applications. The programme also emphasizes the development of practical laboratory skills and offers opportunities for internships and hands-on learning experiences to ensure students acquire the technical and employability skills required in the global job market.

AIM OF THE PROGRAMME

The M.Sc Microbiology Programme aims to provide a holistic understanding of the discipline while equipping students with essential life and transferable skills for pursuing higher education or a career in various fields related to microbiology. Emphasizing the importance of student research, the programme integrates research opportunities as a fundamental component, encouraging students to engage in scientific inquiry and contribute to the field.

The objectives of the Learning Outcomes-based Curriculum Framework (LOCF) in Microbiology revisit traditional expectations of teaching and learning by focusing on outcomes demonstrable through five key attributes: understanding, use, communication, expansion, and application of subject knowledge. Students will learn to communicate scientific findings clearly, use their skills in practical and theoretical contexts, and expand their expertise to include innovative applications in research, industry, healthcare, and environmental management. This comprehensive approach prepares graduates to navigate and contribute to the evolving landscape of microbiology with a clear awareness of their role in addressing global challenges.

GRADUATE ATTRIBUTES

GA 1 Academic Excellence
GA 2 Communication Skills
GA 3 Critical Thinking
GA 4 Problem solving
GA 5 Individual and Team Work
GA 6 Mortal and Ethics
GA 7 Environment and Sustainability

Academic Excellence:

a) Students will engage in a curriculum that covers a broad range of microbiological topics, from microbial genetics and physiology to environmental and industrial microbiology.

b) This rigorous academic training is complemented by hands-on laboratory work and research projects, ensuring a deep and comprehensive understanding of the field.

Communication Skills:

a) The programme includes coursework and activities designed to enhance students' communication abilities.
b) This includes writing scientific papers, presenting research findings at conferences, and participating in group discussions and debates.
c) Students will also learn to communicate complex scientific concepts to non-specialist audiences, a vital skill for public engagement and education.

Critical Thinking:

a) Through case studies, research projects, and critical reviews of scientific literature, students will develop the ability to think analytically and critically.
b) They will be trained to question assumptions, evaluate evidence, and approach problems with a scientific mindset, fostering a culture of inquiry and skepticism.

Problem Solving:

a) Practical laboratory sessions and fieldwork will provide opportunities for students to tackle real-world problems.
b) They will learn to design experiments, troubleshoot technical issues, and apply theoretical knowledge to practical challenges, preparing them to solve complex problems in professional settings.

Individual and Team Work:

a) The programme emphasizes collaborative learning through group projects, lab partnerships, and interdisciplinary research initiatives.
b) Students will learn to value diverse perspectives, distribute tasks effectively, and work towards common goals, while also developing the self-discipline and motivation required for independent research and study.

Morals and Ethics:

a) Ethical considerations are integrated into the curriculum through courses on bioethics, responsible conduct of research, and the societal impacts of microbiology.

b) Students will learn about the ethical dilemmas that can arise in scientific research and practice, and will be encouraged to adopt a principled approach to their work.

Environment and Sustainability:

a) The programme addresses the role of microorganisms in environmental processes and the potential for microbiology to contribute to sustainable solutions.

b) Students will explore topics such as biodegradation, bioremediation, and the use of microbes in sustainable agriculture and industry, equipping them to contribute to environmental sustainability initiatives.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO1	:	Post Graduates will be able to promote learning environment to meet the Industry expectation
PEO2	:	Post Graduates will be incorporated the critical thinking with good Communication and Leadership skills to become a self-employed
PEO3	:	Post Graduates will be upholding the human values and environmental sustenance for the betterment of the society

PROGRAMME OUTCOMES (POs)

PO1	:	Post graduates will attain profound proficiency and expertise
PO2	:	Post graduates will be ensured with corporative self – directed learning
PO3	:	Post graduates will acquire acumen to handle diverse contexts and function in domains of multiplicity
PO4	:	Post graduates will exercise intelligence in research Investigations and Introducing innovations

PO5 : Post graduates will learn ethical values and commit to Professional ethics.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1 : Acquire specific skills to microbiology and allied fields for converting information to knowledge through hypothesis, design, execution and analysis.

PSO2 : In depth understanding of basic and applied aspects of microbiology

PSO3 : Familiarized with latest and advanced tools and techniques of microbiology

PSO4 : Capacity to develop, employ and integrate technical and professional skills as a member of team withholding the essence of social collaboration and integrity

PSO5 : To independently be able to formulate research projects on microbiology and allied interdisciplinary or multidisciplinary fields through literature search, finding research gaps and framing objectives in order to strive for innovation.

REGULATIONS (2023-2024)

1. DURATION OF THE PROGRAME

1.1. Two years (Four semesters)

1.2. Each academic year shall be divided into two semesters. The odd semesters Shall consist of the period from June to November of each year and the even Semesters from December to May of each year.

1.3. There shall be not less than 90 working days for each semester.

2. ELIGIBILITY FOR ADMISSION

2.1. Candidate who has passed the B.Sc. degree in any Life Sciences [Microbiology/Applied Microbiology/Industrial Microbiology/Botany/Plant Sciences and Plant Biotechnology/Zoology/Animal Science/Applied Animal Science and Animal Biotechnology/Biochemistry/Bioinformatics/Biology/Food Science & Nutrition/B.Sc. Medical Lab Technology/BSMS/BAMS/BUMS/BHMS/Chemistry with Botany/Zoology]as Allied Subjects of this University or an Examination of any other University accepted by the Syndicate as equivalent there to shall be permitted to appear and qualify for

the M.Sc. Degree examination in this Branch at Muthayammal college of arts and science (Autonomous), Rasipuram.

3. CREDIT REQUIRMENTS AND ELIGIBILITY FOR AWARD OF DEGREE

3.1. A Candidate shall be eligible for the award of the Degree only if he/she has undergone the prescribed course of study in a College affiliated to the University for a period of not less than two academic years and passed the examinations of all the four Semesters prescribed earning a minimum of 91 credits as per the distribution given in Regulation fulfilled such other conditions as have been prescribed thereof.

4. COURSE OF STUDY, CREDITS AND SCHEME OF EXAMINATION

4.1. The Course Components and Credit Distribution shall consist of the following: (Minimum Number of Credits to be obtained)

S. No	Study Components	Credit Distribution
01	Core, Elective, EDC and Project Courses	**84**
02	Internship	**02**
03	Human Rights	**02**
04	Professional Competency Skills	**02**
	Extension Activity	**01**
Total Credits		**91**

4.1.1. Extension Activity:

Students shall be awarded a maximum of 1 Credit for Compulsory Extension Service. All the Students shall have to enroll for clubs / NSO (Sports & Games) Retract / Youth Red Cross or any other Service Organizations in the College and shall have to put in compulsory minimum attendance of 40 hours which shall be duly certified by the Principal of the College before 31st March in a year. If a student lacks 40 hours attendance in the first year, he or she shall have to compensate the same during the subsequent years.

Those students who complete minimum attendance of 40 hours in one year will get 'half-a- credit and those who complete the attendance of 80 or more hours in Two Years will get 'one credit'. Literacy and Population Education and Field Work shall be compulsory components in the above extension service activities.

4.2. Inclusion of the Massive Open Online Courses (MOOCs) available on SWAYAM and NPTEL

4.2.1 Students can choose the MOOC Course Available on SWAYAM and NPTEL under Core, Elective or Soft skill category. He/ she will be awarded degree only after producing valid certificate of the MOOC course for credit Mobility

5. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTER

5.1. Eligibility: Students shall be eligible to go to subsequent semester only if they earn sufficient attendance as prescribed by the Periyar University.

5.2. Attendance: All Students must earn 75% and above of attendance for appearing for the End Semester Examination. (Theory/Practical)

5.3. Condonation of shortage of attendance: If a Student fails to earn the minimum attendance (Percentage stipulated), the Principals shall condone the shortage of attendance up to a maximum limit of 10% (i.e. between 65% and above and less than 75%) after collecting the prescribed fee for Theory/Practical examination separately, towards the condonation of shortage of attendance. Such fees collected and should be remitted to the University.

5.4. Non-eligibility for condonation of shortage of attendance: Students who have secured less than 65% but more than 50% of attendance are NOT ELIGIBLE for condonation of shortage of attendance and such Students will not be permitted to appear for the regular examination, but will be allowed to proceed to the next year/next semester of the program and they may be permitted to take next University examination by paying the prescribed condonation fee.

5.5. Detained students for want of attendance: Students who have earned less than 50% of attendance shall not be permitted to proceed to the next semester and to complete the Program of study. Such Students shall have to repeat the semester, which they have missed by rejoining after completion of final semester of the course, by paying the fee for the break of study as prescribed by the College from time to time.

5.6. Condonation of shortage of attendance for married women students: In respect of married women students undergoing PG programs, the minimum attendance for condonation (Theory/Practical) shall be relaxed and prescribed as 55% instead of 65% if they conceive during their academic career. Medical certificate from the Doctor (D.G.O) from the Government Hospital and the prescribed fee along with attendance details shall be forwarded to the college to consider the condonation of attendance mentioning the category

5.7. Zero Percent (0%) Attendance: The Students, who have earned 0% of attendance, have to repeat the program (by rejoining) without proceeding to succeeding semester and they have to obtain prior permission from the College/University immediately to rejoin the program.

5.8. Transfer of Students and Credits: The strength of the credits system is that it permits inter Institutional transfer of students. By providing mobility, it enables individual students to develop their capabilities fully by permitting them to move from one Institution to another in accordance with their aptitude and abilities by obtaining necessary permission from the university.

5.8.1. Transfer of Students is permitted from one Institution to another Institution for the same program with same nomenclature.

Provided, there is a vacancy in the respective program of Study in the Institution where the transfer is requested.

Provided the Student should have passed all the courses in the Institution from where the transfer is requested.

5.8.2 The marks obtained in the courses will be converted and grades will be assigned as per the College norms.

5.8.3 The transfer students are eligible for classification.

5.8.4 The transfer students are not eligible for Ranking, Prizes and Medals.

5.8.5 Students who want to go to foreign Universities up to two semesters or Project Work with the prior approval of the Departmental/College Committee are allowed to get transfer of credits and marks which will be converted in to Grades as per the University norms and are eligible to get CGPA and Classification; they are not eligible for Ranking, Prizes and Medals.

5.9. Students are exempted from attendance requirements for online courses of the College and MOOC's.

6. EXAMINATION AND EVALUATION

6.1. Register for all subjects: Students shall be permitted to proceed from the First Semester up to Final Semester irrespective of their failure in any of the Semester Examination. For this purpose, Students shall register for all the arrear subjects of earlier semesters along with the current (subsequent) Semester Subjects.

6.2. Marks for Internal and End Semester Examinations

Category	Theory	Practical
Internal Assessment	25	**40**
End semester Examination	**75**	**60**

6.3. Procedure for Awarding Internal Marks Internal Examination Marks – Theory

Components	Marks
CIA I & II	10
Attendance	5
Assignment/Quiz	5
Seminar	5
Total	25

6.4. Awarding Marks for Attendance (out of 5)

Percentage of Attendance	Marks
Below 60%	0 marks
60% to 75%	3 marks
75% to 90%	4 marks
Above 90%	5 marks

6.5. Components for Practical CIA.

Components	Marks
CIA - I	15
CIA - II	15
Observation Note	05
Attendance	5
Total	40

6.6. Components for Practical ESE.

Components	Marks
Completion of Experiments	50
Record	05
Viva voce	05
Total	60

6.7. Internship/ Industrial Training, Mini Project and Major Project Work

Internship/Industrial Training		Project Work		
	Marks	Components		Marks
CIA*1		CIA		
Work Diary	25	a) Attendance	20 Marks	50
Report	50	b) Review / Work Diary*1	30 Marks	
Viva-voce	25			
Examination				
Total	100	ESE*2		
		a) Final Report	120 Marks	150
		b) Viva-voce	30 Marks	
		Total		

*1 Evaluation of report and conduct of viva voce will be done jointly by Internal and External Examiners

6.8. Guidelines for Professional Competency Skill- Online Mode - Online Exam 3 hours

Components	Marks
100 Objective Type Questions 100*1=100 Marks	100

Objective type Questions from Question Bank.

- The passing minimum for this paper is 50%
- In case, the candidate fails to secure 50% passing minimum, he/ she may have to reappear for the same in the subsequent semesters.

6.9. Components for Human Rights Course (CIA Only)

The Course Human Rights is to be treated as 100% C I A course which is offered in II Semester for I year PG students.

Total Marks for the Course =100

Components	Marks
Two Tests	75
Assignments	25
Total	**100**

- In case the candidate fails to secure 50 marks, which is the passing minimum, he/she may have to reappear for the same in the subsequent semesters

QUESTION PAPER PATTERN FOR CIA I, II AND ESE	
(3 HOURS)	MAXIMUM : 75Marks
SECTION-A (Objective Type) Answer ALL Questions ALL Questions Carry EQUAL Marks	(10 x1=10 marks)
SECTION-B (Analytical Type) Answer any THREE Questions out of FIVE Questions ALL Questions Carry EQUAL Marks	(3 x 5 = 15 marks)
SECTION-C (Either or Type) Answer ALL Questions ALL Questions Carry EQUAL Marks	(5 x 10 = 50 marks)

6.10. PASSING MINIMUM

6.10.1. There shall be no passing minimum for Internal.

6.10.2. For external examination, passing minimum shall be 50% [Fifty Percentage] of the maximum marks prescribed for the course for each Course/Practical/Project and Viva-Voce.

6.10.3. In the aggregate [External/Internal] the passing minimum shall be of 50%.

6.10.4. He / She shall be declared to have passed the whole examination, ifhe/she passes in all the Courses and Practical wherever prescribed as per the scheme of the examinations by earning 90 CREDITS. He/she shall also fulfill the extension activities prescribed earning a minimum of 1 credit to qualify for the Degree.

6.11. SUPPLIMENTARY EXAMINATION:

Supplementary Examinations is conducted for the students who appeared in the final semester examinations. Eligible criteria for appearing in the Supplementary Examinations are as follows:

6.11.1. Eligibility: A Student who is having arrear of only one theory course in any of the semester or two theory course in the Final semester of the PG degree programme alone is eligible for Supplementary Examinations.

6.11.2. Non-eligibility for those completed the program: Students who have completed their Program duration but having arrears are not eligible to appear for Supplementary Examinations.

6.12. RETOTALLING, REVALUATION AND PHOTOCOPY OF THE ANSWER SCRIPTS:

6.12.1. Re-totaling: All UG Students who appeared for their Semester Examinations are eligible for applying for re-totaling of their answer scripts.

6.12.2. Revaluation: All current batch Students who have appeared for their Semester Examinations are eligible for Revaluation of their answer scripts. Passed out candidates are not eligible for Revaluation.

6.12.3. Photo copy of the answer scripts: Students who have applied for revaluation can apply for the Photocopy of answer scripts by paying prescribed fee.

7. CLASSIFICATION OF SUCCESSFUL STUDENTS

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
00-49	0.0	U	Re-appear
	0.0	AAA	

7.1. Computation of Grade Point Average (GPA) in a Semester, Cumulative Grade Point Average (CGPA) and Classification

GPA for a Semester: = ∑iCiGi ,∑iCi

That is, GPA is the sum of the multiplication of grade points by the credits of the courses divided by the sum of the credits of the courses in a semester.

CGPA for the entire programme: = ∑n∑iCniGni ,∑n∑iCni That is, CGPA is the sum of the multiplication of grade points by the credits of the entire programme divided by the sum of the credits of the courses of the entire programme

Where,

Ci= Credits earned for course I in any semester,

Gi=GradePointsobtainedforcourseiinanysemestern=Semesterinwhichsuchcourseswere credited.

7.2. Letter Grade and Classification

CGPA	GRAD E	CLASSIFICATION OF FINAL RESULT
9.5-10.0	O+	First Class -Exemplary*
9.0 and above but below9.5	O	
8.5 and above but below 9.0	D++	First Class with Distinction*
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
	U	

*The Students who have passed in the first appearance and within the prescribed semester of the PG Program are eligible.

8. RANKING

Students who pass all the examinations prescribed for the Program in the FIRST APPEARANCE ITSELF ALONE are eligible for Ranking I, II and III.

9. MAXIMUM PERIOD FOR COMPLETION OF THE PROGRAM TO QUALIFY FOR A DEGREE

9.1. A Student who for whatever reasons is not able to complete the program within the normal period (N) or the Minimum duration prescribed for the programme, may be allowed two years period beyond the normal period to clear the backlog to be qualified for the degree. (Time Span =N+2years for the completion of programme)

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MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE (Autonomous)
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M.Sc., MICROBIOLOGY Abstract under LOCF – CBCS Pattern with effect from 2023- 2024 Onwards

Structure of Credit Distribution as per the TANSCHE/UGC Guidelines

S. No.	Study Components	Sem. I		Sem. II		Sem. III		Sem. IV		No. of Paper	Total Credit
		No. of Paper	Credit	No. of Paper	Credit	No. of Paper	Credit	No. of Paper	Credit		
1	DISCIPLINE SPECIFIC CORESES (DSC)- THEORY	2	10	2	10	3	15	2	10	9	**45**
2	DSC -PRACTICAL	1	3	1	3	1	3			3	**9**
3	DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE)	2	6	2	6	1	3			5	**15**
4	PROJECT WORK							1	6	1	**6**
5	INTERNSHIP					1	2			1	**2**
6	GENERIC ELECTIVE COURSES(GEC)- EDC			1	3					1	**3**
7	SKILL ENHANCEMENT COURSES (SEC)- SBEC			1	2	1	2	1	2	3	**6**
8	HUMAN RIGHTS			1	2					1	**2**
9	EXTENSION ACTIVITY							1	1	1	**1**
10	ONLINE- COMPETITIVE EXAMINATION							1	2	1	**2**
	Cumulative Credits	**5**	**19**	**8**	**26**	**7**	**25**	**6**	**21**	**26**	**91**

Total No. of Subjects	26
Marks	**2500**

TOTAL CREDIT	91
Extra Credit	4
Total Credits	**95**

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE (Autonomous) - Rasipuram-637408

Scheme of Examinations - LOCF- CBCS Pattern

(for the Students Addmited from the Academic Year: 2023 - 2024 Onwards)

Programme : M.Sc. MICROBIOLOGY

S. No.	STUDY COMPONENTS	COURSE_CODE	TITLE OF THE COURSE	Hrs./W		CREDIT POINTS	MAX. MARKS		
				Lect.	Lab.		CIA	ESE	TOTAL
SEMESTER - I									
1	DSC THEORY - I	23M1PMIC01	GENERAL MICROBIOLOGY AND MICROBIAL DIVERSITY	6		5	25	75	100
2	DSC THEORY - II	23M1PMIC02	IMMUNOLOGY, IMMUNOMICS AND MICROBIAL GENETICS	6		5	25	75	100
3	DSC PRACTICAL - I	23M1PMIP01	PRACTICAL : GENERAL MICROBIOLOGY, IMMUNOLOGY AND MICROBIAL GENETICS		6	3	40	60	100
4	DSE - I	23M1PMIE01	ELECTIVE I :	6		3	25	75	100
5	DSE - II	23M1PMIE04	ELECTIVE II :	6		3	25	75	100
			TOTAL	**24**	**6**	**19**	**140**	**360**	**500**
SEMESTER - II									
1	DSC THEORY - III	23M2PMIC03	MEDICAL BACTERIOLOGY AN DMYCOLOGY	6		5	25	75	100
2	DSC THEORY - IV	23M2PMIC04	MEDICAL VIROLOGY AND PARASITOLOGY	6		5	25	75	100
3	DSC PRACTICAL - II	23M2PMIP02	PRACTICAL : MEDICAL BACTERIOLOGY, MYCOLOGY AND PARASITOLOGY		6	3	40	60	100
4	DSE - III	23M2PMIE08	ELECTIVE III :	3		3	25	75	100
5	DSE - IV	23M2PMIE12	ELECTIVE IV :	3		3	25	75	100
6	SEC – I	23M2PMIS01	VERMITECHNOLOGY	2		2	25	75	100
7	GEC- EDC - I	23M2PBTED2	BIO ENTREPRENEURSHIP	3		3	25	75	100
8	HUMAN RIGHTS	23M2PHUR01	HUMAN RIGHTS	1		2	100		100
			TOTAL	**24**	**6**	**26**	**265**	**435**	**800**
SEMESTER - III									
1	DSC THEORY - V	23M3PMIC05	SOIL AND ENVIRONMENTAL MICROBIOLOGY	6		5	25	75	100
2	DSC THEORY - VI	23M3PMIC06	MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY	6		5	25	75	100
3	DSC PRACTICAL - III	23M3PMIP03	PRACTICALS : SOIL, ENVIRONMENTAL MICROBIOLOGY AND RECOMBINANT DNA TECHNOLOGY		6	3	40	60	100
4	DSC THEORY - VII	23M3PMIC07	FERMENTATION TECHNOLOGY AND PHARMACEUTICAL MICROBIOLOGY	6		5	25	75	100

5	DSE - V	23M3PMIE13	ELECTIVE V :	4		3	25	75	100
6	SEC - II	23M3PMIS02	ORGANIC FARMING AND BIOFERTILIZER TECHNOLOGY	2		2	25	75	100
7	INTERNSHIP	23M3PMIIS1	INTERNSHIP			2	100		100
			TOTAL	**24**	**6**	**25**	**265**	**435**	**700**
SEMESTER - IV									
1	DSC THEORY - VIII	23M4PMIC08	FOOD AND DAIRY MICROBIOLOGY	7		5	25	75	100
2	DSC THEORY - IX	23M4PMIC09	RESEARCH METHODOLOGY AND BIOSTATISTICS	7		5	25	75	100
3	PROJECT WORK	23M4PMIPR1	PROJECT WORK		12	6	50	150	200
4	ONLINE - COMPETITIVE EXAMINATION	23M4PMIOE1	MICROBIOLOGY FOR COMPETITIVE EXAMINATIONS			2	100		100
5	SEC - III	23M4PMIS03	MICROBIAL QUALITY CONTROLAND TESTING	4		2	25	75	100
6	EXTENSION ACTIVITY	23M4PMIEX1	EXTENSION ACTIVITY			1			
			TOTAL	**18**	**12**	**21**	**225**	**375**	**600**
			OVER ALL TOTAL	**90**	**30**	**91**	**895**	**1605**	**2600**
1	EXTRA CREDIT COURSE	23M4PMBEC1	MOOC Courses offered in SWAYAM/NPTEL	-	-	2	-	-	-
2	VALUE ADDED COURSE			-	-	2	-	-	-

HOD **Member Secretary Academic Council** **Principal**

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE
(Autonomous)
Rasipuram - 637408.

M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PMIC01	**GENERAL MICROBIOLOGY AND MICROBIAL DIVERSITY**	**DSC THEORY - I**	**I**	**6**	**4**	**2**	**-**	**5**
Objective	Students understand the basic knowledge in Microbiology, Microbial taxonomy, Metabolism and Microbial diversity.							

Unit	Course Content	Knowledge Levels	Sessions
I	**History and Scope of Microbiology.** Microscopy – Principles and applications. Types of Microscopes - Bright field, Dark-field, Phase-contrast, Fluorescence microscope, Transmission electron microscope (TEM) and Scanning electron microscope (SEM). Sample preparation for SEM & TEM. Atomic force, Confocal microscope. Micrometry – Stage, Ocular and its applications.	K1	15
II	**Bacterial Structure, properties and biosynthesis of cellular components** – Cell wall. Actinomycetes and Fungi - Distribution, morphology, classification, reproduction and economic importance. Sporulation. Growth and nutrition - Nutritional requirements, Growth curve, Kinetics of growth, Batch culture, Synchronous growth, Measurement of growth and factors affecting growth.	K2	15
III	**Algae** - Distribution, morphology, classification, reproduction and economic importance. Isolation of algae from soil and water. Media and methods used for culturing algae, Strain selection and large-scale cultivation. Life cycle – *Chlamydomonas*, *Volvox Spirogyra* (Green algae), *Nostoc* (Cyanobacteria) *Ectocarpus*, *Sargassum* (Brown algae), *Polysiphonia*, *Batracho spermum* (Red algae).	K3	15
IV	**Microbial techniques** - Safety guidelines in Microbiology Laboratories. Sterilization, Disinfection and its validation. Staining methods – Simple, Differential and Special staining. Automated Microbial identification systems - Pure cultures techniques – Cultivation of Anaerobic organisms. Maintenance and preservation of pure cultures. Culture collection centres - National and International.	K4	15
V	Biodiversity - Introduction to microbial biodiversity – Thermophiles - Classification, Thermophilic Archaebacteria and its applications. Methanogens - Classification, Habitats, applications. Alkaliphiles and	K4	15

	Acidophiles - Classification, discovery basin, its cell wall and membrane. Barophiles - Classification and its applications. Halophiles - Classification, discovery basin, cell walls and membranes – purple membrane, compatible solutes, Osmoadaptation / halotolerance - Applications of halophiles. Conservation of Biodiversity.		
Course Outcome	**CO1:** Remember the history and applications of Microscopy.	K1	
	CO2: Illustrate the various nutritional requirements and growth characters of microorganisms.	K2	
	CO3: Identify the economic importance of Algae.	K3	
	CO4: Classify the bacterial identification methods.	K4	
	CO5: Categorize about the Archaebacteria.	K4	
Learning Resources			
Text Books	1. Prescott LM, Harley JP and Klein DA. Microbiology. 7th edition, McGraw Hill, Newyork. 2008 2. Tortora, G.J., Funke, B.R. and Case, C.L. (2016) Microbiology: An Introduction, 11th Edition, Pearson Education, India 3. Dubey, R.C. and Maheshwari, D.K. (2013) A Textbook of Microbiology. Revised Edition, Chand and company, NewDelhi		
Reference Books	1. Holt JS, Kreig NR, Sneath PHA and Williams ST. Bergeys Manual of Determinative Bacteriology (9th Edition), Williams and Wilkins, 23, Baltimore.1994. 2. Baveja, C.P. and Baveja, V. (2017) APC Text Book of Microbiology.4thEdition, Arya Publications, New Delhi 3. Pelczar TR, Chan ECS and Kreig NR. Microbiology. 5th Edition, Tata McGraw – Hill, New Delhi.2006. 4. Alcamo E. Fundamentals of Microbiology. 6th Ed., Jones and Bartlett Publishers, New Delhi. 2001.		
Website Link	1. https://microbiologyinfo.com/top-and-best-microbiology-books/ 2. www.microbiologyonline.org.uk 3. www.life.umd.edu/classroom/bsci424/BSCI223WebSiteFiles/LectureList.htm 4. https://open.umn.edu/opentextbooks/BookDetail.aspx?bookId=404		
	L-Lecture	T-Tutorial	P-Practical	C-Credit

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M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**			**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PMIC01	**GENERAL MICROBIOLOGY AND MICROBIAL DIVERSITY**			**DSC THEORY - I**		**I**	**6**	**4**	**2**	**-**	**5**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	S	M	S	S	M	S	S	S
CO2	L	M	S	S	S	S	S	S	S	S
CO3	S	M	S	M	S	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW				M-MEDIUM		S-STRONG			

Tutorial Schedule	Group Discussion, Quiz program, model preparation and Kahoot app
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, Poster Presentation, Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
Dr.M.Selvan	Dr.M.Selvan	Dr.S.Shahitha

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M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PMIC02	**IMMUNOLOGY, IMMUNOMICS AND MICROBIAL GENETICS**	**DSC THEORY - II**	**I**	**6**	**4**	**2**	**-**	**5**
Objective	To understand the basic knowledge in Immunology, immune systems and genomic DNA							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction to biology of the immune system** – Cells and organs of Immune System. T and B lymphocytes – Origin, development, differentiation, lymphocyte subpopulation in humans. Innate immunity- Complement, Toll-like receptors and other components. Acquired immunity – Active and Passive immunity. Antigens - features associated with antigenicity and immunogenicity. Basis of antigen specificity. MHC genes and products, Structure of MHC molecules, Genetics of HLA Systems – Antigens and HLA typing. Antigen processing and presentation to T- lymphocytes.	K1	15
II	**Immunoglobulins.** Theories of antibody production. Class switching and generation of antibody diversity. Monoclonal and polyclonal antibodies. Complement system – mode of activation- Classical, Alternate and Lectin pathways, biological functions. Antigen recognition – TCR, Diversity of TCR, T cell surface alloantigens, lymphocyte activation, clonal proliferation and differentiation. Physiology of acquired immune response – various phases of HI, CMI – Cell mediated cytotoxicity, DTH response.	K2	15
III	**Hypersensitivity** – Types and mechanisms, Autoimmunity, Tumor Immunity and Transplantation immunology. Immunodeficiency-Primary immunodeficiency and Secondary immunodeficiencies. Genetics of Immunohematology – Genetic basis and significance of ABO and other minor blood groups in humans, Bombay blood group, Secretors and Non-secretors, Rh System and genetic basis of D- antigens. Diagnostic Immunology - Precipitation reaction, Immunodiffusion methods - SRID, ODD. Immunoelectrophoresis - Rocket and Counter current electrophoresis. Agglutination - Hemagglutination - Hemagglutination inhibition. Labeled Assay- Immunofluorescence assay, Radio immunoassay, FISH, ELISA. Flow cytometry. Immune regulation mechanisms – immuno-induction, immuno-suppression, immuno-tolerance, immuno-potentiation, Immunomodulation. Role of cytokines, lymphokines and chemokines. Introduction to Vaccines and Adjuvants - Types of vaccines. Development of vaccines and antibodies	K3	17

	in plants. Immunomics - Introduction and Applications. Antigen engineering for better immunogenicity and use for vaccine development - multiepitope vaccines. Reverse vaccinology.		
IV	**Structural of prokaryotic and eukaryotic genome**. Introduction to prokaryotic genomic structure, Eukaryotic Genome - Structure of chromatin, chromosome, centromere, telomere, nucleosome. Modifications- methylation, acetylation, phosphorylation and its effect on structure and function of chromatin, DNA methylation and gene imprinting, organelle genome.	K3	13
V	**Gene Transfer Mechanisms -** Conjugation and its uses. Transduction, Generalized and Specialized, Transformation – Natural Competence and Transformation. Transposition and Types of Transposition reactions. Insertion sequences, complex and compound transposons – T10, T5, and Retroposon. Mechanism – Transposons of *E. coli*, Bacteriophage and Yeast. Importance of transposable elements in horizontal transfer of genes and evolution.	K3	15
Course Outcome	**CO1:** Remember the knowledge about cells of the immune systems and their processes.	K1	
	CO2: Understand the antigen recognition and antibody production.	K2	
	CO3: Apply the antigen – antibody reactions.	K3	
	CO4: Compare the genome of prokaryotes and eukaryotes.	K3	
	CO5: Conclude the gene transfer methods and their mechanisms.	K3	

Learning Resources	
Text Books	1. Owen, J., Punt, J and Strand ford, S. “Kuby Immunology”, 7th Ed., W.H. Freeman Publication, NewYork, USA, 2013. 2. Abbas, K.A., Litchman, A.H. and Pober, J.S. “ Cellular and Molecular Immunology”, 4th Ed., W.B. Saunders Co., Pennsylvania, USA, 2005. 3. Gardner E. J. Simmons M. J. and Snusted D.P. (2006). Principles of Genetics. (8th Edition). Wiley India Pvt. Ltd.
Reference Books	1. Roitt, I., Brostoff, J. and David, M. “Immunology”, 6th Ed., Mosby publishers Ltd., New York, USA, 2001. 2. Tizard, R.I. “Immunology”, 4th Ed., Saunders college publishing, Chennai Micro print Pvt. Ltd., Chennai, 2004. 3. Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. (5th Edition). ASM Press.
Website Link	1. https://www.elsevier.com/books/bacterial-physiology-and metabolism/sokatch/978-1-4832-3137 2. https://www.frontiersin.org/journals/microbiology/sections/microbial- physiology-and-metabolism. 3. https://www.macmillanlearning.com/college/ca/product/Lehninger-Principles-of-Biochemistry/p/1319228003

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M1PMIC02	**IMMUNOLOGY, IMMUNOMICS AND MICROBIAL GENETICS**	**DSC THEORY - II**	**I**	**6**	**4**	**2**	**-**	**5**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	S	M	S	M	M	S	S
CO2	S	M	S	S	M	S	M	M	S	S
CO3	S	M	S	S	M	S	M	M	S	S
CO4	S	M	S	S	M	S	M	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

Level of Correlation between CO and PO	L-LOW	M-MEDIUM	S-STRONG

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
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M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PMIP01	**PRACTICAL: GENERAL MICROBIOLOGY, IMMUNOLOGY AND MICROBIAL GENETICS**	**DSC PRACTICAL - I**	**I**	**6**	**-**	**-**	**6**	**3**
Objective	The learners will be able to gain adequate knowledge about biochemical methods, immunological methods and molecular methods							

S.No.	List of Experiments / Programmes	Knowledge Levels	Sessions
1	Microscopic Techniques: Light microscopy: Hay infusion broth. Wet mount to show different types of microbes, hanging drop.	K1-K3	6
2	Dark field microscopy – Motility of Spirochetes.	K3	3
3	Washing and cleaning of glass wares: Sterilization methods: moist heat, dry heat, and filtration. Quality control check for each method.	K3	6
4	Staining techniques - Simple staining, Gram's staining, Acid fast staining, Meta chromatic granule staining, Spore, Capsule, Flagella.	K2-K5	9
z5	Media Preparation: Preparation of liquid, solid and semisolid media. Agar deeps, slants, plates.	K2-K5	6
6	Preparation of basal, enriched, selective and enrichment media.	K2-K5	3
7	Preparation of Biochemical test media, media to demonstrate enzymatic activities	K2-K5	3
8	Microbial Physiology: Purification and maintenance of microbes. Streak plate, pour plate, and slide culture technique. Aseptic transfer.	K1-K5	6
9	Direct counts – Total cell count, Turbidometry. Viable count - pour plate, spread plate. Bacterial growth curve	K2-K4	6
10	Effect of physical and chemical factors on growth. Anaerobic culture methods.	K4	3
11	Hematological reactions - Blood Grouping – forward and reverse, Rh Typing	K2-K5	3
12	Identification of various immune cells by morphology – Leishman staining, Giemsa staining.	K2-K5	3
13	Agglutination Reactions- Latex Agglutination reactions- RF, ASO, CRP. Detection of HBs Ag by ELISA.	K1-K4	3

14	Precipitation reactions in gels– Ouchterlony double immune diffusion (ODD) and Mancini's single radial immune diffusion (SRID) Immuno-electrophoresis and staining of precipitin lines- Rocket immuno electrophoresis and counter current immune electrophoresis.	K2-K5	6
15	Preparation of lymphocytes from peripheral blood by density gradient centrifugation.	K2-K5	3
16	Purification of immunoglobulin– Ammonium Sulphate Precipitation. Separation of IgG by chromatography using DEAE cellulose or Sephadex.	K2-K5	6
17	Western Blotting – Demonstration. Isolation of genomic DNA from *E. coli* and analysis by agarose gel electrophoresis	K2-K5	6
18	Estimation of DNA using colorimeter (Diphenylamine reagent) Separation of proteins by polyacrylamide gel electrophoresis (SDS PAGE)	K2-K5	6
19	UV induced mutation and isolation of mutants by replica plating technique.	K2-K5	3
20	Plasmid DNA isolation from *E.coli*. RNA isolation from yeast	K2-K5	6
21	RNA estimation by Orcinol method.	K2-K5	3
Course Outcome	**CO1:** Remember and apply the various microscopic and staining techniques of bacteria.	K1	
	CO2: Understand the knowledge about culture media, factors and pure culture techniques.	K2	
	CO3: Apply the knowledge about serological and immunological techniques.	K3	
	CO4: Analyze the various separation methods of biomolecules.	K4	
	CO5: Estimate the genomic DNA, RNA and Plasmid DNA.	K5	

Learning Resources	
Text Books	1. James G. Cappuccino and Natalie Sherman (2014) Microbiology: A Laboratory Manual (10th Edition), Pearson. 2. Dubey R.C. and Maheshwari D. K. (2010). Practical Microbiology. S. Chand.
Reference Books	1. Aneja, K.R (2003) Experiments in Microbiology, Plant Pathology and Biotechnology (4th edition), New age 2. Brown T.A. (2016). Gene Cloning and DNA Analysis. (7th Edition). John Wiley and Jones, Ltd. 3. Alfred E. Brown (2010) Benson's Microbiological Applications: Laboratory Manual in Generl Microbiology, 11th Edition, McGraw-Hill Companies. 4. Maloy S. R., Cronan J.E. Jr. and Freifelder D. (2011). Microbial Genetics. (2nd Editior Narosa Publishing Home Pvt Ltd.

Website Link	1. http://www.pdfsdocuments.com/cp-baveja-microbiology.pdf 2. http:/www.faculty.washington.edukorshin/Class486/Microbiol Techniques.pdf 3. http://www.microbiologyonline.org.uk/media/.../sgm_ basic practical micro biology_2.pdf 4. http://www.cmu.edu.cn/jc_sys1/upl_files/200858184159474.pdf

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards

Course Code	Course Title	Course Type	Sem.	Hours	L	T	P	C
23M1PMIP01	**Practical: GENERAL MICROBIOLOGY, IMMUNOLOGY AND MICROBIAL GENETICS**	**DSC PRACTICAL - I**	**I**	**6**	**-**	**-**	**6**	**3**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	S	S	S	S	S	M	S	S
CO2	M	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S
Level of Correlation between CO and PO	L-LOW				M-MEDIUM			S-STRONG		

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Poster Presentation, Demonstration and Video presentation
Assessment Methods	Model practical and ESE

Designed By	Verified By	Approved By Member Secretary
Dr.M.Selvan	Dr.M.Selvan	Dr.S.Shahitha

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M.Sc-Microbiology Syllabus LOCF CBCS with effect from 2023 2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PMIC03	**MEDICAL BACTERIOLOGY AND MYCOLOGY**	**DSC THEORY - III**	**II**	**6**	**4**	**2**	**-**	**5**
Objective	The course is designed to develop the student with enough knowledge about disease caused by Bacteria and Fungi							

Unit	Course Content	Knowledge Levels	Sessions
I	Classification of medically important bacteria, Normal flora of human body, Collection, transport, storage and processing of clinical specimens, Microbiological examination of clinical specimens, antimicrobial susceptibility testing. Handling and maintenance of laboratory animals – Rabbits, guinea pigs and mice.	K1	15
II	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by species of *Staphylococci, Streptococci, Pneumococci, Neisseriae*, *Bacillus, Corynebacteria, Mycobacteria* and *Clostridium sps.*	K2	15
III	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by Enterobacteriaceae members, *Yersinia, Pseudomonas, Vibrio, Mycoplasma, Helicobacter, Rickettsiae, Chlamydiae, Bordetella, Francisella., Spirochaetes - Leptospira, Treponema* and *Borrelia*. Nosocomial, zoonotic and opportunistic infections -prevention and control.	K3	15
IV	Morphology, taxonomy and classification of fungi. Detection and recovery of fungi from clinical specimens. Dermatophytes and agents of superficial mycoses. *Trichophyton, Epidermophyton & Microsporum*. Yeasts of medical importance – *Candida, Cryptococcus*. Mycotoxins. Antifungal agents, testing methods and quality control.	K4	15
V	Dimorphic fungi causing Systemic mycoses, *Histoplasma, Coccidioides, Sporothrix, Blastomyces.* Fungi causing Eumycotic Mycetoma, Opportunistic fungi- Fungi causing secondary infections in immunocompromised patients. Immunodiagnostic methods in mycology- Recent advancements in diagnosis. Antifungal agents.	K4	15
Course Outcome	**CO1:** Remember about the Collection, transport and process of various kinds of clinical specimens.	K1	
	CO2: Understand about the knowledge of gram positive bacteria.	K2	

	CO3: Identify the disease characters of various bacteria.	K3	
	CO4: Analyze the knowledge about the disease of dermatophytes, yeast and their treatment.	K4	
	CO5: Analyze the systemic mycosis and various immunodiagnostic methods to fungal infections.	K4	

Learning Resources				
Text Books	1. Kanunga R. (2017). Ananthanarayanan and Panicker's Text book of Microbiology. Orient Longman, Hyderabad. 2. Greenwood, D., Slack, R. B. and Peutherer, J. F. (2012) Medical Microbiology, (18th Edition). Churchill Livingstone, London. 3. Chander J. (2018). Textbook of Medical Mycology. (4th Edition). Jaypee brothers Medical Publishers.			
Reference Books	1. Chees brough M. (2006). District Laboratory Practice in Tropical countries. Part 22ndedn. Cambridge University Press. 2. Topley and Wilson's. (1998). Principles of Bacteriology.9th edn. Edward Arnold, London. 3. Murray P.R., Rosenthal K.S. and Michael A. (2013). Medical Microbiology. P faller. 7th edn. Elsevier, Mosby Saunders			
Website Link	1. http://textbookofbacteriology.net/nd 2. https://www.pathelective.com/micro-resources 3. http://mycology.cornell.edu/fteach.html			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M2PMIC03	**MEDICAL BACTERIOLOGY AND MYCOLOGY**	**DSC THEORY - III**	**II**	**6**	**4**	**2**	**-**	**5**	

CO-PO Mapping										
CO Number	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	M	S	S	S	M	S	S	S	S	S
CO2	M	S	S	S	M	S	S	S	S	S
CO3	M	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW				M-MEDIUM			S-STRONG		

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
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M.Sc-Microbiology Syllabus LOCF CBCS with effect from 2023 2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PMIC04	**MEDICAL VIROLOGY AND PARASITOLOGY**	**DSC THEORY - IV**	**II**	**6**	**4**	**2**	**-**	**5**
Objective	To study about the medically important viruses, parasites and their treatments							

Unit	Course Content	Knowledge Levels	Sessions
I	General properties of viruses - Structure and Classification - viroids, prions, satellite RNAs and virusoids. Cultivation of viruses - embryonated eggs, experimental animals and cell cultures. Purification and Assay of viruses – Physical and Chemical methods (Electron Microscopy, Protein and Nucleic acids studies.) Infectivity Assays (Plaque and end-point).	K1-K2	13
II	Virus Entry, Host Defenses Against Viral Infections, Epidemiology, pathogenic mechanisms, Pathogenesis, laboratory diagnosis, treatment for the following viruses: DNA Viruses- Pox, Herpes, Adeno, Papova and Hepadna, RNA Viruses- Picorna, Orthomyxo, Paramyxo, Rhabdo, Rota, HIV and other Hepatitis viruses, Arbo – Dengue virus, Ebola virus, Emerging and reemerging viral infections	K1-K3	14
III	Bacterial viruses - ΦX 174, M13, MU, T4, lambda, Pi; Structural organization, life cycle and phage production. Lysogenic cycle-typing and application in bacterial genetics. Diagnosis of viral infections –conventional serological and molecular methods. Antiviral agents and viral vaccines.	K4	15
IV	Introduction to Medical Parasitology – Classification, host-parasite relationships. Epidemiology, life cycle, pathogenic mechanisms, laboratory diagnosis, treatment for the following: Protozoa causing human infections – *Entamoeba,* Aerobic and Anaerobic amoebae, *Giardia, Trichomonas, Balantidium. Toxoplasma, Cryptosporidium, Leishmania,* and *Trypanasoma.*	K4	15
V	Classification, life cycle, pathogenicity, laboratory diagnosis and treatment for parasites – Helminthes - Cestodes – *Taenia Solium, T. Saginata, T. Echinococcus*. Trematodes – *Fasciola Hepatica, Fasciolopsis Buski, Paragonimus, Schistosomes*. Nematodes - *Ascaris, Ankylostoma, Trichuris, Trichinella, Enterobius, Strongyloides* and *Wuchereria*. Other parasites causing infections in immune compromised hosts and AIDS. Cultivation of parasites. Diagnosis of parasitic infections – Serological and molecular diagnosis. Anti-protozoan drugs.	K4	18

Course Outcome	**CO1:** Remember the knowledge cultivation of viruses and assay of viruses.	K1	
	CO2: Understand the various knowledge of DNA and RNA viruses.	K2	
	CO3: Identify the viral infections and antiviral agents.	K3	
	CO4: Conclude the various knowledge about Protozoan Parasites and Haemoflagellates.	K4	
	CO5: Conclude the knowledge about the helminthes, diagnosis and treatment.	K4	

Learning Resources	
Text Books	1. Kanunga R. (2017). Ananthanarayanan and Panicker's Text book of Microbiology. (10th Edition). Universities Press (India) Pvt. Ltd. 2. Dubey, R.C. and Maheshwari D.K. (2010). A Text Book of Microbiology. S. Chand & Co. 3. Arora, D. R. and Arora B. B. (2020). Medical Parasitology. (5th Edition). CBS Publishers & Distributors Pvt. Ltd. New Delhi.
Reference Books	1. Willey J., Sandman K. and Wood D. Prescott's Microbiology. (11th Edition). McGraw Hill Book. 2. Jawetz E., Melnick J. L. and Adelberg E. A. (2000). Review of Medical Microbiology. (19th Edition). Lange Medical Publications, U.S.A. 3. Finegold S.M. (2000). Diagnostic Microbiology. (10th Edition). C.V. Mosby Company, St. Louis. 4. Levanthal R. and Cheadle R. S. (2012). Medical Parasitology. (6th Edition). S.A. Davies Co. Philadelphia.
Website Link	1. https://en.wikipedia.org/wiki/Virology 2. https://nptel.ac.in/courses/102/103/102103039/

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M2PMIC04	**MEDICAL VIROLOGY AND PARASITOLOGY**	**DSC THEORY - IV**	**II**	**6**	**4**	**2**	**-**	**5**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	S	S	S	S	M	S	S	M	M	M	
CO2	S	S	S	S	M	S	S	M	S	S	
CO3	S	S	S	S	M	S	S	S	S	S	
CO4	S	S	S	S	M	S	S	S	S	S	
CO5	S	S	S	S	M	S	S	S	S	S	
Level of Correlation between CO and PO	L-LOW				M-MEDIUM			S-STRONG			

Tutorial Schedule	Group Discussion, Quiz program, model preparation and Kahoot app
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
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M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PMIP02	**PRACTICAL : MEDICAL BACTERIOLOGY, MYCOLOGY AND PARASITOLOGY**	**DSC PRACTICAL - II**	**II**	**6**	**-**	**-**	**6**	**3**
Objective	To learn about the knowledge about microorganisms							

S.No.	List of Experiments / Programmes	Knowledge Levels	Sessions
1	Staining of clinical specimens - Wet mount, Differential and Special staining methods.	K2-K5	6
2	Isolation and identification of bacterial pathogens from clinical specimens - cultivation in basal, differential, enriched, selective and special media – Biochemical identification tests.	K2-K5	6
3	Enumeration of bacteria in urine to detect significant bacteriuria.	K2-K5	3
4	Antimicrobial sensitivity testing - Kirby Bauer method and Stokes method.	K2-K5	3
5	Minimum inhibitory concentration (MIC) test. Minimum bactericidal concentration (MBC) test.	K2-K5	6
6	Identification and Classification of common fungi. Mounting and staining of VAM spores.	K2-K5	6
7	Examination of different fungi by Lactophenol cotton blue staining.	K2-K5	3
8	Examination of different fungi by KOH staining.	K5	9
9	Cultivation of fungi and their identification - *Mucor, Rhizopus, Aspergillus, Penicillium.*	K1-K5	3
10	Microscopic observation of different asexual fungal spores. Microscopic observation of fungal fruiting bodies.	K1-K5	3
11	Identification of Dermatophytes. Isolation and characterization of bacteriophage from natural sources by phage titration.	K1-K4	6
12	Cultivation of viruses – Egg Inoculation methods. Diagnosis of Viral Infections –ELISA –HIA. Spotters of viral inclusions and CPE-stained smears.	K1-K4	6
13	Examination of parasites in clinical specimens - Ova/cysts in faeces.	K1-K5	3
14	Concentration methods – Floatation methods-simple Saturated salt solution method – Zinc sulphate methods - Sedimentation methods- Formal ether	K1-K5	6

	method.		
15	Blood smear examination for malarial parasites. Thin smear by Leishman's stain – Thick smear by J.B. stain.	K1-K5	3
16	Identification of common arthropods of medical importance - spotters of Anopheles, Glossina, Phlebotomus, Aedes, Ticks and mites.	K1-K5	3
Course Outcome	**CO1:** Remember the isolation and identification techniques of bacteria using various staining and cultural methods.	K1	
	CO2: Understand the knowledge about the antibacterial activities for various bacteria.	K2	
	CO3: Apply the methods to identification and growth of various fungi.	K3	
	CO4: Analyze the isolation and cultivation of viruses.	K4	
	CO5: Evaluate the various parasites in clinical samples and identification of their vectors.	K5	

Learning Resources	
Text Books	1. Dubey, R.C and Maheshwari, O.K (2005) Practical Microbiology, S Chand and Co. Ltd., (First edition), New Delhi. 2. James G. Cappuccino and Natalie Sherman (2014) Microbiology: A Laboratory Manual (10th Edition), Pearson
Reference Books	1. Kannan N (2003). Handbook of laboratory culture media, Reagents, Stains and buffers. Panima Publishing Corporation, New Delhi. 2. Cowan and Steel (1995) Manual for Identification of Medical Bacteria, 4th Edn. Cambridge University Press, London. 3. Murray, P.R., Baron, E.J., Jorgensen, J.H., P faller, M.A. and Yoke, R.H. (2003) Manual of Clinical Microbiology, 8th Edn. Vol 1&2, ASM Press, Washington, D.C.
Website Link	1. https://www.vnmkv.ac.in/student-academic/FMS-122.pdf 2. http://uomosul.edu.iq/public/files/datafolder_2912/_20191228_083834_930.pdf 3. https://books-library.net/files/books-library.online-01101408Pe0S5.pdf

M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M2PMIP02	**PRACTICAL : MEDICAL BACTERIOLOGY, MYCOLOGY AND PARASITOLOGY**	**DSC PRACTICAL - II**	**II**	**6**	**-**	**-**	**6**	**3**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	S	S	S	M	M	S	S
CO2	S	M	S	S	S	S	S	M	S	S
CO3	S	M	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW				M-MEDIUM			S-STRONG		

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Poster Presentation, Demonstration and Video presentation
Assessment Methods	Model practical and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
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M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PMIC05	**SOIL AND ENVIRONMENTAL MICROBIOLOGY**	**DSC THEORY - V**	**III**	**6**	**4**	**2**	**-**	**5**
Objective	Students acquire the knowledge about microorganisms involved in environment and agriculture							

Unit	Course Content	Knowledge Levels	Sessions
I	**Soil Microbiology** – Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of major group of microorganisms in soil. Quantification of soil microflora, role of microorganism in soil fertility. Mineralization of Organic & Inorganic matter in Soil. Biological Nitrogen fixation - symbiotic - root nodulation and non-symbiotic. Biochemistry Nitrogen fixation. Phytopathology and Disease cycle of Plant pathogens - Tikka and Citrus canker. Systemic Acquired Resistance (SAR), pathogenesis related (PR) proteins, Plantibodies, Phenolics, Phytoalexins.	K1	12
II	**Microbial Interactions -** Mutualism, Commensalism, Amensalism, Synergism, Competition, Rhizosphere- Rhizosphere effect, Mycorrhizae – Types, Endophytes, PGPR- Plant growth promoting bacteria– symbiotic (*Bradyrhizobium, Rhizobium, Frankia*), Non-Symbiotic (*Azospirillum, Azotobacter*, Mycorrhizae, MHBs, Phosphate solubilizers, algae), Novel combination of microbes as biofertilizers, PGPRs. Biofertilizers and Biocontrol agents – Types, benefits and application.	K3	12
III	**Components of Environment:** Hydrosphere, lithosphere, atmosphere, and biosphere – definitions with examples; Bio-geochemical cycles in the ecosystem- Carbon, Nitrogen, Sulfur and Phosphorous cycles. Physical factors affecting distribution of microorganisms in various environments. Safety of drinking (potable) water, methods to detect potability of water samples and sanitation. Space microbiology - Microbiological research in space environment.	K3	12
IV	**Waste management –** Solid waste - Types - management - Factors affecting solid waste generation rates. Industrial effluent treatment, primary, secondary, tertiary and advanced treatment process. Quality assessment of decontaminated matters and other biological effluents. Biological reference standards. Utilization of Solid Waste as Food, Feed and Fuel. Composting, Vermicomposting, Bio manure and Biogas production. E-Waste management.	K4	12

V	**Degradation of organic matter -** lignin, cellulose, hemicellulose, pectin, common pesticides- herbicides (2, 4-D) and pesticides (DDT), heavy metals. Biodegradation of Xenobiotics - Recalcitrant Halocarbons, Recalcitrant TNTs, PCBs and Synthetic polymers. Biodegradation of Hydrocarbons. Biodeterioration of Textiles and Leather. Pollution Control Bodies and Environmental laws in India. Environmental impact assessment and guidelines, US Environment protection Agency norms. **Current Trends- *Microbes in Sustainable Agriculture***	K5	12
	…… Self Study.		
Course Outcome	**CO1:** Remember and understand the knowledge about soil microbes, phytopathology.	K1	
	CO2: Apply the knowledge about microbial interactions, biofertilizers and biocontrol agents	K3	
	CO3: Construct the knowledge about the various components in environment	K3	
	CO4: Categorize the waste management and compost	K4	
	CO5: Evaluate the knowledge about the biodegradation process	K5	

Learning Resources	
Text Books	1. Joseph C. Daniel. (2006). Environmental aspects of Microbiology 2nd Edition. Bright Sun Publications. 2. K. Vijaya Ramesh. (2004).Environmental Microbiology. 1st Edition. MJP Publishers. 3. Subba Rao. N.S. (2017). Soil Microbiology. 4th Edition. Oxford and IBH Publishing Pvt. Ltd.
Reference Books	1. Dirk, J. Elasas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology, Marcel Dekker INC, New York, Hong Kong. 2. EcEldowney S, Hardman D.J., Waite D.J., Waite S. (1993). Pollution: Ecology and Biotreatment – Longman Scientific Technical. 3. Clescri, L.S., Greenberg, A.E. and Eaton, A.D. (1998). Standard Methods for Examination of Water and Wastewater, 20thEdition. American Public Health Association.
Website Link	1.https://nptel.ac.in/courses/126105016 2. https://www.classcentral.com/course/swayam-plant-pathology-and-soil-health-14236 3. https://www.wasteonline.org.uk/resources/InformationSheets/WasteDisposal.htm
Self-Study Material	1.https://doi.org/10.3389/fsoil.2022.821589 2. https://organicabiotech.com/microbes-in-agriculture-and-their-role-in-plant-growth-promotion/

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M3PMIC05	**SOIL AND ENVIRONMENTAL MICROBIOLOGY**	**DSC THEORY - V**	**III**	**6**	**4**	**2**	**-**	**5**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**S**	S	S	M	S	**S**
CO2	**S**	**S**	**S**	**S**	**S**	S	M	S	S	**S**
CO3	**S**	**S**	**S**	**S**	**S**	S	S	M	S	**S**
CO4	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			SS-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation	
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE	
Designed By	**Verified By**	**Approved By Member Secretary**
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M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PMIC06	**MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY**	**DSC THEORY - VI**	**III**	**6**	**4**	**2**	**-**	**5**
Objective	Students learn about the structure, replication, gene cloning strategies in plants and animals							

Unit	Course Content	Knowledge Levels	Sessions
I	**DNA replication** – Structures of DNA, replication modes and enzymes involved. Detailed mechanism of semi-conservative replication. Molecular basis of gene mutation - Types of mutations - base substitutions, frame shift, deletion insertion, duplication, inversion. Silent, conditional and lethal mutation. Chemical mutagenesis. Repair of DNA damage. Photo reactivation. SOS repair mechanism. Base excision repair. Nucleotide excision repair. Detection and analysis of mutations (Replica plating, Antibiotic enrichment, Ames test).	K2	12
II	**Gene regulation and expression** – Prokaryotic and eukaryotic transcription. Structure and processing of m-RNA, r-RNA and t-RNA. Ribosomes. Post transcriptional modifications. Genetic Code and Wobble hypothesis. Translation in prokaryotes and eukaryotes, post translational modifications. Lac operon, arabinose and tryptophan operons. Gene regulation in eukaryotic systems - repetitive DNA, gene rearrangement, promoters, enhancer elements.	K2	12
III	**Tools and methods in gene cloning.** Restriction endonucleases – nomenclature, classification and characteristics - DNA methylases, DNA polymerases, Ligases. Adapters, linkers and homopolymer tailing. Gene cloning vectors for prokaryotes and eukaryotes - cloning properties and types of plasmids vectors (pBR322 and derivatives, pUC vectors and pGEM3Z) - Phage Vectors(M13 and Lambda), cosmids, phasmids, phagemids and BACs - Eukaryotic vectors - Yeast vectors – Animal and plant vectors – expression vectors. Shuttle vectors - Expression of foreign genes in bacteria, animal and plant– merits and demerits. Artificial gene transfer techniques - electroporation, microinjection, protoplast fusion and microparticle bombardment. Screening for recombinants.	K3	12

IV	**Genomic DNA and cDNA library** - Construction and Screening. Substrative hybridization for tissue specific DNA libraries. Techniques in genetic engineering Characterization of cloned DNA: Hybrid arrested translation (HAT) - Restriction mapping - restriction fragment length polymorphism (RFLP) - Polymerase chain reaction (PCR) – Principles, types and their applications. Blotting techniques – Southern, Northern and Western blotting. DNA sequencing - Primer walking, Sanger's method and automated sequencing methods. Pyro sequencing – DNA chips and micro array. Applications of Genetic Engineering in Medicine and Agriculture.	K4	12
V	**Applications of Genetic Engineering** - Transgenic animals, Recombinant Cytokines and their use in the treatment of animal infections. Transgenic plants- *Agrobacterium* mediated transformation. Monoclonal Antibodies in Therapy- Vaccines and their Applications in Animal Infections - Human Gene Therapy - Germline and Somatic Cell Therapy - Ex-vivo Gene Therapy. In-vivo Gene Therapy. Vectors in Gene Therapy-Viral and Non-Viral Vectors. Transgenic Plants. **Current Trends-* rDNA technology to improve the life**	K5	12
	…… Self Study.		
Course Outcome	**CO1:** Recall the synthesis of bio molecules	K2	
	CO2: Summarize the gene expression, mutation and repair mechanism	K2	
	CO3: Develop the gene cloning techniques in prokaryotes and eukaryotes	K3	
	CO4: Cconstruction of gene library and gene sequencing	K4	
	CO5: Evaluate the Genetic Engineering methods in the field of agriculture and medicine towards scientific research.	K5	

Learning Resources	
Text Books	1. Snusted D.P. and Simmons M. J. (2019). Principles of Genetics. (7th Edition). John Wiley and Soms, Inc. 2. Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd. 3. Maloy S. R. Cronan J.E. Jr. and Freifelder D. (2011). Microbial Genetics. (2nd Edition). Narosa Publishing House Pvt. Ltd.
Reference Books	1. Brown T. A. (2016). Gene Cloning and DNA Analysis- An Introduction. (7th Edition). John Wiley and Sons, Ltd. 2. Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. (5th Edition). ASM Press.
Website Link	1. https://geneticeducation.co.in/what-is-transcriptomics 2. https://www.molbiotools.com/usefullinks.html 3. https://geneticeducation.co.in/what-is-transcriptomics
Self-Study Material	1. https://doi.org/10.1016/B978-0-323-91595-3.00003-3 2. https://doi.org/10.3389/fsoil.2022.821589

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M3PMIC06	**MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY**	**DSC THEORY - VI**	**III**	**6**	**4**	**2**	**-**	**5**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**S**	S	S	M	S	**S**
CO2	**S**	**S**	**S**	**S**	**S**	S	M	S	S	**S**
CO3	**S**	**S**	**S**	**S**	**S**	S	S	M	S	**S**
CO4	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			SS-STRONG	

Tutorial Schedule	-	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation	
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE	
Designed By	**Verified By**	**Approved By Member Secretary**
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M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PMIC07	**FERMENTATION TECHNOLOGY AND PHARMACEUTICAL MICROBIOLOGY**	**DSC THEORY - VII**	**III**	**6**	**4**	**2**	**-**	**5**
Objective	Students acquire the knowledge about fermenter, fermentation process and production of various pharmaceutical products and quality control techniques.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction to fermentation** – the range of fermentation process. The chronological development of the fermentation industry. Types of fermentation - Batch, continuous, dual or multiple, surface, submerged, aerobic and anaerobic. Fermenter – Design, types and construction, Instrumentation and control. Industrially important microorganisms – Isolation, primary and secondary screening, preservation and improvement of industrially important strains.	K2	12
II	**Upstream processing** - Development of inoculums for fermentation process. Media for industrial fermentation - Formulation, optimization. Sterilization. Stages of upstream - Growth of inoculums, fermenter pre culture and production fermentation. Productivity. Yield coefficients. Heat production. Aeration and agitation. Gas exchange and mass transfer. Computer Applications in fermentation technology.	K3	10
III	**Downstream Processing** - Recovery and purification of intracellular and extracellular products. Biomass separation by centrifugation, filtration, flocculation and other recent developments. Cell disintegration - Physical, chemical and enzymatic methods. Extraction - Solvent, two phase, liquid extraction, whole broth, aqueous multiphase extraction. Purification by different methods. Concentration by precipitation, ultra-filtration, reverse osmosis. Drying and crystallization.	K4	12
IV	**Overview of pharmaceutical microbiology** - Ecology of microorganisms - Atmosphere, water, skin, respiratory flora of workers, raw materials, packaging, building equipment and their control measures. Design and layout of sterile manufacturing unit. Contamination and Spoilage of Pharmaceutical products - sterile injectable and non-injectable, ophthalmologic preparation, implants.	K4	12

V	**Production of pharmaceutical products and quality assurance** – Vaccines, immunodiagnostics, immune-sera, immunoglobulin. Antibiotics - Penicillin, Griseofulvin, Metronidazole. Enzymes - Streptokinase, Streptodornase. **Quality assurance and quality management in pharmaceuticals** – In-Process, Final-Product Control and sterility tests. Regulatory aspects - BIS (IS), ISI, ISO, WHO and US certification. **Current Trends-* Vaccines development in India***	K5	12
	…… Self Study.		
Course Outcome	**CO1:** Illustrate about fermentation and its types, sensitize on methods of strain development for improved yield.	K2	
	CO2: Apply the knowledge on the fermenter design and types	K3	
	CO3: Analyze the effective recovery and purification of the products	K4	
	CO4: List out the importance of pharmaceutical microbiology.	K4	
	CO5: Appraise the methods for the production of pharmaceutical products	K5	

Learning Resources	
Text Books	1. Chand Pasha Kedernath. (2021). Text book of Pharmaceutical Microbiology. Ramnath Publisher. 2. Priyatama Powar, Shital Nimbargi, Vaijayanti Sapre (2020). Pharmaceutical Microbiology, 1st edition, Technical publication. 3. Byong H. Lee (2021). Advanced Fermentation And Cell Technology. 1st edition. John Wiley & Sons Ltd.
Reference Books	1. Handa, S.S. and Kapoor, V.K. (2022) Pharamcognosy. 4th Edition. Vallabh Prakashan Publishers, New Delhi. 2. Kokate, C.K., Durohit, A.P. and Gokhale, S.R., (2002). Pharmacognosy. 12thedition Nirali Prakasham Publishers, Pune. 3. Reginald Franco (2022) Principles of Fermentation Technology. Kaufman Press (CBC).
Website Link	1. https://ib.bioninja.com.au/options/untitled/b1-microbiology%20organisms/fermenters.html 2. https://www.acs.org/content/acs/en/education/whatischemistry/landmarks/penicilli%20n.html 3.https://www.usp.org/sites/default/files/usp/document/harmonization/genmethod/q05b_pf_ira_34_6_2008.pdf
Self-Study Material	1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10435768/ 2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7560117/

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M3PMIC07	**FERMENTATION TECHNOLOGY AND PHARMACEUTICAL MICROBIOLOGY**		**DSC THEORY - VII**	**III**	**6**	**4**	**2**	**-**	**5**	
CO-PO Mapping										
CO Number	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	S	S	S	S	S	S	M	S	M	S
CO2	S	M	M	S	S	S	M	S	M	S
CO3	S	S	S	S	M	S	S	S	S	S
CO4	S	M	M	M	M	S	S	M	S	S
CO5	S	S	S	S	S	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW			M-MEDIUM			S-STRONG			
Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app									
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation									
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE									
Designed By	**Verified By**					**Approved By Member Secretary**				
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M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PMIP03	**PRACTICALS : SOIL, ENVIRONMENTAL MICROBIOLOGY AND RECOMBINANT DNA TECHNOLOGY**	**DSC PRACTICAL - III**	**III**	**6**	**-**	**-**	**6**	**3**
Objective	Students learn about the microbial screening in environment and various water quality analysis							

S.No.	Course Content	Knowledge Levels	Sessions
1	Detection of Antibiotic resistant mutants by gradient plate method	K3	3
2	Identification of auxotrophic mutants by replica plating method	K3	3
3	Amplification of DNA by PCR Western blotting - Demonstration Southern blotting – Demonstration	K2	3
4	Physical, chemical and Microbiological analysis of water Physical analysis - Color, pH, TDS Chemical analysis - alkalinity, acidity, DO, BOD, COD Microbiological analysis- A) Total Heterotrophic Count B) Test for indicator organisms 1) MPN 2) Membrane Filtration	K4	9
5	Enumeration of bacteria and fungi from air – Air sampler	K4	3
6	Isolation of free-living nitrogen fixers from soil and *Rhizobium* from root nodules of leguminous plants.	K5	6
7	R:S ratio of soil microbes	K5	3
8	Isolation and enumeration of phosphate-solubilizing bacteria from soil	K5	3
9	Isolation of VAM fungi from soil	K3	3
10	Preparation of Biofertilizers and testing the efficiency of prepared biofertilizers	K4	3
11	Estimation of soil enzymes- urease and phosphatase	K3	6
12	Isolation of cellulose degrading bacteria	K3	6

13	Visual examination, observation, and identification of some common plant infections.	K3	3
14	Isolation of plant pathogen – *Alternaria and Curvularia sps.*	K3	3
15	Collection of 5 herbarium specimens of infected leaves.	K4	3
16	Study of phylloplane microflora by leaf impression method	K4	3
17	Preparation of a vermicompost	K4	3
18	Cultivation of edible mushroom from solid waste	K5	6
19	Cultivation of Azolla	K5	6
Course Outcome	**CO1:** Identify the biomolecules and mutants by blotting techniques and transformation	K3	
	CO2: Examine the soil microorganisms in agricultural aspects	K4	
	CO3: Analyze the methods to isolate the microorganisms from soil and air sample.	K4	
	CO4: Evaluate the physical, chemical and microbiological analysis of water and their quality	K5	
	CO5: Estimate the value of biofertilizer, vermicompost, mushroom and Azolla production	K5	
Learning Resources			
Text Books	1. Gunasekaran P. (2007). Laboratory Manual in Microbiology. New Age International. 2. James G Cappucino and Natalie Sherman. (2016). Microbiology – A laboratory manual. (5th Edition). The Benjamin publishing company. New York. 3. Hurst, C.J., Crawford R.L., Garland J.L., Lipson D.A., Mills A.L. and Stetzen bach L.D. (2007). Manual of Environmental Microbiology. (3rd Edition). American Society for Microbiology.		
Reference Books	1. Yates M.V., Nakatsu C.H., Miller R.V. and Pillai, S.D. (2016). Manual of Environmental Microbiology. (4th Edition). Wiley. 2. Brown T.A. (2016). Gene Cloning and DNA Analysis. (7th Edition). John Wiley and Jones, Ltd. 3. Dale J. W., Schantz M. V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd. 4. Pepper I., Gerba C. and Brendecke J. (2004). Environmental Microbiology - A Laboratory Manual. (2nd Edition). Academic Press, Elsevier.		
Website Link	1.https://www.molbiotools.com/usefullinks.html 2.https://geneticgenie.org3 3. https://currentprotocols.onlinelibrary.wiley.com/doi/pdf/10.1002/cpet.5 4. https://vlab.amrita.edu/index.php?sub=3&brch=272		

M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PMIP03	**PRACTICALS : SOIL, ENVIRONMENTAL MICROBIOLOGY AND RECOMBINANT DNA TECHNOLOGY**	**DSC PRACTICAL - III**	**III**	**6**	**-**	**-**	**6**	**3**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Poster Presentation, Demonstration and Video presentation
Assessment Methods	Model practical and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
Mrs.N.Sathyabama	Dr.M.Selvan	Dr.S.Shahitha

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M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4PMIC08	**FOOD AND DAIRY MICROBIOLOGY**	**DSC THEORY - VIII**	**IV**	**7**	**5**	**2**	**-**	**5**
Objective	Students learn about food spoilage causing microbes and their ill effect on humans and to know about fermented food production and quality control techniques							

Unit	Course Content	Knowledge Levels	Sessions
I	**Microorganisms of food** - Scope of food Microbiology. Contamination and spoilage of food – vegetables, fruits, poultry, fish, eggs, meat, meat products and canned foods. Food Preservation - Temperature (low and high), drying, radiation and chemicals	K3	12
II	**Food microbiology and public health.** Food hazards. Food infections - *Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonella, Shigella, Yersinia enterocolitica, Listeria monocytogenes* and *Campylobacter jejuni* and *Clostridium botulinum* Nonbacterial food borne illness - Helminthes, nematodes, protozoa, Mycotoxin - aflatoxin and food borne virus. Impact of chemicals used in artificial ripening of fruits	K3	10
III	**Quality assurance of food** - International aspects of Quality and safety assessment of foods. Microbiological quality standards for food. Government regulatory practices and policies - FDA, HACCP, BIS (IS), FSSAI-2014. Food adulteration and common food additives.	K4	12
IV	**Introduction to Dairy microbiology** – Milk production and hygiene. Microorganisms associated with milk. Microbial metabolites and their role in spoilages- souring, curdling, gassiness, ropiness, proteolysis, and lipolysis, abnormal flavour and colour. Antimicrobial systems in raw milk. Microbiological grading of raw milk. Milk borne diseases and their control. Bacteriological aspects of milk processing – Thermization, pasteurization, boiling, sterilization, UHT, bactofugation and membrane filtration.	K5	12
V	**Composition and chemistry of cream**, butter, ghee, ice cream, cheese, kefir, koumiss, rennin, condensed and dried milks, infant food. Spoilage of ghee and use of antioxidants. Chemistry of milk fermentation. Chemistry of rennin coagulation of milk and changes occurring during ripening of cheese, physic - chemical changes in the manufacture and storage of milk powder, lactose, crystallization and its significance. Dairy plant hygiene and sanitation. Disposal of dairy waste. Microbiological standards for Milk and Milk	K5	12

	products- PFA BIS, Codex/ ISO standards. **Current Trends-* The Hidden Dangers of Fast and Processed Food***		
	…… Self Study.		
Course Outcome	**CO1:** Identify the microorganisms involved in food spoilage.	K3	
	CO2: Discriminate the bacterial and nonbacterial food borne infections important in public health.	K4	
	CO3: Survey the various national and international aspects of food safety and quality assurance	K4	
	CO4: Appraise on microbiology of milk, preservation techniques and production of dairy products.	K5	
	CO5: Defend on Dairy plant hygiene, quality control and waste disposal.	K5	

Learning Resources	
Text Books	1. Aneja K.R (2022) Modern Food Microbiology. 1st edition, Med tech Scientific International. 2. Adams M.R, Moss M.O (2022). Food Microbiology, 2nd edition, New Age International Publishers.
Reference Books	1. Omar A. Oyarza bal, Steffen Backert, (2016). Microbial Food Safety: An Introduction, Springer 2. Dongyou Liu (2021). 1st edition, CRC Press.
Website Link	1. https://www.onlinebiologynotes.com/detection-of-microorganisms-in-foods-methods-and-techniques/ 2. https://www.rapidmicrobiology.com/test-method/separation-and-concentration-of-microorganisms-from-food-matrices 3. https://www.youtube.com/watch?v=8WIvSjFngWs
Self-Study Material	1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6146358/ 2. https://www.researchgate.net/publication/285169531_Fast_foods_and_their_impact_on_health

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M4PMIC08	**FOOD AND DAIRY MICROBIOLOGY**	**DSC THEORY - VIII**	**IV**	**7**	**5**	**2**	**-**	**5**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	M	S	M	S
CO2	S	M	M	S	S	S	M	S	M	S
CO3	S	S	S	S	M	S	S	S	S	S
CO4	S	S	S	M	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
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M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4PMIC09	**RESEARCH METHODOLOGY AND BIOSTATISTICS**	**DSC THEORY - IX**	**IV**	**7**	**5**	**2**	**-**	**5**
Objective	Students learn the knowledge about scientific research, enabling contributions to biomedical research.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction to Research Methodology** - Meaning and importance. Statement, Constraints. Review of literature - Review and synopsis presentation. Types of research, Research tools. Methods and techniques of data collection - types of data, methods of primary data collection (observation/ experimentation/ questionnaire/ interviewing/ case/pilot study, methods), methods of secondary data collection.	K1	13
II	**Sampling and sampling distributions**. Sampling frame, importance of probability sampling, sampling - simple random, systematic, stratified random and cluster. Variables - nominal, ordinal, discontinuous, continuous, derived. Research process, designs and Report writing - types of research reports, guidelines for writing an article and report, report format, appendices, Ethical issues related to publishing, Plagiarism, and Self-Plagiarism.	K2	13
III	**Introduction to Biostatistics** - Basic concepts, Measurement and measurement scales, Sampling and data collection, Data presentation. Measures of central tendency: Mean, Median, Mode. Measures of variability - Standard deviation, standard error, range, mean deviation and coefficient of variation. Frequency table of single discrete variable, bubble spot, computation of mean, variance and standard Deviations, t test, correlation coefficient.	K3	13
IV	**Correlation and regression** - Positive, negative, calculation of Karl- Pearsons co-efficient of correlation. Linear regression and multiple linear regression, ANOVA, one and two way classification. Calculation of an unknown variable using regression equation. Tests of significance - Tests of significance: Small sample test (Chi-square t test, F test), large sample test (Z test) and standard error.	K4	13
V	**Probability and distributions** - Introduction to probability theory and distributions, (concept without deviation) binomial, poison and normal (only definitions and problems). Computer oriented statistical techniques. SPSS,	K4	13

	RSM: methods for process optimization set up CCD, Box Behnken, optimal RSM design, regression models FDS curves, surface contours, multi linear constraints and categoric factors to optimal design. **Current Trends-* Bioinformatics***		
	…… Self Study.		
Course Outcome	**CO1:** List out the methods for data collection and research tools	K1	
	CO2: Summarize about the sampling, variables and report writing	K2	
	CO3: Experiment the basic concepts in statistics	K3	
	CO4: Analyze the statistical calculations	K4	
	CO5: Survey the knowledge probability theories	K4	

Learning Resources	
Text Books	1. Sharma K. R. (2002) Research methodology. National Publishing House, New Delhi. 2. Daniel W.W. (2005). Biostatistics; A foundation for analysis in the health sciences. (7th Edition). Jhon Wiley & sons Inc, New York. 3. Ahuja V.K. (2017) Laws Relating to Intellectual Property Rights. Lexis Nexis.
Reference Books	1. Anderson J.B. and Poole M. (2011). Assignment and Thesis Writing. 4th edn. Wiley India Private Limited. 2. Adams K. A. and Lawrence E. M. K. (2014). Research Methods, Statistics, and Applications. SAGE Publications, Inc., New Delhi. 3. Zar J. H. (2006). Biostatistical Analysis. (4th Edition). Pearson Education Inc. New Jersey.
Website Link	1. https://onlinecourses.swayam2.ac.in/aic22_ge21/preview? 2.https://www.studocu.com/en-ca/document/mount-royal-university/quantitative-research-methods-and-data-analysis/lecture-notes-all-lectures/344093 3. https://onlinecourses.swayam2.ac.in/aic21_ge02/preview
Self-Study Material	1. https://ebookcentral.proquest.com/lib/inflibnet-ebooks/reader.action?docID=5121181 2. https://ebookcentral.proquest.com/lib/inflibnet-ebooks/reader.action?docID=3137905

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4PMIC09	**RESEARCH METHODOLOGY AND BIOSTATISTICS**	**DSC THEORY - IX**	**IV**	**7**	**5**	**2**	**-**	**5**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	M	M	S	M	S
CO2	S	S	S	S	S	M	M	S	M	M
CO3	S	S	S	S	S	M	M	S	M	S
CO4	S	S	S	S	S	M	M	S	M	M
CO5	S	S	S	S	S	M	M	S	M	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
Dr.M.Sankareswaran	Dr.M.Selvan	Dr.S.Shahitha

List of Elective Course (DSE) Details for M.Sc., Microbiology
SYLLABUS - LOCF-CBCS Pattern
EFFECTIVE FROM THE ACADEMIC YEAR 2023-2024 Onwards

S. No.	SEM	COURSE_CODE	TITLE OF THE COURSE
1	I	23M1PMIE01	FORENSIC SCIENCE
2	I	23M1PMIE02	HEALTH HYGIENE
3	I	23M1PMIE03	MICROALGAL TECHNOLOGY
4	I	23M1PMIE04	BIOINSTRUMENTATION
5	I	23M1PMIE05	HERBAL TECHNOLOGY AND COSMETIC MICROBIOLOGY
6	I	23M1PMIE06	ESSENTIALS OF LABORATORY MANAGEMENT AND BIOSAFETY
7	II	23M2PMIE07	EPIDEMIOLOGY
8	II	23M2PMIE08	CLINICAL DIAGNOSTIC MICROBIOLOGY
9	II	23M2PMIE09	BIOREMEDIATION
10	II	23M2PMIE10	BIOINFORMATICS
11	II	23M2PMIE11	NANOBIOTECHNOLOGY
12	II	23M2PMIE12	CLINICAL RESEARCH AND CLINICAL TRIALS
13	III	23M3PMIE13	BIOSAFETY, BIOETHICS AND IPR
14	III	23M3PMIE14	TOXINOLOGY
15	III	23M3PMIE15	WATER CONSERVATION AND WATER TREATMENT TECHNOLOGIES
16	IV	23M4PMIE16	BIOENERGY
17	IV	23M4PMIE17	MARINE MICROBIOLOGY
18	IV	23M4PMIE18	MICROBIOLOGY FOR COMPETITIVE EXAMINATIONS

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M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PMIE01	**FORENSIC SCIENCE**	**DSE - I**	**I**	**6**	**6**	**-**	**-**	**3**

Objective	To Understand the Scope, need and learn the tools and techniques in forensic science.

Unit	Course Content	Knowledge Levels	Sessions
I	**Forensic Science** - Definition, history and development of forensic science. Scope and need of forensic science in present scenario. Branches of forensic science. Tools and techniques of forensic science. Duties of a forensic scientist.	K1-K2	15
II	**Forensic science laboratories** - Organizational setup of a forensic science laboratory. Central and State level laboratories in India. Mobile forensic science laboratory and its functions. Forensic microbiology - Types and identification of microbial organisms of forensic significance.	K1-K2	15
III	**Forensic serology** - Definition, identification and examination of body fluids - Blood, semen, saliva, sweat and urine. Forensic examination and identification of hair and fibre.	K1-K3	15
IV	**DNA profiling** - Introduction, history of DNA typing. Extraction of DNA from blood samples - Organic and Inorganic extraction methods. DNA fingerprinting - RFLP, PCR, STR. DNA testing in disputed paternity.	K1-K4	15
V	**Forensic toxicology** - Introduction and concept of forensic toxicology. Medico legal post mortem and their examination. Poisons - Types of poisons and their mode of action.	K1-K4	15
Course Outcome	**CO1:** Remember the scope and need of forensic science in the present scenario.	K1	
	CO2: Understand about the functioning of forensic science laboratories.	K2	
	CO3: Apply the methods for biological samples in Forensic science.	K3	
	CO4: Analyze the extraction and identification of DNA obtained from body fluids.	K4	
	CO5: Conclude the concept of forensic toxicology.	K4	
Learning Resources			

Text Books	1. Nanda B. B. and Tewari R. K. (2001) Forensic Science in India: A Vision for the Twenty First Century. Select Publishers, New Delhi. ISBN- 10:8190113526 / ISBN-13:9788190113526. 2. Li R. (2015) Forensic Biology. (2nd Edition). CRC Press, New York. ISBN-13:978-1-4398-8972-5. 3. Sharma B.R (2020) Forensic science in criminal investigation and trials. (6th Edition) Universal Press.
Reference Books	1. Saferstein R. and Hall A. B. (2020). Forensic Science Hand book, Vol. I, (3rd Edition). CRC Press, New York. ISBN-10:1498720196. 2. Val McDermid (2014). Forensics. (2nd Edition). ISBN 9780802125156. 3. Vincent J. DiMaio., Dominick DiMaio. (2001). Forensic Pathology (2nd Edition). CRC Press.
Website Link	1. http://clsjournal.ascls.org/content/25/2/114 2. https://www.elsevier.com/books/microbial-forensics/budowle/978-0-12-382006-8 3. https://cisac.fsi.stanford.edu/events/microbial forensics

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M1PMIE01	**FORENSIC SCIENCE**	**DSE - I**	**I**	**6**	**6**	**-**	**-**	**3**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	M	S	S	S	S	M	M	S	S
CO2	M	M	S	S	M	S	M	M	S	S
CO3	L	M	S	S	S	S	M	M	S	S
CO4	M	M	S	S	S	S	M	M	S	S
CO5	M	M	S	S	S	S	S	M	S	S
Level of Correlation between CO and PO	L-LOW				M-MEDIUM				S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, model preparation and Kahoot app
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, Poster Presentation, Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
Mr.N.Radhakrishnan	Dr.M.Selvan	Dr.S.Shahitha

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M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PMIE02	**HEALTH HYGIENE**	**DSE THEORY-II**	**I**	**6**	**6**	**-**	**-**	**3**

Objective	Student learn about the health and hygiene in life		
Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Introduction to hygiene and healthful live**. Factors affecting health, health habits and practices. Recognizing positive & negative practices in the community. Scientific principles related to health.	K1	12
II	**Nutrition and Health** – Balanced diet, Food surveillance, food Fortification, adulteration and preventive measures. Health laws for food safety. Environmental and housing hygiene. Ventilation and lighting.	K2	13
III	**Physical health, physical exercises and their importance** – Walking, jogging, yoga and meditation, stress relief. International control of health, WHO. Personal hygiene, Sun bathing, Colon Hygiene. Health destroying habits and addictions - Pan, Supari, ganja, drinking, smoking, tea and coffee.	K3	14
IV	**Mental hygiene** - factors responsible, developmental tasks, basic needs, emotional stability. Mental hygiene and health in infancy, early childhood, adolescence, adulthood and old age. Mental health occupational hazards.	K4	13
V	**Health programme and health education** – Malaria control, Tuberculosis control, AIDS control programmes and Immunization Programmes. Family planning, Reproductive and Child health programmes (RCH). **Current Trends- * Professional cleaning and hygiene in the healthcare industry***	K5	14
	…… Self Study.		
Course Outcome	**CO1:** Recall the factors affecting health and health habits.	K1	
	CO2: Show the importance of nutrition in health	K2	
	CO3: Develop the method of physical exercises to maintain the health	K3	
	CO4: Test for the Mental hygiene and maintain emotional stability.	K4	
	CO5: Compare the various health education programmes	K5	
Learning Resources			
Text Books	1. Bamji M. S., Krishnaswamy K. and Brahmam G. N. V. (2019). Textbook of Human Nutrition.(4th Edition). Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi 2. Paniker J. C. K. and Ananthanarayan R. (2017). Textbook of Microbiology. (10th Edition). Universities Press (India) Pvt. Ltd		

Reference Books	1. Srilakshmi, B. (2010) Food Science, (5th Edition) New Age International Ltd., New Delhi. 2. Park K. 2007, Park's text book of Preventive and Social Medicine, Banarsidas Bhanot publishers, India.			
Website Link	1. Health and Hygiene - Personal Hygiene, Community Hygiene and Diseases (vedantu.com) 2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=112325 3. https://nap.nationalacademies.org/read/11756/chapter/13			
Self-Study Material	1. https://www.aise.eu/our-industry/professional-cleaning-hygiene.aspx			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PMIE02	**HEALTH HYGIENE**		**DSE THEORY-II**		**I**	**6**	**6**	**-**	**-**	**3**
CO-PO Mapping										
CO Number	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	S	S	S	S	S	S	M	S	M	S
CO2	S	M	M	S	S	S	M	S	M	S
CO3	S	S	M	S	S	S	M	S	M	S
CO4	S	S	S	M	S	S	M	S	M	S
CO5	S	S	S	S	S	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW			M-MEDIUM			S-STRONG			

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
Dr.M.Selvan	Dr.M.Selvan	Dr.S.Shahitha

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M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PMIE03	**MICROALGAL TECHNOLOGY**	**DSE THEORY - III**	**I**	**6**	**6**	**-**	**-**	**3**
Objective	Students learn the knowledge of various applications of microalage							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction to Algae** - General characteristics. Classification of algae according to Fritsch. Salient features of different groups of algae. Distribution - Freshwater, brackish water and marine algae. Identification methods. An overview of applied Phycology. Economically important microalgae.	K1	13
II	**Cultivation of freshwater and marine microalgae** - Growth media. Isolation and enumeration of microalgae. Laboratory cultivation and maintenance. Outdoor cultivation - Photobioreactors - construction, types and operation; raceway ponds - Heterotrophic and mixotrophic cultivation - Harvesting of microalgae biomass.	K3	13
III	**Microalgae in food and nutraceutical applications** - Algal single cell proteins. Cultivation of *Spirulina* and *Dunaliella.* Microalgae as aquatic, poultry and cattle feed. Microalgal biofertilizers. Value-added products from microalgae. Pigments - Production of microalgal carotenoids and their uses. Phycobili proteins - production and commercial applications. Polyunsaturated fatty acids as active nutraceuticals. Microalgal secondary metabolites - Pharmaceutical and cosmetic applications.	K3	14
IV	**Microalgae in environmental applications**. Phycoremediation - Domestic and industrial waste water treatment. High-rate algal ponds and surface-immobilized systems - Treatment of gaseous wastes by microalgae. Sequestration of carbon dioxide. Scavenging of heavy metals by microalgae. Negative effects	K4	14
V	**Microalgae as feed stock for production of biofuels** - Carbon-neutral fuels. Lipid-rich algal strains - Botryococcus braunii. Drop-in fuels from algae - hydrocarbons and biodiesel, bioethanol, biomethane, biohydrogen and syngas from microalgae biomass. Biocrude synthesis from microalgae. Integrated biorefinery concept. Life cycle analysis of algae biofuels. **Current Trends-*Microalgal Biorefinery Technologies ***	K5	14
	…… Self Study.		

Course Outcome	**CO1:** Classify the microalgae in different environment	K2
	CO2: Choose the methods of algal cultivation and harvesting.	K3
	CO3: Develop and recommend the use of microalgae as food, feed and fodder.	K3
	CO4: List out the microalgae in phycoremediation.	K4
	CO5: Evaluate the biomass energy using microalgae	K5

Learning Resources	
Text Books	1. Shekh A., Schenk P., Sarada R. (2021). Microalgal Biotechnology. Recent Advances, Market Potential and Sustainability. Royal Society of Chemistry. 2. Sharma O.P. (2011). Algae. Tata McGraw-Hill Education. 3. Lele. S.S., Jyothi Kishen Kumar (2008). Algal bio process technology. New Age International P (Ltd)
Reference Books	1. Bux F. and Chisti Y. (2016). Algae Biotechnology: Products and Processes. Springer. 2. Singh B., Bauddh K., Bux, F. (2015). Algae and Environmental Sustainability. Springer.
Website Link	1. https://www.classcentral.com/course/algae-10442 2. https://freevideolectures.com/course/4678/nptel-industrial-biotechnology/46 3. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microalgae
Self-Study Material	1. https://www.mdpi.com/2311-5637/9/3/202 2. https://nptel.ac.in/courses/103103207

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M1PMIE03	**MICROALGAL TECHNOLOGY**	**DSE THEORY - III**	**I**	**6**	**4**	**2**	**-**	**3**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	M	S	M	S
CO2	S	M	M	S	S	S	M	S	M	S
CO3	S	S	M	S	S	S	M	S	M	S
CO4	S	S	S	M	S	S	M	S	M	S
CO5	S	S	S	S	S	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
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Rasipuram - 637408.

M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PMIE04	**BIOINSTRUMENTATION**	**DSE - II**	**I**	**6**	**6**	**-**	**-**	**3**
Objective	To explain the principles and working mechanisms of laboratory instruments							

Unit	Course Content	Knowledge Levels	Sessions
I	**Basic laboratory Instruments**. Aerobic and anaerobic incubator – Biosafety Cabinets - Fume Hood, pH meter, Lyophilizer, Flow cytometry. Centrifugation techniques: Basic principles of centrifugation - Standard sedimentation coefficient - measurement of sedimentation co-efficient; Principles, methodology and applications of differential, rate zonal and density gradient centrifugation - Applications in determination of molecular weight.	K1-K2	15
II	**General principles of chromatography** - Chromatographic Performance parameters; Types- Thin layer chromatography, Paper Chromatography, Liquid chromatography (LPLC &HPLC), Adsorption, ion exchange, Gel filtration, affinity, Gas liquid (GLC). Flash Chromatography and Ultra Performance convergence chromatography. Two dimensional chromatography. Stimulated moving bed chromatography (SEC).	K1-K2	15
III	**Electrophoresis:** General principles - moving boundary electrophoresis - electrophoretic mobility – supportive materials – electro endosmosis – types (horizontal, vertical and two dimensional electrophoresis) - Principle and applications - paper electrophoresis, Serum electrophoresis, starch gel electrophoresis, Disc gel, Agarose gel, SDS – PAGE, Immuno electrophoresis. Blotting techniques -Southern, northern and western blotting.	K1-K3	15
IV	**Spectroscopic techniques:** Principle, simple theory of absorption of light by molecules, electromagnetic spectrum, instrumentation and application of UV- visible, Raman, FTIR spectrophotometer, spectrofluorimetry, Atomic Absorption Spectrophotometer, Flame spectrophotometer, NMR, ESR, Emission Flame Photometry and GC-MS. Detection of molecules in living cells - FISH and GISH. Biophysical methods: Analysis of biomolecules by Spectroscopy UV/visible.	K1-K4	15
V	**Radioisotopic techniques:** Principle and applications of tracer techniques in biology. Radioactive isotopes - radioactive decay; Detection and measurement of radioactivity using ionization chamber,	K1-K3	15

	proportional chamber, Geiger - Muller and Scintillation counters, auto radiography and its applications. Commonly used isotopes in biology, labelling procedures and safety aspects.		
Course Outcome	**CO1:** Remember the knowledge about the use of the laboratory basic instruments.	K1	
	CO2: Understand the knowledge about chromatography techniques in the separation of biomolecules.	K2	
	CO3: Apply the electrophoresis techniques for biomolecules.	K3	
	CO4: Analyze the biomolecules using spectroscopic techniques.	K4	
	CO5: List out the radioisotopes and its applications.	K4	

Learning Resources	
Text Books	1. Sharma B. K. (2014). Instrumental Method of Chemical Analysis. Krishna Prakashan Media (P) Ltd. 2. Mitchell G. H. (2017). Gel Electrophoresis: Types, Applications and Research. Nova Science Publishers Inc.
Reference Books	1. Skoog A. and West M. (2014). Principles of Instrumental Analysis. (14th Edition). B. Saunders Co., Philadephia. 2. Pavia D. L. (2012) Spectroscopy (4th Edition). Cengage. 3. Madigan MT, Martinko JM & Parker J (2000) Brock's Biology of Microorganisms, 9th edn. Englewood Cliffs, NJ: Prentice Hall. 4. Ponmurugan P. and Gangathara P. B. (2012). Biotechniques. (1st Edition). MJP Publishers.
Website Link	1.https://norcaloa.com/BMIA 2. https://www.watelectrical.com/biosensors-types-its-working-and-applications. 3.http://www.wikiscales.com/articles/electronic-analytical-balance/

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**			**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PMIE04	**BIOINSTRUMENTATION**			**DSE - II**	**I**	**6**	**6**	**-**	**-**	**3**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	M	S	M	L	L	M
CO2	S	M	S	S	S	S	M	M	M	M
CO3	S	M	S	S	S	S	M	M	L	M
CO4	S	M	S	S	S	S	M	M	M	S
CO5	S	M	S	M	M	S	M	M	M	S
Level of Correlation between CO and PO	L-LOW				M-MEDIUM			S-STRONG		

Tutorial Schedule	Group Discussion, Quiz program, model preparation and Kahoot app
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, Poster Presentation, Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
Mrs.S.Subana	Dr.M.Selvan	Dr.S.Shahitha

M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PMIE05	**HERBAL TECHNOLOGY AND COSMETIC MICROBIOLOGY**	**DSE THEORY - V**	**I**	**6**	**6**	**-**	**-**	**3**

Objective	Students learn about the Indian medicinal plants and their applications in microbiology.		
Unit	**Details**	**Knowledge Levels**	**Sessions**
I	**Herbal medicine – Indian medicinal plants:** Scope and Applications of Indian medicinal plants in treating bacterial, Fungal and viral diseases. Basic principles in volvedin Ayurvedha, Sidha, Unani and Homeopathy.	K1	10
II	**Collection and authentication of selected Indian medicinal plants:** *Emblica officinalis, Withania somnifera, Phyllanthus amarus, Tinospora cordifolia, Andrographis paniculata, Piper longum, Ocimum sanctum, Azardirchata indica, Terminalia chebula, Alliumsativum*. Preparation of extracts-Hot and cold methods. Preparation of stock solutions.	K3	14
III	**Antimicrobial activity of selected Indian medicinal Plants:** In vitro determination of antibacterial and fungal activity of selected whole medicinal plants / parts – well-diffusion methods. MIC - Macro and micro dilution techniques. Antiviral activity – celllines - cytotoxicity, cytopathic and non – cytopathic effect.	K4	14
IV	**History of Cosmetic Microbiology** – Need for cosmetic microbiology, Scope of cosmetic microbiology - Role of microbes in cosmetic preparation. Preservation of cosmetics. Antimicrobial properties of natural cosmetic products – Garlic, neem, turmeric, aloevera and tulsi. Sanitary practices in cosmetic manufacturing-HACCP protocols in cosmetic microbiology.	K4	14
V	**Cosmetic microbiology test methods** - Antimicrobial preservative efficacy, microbial content testing and biological toxicological testing. Validation methods – bioburden and Pharmacopeial microbial assays. Preservatives of cosmetics-Global regulatory and Toxicological aspect of cosmetic preservatives. **Current trends-* Role of Herbal Cosmetic Technology***	K5	14
	…… Self Study.		
Course Outcome	**CO1:** Find out the applications of Indian medicinal plants in Treating diseases.	K1	
	CO2: Identification and authentication of herbal plants	K3	
	CO3: Analyze the antimicrobial activity of medicinal plants.	K4	
	CO4: Evaluate the role of microorganisms and their metabolites in the	K4	

	preparation of cosmetics.		
	CO5: Assess the procedures and biosafety measures in the mass Production of cosmetics.	K5	

Learning Resources	
Text Books	1. Panda H. (2004). Hand book on herbal medicines. Asia Pacific Business Press Inc. ISBN: 8178330911. 2. Ayurvedic Formulary of India. (2011). Part1, 2 & 3. Pharmacopoeia Commission for Indian Medicine and Homeopathy. ISBN-10:8190648977. 3. Geis P.A. (2020). Cosmetic microbiology: A Practical Approach. (3rdEdition). CRC Press. ISBN: 9780429113697.
Reference Books	1. Cupp M.J. (2010).Toxicology and Clinical Pharmacology of Herbal Products (pp.85-93) .M.J. Cupp. Humana Press. Totowa, NJ, USA. ISBN-10:1617371904. 2. TurnerR. (2013). Screening methods in Pharmacology. Elsevier. ISBN: 9781483264233.
Website Link	1.https://www.academia.edu/50236711/Modern_Extraction_Methods_for_Preparation_of_Bioactive_Plant_Extracts. 2. https://www.fda.gov/cosmetics/potential-contaminants-cosmetics/microbiological-safety- and -cosmetics.
Self-Study Material	1. https://nopr.niscpr.res.in/bitstream/123456789/8116/1/NPR%204%284%29%20306-314.pdf

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M1PMIE05	**HERBAL TECHNOLOGY AND COSMETIC MICROBIOLOGY**	**DSE THEORY - V**	**I**	**6**	**6**	**-**	**-**	**3**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	S	S	S	M	S	M	S
CO2	S	S	M	S	S	S	M	S	S	S
CO3	M	S	S	S	S	S	S	S	M	S
CO4	S	S	M	S	M	S	M	S	M	S
CO5	S	S	S	S	M	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW			M-MEDIUM			S-STRONG			

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
Mrs.N.Sathyabama	Dr.M.Selvan	Dr.S.Shahitha

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE
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Rasipuram - 637408.

M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PMIE06	**ESSENTIALS OF LABORATORY MANAGEMENT AND BIOSAFETY**	**DSE THEORY - VI**	**I**	**6**	**6**	**-**	**-**	**3**
Objective	Students learn about the laboratory safety measures							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction to the laboratory and laboratory hazards** - General laboratory facilities – Occupational safety- Lab accidents - Fires, chemical burns, slips and falls, Animal bites. Cuts from broken glass. Toxic fume inhalation. General laboratory rules, Good laboratory practice (GLP). Laboratory plan.	K2	13
II	**Common hazards in laboratory:** Chemical hazards- Safe handling of chemicals and gases, hazard labels and symbols. Material safety datasheet (MSDS), Chemical handling - Fume hood, Storage of chemicals. Chemical Waste Disposal Guideline. Physical hazards - Physical agent data sheets (PADS), Electric hazards- Electrical shock, Electrical explosions, Electrical burns. Safe work practices. Potential ignition sources in the lab. Stages of Fire. Fire Extinguishers. Fire Response.	K3	14
III	**Prevention and First aid for laboratory accidents.** Personal protective equipment (PPE), Proper attire (Eye/Face Protection, laboratory coats, gloves, respirators. Disposal/Removal of PPE. Emergency equipment safety - Showers/ Eye Washes. Laboratory security and emergency response. First aid for - Injuries caused by broken glass, Acid/Alkali splashes on the skin, swallowing acid/alkali, burns caused by heat, electric shock.	K4	14
IV	**Biosafety** - Historical background. Blood borne pathogens (BBP) and laboratory - acquired infections. Introduction to biological safety cabinets. Primary containment for biohazards. Biosafety levels of specific microorganisms. Recommended biosafety. Levels for infectious agents and infected animals. Risk groups with examples - Risk assessment. Safety levels. Case studies - Safe working, hand hygiene. Laboratory instruments, packing, sending, transport, import and export of biological agents. Hygiene, disinfection, decontamination, sterilization.	K4	14
V	**Biosafety regulations and guidelines.** Centres for disease control and prevention and the National institutes of health. Occupational safety and health administration. Recombinant DNA advisory committee (RDAC),	K5	14

	Institutional biosafety committee (IBSC), Review committee on genetic manipulation (RCGM), Genetic engineering approval committee (GEAC). Implementation of biosafety guidelines. **Current Trends-*Digital technologies in laboratory safety management***		
	…… Self Study.		
Course Outcome	**CO1:**Interpret the laboratory protective measures	K2	
	CO2: Identify the physical and chemical hazardous in laboratory	K3	
	CO3: Apply the various first aids for laboratory accidents	K4	
	CO4: Inspect the biological safety in laboratory.	K4	
	CO5: Appraise the committee in the importance of biosafety guidelines.	K5	

Learning Resources	
Text Books	1. Muthuraj M. and Usharani B. (2019). Biosafety in Microbiological Laboratories. (1st Edition). Notion Press. ISBN 10: 1645878856 2. Biosafety in Microbiological and Biomedical Laboratories - U.S. Health Department and Human Services. (2016). (5th Edition). Lulu.com.
Reference Books	1. Dayuan X. (2015). Biosafety and Regulation for Genetically Modified Organisms, Alpha Science International Ltd, ISBN-10: 1842657917. 2. Rashid N. (2013). Manual of Laboratory Safety (Chemical, Radioactive, and Biosafety with Biocides) (1st Edition).
Website Link	1. https://www.cdc.gov/labs/pdf/CDC-BiosafetymicrobiologicalBiomedicalLaboratories-2009. 2. https://ucanapplym.s3.ap-south. 3. https://consteril.com/biosafety-levels-difference.
Self-Study Material	1. https://www.news-medical.net/life-sciences/The-Digitalization-of-Laboratories.aspx

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M1PMIE06	**ESSENTIALS OF LABORATORY MANAGEMENT AND BIOSAFETY**	**DSE THEORY - VI**	**I**	**6**	**6**	**-**	**-**	**3**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
Mrs S.Subana	Dr.M.Selvan	Dr.S.Shahitha

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M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PMIE07	**EPIDEMIOLOGY**	**DSE THEORY - VII**	**II**	**3**	**3**	**-**	**-**	**3**
Objective	Students learn about the role of epidemiology in public health							

Unit	Course Content	Knowledge Levels	Sessions
I	**Fundamentals of epidemiology** - Definitions of epidemiology – Epidemiology of infectious diseases in Public Health. Natural history of disease - Historical aspects of epidemiology. Common risk factors - Epidemiologic Triad - Agent factors, host factors and environmental factors. Transmission basics - Chain of infection, portal of entry. Modes of transmission -Direct and indirect. Stages of infectious diseases. Agents and vectors of communicable diseases of public health importance and dynamics of disease transmission. Epidemiology of Zoonosis - Factors, routes of transmission of bacterial, viral, parasitic and fungal zoonotic agents. Control of zoonosis.	K1-K2	6
II	**Tools of Epidemiology** - Measures of Disease - Prevalence, incidence. Index case. Risk rates. Descriptive Epidemiology - Cohort studies, measuring infectivity, survey methodology including census procedures. Surveillance strategies - Disease surveillance, geographical indication system, outbreak investigation in public health and contact investigation.	K2-K3	6
III	**Epidemiological aspects of diseases of national importance** - Background to communicable and non-communicable diseases. Vector borne diseases in India. Diarrhoeal diseases. Zoonoses. Viral haemorrhagic fevers. Mycobacterial infections. Sexually transmitted diseases. Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS). Emerging disease threats - Severe Acute Respiratory Syndrome (SARS), Covid-19, Ebola, MDR - TB, Malaria, Mucor mycosis, Avian flu. Dengue, Swine Flu, Chikungunya. Epidemiology, prevention, and control of non-communicable diseases - Asthma, Coronary heart disease, Malignancy, diabetes mellitus, respiratory diseases, eye diseases, Dental disorders. Emerging and Re-emerging Diseases.	K3	6
IV	**Mechanisms of Antimicrobial resistance** - Multidrug Efflux pumps, Extended Spectrum β-lactamases (ESBL). Hospital acquired infections - Factors, infection sites, mechanisms, Role of Multidrug resistant pathogens. Role of *Pseudomonas, Acinetobacter, Clostridium difficile,* HBV, HCV, Rotavirus, *Cryptosporidium* and *Aspergillus* in Nosocomial infections. Prevention and	K3-K4	6

	management of nosocomial infections.		
V	**National Programmes related to Communicable and Non-Communicable diseases** - National Malaria Eradication Programme, Revised National Tuberculosis Control Programme, Vector Borne Disease Control Programme, National AIDS Control Programme, National Cancer Control Programme and National Diabetes Control Programme. Biochemical and immunological tools in epidemiology - Biotyping, Serotyping, Phage typing, FAME (Fatty acid methyl ester analysis), Curie Point PyMS (Pyrolysis Mass spectrometry), Protein profiling, Molecular typing methods. **Current Trends-* Current Trends in Epidemiology ***	K5	6
	…… Self Study.		
Course Outcome	**CO1:** Recall and outline the basic disease transmission	K1	
	CO2: Outline the measurement of disease transmission.	K2	
	CO3: Build the knowledge of communicable and non – communicable diseases.	K3	
	CO4: Analyze the implications of drug resistance in the society and drug design	K4	
	CO5: Recommend the National awareness programs for control of diseases	K5	

Learning Resources	
Text Books	1. Dicker R., Coronado F., Koo. D. and Parrish. R. G. (2012). Principles of Epidemiology in Public Health Practice, (3rd Edition). CDC. 2. Gerstman B. (2013). Epidemiology Kept Simple: An Introduction to Classic and Modern Epidemiology. (3rd Edition). Wiley Blackwell. 3. Greenwood, D., Slack, R. B. and Peutherer, J. F. (2012) Medical Microbiology, (18th Edition). Churchill Livingstone, London.
Reference Books	1. Bhopal R. S. (2016).Concepts of Epidemiology - An Integrated Introduction to the Ideas, Theories, Principles and Methods of Epidemiology. (3rd Edition). Oxford 2. Celentano D. D. and Szklo M. (2018). Gordis Epidemiology. (6th Edition). Elseiver, USA.
Website Link	1. https://www.scielo.br/j/rbca/a/mjDFGTtfWtBm786ZmR9TG9d/?lang=en 2. https://hal.archives-ouvertes.fr/hal-00902711/document 3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7187955/
Self-Study Material	1. https://epidemiologist.io/insight/current-trends-in-epidemiology/ 2. https://nptel.ac.in/courses/103103207

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PMIE07	**EPIDEMIOLOGY**		**DSE THEORY - VII**		**II**	**3**	**3**	**-**	**-**	**3**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	S	S	S	S	M	S	M	S
CO2	S	S	S	L	S	S	M	S	M	S
CO3	M	S	M	S	S	S	M	S	M	S
CO4	S	S	S	M	S	S	M	S	M	S
CO5	S	S	S	S	S	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
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M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PMIE08	**CLINICAL DIAGNOSTIC MICROBIOLOGY**	**DSE THEORY - III**	**II**	**3**	**3**	**-**	**-**	**3**

Objective	To learn about the various diagnostic methods and treatment application		
Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Microbiology Laboratory Safety Practices** -General Safety Guidelines, Handling of Biological Hazards, Infectious health care waste disposal - Biomedical waste management, Emerging and Re-emerging infections.	K1-K2	12
II	**Diagnostic procedures** - General concept of Clinical specimen collection, transport, storage and general processing in Microbiology laboratory - Specimen acceptance and rejection criteria.	K1-K2	12
III	**Diagnosis of microbial diseases** - Clinical, differential, Microbiological, immunological and molecular diagnosis of microbial diseases. Modern and novel microbial diagnostic methods. Automation in Microbial diagnosis.	K1-K3	12
IV	**Antibiotic sensitivity tests** - Disc diffusion - Stokes and Kirby Bauer methods, E test - Dilution - Agar dilution & broth dilution - MBC/MIC - Quality control for antibiotics and standard strains.	K4	12
V	**Nosocomial infections** – common types, sources, reservoir and mode of transmission, pathogenesis and control measures. Hospital Infection Control Committee (HICC) – Functions.	K2-K4	12
Course Outcome	**CO1:** Remember the knowledge about Laboratory safety procedures and hospital waste disposal strategies.	K1	
	CO2: Understand the knowledge about collection and processing of clinical specimens.	K2	
	CO3: Apply the various methods of diagnosis to microbial diseases.	K3	
	CO4: Analyze the various antibiotics and their standardization.	K4	
	CO5: Classify the nosocomial infections and control measures by HICC.	K4	
Learning Resources			

Text Books	1. Tille P. M. (2021). Bailey and Scott's Diagnostic Microbiology. (15th Edition). Elsevier. ISBN: 9780323681056. 2. Jawetz E., Melnick J. L. and Adelberg E. A. (2000). Review of Medical Microbiology. (19th Edition). Lange Medical Publications, U.S.A. 3. Sood R. (2009). Medical Laboratory Technology – Methods and Interpretations. (6th Edition). Jaypee Brothers Medical Publishers (P) Ltd. New Delhi. ISBN: 9788184484496.
Reference Books	1. Bennett J. E., Dolin R. and Blaser M. J. (2019). Principles and Practice of Infectious Diseases. (9th Edition). Elsevier. EBook ISBN: 9780323550277. Hardcover ISBN:9780323482554 2. Koneman E.W., Allen S. D., Schrecken berg P. C. and Winn W. C. (2020). Koneman's Color Atlas and Textbook of Diagnostic Microbiology. (7th Edition). Jones & Bartlett Learning. ISBN: 1284322378 9781284322378. 3. Cheesbrough, M. (2004). District Laboratory Practice in Tropical Countries - Part 2, (2nd Edition). Cambridge University Press. ISBN-13:978-0-521-67631-1 / ISBN-10:0-521-67631-2.
Website Link	1. https://www.ncbi.nlm.nih.gov/books/NBK20370/ 2. https://journals.asm.org/doi/10.1128/JCM.02592-20 3. http://www.textbookofbacteriology.net/normalflora_3.html 4. https://www.sciencedirect.com

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M2PMIE08	**CLINICAL DIAGNOSTIC MICROBIOLOGY**		**DSE THEORY - III**	**II**	**3**	**3**	**-**	**-**	**3**	
CO-PO Mapping										
CO Number	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	S	M	S	M	M	S	M	M	M	S
CO2	S	M	S	M	M	S	M	M	S	S
CO3	S	M	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW			M-MEDIUM			S-STRONG			
Tutorial Schedule	Group Discussion, Quiz program, model preparation and Kahoot app									
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation									
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE									

Designed By	**Verified By**	**Approved By Member Secretary**
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M. Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PMIE09	**BIOREMEDIATION**	**DSE THEORY - IX**	**II**	**3**	**3**	**-**	**-**	**3**
Objective	Students able to know the nature of Bioremediation and Management of Environmental Pollution							

Unit	Course Content	Knowledge Levels	Sessions
I	**Bioremediation** - process and organisms involved. Bioaugmentation - Ex-situ and in-situ processes; Intrinsic and engineered bioremediation. Major pollutants and associated risks; organic pollutant degradation. Microbial aspects and metabolic aspects. Factors affecting the process. Recent developments and significance.	K1	12
II	**Water treatment** -Microbes involved in aerobic and anaerobic processes in nature. - BOD, COD, dissolved gases, removal of heavy metals, total organic carbon removal. Secondary waste water treatments - use of membrane bioreactor. Aquaculture effluent treatment. Aerobic sludge and landfill leachate process. Aerobic digestion.	K2	12
III	**Composting of solid wastes-** anaerobic digestion - methane production and important factors involved, Pros and cons of anaerobic process, sulphur, iron and nitrate reduction, hydrocarbon degradation, degradation of nitroaromatic compounds. Bioremediation of dyes, bioremediation in paper and pulp industries. Aerobic and anaerobic digesters – design. Various types of digester for bioremediation of industrial effluents	K3	12
IV	**Microbial leaching of ores** - process, microorganism's involved and metal recovery with special reference to copper and iron. Biotransformation of heavy metals and xenobiotics. Petroleum biodegradation - reductive and oxidative. Dechlorination. Biodegradable of plastics and super bug	K4	12
V	**Phytoremediation** of heavy metals in soil - Basic principles of phytoremediation - Uptake and transport, Accumulation and sequestration Phytoextraction. Phytodegradation. Phytovolatilization. Rhizodegradation. Phytostabilization – Organic and synthetic amendments in multi metal contaminated mine sites. Role of Arbuscular mycorrhizal fungi and plant growth promoting rhizobacteria in phytoremediation. **Current trends-* Nanobioremediation applications of Nanotechnology**	K5	12
	…… Self Study.		

Course Outcome	**CO1:** Assess the role of organisms in Bioremediation	K1	
	CO2: Design and optimization of biological processing unit operations	K2	
	CO3: Apply engineered solutions to Environmental Problems	K3	
	CO4: Explore Microbes in Degradation of Toxic wastes	K4	
	CO5: Evaluate the types of Phytoremediation	K5	

Learning Resources	
Text Books	1. Bhatia H.S. (2018). A Text book on Environmental Pollution and Control. (2nd Edition). Galgotia Publications. 2. Chatterjee A. K. (2011). Introduction to Environmental Biotechnology. (3rd Edition) Printice-Hall, India. 3. Pichtel, J. (2014). Waste Management Practices: Municipal, Hazardous, and Industrial, 2nd edition, CRC Press.
Reference Books	1. Sangeetha J., Thangadurai D., David M. and Abdullah M.A. (2016). Environmental Biotechnology: Biodegradation, Bioremediation, and Bioconversion of Xenobiotics for Sustainable Development. (1st Edition). Apple Academic Press. 2. Singh A. and Ward O. P. (2004). Biodegradation and Bioremediation. Soil Biology. Springer. 3. Singh A., Kuhad R. C., and Ward O. P. (2009). Advances in Applied Bioremediation 56 (1st Edition). Springer-Verlag Berlin Heidelberg, Germany.
Website Link	1. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/bioremediation 2. https://microbiologysociety.org/blog/bioremediation-the-pollution-solution. 3. html ttps://www.intechopen.com/chapters/70661
Self- study	https://scholar.google.co.in/scholar?q=nanotechnology+in+bioremediation++E+books&hl=en&as_sdt=0&as_vis=1&oi=scholart

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M2PMIE09	**BIOREMEDIATION**	**DSE THEORY - II**	**II**	**3**	**3**	**-**	**-**	**3**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	M	S	M	S	M	S
CO2	S	M	S	S	S	S	M	S	M	S
CO3	M	S	S	S	M	S	M	S	M	S
CO4	S	S	M	S	S	S	M	S	M	S
CO5	S	S	S	S	S	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
Dr.S.Shahitha	Dr.M.Selvan	Dr.S.Shahitha

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M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PMIE10	**BIOINFORMATICS**	**DSE THEORY - X**	**II**	**3**	**3**	**-**	**-**	**3**
Objective	Students learn the computational tools to analyse biological data							

Unit	Course Content	Knowledge Levels	Sessions
I	**Biological Data Mining** – Exploration of Data Mining Tools. Cluster Analysis Methods. Data Visualization. Biological Data Management. Biological Algorithms – Biological Primary and Derived Databases. Concept of Alignment, Pairwise Sequence Alignment (PSA), Multiple Sequence Alignment (MSA), BLAST, CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).	K1	7
II	**Phylogenetic Tree Construction** - Concept of Dendrograms. Evolutionary Trees - Distance Based Tree Reconstruction - Ultrametric trees and Ultrametric distances – Reconstructing Trees from Additive Matrices - Evolutionary Trees and Hierarchical Clustering - Character Based Tree Reconstruction - Maximum Parsimony Method, Maximum likelihood method - Reliability of Trees – Substitution matrices – Evolutionary models	K2	7
III	**Computational Protein Structure prediction** – Secondary structure – Homology modelling- Fold recognition and ab initio 3D structure prediction – Structure comparison and alignment – Prediction of function from structure. Geometrical parameters – Potential energy surfaces – Hardware and Software Requirements-Molecular graphics – Molecular file formats Molecular visualization tools.	K3	7
IV	**Prediction of Properties of Ligand Compounds** – 3D Autocorrelation -3D Morse Code-Conformation Dependent and Independent Chirality Codes – Comparative Molecular Field Analysis – 4 D QSAR –HYBOT Descriptors – Structure Descriptors – Applications – Linear Free Energy Relationships – Quantity Structure - Property Relationships –Prediction of the Toxicity of Compounds	K4	7
V	**Molecular Docking-** Flexible - Rigid docking – Target- Ligand preparation- Solvent accessibility- Surface volume calculation, Active site prediction- Docking algorithms- Genetic, Lamarckian - Docking analyses- Molecular interactions, bonded and non-bonded - Molecular Docking Software and Working Methods. Genome to drug discovery – Subtractive Genomics – Principles of Immuno informatics and Vaccine Development. **Current trends-**	K5	7

	*** Structural Bioinformatics ***		
	…… Self Study.		
Course Outcome	**CO1:** Recall the databases that provide information on nucleic acids and proteins	K1	
	CO2: Explain the algorithms for sequence alignment	K2	
	CO3: Utilize the methods for constructing phylogenetic tree	K3	
	CO4: Discover the structure of proteins.	K4	
	CO5: Evaluate the drugs by predicting drug ligand interactions and molecular docking.	K5	

Learning Resources	
Text Books	1. Lengauer T. (2008). Bioinformatics- from Genomes to Therapies (Vol-1). Wiley- VCH. 2. Mount D.W., (2013). Bioinformatics sequence and genome analysis, 2ndedn.CBS Publishers, New Delhi 3. Rastogi S. C., Mendiratta N. and Rastogi P. (2014). Bioinformatics - Methods and Applications (Genomics, Proteomics and Drug Discovery) (4th Edition). Prentice-Hall of India Pvt.Ltd.
Reference Books	1. Harsha wardhan P.Bal, (2006). Bioinformatics Principles and Applications, Tata McGraw-Hill Publishing Company Limited 2. Bosu O. and Kaur S. (2007). Bioinformatics - Database, Tools, and Algorithms. Oxford University Press. 3. Xiong J, (2011). Essential bioinformatics, First south Indian Edition, Cambridge University Press.
Website Link	1. https://www.hsls.pitt.edu/obrc/index.php?page=dna 2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1669712/
Self-Study Material	1. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBI1403.pdf

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PMIE10	**BIOINFORMATICS**		**DSE THEORY - X**		**II**	**3**	**3**	**-**	**-**	**3**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	M	S	M	M	M	M	M
CO2	S	M	S	S	S	S	s	M	M	M
CO3	S	M	S	S	S	S	S	S	S	M
CO4	S	S	S	S	M	S	S	S	S	S
CO5	M	S	S	S	S	S	S	S	M	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
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M. Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PMIE11	**NANOBIOTECHNOLOGY**	**DSE THEORY - XI**	**II**	**3**	**3**	**-**	**-**	**3**
Objective	Students learn the nanostructures for targeted drug delivery in medical applications.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction to nanobiotechnology:** Nano size-changing phenomena at nano scale, Classification of nanomaterials based on their dimensions (0D, 1D, 2D and 3D materials) and based on realization of their applications (The First, second, third and fourth generation materials), Class of nanomaterials and their applications. Need for nanomaterials and the risks associated with the materials.	K1	6
II	**Fabrication of Nanomaterials -** Top-down and Bottom-up approaches, Solid phase synthesis-milling, Liquid phase synthesis - Sol-gel synthesis, colloidal synthesis, micro emulsion method, hydrothermal synthesis and solvo thermal synthesis, Vapour / Gas phase synthesis-Inert gas condensation, flame pyrolysis, Laser ablation and plasma synthesis techniques. Microbial synthesis of nanoparticles.	K2	6
III	**Characterization of nanoparticles** – Based on particle size/morphology-Dynamic light scattering (DLS), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM), Based on surface charge - zeta potential, Based on structure – X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), Energy dispersive X-ray analysis (EDX), Based on optical properties - UV – Spectrophotometer, Based on magnetic properties - Vibrating sample magnetometer (VSM).	K3	6
IV	**Nanomaterial based Drug delivery and therapeutics** - surface modified nano particles, MEMS/NEMS based devices, peptide/DNA coupled nanoparticles, lipid and inorganic nanoparticles for drug delivery, Metal/ metaloxide nano particles as antibacterial, antifungal and antiviral agents. Toxicity of nanoparticles and Toxicity Evaluation	K4	6
V	**Nanomaterials in diagnosis** - Imaging, nanosensors in detection of pathogens. Treatment of surface water, ground water and waste water contaminated by toxic metal ions, organic and inorganic solutes and microorganism. **Current trends-* Nanotechnology in Agriculture***	K5	6

	…… Self Study.		
Course Outcome	**CO1:** Recall the knowledge in the field of nano biotechnology for development	K1	
	CO2: Compare the applications of nanomaterials in the field of medicine and environment.	K2	
	CO3: Apply the prospects and significance of nano biotechnology.	K3	
	CO4: Analyze the recent advances in this area and create a career or pursue research in the field.	K4	
	CO5: Evaluate the types of Nanomaterials detection and diagnosis	K5	

Learning Resources	
Text Books	1. Brydson R. M., Hammond, C. (2005). Generic Methodologies for Nanotechnology: Characterization. In Nanoscale Science and Technology. John Wiley & Sons, Ltd. 2. Mohan Kumar G. (2016). Nanotechnology: Nanomaterials and nano devices. Narosa Publishing House. 3. Pradeep T. (2007). Nano: The Essentials-Understanding nanoscience and Nanotechnology.
Reference Books	1. Nouailhat A. (2008). An Introduction to Nanoscience and Nanotechnology, Wiley. 2. Sharon M. and Maheshwar (2012). Bio-Nanotechnology: Concepts and Applications. New Delhi. Ane books Pvt Ltd. 3. Reisner, D.E. (2009). Bionano technology: Global Prospects. CRC Press
Website Link	1. https://www.gale.com/nanotechnology 2. http://www.istl.org/11-winter/internet1.html 3. https://www.cdc.gov/niosh/topics/nanotech/default.html
Self- study	1. https://vajiramandravi.com/quest-upsc-notes/nanotechnology-in-agriculture/

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M2PMIE11	**NANOBIOTECHNOLOGY**	**DSE THEORY – XI**	**II**	**3**	**3**	**-**	**-**	**3**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	M	S	M	S	M	S
CO2	S	M	S	S	S	S	M	S	M	S
CO3	M	S	S	S	M	S	M	S	M	S
CO4	S	S	M	S	S	S	M	S	M	S
CO5	S	S	S	S	S	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	-		
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation		
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE		
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M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PMIE12	**CLINICAL RESEARCH AND CLINICAL TRIALS**	**DSE THEORY – XII**	**II**	**3**	**3**	**-**	**-**	**3**
Objective	To understand the basic concepts of the clinical research, ethics and Quality Control.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction to Clinical Research:** Clinical Research: An Overview, Different types of Clinical Research. Clinical Pharmacology: Pharmacokinetics, Pharmacodynamics, Pharmaco epidemiology, Bioavailability, Bioequivalence, Terminologies and definition in Clinical Research. Drug Development Process: Drug Discovery Pipeline, Drug Discovery Process. Preclinical trail, Human Pharmacology (Phase-I), Therapeutic Exploratory trail (Phase-II), Therapeutic Confirmatory Trail (Phase-III) and Post marketing surveillance (Phase-IV).	K1-K2	12
II	**Ethical Considerations and Guideline in Clinical Research:** Historical guidelines in Clinical Research - Nuremberg code, Declaration of Helsinki, Belmont report. International Conference on Harmonization (ICH)-Brief history of ICH, Structure of ICH & ICH Harmonization Process, Guidelines for Good Clinical Practice. Regulation in Clinical Research-Drug and cosmetic act, FDA, Schedule-Y- Ethics Committee and their responsibilities. Clinical Research Regulatory Submission & approval Process- IND, NDA and ANDA submission Procedure. DCGI submission procedure. Other Regulatory authorities - EMEA, MHRA, PhRMA.	K1-K3	12
III	**Research,** Ethics Committees and Institutional Review Board, Responsibilities of Sponsor. Responsibilities of Investigator, Protocol in Clinical Research Clinical Trial Design, Project Planning Project Managements - Informed Consent, Investigator's Brochure (IB), Selection of an Investigator and Site, Patient screening, Inclusion and exclusion criteria, Randomization, Blinding. Essential Documents in clinical research - IB, ICF, PIS, TMF, ISF, CDA & CTA.	K3	12
IV	**Quality Assurance, Quality Control & Clinical Monitoring:** Defining the terminology-Quality, Quality system, Quality Assurance & Quality Control-QA audit plan. 21 CRF Part 11, Site Auditing, Sponsor Compliance and Auditing, SOP For Clinical Research - CRF Review & Source Data Verification, Drug Safety Reporting Corrective and preventative action process.	K3	12

V	**Business Development in the Clinical Research Industry:** Introduction & Stages of Business Development-Start-up Phase, Growth Phase, Maturity Phase, Decline Phase. Outsourcing in Clinical Research, Reasons for outsourcing to contract research organizations, The India Advantage, Scope and Future of CRO, List of Clinical Research Organizations in India, List of IT companies offering services in Clinical Research. Role of business development manager.	K1-K4	12
Course Outcome	**CO1:** Remember the basic concepts of Drug development process and different phases of clinical trials.	K1	
	CO2: Understand the knowledge about the ethics and regulatory perspectives on clinical research.	K2	
	CO3: Apply the clinical trials management concepts and documentation process.	K3	
	CO4: Choose the quality assurance and quality control to ensure the protection of human beings.	K3	
	CO5: Conclude the skills recitation to commercial start up and the organization.	K4	

Learning Resources

Text Books	1. Gallin J. I., Ognibene F. P. and Johnson L. L. (2007). Principles and Practice of Clinical Research. (4th Edition). Elsevier, ISBN-10: 0128499052 2. Hulley S. B., Cummings S. R., Browner W. S., Grady D. G. and Newman T. B. (2013). Designing Clinical Research. (4th Edition). Jaypee Medical. ISBN-13: 978-1608318049.
Reference Books	1. Friedman L.M., Fuberge C.D., DeMets D. and Reboussen, D.M. (2015). 2. Browner W. S., (2012). Publishing and Presenting Clinical Research. (3rd Edition). Lippincott Williams and Wilkins. 3. Rondel R. K., Varley S. A. and Webb C. F. (2008). Clinical Data Management. (2nd Edition). Wiley.
Website Link	1. https://www.hzu.edu.in/uploads/2020/10/Textbook-of-Clinical-Trials-Wiley-(2004).pdf 2. https://www.auctoresonline.org/journals/clinical-research-and-clinical-trials 3. https://www.who.int/health-topics/clinical-trials#tab=tab_1

	L-Lecture	T-Tutorial	P-Practical	C-Credit

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M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PMIE12	**CLINICAL RESEARCH AND CLINICAL TRIALS**	**DSE THEORY – XII**	**II**	**3**	**3**	**-**	**-**	**3**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	M	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

Level of Correlation between CO and PO	L-LOW	M-MEDIUM	S-STRONG

Tutorial Schedule	Group Discussion, Quiz program, model preparation and Kahoot app
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

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M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PMIE13	**BIOSAFETY, BIOETHICS AND IPR**	**DSE THEORY - XIII**	**III**	**4**	**2**	**2**	**-**	**3**
Objective	Students learn about comprehensive understanding of biosafety principles and ethical considerations and intellectual property rights (IPR)							

Unit	Course Content	Knowledge Levels	Sessions
I	**Intellectual Property Rights:** Different forms of Intellectual Property Rights – their relevance, importance to industry, Academia. Role of IPR's in Biotechnology, Patent Terminology - Patents, trademarks, copyrights, industrial designs, geographical indications, trade secrets, non-disclosure agreements. Patent life and geographical boundaries. International organizations and IPR - Overview of WTO, TRIPS, WIPO, GATT, International conventions, Trade agreements, Implication of TRIPS for developing countries.	K1	10
II	**Process involved in patenting**. Patent Search - Procedural steps in patenting, process of filing, PCT application, pre-grant & post-grant opposition, PCT and patent harmonization including Sui-generis system, patent search methods, patent databases and libraries, online tools, Country-wise patent searches (USPTO, EPO, India etc.), patent mapping.	K2	10
III	**Patentability of biotechnology inventions** - Patentability of biotechnology inventions in India, statutory provisions regarding biotechnological inventions under the current Patent Act 1970 (as Amended 2005). Biotechnological inventions as patentable subject matter, territorial nature of patents - from territorial to global patent regime, interpreting trips in the light of biotechnology inventions, feasibility of a uniform global patent system, merits and demerits of uniform patent law, relevance of the existing international patent, tentative harmonisation efforts, implications of setting up a uniform world patent system.	K3	10
IV	**Introduction to bioethics** - need of bioethics, applications and issues related to bioethics, social and cultural issues. Bioethics and biodiversity - conserving natural biodiversity, convention on protecting biodiversity, protocols in exchanging biological material across borders. Bioethics and law: a developmental perspective. Bioethics & GMO's - issues and concerns pertaining to genetically modified foods (golden rice) and food crops	K3	10

	(Soybean), organisms and their possible health implications and mixing up with the gene-pool.		
V	**Bioethics in medicine** - Protocols of ethical concerns related to prenatal diagnosis, gene therapy and its types, organ transplantation-kidney, xeno transplantation, ethics in patient care, informed consent. Bioethics and cloning - permissions and procedures in animal cloning, human cloning, risks and hopes. Bioethics in research: stem cell research, human genome project, use of animals in research, human volunteers for clinical research, studies on ethnic races. Nuremberg code. **Current Trends-* Laws Applicable to Medical Practice and Hospitals in India***	K4	10
	…… Self Study.		
Course Outcome	**CO1:** Label the forms and importance of IPR	K1	
	CO2: Interpret the knowledge of patent search and their process	K2	
	CO3: Buildthe knowledge of patents inventions	K3	
	CO4: Identify the issues related to bioethics	K3	
	CO5: Classify the bioethics in research	K4	

Learning Resources	
Text Books	1. Usharani B., Anbazhagi S. and Vidya C. K. (2019). Biosafety in Microbiological Laboratories. (1st Edition). Notion Press. ISBN-10 1645878856 2. Goel D. and Parashar S. (2013). IPR, Biosafety and Bioethics. (1st Edition). Pearson Education: Chennai. ISBN-13: 978-8131774700 3. Sibi. GIntellectual, Property Rights, Bioethics, Biosafety and Entrepreneurship in biotechnology. (2021). Wiley Publications.
Reference Books	1. Nithyananda K. V. (2019). Intellectual Property Rights: Protection and Management, India, IN: Cengage Learning India Private Limited. 2. Ahuja, V K. (2017). Law relating to Intellectual Property Rights, India, IN: Lexis Nexis. 3. Goel Parashar. IPR, Biosafety and Bioethics (2013). Pearson Publications.
Website Link	1. https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf. 2. http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf. 3. https://bioethics.msu.edu/what-is-bioethics
Self-Study Material	1.https://www.imalko.in/downloads/laws.pdf 2.https://wbconsumers.gov.in/writereaddata/ACT%20&%20RULES/Relevant%20Act%20&%20Rules/Medical%20Council%20of%20India%20%20Act.pdf

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PMIE13	**BIOSAFETY, BIOETHICS AND IPR**	**DSE THEORY - XIII**	**III**	**4**	**2**	**2**	**-**	**3**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	M	M	M	M	M
CO2	S	S	S	S	S	M	M	M	M	M
CO3	S	S	S	S	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

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Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PMIE14	**TOXINOLOGY**	**DSE THEORY - XIV**	**III**	**4**	**2**	**2**	**-**	**3**
Objective	Students learn about the different biological toxins and applications							

Unit	Course Content	Knowledge Levels	Sessions
I	**General Introduction** - Definition of toxins, different categories of toxins and venoms, recent trends in venom and toxin research.	K1	8
II	**Bacterial toxins** - Bacterial toxins Bacterial toxinogenesis, endotoxins, exotoxins, exotoxins, bacterial protein toxins with special reference to cholera, diphtheria and tetanus toxins, molecular mechanism of action of endotoxins, exotoxins, enterotoxins, neurotoxins and mycotoxins.	K2	8
III	**Plant toxins & Toxins from snake venom** - Natural toxins in plants, Plant toxic proteins, impact of plant toxin on human, natural toxins in food, plants, allelopathy. Toxins from snake venom Snakes and Biological significance of their venoms, composition of snake venom, evolution of venom, 3D structure of some important venom constituents and their mechanism of action (phospholipase A2, cardiotoxin, neurotoxin) three-finger toxins, anti-venom and medicinal plants in treatment of snakebite patients.	K3	10
IV	**Tools for isolation and characterization of toxins** - Multidimensional chromatographic techniques (gel-filtration, ion exchange reverse-phase HPLC, SDS-PAGE, 2- dimensional gel electrophoresis), toxin mass fingerprinting, N-terminal peptide sequencing, analysis of protein data by using proteomics software.	K3	10
V	**Medicinal and industrial applications of venoms and toxins**. Use of toxin in neurobiology and muscular research anticancer drug, diagnosis of haemostatic disorders, antibacterial agents, bioinsecticides and other industrial applications. **Current Trends-*Advancements in venom and toxin biotechnology***	K4	12
	…… Self Study.		
Course	**CO1:** List out the different categories of toxins	K1	
	CO2: Outlineabout the bacterial toxins and their mechanisms	K2	

Outcome		
	CO3: Identify the mode of actions of plant toxin and snake venom	K3
	CO4: Apply the methods to characterized and isolation of toxins	K3
	CO5: Conclude the toxins are used as medicinal and industrial applications	K4

Learning Resources	
Text Books	1. Pholtan Rajeev S.R. (2021) Pictorial handbook for toxinology. Rudra Publications. 2. Wilson K. and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. (7thEdition). Cambridge University Press India Pvt. Ltd. ISBN 1- 4051-3544-1.
Reference Books	1. GopalaKrishnakone (2015). Biological Toxins and Bioterrorism. Springer 2. Reilly M. J. (2018). Bioinstrumentation. CBS Publishers and Distributors Pvt Ltd. ISBN 13 978-8123928395
Website Link	1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5869414/ 2. https://www.reseachgate.net/publication/269037373_TOXIN_AS_A_MEDICINE 3. https://www.toxinology.org/
Self-Study Material	1. https://www.cell.com/current-biology/fulltext/S0960-9822(09)01541-3

L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M3PMIE14	**TOXINOLOGY**	**DSE THEORY - XIV**	**III**	**4**	**2**	**2**	**-**	**3**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	S	S	M	S	S	S
CO3	S	S	S	S	S	M	S	S	M	S
CO4	S	S	M	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	S	S	S

Level of Correlation between CO and PO	L-LOW	M-MEDIUM	S-STRONG

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	Verified By	Approved By Member Secretary
Mrs S.Subana	Dr.M.Selvan	Dr.S.Shahitha

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE
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M.Sc- Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PMIE15	**WATER CONSERVATION AND WATER TREATMENT TECHNOLOGIES**	**DSE THEORY - XV**	**III**	**3**	**3**	**-**	**-**	**4**
Objective	Students learn about Water Scarcity and waste water treatment							

Unit	Course Content	Knowledge Levels	Sessions
I	**Water Scarcity:** Major Causes of Water Scarcity, Types of Water Scarcity, Water Footprint - Effects of Water Scarcity Across the Globe -Water Scarcity in India; Effects of Water Scarcity in India - Social and Political Effects and Economic Risks of Water Scarcity in India.	K1	7
II	**Multi-pronged approach to Prevent Water Scarcity:** Aquifer Recharging, Water reuse and Zero - Liquid Discharge Technology, Coastal Reservoir, Desalination Plants - Measures for Preventing Water Scarcity in India - Jal Shakti Abhiyan Campaign, Atal Bhujal Yojan adoption of Composite Water Management Index (CWMI), Water conservation resource management, Rain Water Harvesting	K2	8
III	**Water Quality and Pollution:** Impurities in the water, Characteristics of different water sources Vulnerability of the water sources to contamination, Water quality criteria – Quality of surface waters, flowing waters, impounded waters, Ground water, Water quality standards, Microbiological quality of drinking Water, Chemical quality of drinking water.	K3	7
IV	**Water Treatment Technologies:** Sedimentation, Filtration, Coagulation and flocculation, Water softening and adsorption processes, Membrane filtration, Micro filtration, Ultra filtration and Nano filtration, Water disinfection, Activated carbon filtration, House hold Water Treatment and Safe Storage (HWTS). Methods for house hold water treatment Safe water storage, House hold water treatment and safe storage decision tree, Assessing the impact of HWTS, Government policies for HWTS	K4	8
V	**New and Emerging Drinking Water Treatment Technologies:** Nanotechnology, Acousticnano tuber technology, Photo catalytic water purification technology, Aquapor in Inside™ technology, Automatic Variable Filtration (AVF) technology, Sun Spring System, Desalination. **Current Trends-* Innovative approaches for drinking and waste water treatment***	K4	7

	…… Self Study.		
Course Outcome	**CO1:**Tell about the major causes of water scarcity	K1	
	CO2:Outline about the prevention of water scarcity	K2	
	CO3: Construct the knowledge of water quality criteria	K3	
	CO4: Analyze the water quality using physical methods	K4	
	CO5: Discover the nanotechnology methods in drinking water treatment	K4	
Learning Resources			
Text Books	1. Vasileios A., Tzanakakis N. Paranychianakis V. And Angelakis A.N. (2020).Water Supply and Water Scarcity. MDPI, ISBN978-3-03943-306-3 (Hbk).ISBN978-3-03943-3070. 2. Pannirselvam M., Shu Li., Griffin G.,Philip L., Natarajan A. and Hussain S. (2019). Water Scarcity and Ways to Reduce the Impact.ISBN:978-3-319-75199-3. 3.Tiwari A., Kumar A., Singh A., Singh T.N., Suozzi E., Matta G. And Russo S. (2022). Water scarcity, Contamination and Management. Elsevier. ISBN:9780323853781		
Reference Books	1. Fujita K. and Mizushima T. (2021). Sustainable Development in India–Ground water Irrigation, Energy Use, and Food Production. ISBN9780367460976 2. Gupta R. (2008).Water Crisis in India. Atlantic Publishers.ISBN:9788126909582, 9788126909582. 3. Ahuja S. (2013). Monitoring Water Quality – Pollution Assessment, Analysis and Remediation. Elsevier. Book ISBN: 9780444594044. Hardcover ISBN: 9780444593955.		
Website Link	1. https://link.springer.com/book/10.1007/978-1-59745-278-6 2. https://apps.who.int/iris/handle/10665/206916?show=full 3. https://www.acs.org/content/acs/en/policy/publicpolicies/sustainability/water-statement.html		
Self-Study Material	1. https://science.howstuffworks.com/environmental/green-tech/sustainable/10-innovations-water-purification.htm		

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**			**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PMIE15	**WATER CONSERVATION AND WATER TREATMENT TECHNOLOGIES**			**DSE THEORY - XV**	**III**	**3**	**3**	**-**	**-**	**4**

CO-PO Mapping										
CO Number	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	S	S	S	S	S	S	M	S	M	S
CO2	S	M	M	S	S	S	M	S	M	S
CO3	S	S	M	S	S	S	M	S	M	S
CO4	S	S	S	M	S	S	M	S	M	S
CO5	S	S	S	S	S	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
Mrs.S.Vahithabanu	Dr.M.Selvan	Dr.S.Shahitha

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M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4PMIE16	**BIOENERGY**	**DSE THEORY - XVI**	**IV**	**4**	**4**	**-**	**-**	**2**
Objective	Students learn about bio-energy utilizing organic wastes by microorganisms and their potential use.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Bioenergy** – Biomass Energy Resources. Biomass conversion methods. Microbes as bio resources for bioenergy products (Bacteria, fungi, yeast and microalgae) – Bio prospecting of microbial strains for biofuel production.	K1	8
II	**Biodiesel** – Microbes and Biodiesel. Production and feed stock. Techniques of lipid extraction and conversion to biodiesel. Biodiesel quality and its assessment. Strategies of genetic engineering of organisms for biodiesel production. Biodiesel production from single cell organisms (*Cryptococcus, Cunning hamella, Mortierella*).	K2	10
III	**Alcoholic Fuels from microorganisms:** Biochemical conversion to ethanol: Biomass pre-treatment, Starch to sucrose conversion and Sucrose to ethanol fermentation. Role of enzymes and their applications in ethanol production. Distillation and Quantification of ethanol. Production and Estimation of biobutanol, biomethanol, biopropanol and bioglycerol.	K3	10
IV	**Biogas** - Microbes and Biogas production, Biogas plants – types – design – construction – Biogas Bottling Technology and Development in India, Biogas appliances – burner, luminaries and power generation – effect on engine performance. Application of Biogas slurry in agriculture.	K4	10
V	**Biohydrogen–** Production from bacteria and algae. Commercialized microalgae (*Spirulina, Dunaliella, Hematococcus* and *Chlorella*) and their production. Economics of microalgae production. Cultivation of seaweeds. Microbial fuel cells. **Current Trends-* Emerging Technologies in Microbial Fuel Cells (MFCs)***	K4	10
	…… Self Study.		
Course Outcome	**CO1:** List out the various biomass resources	K1	
	CO2: Classify the process of biodiesel production using microbes	K2	
	CO3: Apply the methods to the biochemical conversion of organic materials to fuels	K3	

	CO4: Survey the nature of biogas as a bio-fuel and their technologies and applications.	K4	
	CO5: Analyze the production of commercial microalgae.	K4	

Learning Resources	
Text Books	1. Dahiya A. (2014). Bioenergy- Biomass to Biofuel. (1st Edition). Academic Press Editor 2. Jawaid M., Hakeem K. R. and Rashid U. (2014). Biomass and Bioenergy: Processing and Properties. (1st Edition). Springer Cham.
Reference Books	1. Konur O. (2018). Bioenergy and Biofuels. (1st Edition). CRC Press. 2. Lee S. (2018).Biofuel and Bioenergy. Taylor and Francis. 3. Lee J. W. (2012). Advanced Biofuels and Bioproducts. (13th Edition), Springer.
Website Link	1. https://www.elsevier.com/ 2.https://www.sciencedirect.com/ 3. https://www.un.org/en/climatechange/what-is-renewable-energy.
Self-Study Material	1. https://vajiramandravi.com/quest-upsc-notes/microbial-fuel-cell/

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M4PMIE16	**BIOENERGY**	**DSE THEORY - XVI**	**IV**	**4**	**4**	**-**	**-**	**2**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S
CO3	M	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	M	S	S	S	S
CO5	S	S	S	S	S		S	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
Mrs S.Subana	Dr.M.Selvan	Dr.S.Shahitha

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M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4PMIE17	**MARINE MICROBIOLOGY**	**DSE THEORY - XVII**	**IV**	**4**	**4**	**-**	**-**	**2**
Objective	Students learn about microorganisms in marine environment and their applications							

Unit	Course Content	Knowledge Levels	Sessions
I	**Marine microbial environment** - Benthic & littoral zone, salt pan, mangroves and estuarine microbes, microbial loop. Marine microbial communities – Bacteria, fungi, protozoa. Microbial interactions – Endo symbionts and Ecto symbionts.	K1	8
II	**Dynamics of Marine Microbes** - Carbon cycle: Phototrophic microbes, the oceanic carbonate system and global warming – Nitrogen cycle: Nitrogen fixers – Iron limitation – ocean fertilization – phosphorus cycle. Decomposition of organic matter. Bioleaching and biodeterioration of natural and synthetic materials.	K2	10
III	**Marine extremophiles:** Mechanism of survival at extreme environments – Adaptive mechanisms in thermophilic, alkalophilic, osmophilic, barophilic, psychrophilic hyperthermophilic and halophilic microorganisms – Importance in biotechnology.	K3	8
IV	**Marine Microbial Diseases:** Aqua culture pathogens & Water borne pathogens -*Aeromonas, Vibrio, Salmonella, Pseudomonas, Leptospira, Corynebacteria* and viral diseases. Rapid diagnosis of contamination in sea foods and aquaculture products.	K4	9
V	**Applications of Marine Microbial Biotechnology:** Production and applications of marine microbial products – Enzymes, Antibiotics, Organic acids, Toxins, Biosurfactants and Pigments. Sea food preservation methods. Probiotic bacteria and their importance in aquaculture. **Current Trends-* Current Trends in Marine Biology ***	K5	10
	…… Self Study.		
Course Outcome	**CO1:** Find the marine microbial communities	K1	
	CO2: Outline the cycling of nutrients in marine environment	K2	
	CO3: Identify the extremophiles in marine environment	K3	
	CO4: Analyze the microbial diseases in marine foods	K4	
	CO5: Evaluate the production of marine microbial products	K5	

Learning Resources	
Text Books	1. Munn C. B. (2019). Marine Microbiology: Ecology and Applications. (3rd Edition). CRC Press. ISBN: 9780367183561. 2. Bhakuni, D.S. and Rawat D. S. (2005). Bioactive Marine Natural Products. Anamaya publishers, New Delhi. ISBN: 1-4020-3472-5. 3. Brock T. D. (2011). Thermophilic Microorganisms and Life at High Temperatures. Springer. ISBN-13:978-1461262862 / ISBN-10:1461262860.
Reference Books	1. Gasol J. M. and Kirchman D. L. (Eds.). (2018). Microbial Ecology of the Oceans. (3rd Edition). Wiley-Blackwell. ISBN: 978-1-119-10718-7. 2. Kim S. K. (2019). Essentials of Marine Biotechnology. Springer.
Website Link	1. https://link.springer.com/content/pdf/bfm%3A978-0-387-23709-1%2F1 2. https://www.researchgate.net/publication/285931262_Bioactive_Marine_Natural_Products 3. http://link.springer.com/content/pdf/bfm%3A978-3-642-03470-1%2F1.pdf
Self-Study Material	1. https://www.cambridgescholars.com/resources/pdfs/978-1-5275-8702-1-sample.pdf

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4PMIE17	**MARINE MICROBIOLOGY**	**DSE THEORY - XVII**	**IV**	**4**	**4**	**-**	**-**	**2**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	S	S	S	S	M	S	M	S
CO2	S	S	S	L	S	S	M	S	M	S
CO3	M	S	M	S	S	S	M	S	M	S
CO4	S	S	S	M	S	S	M	S	M	S
CO5	S	S	S	S	S	S	M	S	S	S

Level of Correlation between CO and PO	L-LOW	M-MEDIUM	S-STRONG

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
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List of Skill Based Elective Course (SEC) for M.Sc., Microbiology
SYLLABUS - LOCF-CBCS Pattern
EFFECTIVE FROM THE ACADEMIC YEAR 2023-2024 Onwards

S. No.	SEM	COURSE_CODE	TITLE OF THE COURSE
1	II	23M2PMIS01	VERMITECHNOLOGY
2	III	23M3PMIS02	ORGANIC FARMING AND BIOFERTILIZER TECHNOLOGY
3	IV	23M4PMIS03	MICROBIAL QUALITY CONTROL AND TESTING

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M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PMIS01	**VERMITECHNOLOGY**	**SEC THEORY - I**	**II**	**2**	**2**	**-**	**-**	**2**
Objective	To understand the basic concepts of vermicomposting process.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction to Vermiculture** - Definition, classification, history, economic importance- In sustainable agriculture, organic farming, earthworm activities, soil fertility & texture, soil aeration, water impercolation, decomposition & moisture, bait & food and their value in maintenance of soil structure. Its role in the bio transformation of the residues generated by human activity and production of organic fertilizers. Choosing the right worm. Useful species of earthworms. Local species of earthworms. Exotic species of earthworms. Factors affecting distribution of earthworms in soil.	K1-K2	06
II	**Earthworm Biology and Rearing** - Key to identify the species of earthworms. Biology of *Eisenia fetida.* a) Taxonomy Anatomy, physiology and reproduction of Lumbricidae. b) Vital cycle of *Eisenia fetida*: alimentation, fecundity, annual reproducer potential and limiting factors (gases, diet, humidity, temperature, PH, light, and climatic factors). Biology of *Eudrilus eugeniae*. c) Taxonomy Anatomy, physiology and reproduction of Eudrilidae. d) Vital cycle of *Eudrilus eugeniae*: alimentation, fecundity, annual reproducer potential and limit factors (gases, diet, humidity, temperature, PH, light, and climatic factors).	K1-K3	06
III	**Vermicomposting Process** - Feeds for Vermitech systems- Animal manures- Kitchen Waste and Urban waste- Paper pulp and card board solids- Compost and waste products - Industrial Wastes. Vermicomposting Basic process- Initial pre-composting phase- Mesophilic phase - Maturing and stabilization phase- Mechanism of Earthworm action. Methods of vermicomposting - a) windrows system; b) wedge system; c) container system-pits, tanks & cement rings; commercial model; beds or bins-top fed type, stacked type, d) Continuous flow system.	K3	06
IV	**Vermicomposting -** Trouble Shooting-Temperature-Aeration - Acidity- Pests and Diseases- Ants, rodents, Birds, Centipedes, sour crop, Mite pests. Odour problems. Separation techniques - Light Separation-Sideways Separation - Vertical Separation-Gradual transfer. Harvesting Earthworms - manual method- migration method. Packing & Nutritional analysis of vermicompost.	K4	06

V	**Applications of Vermiculture** - Vermiculture Bio-technology, use of vermi castings in organic farming/horticulture, as feed/bait for capture/culture fisheries; forest regeneration. Application quantity of vermicompost in Agricultural fields- crops, fruits, vegetables & flowers. By-products and value-added products - Verm wash - vermicompost tea - vermi meal-enriched vermicompost - pelleted vermicompost.	K1-K5	06
Course Outcome	**CO1:** Remember the basic concepts of uses of vermicompost to the soil.	K1	
	CO2: Understand the knowledge about the different species of earthworms and their factors.	K2	
	CO3: Apply the vermicompost production methods and their mechanisms.	K3	
	CO4: Analyze the Best Practices of Vermicomposting such harvesting and packing.	K4	
	CO5: Evaluate the applications of vermicompost to different soils and different crops.	K5	

Learning Resources	
Text Books	1. Rathoure A. K., Bharati P. K. and Ray J. (2020). Vermitechnology, Farm and Fertilizer. Vermitechnology, Farm and Fertilizer Discovery Publishing House Pvt. Ltd. 2. Christy M. V. 2008. Vermitechnology, (1st Edition), MJP Publishers.
Reference Books	1. Roy D. (2018). Handbook of Vermi technology. Lambert Academic Publishing. 2. Lekshmy M. S., Santhi R. (2012). Vermi technology, Sara Publications, New Delhi, India. 3. Edwards CA, Arancon NQ Sherman R L. (2011) Vermi culture Technology: Earthworms, Organic Wastes, and Environmental Management 1st edn. CRC Press.
Website Link	1. https://en.wikipedia.org/wiki/Vermicompost 2. https://composting.ces.ncsu.edu/vermicomposting-2/ 3. https://rodaleinstitute.org/science/articles/vermicomposting-for-beginners/

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M2PMIS01	**VERMITECHNOLOGY**	**SEC THEORY - I**	**II**	**2**	**2**	**-**	**-**	**2**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	M	S	M	M	S	S
CO2	S	S	S	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW				M-MEDIUM				S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, model preparation and Kahoot app
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
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M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PMIS02	**ORGANIC FARMING AND BIOFERTILIZER TECHNOLOGY**	**SEC THEORY - II**	**III**	**2**	**2**	**-**	**-**	**2**
Objective	Students learn about the importance, types, advantages of organic farming, biofertilizer and sustainable agriculture							

Unit	Details	Knowledge Levels	Sessions
I	**Organic farming** – Principles of Organic Farming, Need of organic farming. Steps of Organic Farming - Basic steps and Successful Organic Transition. Organic manures, vermicompost, green manure, organic residue, biofertilizer soil amendments. Integrated pest and weed management - Use of biocontrol agents, biopesticides etc. Organic and Conventional farming, Chemical and Organic farming. Organic Farming vs Conventional Farming. Crop Rotation	K2	6
II	**Certification and Schemes** - Certification and Schemes. Organic certification in brief. Integrated farming system- definition, goal and components. Factors affecting ecological balance. Land degradation. Soil health management. Models of IFS for rain fed and irrigated conditions and different categories of farmers. Government schemes - NPOF, NHM, HMNEH, NPMSH & F and RKVY.	K3	6
III	**Biofertilizers** - Introduction, types, advantages and future perspective. Introduction, status and scope. Structure and characteristic features of bacterial biofertilizers - *Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium* and *Frankia*. Cyanobacterial biofertilizers - Anabaena, Nostoc, *Hapalosiphon* and fungal biofertilizers - VAM mycorrhiza and ectomycorhiza.	K4	6
IV	**Bio-geochemical cycles** - Carbon, Nitrogen, Sulfur and Phosphorous cycles. Nitrogen fixation - Free living and symbiotic nitrogen fixation. Mechanism of phosphate solubilization and phosphate mobilization, potassium solubilization.	K4	6
V	**Production technology** – Strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid bio-fertilizers. FCO specifications and quality control of biofertilizers. Application technology for seeds, seedlings, tubers. Biofertilizers - Storage, shelf life, quality control and	K5	6

	marketing. Factors influencing the efficacy of biofertilizers. **Current Trends-* Role of Biofertilizer in Organic Farming***		
Course Outcome	**CO1:** Illustration of biofertilizers and distinguish between organic and conventional farming.	K2	
	CO2: Development of Plana Complete Farm Business including marketing, operation and financial outline.	K3	
	CO3: Analyze the application of microbial bio-fertilizers in large scales, thereby increasing soil fertility	K4	
	CO4: Conclude the methods of cyanobacteria in fertilizer production	K4	
	CO5: Evaluate the quality of packaging, storage, increases life, accelerate the inefficacy of biofertilizers as per BIS standards	K5	

Learning Resources	
Text Books	1. Gaur A. C. (2006). Hand book of Organic Farming and Biofertilizers. Ambika Book Agency. 2. Rakshit A and Singh H.B. (2015).ABC of Organic Farming. (1st Edition). Jain Brothers. 3. Subba Rao N.S. (2017). Bio-fertilizers in Agriculture and Forestry. (4th Edition).Med Tech publisher.
Reference Books	1. Bhoop and G., Ram Prasad. (2019). Biofertilizer for sustainable agriculture and 2. Bansal M. (2019). Basics of Organic Farming. CBS Publisher.
Website Link	1. https://agritech.tnau.ac.in/org_farm/orgfarm_introduction.html. 2. https://www.fao.org/organicag/oa-faq/oa-faq6/en/ 3. https://www.ccd.ngo/sustainable-agriculture.html?gclid=EAIaIQobChMI5a-KndCo-wIV2ZZLBR1ozQj9EAAYAiAAEgJW2_D_BwE
Self-Study Material	1. https://www.india.gov.in/topics/agriculture/organic-farming 2. https://agriculture.nagal and.gov.in/bio-fertilizer/

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PMIS02	**ORGANIC FARMING AND BIOFERTILIZER TECHNOLOGY**	**SEC THEORY - II**	**III**	**2**	**2**	**-**	**-**	**2**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	S	S	M	S
CO2	S	S	M	S	M	S	S	S	S	S
CO3	S	M	S	S	S	M	M	S	S	M
CO4	S	S	M	S	M	S	S	S	S	S
CO5	S	S	S	S	M	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
Mrs.N.Sathyabama	Dr.M.Selvan	Dr.S.Shahitha

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE
(Autonomous)
Rasipuram - 637408.

M.Sc - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4PMIS03	**MICROBIAL QUALITY CONTROL AND TESTING**	**SEC THEORY - III**	**IV**	**4**	**2**	**2**	**-**	**2**
Objective	Students learn the various microbiological quality standards for food, water and air regulatory practices and policies							

Unit	Course Content	Knowledge Levels	Sessions
I	**Concepts of quality control techniques** - quality assurance, Total Quality Management (TQM) Continuous Quality Improvement (CQI) Quality Assurance (QA) pre analytical and post analytical techniques, ATCC, MTCC, microbial based assay.	K1	6
II	**Waste water microbiology** – types and sources of contamination, prevention of water borne diseases. Water management, water harvesting and water recycling. Characteristics of waste water from industries - Sugar factory, Pulp & Paper mill, Distillery, Textile, Engineering, Food Industry, Domestic waste. Waste water treatment plant types and quality control. Water pollution causes and remedies.	K3	8
III	**Microflora of water.** Microbiological analysis of water sample. Microbiological analysis of water sample collection, drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests Control of microbes in water: Water borne pathogens, water borne diseases. Control of water borne pathogens - Precipitation, chemical disinfection, filtration, high temperature, UV light.	K4	10
IV	**Microflora of air** - Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres. Collection of air samples and analysis. Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, isolation and Identification. Control Measures of Bioaerosols - UV light, HEPA filters, desiccation, Incineration.	K4	10
V	**Quality control in food** - Food X ray inspection, PPE Equipment, IoT sensors, preventive quality control and reality quality control. Quality control of pharma products. Quality assurance framework, assessment of pharmaceutical quality, determinants of pharmaceutical quality, practical approaches to	K5	10

	quality assurance. **Current Trends-* The importance of Microbiological Quality Control in Food Industry***		
	…… Self Study.		
Course Outcome	**CO1:** Find out the knowledge in quality control techniques	K1	
	CO2: Apply the various parameters of waste water treatment	K3	
	CO3: Survey the quality of water using various methods	K4	
	CO4: Analyze the methods for determining air contaminants	K4	
	CO5: Perceive the quality control techniques for food and pharmaceutical products	K5	

Learning Resources	
Text Books	1. Dubey R.C. and Maheshwari D. K. (2010). Practical Microbiology. S. Chand. 2. Rosamund M. Baird., Norman A. (2019). Handbook of Microbiological quality control in Pharmaceuticals and Medical Devices. CRC Press. 3. Adams M. R. and Moss M. O. (2006). Food Microbiology. (2nd Edition). Royal Society of Chemistry.
Reference Books	1. David Roesti, Marcel Goverde (2019). Pharmaceutical Microbiological Quality Assurance and control: Practical guide for non- sterile Manufacturing. Wiley Publishers. 2. Cullimore D. R. (2010). Practical Atlas for Bacterial Identification. (2nd Edition). Taylor & Francis
Website Link	1. https://www.fssai.gov.in 2. https://www.who.int/news-room/fact-sheets/detail/food-safety 3. https://www.fda.gov/food/hazard-analysis-critical-control-point-haccp/haccp- principles-application-guidelines
Self-Study Material	1. https://gtllab.org/food-safety-microbiological-quality-control-testing

	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M4PMIS03	**MICROBIAL QUALITY CONTROL AND TESTING**	**SEC THEORY - III**	**IV**	**4**	**2**	**2**	**-**	**2**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	M	M	S	M	S
CO2	S	S	S	S	S	M	M	S	M	M
CO3	S	S	S	S	S	M	M	S	M	S
CO4	S	S	S	S	S	M	M	S	M	M
CO5	S	S	S	S	S	M	M	S	M	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By Member Secretary**
Dr.N.Sudhakar	Dr.M.Selvan	Dr.S.Shahitha

M.Sc- Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PMIIS1	**INTERNSHIP**	**INTERNSHIP**	**III**	**-**	**-**	**-**	**-**	**2**
Objective	To give optimum exposure on the practical aspects of Microbiology industry							

S. No.	Guidelines for Internship Training Programme	Knowledge Levels	Sessions
1	The student should undergo **15 Days Internship** training in any Microbiology lab / Food industry / Poultry farm / Water plant / Biofertilizer industry during the vacation which falls at the end of the 2nd Semester.	K2-K4	
2	The training bridges the gap between the theoretical knowledge gained in the college and the practical application of the same in the industry / company / stores. The student will have a better exposure about the workplace and its nuances.		
3	Schedule of visit to be made by the staff is to be prepared by the HOD / Staff-in-charge.		
4	The trainees should strictly adhere to the rules and regulations and office timings of the institutions to which they are attached.		
5	A Staff member of a Department (Guide) will be monitoring the performance of the Candidate.		
6	The students should maintain a daily logbook where the student should record his details of the training.		
7	The trainees have to obtain a certificate on successful completion of the internship from the chief executive of an organization.		
8	The student should submit an attendance certificate to the institution for 15 days internship training from an organization.		
9	Internship Training Report (30 – 50 pages) should be prepared by the student and submitted in a month's time and at the end of the semester student should present the report with a power point presentation.		
10	Industrial training reports shall be prepared by the students under the supervision of the faculty of the department.		
11	Industrial training report must contain the following: Cover page Copy of training certificate, Profile of an industry report about the work undertaken by them during the tenure of training observation about the concern findings.		
12	Practical viva – voce examination will be conducted with internal & external examiners at the end of the **3rd semester** and the credits will be awarded.		

13	Report Evaluation: External Viva-Voce examination will be conducted and the maximum mark is 100.		
Course Outcome	**CO1:** Apply new techniques and ideas in microbiology industry	K3	
	CO2: Analyze the results of new initiatives	K4	
	CO3: Create a new work plan with greater output	K6	
	CO4: Create a framework of work execution ideas	K6	
	CO5: Create a detailed technical work plan and terminologies to be followed in industry.	K6	

Learning Resources	
Text Books	1. The Successful Internship by H. Frederick Sweitzer, Mary A. King, 2013. 2. Social Media Tools in Experiential Internship Learning by Samuel Kai Wah Chu, 2020.
Reference Books	1. The Intern Files: How to Get, Keep and Make the Most of Your Internship by Jamie Fedorko, 2006.
Website Link	1. http://gen.lib.rus.ec/

M.Sc - Microbiology LOCF-CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PMIIS1	**INTERNSHIP**		**INTERNSHIP**		**III**	**-**	**-**	**-**	**-**	**2**
CO-PO Mapping										
CO Number	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO2	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**
CO3	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO4	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**
CO5	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
Level of Correlation between CO and PO		L-LOW		M-MEDIUM			S-STRONG			
Tutorial Schedule						-				
Teaching and Learning Methods						-				
Assessment Methods						**CIA – 100 Marks** 1. Work Log Book – 25 Marks 2. Training Report and Viva-Voce – 75 Marks				

Designed By	**Verified By**	**Approved By Member Secretary**
Dr.M.Selvan	Dr.M.Selvan	Dr.S.Shahitha

M.Sc., Microbiology LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4PMIPR1	**PROJECT WORK**	**PROJECT WORK**	**IV**	**12**	**-**	**-**	**12**	**6**
Objective	To inculcate/impart skills on experiment designing, experiment execution and research report to provide skills on writing thesis dissertation							

Details	Course Content	Knowledge Levels	Sessions
PROJECT PREPARATION FORMAT			
Cover Page & Title Page	**Cover Page & Title Page:** The fonts and locations of various items on this page should be exactly as shown in a specimen copy**.**		
Inside cover page	Inside cover page Same as cover page.		
Bonafide Certificate	**Bonafide Certificate**: The Bonafide Certificate shall be in double line spacing using Font Style Times New Roman and Font Size 14.		
Acknowledgement	**Acknowledgement:** This should not exceed one page.		
Abstract	**Abstract:** Abstract should be one page synopsis of the project report typed double line spacing, Font Style Times New Roman and Font Size 14.		
Contents	**Table of Contents:** The table of contents should list all headings, sub headings after the table of contents page, as well as any titles preceding it. The title page and Bonafide Certificate will not find a place among the items listed in the Table of Contents. One and a half spacing should be adopted for typing the matter under this head.		
Tables	**List of Tables**: The list should use exactly the same captions as they appear above the tables in the text. 1.5 spacing should be adopted for typing the matter under this head.		
Figures	**List of Figures**: The list should use exactly the same captions as they appear below the figures in the body of the text. One and a half spacing should be adopted for typing the matter under this head. All charts, graphs, maps, photographs and diagrams should be designated as figures. X and Y axes titles are mandatory for all the graphs.		
Symbols	**List of Symbols, Abbreviations and Nomenclature:** 1.5 spacing should be adopted or typing the matter under this head. Standard symbols, abbreviations etc. should be used.		
Chapters	**Chapter I - Introduction:** Statement of the Problem, Significance, Need for the study, Objectives		
	Chapter II- Review of literature		
	Chapter III- Methodology: Tools used, Procedures, Hypothesis.		
	Chapter IV- Results and Discussion: Tables and Figures, Statistical Presentations, Hypothesis Testing.		

	Chapter V- Summary and conclusion		
	Chapter VI- Scope of the Project		
	References		
Guidelines For Project Preparation			
Numbering	• Every page in the project report, except the project report title page, must be accounted for and numbered. • The page numbering, starting from acknowledgements and till the beginning of the introductory chapter, should be printed in small Roman numbers, i.e, i, ii, iii, iv • The page number of the first page of each chapter should not be printed (but must be accounted for). All page numbers from the second page of each chapter should be printed using Arabic numerals, i.e. 2,3,4,5. • All printed page numbers should be located at the right corner at the bottom of the page.	K4-K6	
Chapters	• Use only Arabic numerals. Chapter numbering should be centered on the top of the page using large bold print. <Size 14><Times New Roman>	K4-K6	
TEXT			
Regular Text	**Regular Text**: Times Roman 12 pts and normal print.	K4-K6	
Chapter Heading	**Chapter Heading -** Times Roman 14 pts. Bold and capital.	K4-K6	
Section Headings	**Section Headings -** Times roman 12 pts. Bold and capital.	K4-K6	
Subsection Headings	**Subsection Headings -** times roman 12 pts. bold print and Leading capitals i.e, only first letter in each word should be in capital.	K4-K6	
Special Text	**Special Text-** Italics/Superscript /Subscript/Special symbols, etc., as per necessity. Special text may include footnotes, endnotes, physical or chemical symbols, mathematical notations, etc.	K4-K6	
Sections	**Sections:** Use only Arabic numerals with decimals. Section numbering should be left justified using bold print. Example: 1.1, 1.2, 1.3, etc.	K4-K6	
Sub Sections	**Sub Sections:** Use only Arabic numerals with two decimals. Subsection numbering should be left Justified using bold print. Example: 1.1.1, 1.1.2, 1.1.3, etc.	K4-K6	
References	Use only Arabic numerals. Serial numbering should be carried out based on Alphabetical order of surname or last name of first author. The format is written like, author name followed by year followed by title of the work followed by details of the journal. Same font as regular text, serial number and all authors names to be in bold print. Title and Journal names should be in italic.	K4-K6	

	One Author: Williams, G. State and Society in. Onco State, Nigeria, Afrographika, 1980. Two Authors: Phizacklea, A & Miles, R. Labour and Racism. London, Routledge & Kegan Paul, 1980. 3+ Authors: O'Donovan, P., *et al*. The United States. Amsterdam, Time-Life International, 1966.		
Typing Instructions	**Typing Instructions:** The impression on the typed copies should be black in color. One and a half spacing should be used for typing the general text. The general text shall be typed in the Font style 'Times New Roman' and Font size 12. Use A4 (210 mm X 297 mm) bond un-ruled paper (80 gsm) for all copies submitted. Use one side of the paper for all printed/typed matter.	K4-K6	
Justification	**Justification:** The text should be fully justified	K4-K6	
Margins	**Margins:** The margins for the regular text are as follows LEFT - 1.5" RIGHT - 1" TOP - 1" BOTTOM - 1"	K4-K6	
Paragraph Spacing	Use 6 pts before & 6 pts after paragraphs. All paragraphs in the seminar/project report should be left justified completely, from the first line to the last line. Use 1.5 spacing between the regular text and quotations. Provide double spaces between: (a) From top of page to chapter title, (b) Chapter title and first sentence of a chapter, Use single spacing (a) In footnotes and endnotes for text. (b) In explanatory notes for tables and figures. (c) In text corresponding to bullets, listings, and quotations in the main body of seminar/project report. (d) Use single space in references and double space between references.	K4-K6	
Tables	All tables should have sharp lines, drawn in black ink, to separate rows/columns as and when necessary. Tables should follow immediately after they are referred to for the first time in the text. Splitting of paragraphs, for including tables on a page, should be avoided. Provide double spaces on the top and the bottom of all tables to separate them from the regular text, wherever applicable. The title of the table etc. should be placed on the top of the table. The title should be centered with respect to the table. The titles must be in the same font as the regular text and should be single	K4-K6	

	spaced.		
Figures	All figures, drawings, and graphs should be drawn in black ink with sharp lines and adequate contrast between different plots if more than one plot is present in the same graph. The title of the figure etc. should be placed on the bottom of the figure. Figures should follow immediately after they are referred to for the first time in the text. Splitting of paragraphs, for including figures on a page, should be avoided. Provide double spaces on the top and the bottom of all figures to separate them from the regular text, wherever applicable. Figures should be centered with respect to the figure. The titles must be in the same font as the regular text and should be single spaced. The title format is given below: Fig. <blank><chapter number>.<serial number><left indent><figure	K4-K6	
Page Dimension & Binding Specifications	The project report should be prepared in A4 size. The dissertation shall be properly bound; The bound front cover should indicate in Silver and embossed letter.		
Course Outcome	**CO1:** Identification of research idea	K4	
	CO2: Analyze of problem solving skills	K4	
	CO3: Analyze sources for conduct of Research	K4	
	CO4: Evaluate the research report	K5	
	CO5: Create the research report	K6	
Learning Resources			
Text Books	1. Research Methodology: Methods and Techniques, by C.R. Kothari, New Age Publications, 2009.		
Reference Books	1. Research Methodology: Methods and Techniques by C.R. Kothari, New Age Publications, 1985. 2. Essentials of Research Design and Methodology by: Geoffrey R. Marczyk, David DeMatteo, David Festinger, 2005.		
Website Link	1. http://gen.lib.rus.ec/		

M.Sc-Microbiology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M4PMIPR1	**PROJECT WORK**	**PROJECT WORK**	**IV**	**12**	**-**	**-**	**12**	**6**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	M	M	L	S	L	M	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S
CO3	S	S	S	S	S	S	S	S	M	M
CO4	S	S	S	M	S	S	S	S	M	M
CO5	M	M	M	S	S	M	M	S	L	S

Level of Correlation between CO and PO	L-LOW	M-MEDIUM	S-STRONG

Tutorial Schedule	-
Teaching and Learning Methods	-
Assessment Methods	**EA - 100%** 1. Project Report - 150 Marks 2. Viva-Voce - 50 Marks 3. Total - 200 Marks

Designed By	**Verified By**	**Approved By Member Secretary**
Dr. M.Selvan	**Dr. M.Selvan**	Dr.S.Shahitha

M.Sc., Microbiology for Competitive Examination Syllabus - LOCF-CBCS-Pattern with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4PMIOE1	**Microbiology for Competitive Examination**	**Self- study Online - Competitive Examination**	**IV**	**-**	**-**	**-**	**-**	**2**
Objective	Creating the awareness on competitive examination among students. Imparting knowledge about appearing for Competitive Examination and it impacts and developing an attitude for appearing such Examinations.							

	Course Content	**Knowledge Levels**	**Sessions**
	Assemblage of different papers related to Microbiology in particular, General Microbiology, Immunology, Bacteriology, Mycology, Virology, Food, Dairy, Environmental and Agri. Microbiology etc., Major emphasis has been put forth to include recent developments in the subjects. This course aims to give a holistic view of all the topics which comprised of some factual text points, multiple choice questions (MCQ), it is extremely suitable for students pursuing their higher degree in University/institute for their entrance exams, students preparing for various national and state level competitive entrance exams such as ICAR-JRF/SRF/NET/ARS, IARI/NDRI Ph.D., SAUs; CSIR/UGC-NET/JRF/SRF; ICMR, DBT, GATE, BARC, II Sc, JNU, BHU, etc. to get admission in Ph.D., Microbiology. In addition, it is also useful for UPSC and PSC. **Rules for creating MCQ pattern.** 1. Objective type online examination will be conducted at the end of 4th semester. 2. Questions must be taken from all previous question papers of CSIR-NET, SET, NEET, UPSC, IBPS and Common Entrance Test for Ph.D. 3. **Test for critical thinking**. Multiple choice questions to test the superficial knowledge. Learners to interpret facts, evaluate situations, explain the causes and effect, make inferences, and predict the results. 4. **Emphasize for Higher-Level Thinking** Use memory-plus, application oriented questions. These questions require students to recall the principles, rules and facts in a real life context. **Eg.1**	K1- K6	

Ability to Justify Methods and Procedures

Why is adequate lighting necessary in a balanced aquarium?

a. Fish need light to see their food.
b. Fish take in oxygen in the dark.
c. Plants expel carbon dioxide in the dark.
d. Plants grow too rapidly in the dark.

Eg.2

Ability to Interpret Cause-and-Effect Relationships

What does a viral DNA becomes after being associated with the bacterial chromosome?
a) plasmid
b) plaque
c) prophage
d) gene

5. Mix up the order of the correct answers

Keep correct answers in random positions and don't let them fall into a pattern that can be detected

6. **Use a Question Format**

Multiple-choice items to be prepared as questions (rather than incomplete statements)

Incomplete Statement Format:

The capital of California is in Direct Question Format------ Less Effective.

In which of the following city is the capital of California? This is Best format.

7. **Keep Option Lengths Similar**

Avoid making your correct answer the long or short answer

8. **Avoid the "All the Above" and "None of the Above" Options**

Students merely need to recognize two correct options to get the answer correct

	9. HOD's instruct to the faculty to prepare minimum 500 questions booklet (cumulatively for each programme) with solutions and circulate among the students.		
Course Outcome	**CO1:** Students will remember the advanced biochemical and molecular techniques.	K1	
	CO2: Students will be able to understand the basic rules and the concepts.	K2	
	CO3: To be able to apply in real life situations.	K3	
	CO4: To analyze and create the new ideas for various competitive examinations.	K4-K5	
	CO5: To assess forms and levels of critical thinking.	K2	
Text Books	1. Tortora, G.J., Funke, B.R. and Case, C.L. (2016) Microbiology: An Introduction, 11th Edition, Pearson Education, India.		
	2. Owen, J., Punt, J and Strand ford, S. "Kuby Immunology", 7th Ed., W.H. Freeman Publication, New York, USA, 2012.		
	3. Watson JD, Hopkins NH, Roberts JW et al. (1987) Molecular Biology of the Gene, 4thedn. Menlo Park, CA: Benjamin-Cummings		
	4. Brown, T.A. 1995.Gene Cloning–An Introduction. [Third Edition]. Chapman and Hall, UK.		
	5. Mcq's In Microbiology: Advanced by Balaram Mohapatra., 2019.		
Reference Books	1. Chetan D. M., Dr. S. Nanjunda Swamy, (2021). Microbiology Multiple-Choice Questions (Mcqs) For Neet and Net Examinations.		
Website Link	https://www.ugc.ac.in/old pdf /model curriculum/env.pdf https://swayam.gov.in/nc_details/NPTEL		

M.Sc., Microbiology for Competitive Examination Syllabus - LOCF-CBCS-Pattern with effect from 2023-2024 Onwards										
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**		
23M4PMIOE1	**MICROBIOLOGY FOR COMPETITIVE EXAMINATION**	**SELF-STUDY ONLINE - COMPETITIVE EXAMINATION**	**IV**	**-**	**-**	**-**	**-**	**2**		
CO - PO Mapping										
CO Number	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	S	S	S	S	M	S	S	M	S	S
CO2	S	M	S	S	S	S	S	S	S	M
CO3	M	S	S	S	S	M	S	S	S	S
CO4	S	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	M	S	S	S	S	S
Level of Correlation between CO and PO					L-LOW		M-MEDIUM		S-STRONG	
Tutorial Schedule	NET/SET/GATE/CET/TRB /NEET Old question papers – solutions –online mock test									
Teaching and Learning Methods	Self-study, Group discussion, Chalk and Talk, Audio-Video Learning, learning through mock test and experienced learning									
Assessment Methods	100 multiple choice questions through computer based online examinations passing minimum is 50%									
Prepared By			**Verified By**				**Approved By Member Secretary**			
Dr.S.Anbalagan			Dr.M.Selvan				Dr.S.Shahitha			