M.Sc., MICROBIOLOGY

SYLLABUS

PROGRAMME CODE: 2PSMIC

2026-2028

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE
(AUTONOMOUS)
(Affiliated to Bharathidasan University,Tiruchirappalli)
(Accredited by NAAC)
SUNDARAKKOTTAI, MANNARGUDI – 614 016
TAMIL NADU, INDIA.

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TAMILNADU, INDIA.

M.Sc., MICROBIOLOGY
CHOICE BASED CREDDIT SYSTEM– LEARNING OUTCOMES BASED CURRICULUM FRAME WORK (CBCS–LOCF)
(For the Candidates admitted in the academic year 2026-2027)

CHOICE BASED CREDIT SYSTEM

The credit-based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice-based credit system provides a „cafeteria" type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning. Our college have has moved to CBCS and implemented the grading system.

OUTCOME-BASED EDUCATION (OBE)
LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

The fundamental premise underlying the learning outcomes-based approach to curriculum planning and development is that higher education qualifications are awarded on the basis of demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values) and academic standards expected of graduates of a programme of study. Learning outcomes specify what graduates completing a particular programme of study are expected to know, understand and be able to do at the end of their programme of study. The expected learning outcomes are used as reference points that would help formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes which in turn will help in curriculum planning and development, and in the design, delivery and review of academic programmes. They provide general guidance for articulating the essential learnings associated with programmes of study and courses with

in a programme, maintain national standards and international comparability of learning outcomes and academic standards to ensure global competitiveness, and to facilitate student/graduate mobility and provide higher education institutions an important point of reference for designing teaching-learning strategies, assessing student learning levels, and periodic review of programmes and academic standards.

Some important aspects of the Outcome Based Education Course: is defined as a theory, practical or theory cum practical subject studied in a semester. Course Outcomes (COs): are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Generally three or more course outcomes may be specified for each course based on its weightage. Programme: is defined as the specialization or discipline of a Degree. Programme Outcomes (POs): Programme outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

Programme Specific Outcomes (PSOs): PSOs are what the students should be able to do at the time of graduation with reference to a specific discipline. Some important terminologies repeatedly used in LOCF. Core Courses (CC) A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. These are the courses which provide basic understanding of their main discipline. In order to maintain a requisite standard certain core courses must be included in an academic program. This helps in providing a universal recognition to the said academic program.

Discipline Centric Elective Courses (DCEC): Elective course may be offered by the main discipline/subject of study is referred to as Discipline Centric Elective Course (DCEC). These courses offer the flexibility of selection of options from a pool of courses. These are considered specialized or advanced to that particular programme and provide extensive exposure in the area chosen; these are also more applied in nature. Generic Elective Courses An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. Generic Elective courses are designed for the students of other disciplines. Thus, as per the CBCS policy, the students pursuing particular disciplines would have to opt Generic Elective courses offered by other disciplines, as per the basket of courses offered by the college. The scope of the Generic Elective (GE) Courses is positively related to the diversity of disciplines in which programme are being offered by the college. Ability Enhancement Compulsory Courses “AECC” are the courses based upon the content that leads to Knowledge enhancement especially in Communicative English and other soft skills.

Non Major Elective Course (NMEC): A student shall choose atleast two Non-major Elective Course (NMEC) outside his/her department.

Skill Enhancement Courses (SECs): These courses focus on developing skills or proficiencies in the student, and aim at providing hands-on training. Skill enhancement courses can be opted by the students of any other discipline, but are highly suitable for students pursuing their academic programme. These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

Field Study/Industrial Visit/Case Study: It has to be completed during the fifth semester of the degree programme. Credit for this course will be entered in the fifth semester‟s marks statement.

Internship: Students must complete internship during summer holidays after the fourth semester. They have to submit a report of internship training with the necessary documents and have to appear for a viva-voce examination during fifth semester. Credit for internship will be entered in the fifth semester‟s mark statement.

Extra Credit Courses: In order to facilitate the students, gaining knowledge/skills by attending online courses MOOC, credits are awarded as extra credits, the extra credit are at three semesters after verifying the course completion certificates. According to the guidelines of UGC, the students are encouraged to avail this option of enriching their knowledge by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTEL etc.

EXAMINATION

Continuous Internal Assessment (CIA):

PG - Distribution of CIA Marks

Passing Minimum: 50 %

Assignments – 3 = 30%

Tests- 2 = 50%

Seminar=10 %

Attendance= 10 %

Question Paper Pattern

Part A:

Part A 1 (10X1=10 marks)

One word question/ Fill in/ Match the following/True or False/ Multiple Choice Questions

Two Questions from Each unit

Part A 2 (5X2=10 marks)

Short Answers

One question from Each unit

Total Marks – 20

Part B: (5X4=20 marks)

Paragraph Answers

Either/ or type, One Questions from each unit

Part C: (10X3=30)

Essay Type Answers

Answer 3 out of 5 Questions

One Question from each unit

Part A: K1 Level

Part B: K2, K3 and K4 Level

Part C: K5 and K6 Level

Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S. No.	Level	Parameter	Description
1	K1	Knowledge/Remembering	It is the ability to remember the previously learned
2	K2	Comprehension Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analysing	The learner distinguishes among different parts
5	K5	Evaluation/Evaluating	The learner justifies a stand or decision
6	K6	Synthesis /Creating	The learner creates a new product or point of view

WEIGHTAGE of K – LEVELS IN QUESTION PAPER

(Cognitive Level) K- LEVELS →	Lower Order Thinking			Higher Order Thinking			Total
	K1	K2	K3	K4	K5	K6	
END SEMESTER EXAMINATIONS (ESE)	20	20		30			**70**
Continuous Internal Assessment (CIA)	10	10		10			**30**

QUESTION PATTERN FOR SEMESTER EXAMINATION/ Continuous Internal Assessment		
PART		**MARKS**
PART –A I. (No choice ,One Mark) **TWO** questions from each unit **II.** (No choice ,Two Mark) **ONE** question from each unit	**(**10x1 =10) **(**5x2 =10)	20
PART -B (Either/ or type, 5-Marks) **ONE** questions from each unit	(5x4 =20)	20
PART -C (3 out of 5) (10 Marks) **ONE** question from each unit	(3x10 =30)	30
	Total	**70**

BLUE PRINT OF QUESTION PAPER FOR SEMESTER EXAMINATION							
DURATION: 3. 00 Hours.							**Max Mark : 100**
K- LEVELS	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	**Total**
PART							**Marks**
PART –A (One Mark, No choice) (10x1 =10)	10						10
(2-Marks, No choice) (10x2=20)	10						10
PART –B (4- Marks) (Either/or type) (5x4=25)		8	8	4			20
PART -C (10 Marks) (3 out of 5) (3x10=30) Courses having only **K5,K6** levels, K5 level- 3 Questions, K6 level- 2 Questions **(One K6 level question is compulsory)**					20	10	30
Total	**20**	**08**	**8**	**4**	**20**	**10**	**70**

EVALUATION

GRADING SYSTEM

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added and converted as final mark. The marks thus obtained will then be graded as per the scheme provided in Table-1.

Grade Point Average (GPA) will be calculated from the first semester onwards for all semester. From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by semester Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA) , respectively. These two are calculated by the following formulae:

$GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{I=1}^{n} C_i}$	$WAM \text{ (Weighted Average Marks)} = \frac{\sum_{i=1}^{n} C_i M_i}{\sum_{I=1}^{n} C_i}$
Where, C_i is the Credit earned for the Course i G_i is the Grade Point obtained by the student for the Course i M_i is the marks obtained for the course i and n is the number of Courses **Passed** in that semester.	

CGPA: Average GPA of all the Courses starting from the first semester to the current semester.

CLASSIFICATION OF FINAL RESULTS:

i) For each of the first three parts, there shall be separate classification on the basis of CGPA, as indicated in Table-2.

ii) For the purpose of declaring a candidate to have qualified for the Degree of Bachelor of Arts/Science/Commerce/Management as Outstanding/Excellent/Very Good/Good/Above Average/Average, the marks and the corresponding CGPA earnedby the candidate in Part-III alone will be the criterion, provided the candidate has secured the prescribed passing minimum in the all the Five parts of the Programme.

iii) Grade in Part –IV and Part-V shall be shown separately and it shall not be taken into account for classification.

iv) A Pass in PART- V will be mandatory although the marks will not count for the calculation of the CGPA.

v) Absence from an examination shall not be taken an attempt.

Table-1: Grading of the Courses - PG

Marks Range	Grade Point	Corresponding Grade
90 and above	10	O
80 and above and below 90	9	A+
70 and above and below 80	8	A
60 and above and below 70	7	B+
50 and above and below 60	6	B
40 and above and below 50	5	C
Below 40	0	RA

Table- 2: Grading of the Courses - PG

Marks Range	Grade Point	Corresponding Grade
90 and above	10	O
80 and above and below 90	9	A+
70 and above and below 80	8	A
60 and above and below 70	7	B+
50 and above and below 60	6	B
Below 50	0	RA

Table-3: Final Result

CGPA	Corresponding Grade	Classification of Final Result
9.00 and above	O	Outstanding
8.00 to 8.99	A+	Excellent
7.00 to 7.99	A	Very Good
6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average
4.00 to 4.99	C	Average
Below 4.00	RA	Re-appearance

VISION

Empowering the women students with quality education on utility of microbes, microbial processes, products, to make them academics and entrepreneurs to serve for the welfare of society.

MISSION

- To initiate, promote, develop, sustain quality and innovative research using sophisticated instruments in the field of Microbiology.
- To motivate the students so as to exploit the potentiality of microbes and microbial processes for the betterment of the society

PROGRAMME OUTCOMES FOR M.Sc., DEGREE PROGRAMMES

PO No.	Programme Outcomes (*Upon completion of the M.Sc. Degree Programme, the Postgraduate will be able to)*
PO-1	**Disciplinary Knowledge**: demonstrate in-depth knowledge and understanding of theories, policies, and practices in one or more disciplines that form a part of a Post Graduate program of study in Master of Science.
PO-2	**Critical Thinking and Problem Solving**: apply analytic thought to a body of knowledge, analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence, identify relevant assumptions or implications, formulate coherent arguments, critically evaluate practices, policies and theories by following scientific approach to knowledge development: solve problems and extrapolate the same to real life situation
PO-3	**Information/digital literacy and Communication Skills:** use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources, and use appropriate software for analysis of data: communicate thoughts and ideas analytically and effectively in writing and orally using appropriate media, and present complex information in a clear and concise manner to different groups.
PO-4	**Research-related skills:** conduct independent inquiry in a chosen scientific discipline, demonstrate sense of inquiry and capability for asking relevant/appropriate questions, problematising, synthesizing and articulating; recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; plan, execute and report the results of an experiment or investigation.
PO-5	**Scientific reasoning and Reflective Thinking:** analyse, interpret and draw conclusions from quantitative/qualitative data and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective; critically and sensibly evaluate life experiences, with self awareness and reflexivity of both self and society.
PO-6	**Multidisciplinary Approach, Innovation and Entrepreneurship:** propose novel ideas of interdisciplinary approach in providing better solutions and new ideas for the sustainable developments; identify opportunities, entrepreneurship vision and use of innovative ideas to create value and wealth for the betterment of the individual and society.
PO-7	**Moral and ethical awareness/reasoning:** embrace moral/ethical values in conducting one‟s life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work, demonstrate the ability to identify ethical issues related to one‟s work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights, appreciate environmental and sustainability issues, and adopt objective, unbiased and truthful actions in all aspects of work.
PO-8	**Self directed Learning:** work independently, identify appropriate resources required for a project, and manage a project till completion.
PO-9	**Lifelong Learning:** engage in continuous learning for professional growth and development, acquire knowledge and skills, adapt to changing environment and to changing trades and demands of work place through knowledge/skill development/reskilling.
PO-10	**Multicultural Competence, Social Interaction and Effective Citizenship:** understand the values and beliefs of multiple cultures, global perspectives, engage and interact respectfully with diverse groups and elicit views of others, mediate disagreements and help reach conclusions in group settings,and demonstrate empathetic social concern and equity centred national development

PROGRAMME SPECIFIC OUTCOME (PSO) FOR M.Sc., DEGREE PROGRAMMES

PSO No.	Program Specific Outcomes (M.Sc., Microbiology)
PSO1	**Placement:** To prepare the students who will demonstrate respectful engagement with others‟ ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.
PSO2	**Entrepreneur:** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations
PSO3	**Research and Development:** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.
PSO4	**Contribution to Business World:** To produce employable, ethical and innovative professionals to sustain in the dynamic business world.
PSO5	**Contribution to the Society:** To contribute to the development of the society by collaborating withstakeholders for mutual benefit

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M.Sc., MICROBIOLOGY
CHOICE BASED CREDIT SYSTEM-LEARNINIG OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)
(Applicable to the candidates admitted from the academic year 2026-2027)

ELIGIBILITY: A candidate who is a graduate of this University or any recognized University in B.Sc., with Biotechnology/Biochemistry/Botany/Zoology/Microbiology/Bioinformatics/ Biology/ Life sciences/ B.Sc., with Biological Sciences as one of the subjects (B.E / B.Tech in Biotechnology) B.Pharm / B.Sc., Agriculture/ B.Sc., Horticulture.

Sem.	Course	Course code	Course Title	Ins. Hrs.	Credit	Exam Hrs.	Marks		Total
							Int.	Ext.	
I	Core Course-I (CC-I)	P26MB101	General Microbiology	6	4	3	30	70	100
	Core Course -II (CC-II)	P26MB102	Biological Macromolecules	6	4	3	30	70	100
	Core Practical -I (CP-I)	P26MB103P	General Microbiology & Biological Macromolecules Practical	6	4	3	40	60	100
	Discipline Centric Elective Course-I (DCEC-I)	P26MBDE11A	Virology	5	4	3	30	70	100
		P26MBDE11B	Applied Biological Sciences						
		P26MBDE11C	Microbial Ecology						
	Generic Elective Course-I (GEC-I)	P26MBGE11A	Microbial diversity and Extremophiles	5	3	3	30	70	100
		P26MBGE11B	Marine Microbiology						
		P26MBGE11C	Microbes in waste management						
	Skill Enhancement Course-I (SEC-I)	P26SEMB11	Probiotic Microbiology	2	2	3	30	70	100
	Value Added Course-I (VAC-I)*	P26MBVA11	Smart Microbiology: AI Tools and Applications	-	2*		30	70	100*
		Total		**30**	**21**	**-**	**-**	**-**	**600**
II	Core Course-III (CC-III)	P26MB204	Microbial Physiology and Metabolism	6	4	3	30	70	100
	Core Course-IV (CC-IV)	P26MB205	Microbial Genetics and Molecular Biology	6	4	3	30	70	100
	Core Practical-II (CP-II)	P26MB206P	Microbial Physiology and Metabolism Microbial Genetics and Molecular Biology Practical	6	4	3	40	60	100
	Discipline Centric	P26MBDE22A	Microbial Genomics and Proteomics	4	4	3	30	70	100

	Elective Course - II (DCEC - II)	P26MBDE22B	Molecular Taxonomy and Phylogeny						
		P26MBDE22C	Bioinformatics						
	Generic Elective Course-II (GEC-II)	P26MBGE22A	Next Generation Microbiology	4	3	3	30	70	100
		P26MBGE22B	Herbal technology and cosmetic microbiology						
		P26MBGE22C	Forensic science						
	Skill Enhancement Course-II (SEC-II)	P26SEMB22	Microbes in Food Processing Technology	2	2	3	30	70	100
	Non-Major Elective Course-I (NMEC-I)			2	2	3	30	70	100
		Total		**30**	**23**	**-**	**-**	**-**	**700**
Summer Internship / Industrial Activity during the Summer Vacation after 1st Year									
III	Core Course-V (CC-V)		Medical Microbiology	6	4	3	30	70	100
	Core Course-VI (CC-VI)		Immunology and Immunotechnology	6	4	3	30	70	100
	Core Practical-III (CP-III)		Medical Microbiology Immunology and Immunotechnology Practical	6	4	2	40	60	100
	Discipline Centric Elective Course - III (DCEC-III)		Research Methodology and Bioethics	5	4	3	30	70	100
			Microbiome Science						
			Microbial Quality Control and Testing						
	Generic Elective Course-III (GEC-III)		Biosafety and Intellectual Property Rights	5	3	3	30	70	100
			Life Science for Competitive Examinations						
			Biostatistics						
	Non-Major Elective Course - II (NMEC-II)			2	2	3	30	70	100
	Internship / Industrial Activity @			-	2	-	20	80	100
	Value Added Course -II (VAC-II)*		Advances in Data Science Using Python and R Programming	-	2*	-	30	70	100*
			Total	**30**	**23**	**-**	**-**	**-**	**700**
IV	Core Course -VII (CC-VII)		Environmental and Agriculture Microbiology	6	4	3	30	70	100
	Core Course -VIII (CC-VIII)		Food and Dairy Microbiology	6	4	3	30	70	100
	Core Practical-IV (CP-IV)		Environmental and Agriculture Microbiology, Food and Dairy Microbiology Practical	6	4	3	40	60	100
	Discipline Centric		Industrial and Pharmaceutical Microbiology	4	4	3	30	70	100

	Elective Course - IV (DCEC-IV)		Clinical Research and Clinical Trials						
			Microbial Biotechnology and Genetic engineering						
	Entrepreneurship / Industry Based Course		Entrepreneurship in Microbiology	3	3	3	30	70	100
	Project Work @			5	5	-	20	80	100
	Extra Credit Course** other than VAC		MOOC- NPTEL /SWAYAM**	-	2**	-	-	-	-
		Total		**30**	**24**	**-**	**-**	**-**	**600**
		Grand Total		**-**	**91**	**-**	**-**	**-**	**2600**

LIST OF NON -MAJOR ELECTIVE COURSE

S.No	Semester	Course Code	Course Name
	II	P26NMEMB21	Human and Microbes
	III		Public Health Microbiology

LIST OF DISCIPLINE CENTRIC ELECTIVE COURSE

S.No.	Semester	Discipline Centric Elective Course (DCEC)
Discipline Centric Elective Course-I (DCEC-I)		
1	I	Virology
2		Applied Biological Sciences
3		Microbial Ecology
Discipline Centric Elective Course-II (DCEC-II)		
1	II	Microbial Genomics and Proteomics
2		Molecular Taxonomy and Phylogeny
3		Bioinformatics
Discipline Centric Elective Course-III (DCEC-III)		
1	III	Research Methodology and Bioethics
2		Microbiome Science
3		Microbial Quality Control and Testing
Discipline Centric Elective Course-IV (DCEC-IV)		
1	IV	Industrial and Pharmaceutical Microbiology
2		Clinical Research and Clinical Trials
3		Microbial Biotechnology and Genetic Engineering

LIST OF GENERIC ELECTIVE COURSE (GEC)

S.No.	Semester	Generic Elective Course (GEC)
Generic Elective Course -I (GEC-I)		
1	I	Microbial diversity and Extremophiles
2		Marine Microbiology
3		Microbes in waste Management
Generic Elective Course -II (GEC-II)		
1	II	Next Generation Microbiology
2		Herbal technology and cosmetic microbiology
3		Forensic Science
Generic Elective Course -III (GEC-III)		
1	III	Biosafety and Intellectual Property Rights
2		Life Science for competitive examinations
3		Biostatistics

SUMMARY OF CURRICULUM STRUCTURE OF PG PROGRAMMES: SCIENCE

Sl. No.	Types of the Course	No. of Courses	Credits for each Course	Total Credits	Marks
1.	Core Course (CC)	8	4	32	800
2.	Core Practical (CP)	4	4	16	400
3.	Discipline Centric Elective Course (DCEC)	4	4	16	400
4.	Generic Elective Course (GEC)	3	3	9	300
5.	Skill Enhancement Course (SEC)	2	2	4	200
6.	Non-Major Elective Courses (NME)	2	2	4	200
7.	Internship / Industrial Activity @	1	2	2	100
8.	Entrepreneurship / Industry Based Course	1	3	3	100
9.	Project Work @	1	5	5	100
Total		**26**	**-**	**91**	**2600**
Value Added Courses *		2*	2	4*	200

*	**The value added courses credit will not be included in the total CGPA . These courses are extra-credit courses. Instruction hours for these courses is 30 hours**
@	Summer Internship will be carried out during the summer vacation after the First year. Viva Voce will be conducted by the college and Marks shall be sent to the University and the same will be included in the 3rd semester Mark Statement. **Summer Internship / Industrial Activity& Project:** **Scheme of Evaluation:**

Description	Marks
Report	80
Viva	20
Total	100

SEMESTER I

Semester: I- CC-I: General Microbiology

Ins. Hours / Week: 6 **Course Credit: 4** **Course Code: P26MB101**

COURSE OBJECTIVES

- Master classification systems for bacteria, viruses, and fungi using Bergey's and Baltimore models.
- Analyze how pathogens use secretion systems and toxins to invade hosts and evade immunity.
- Understand the replication and structural diversity of DNA/RNA viruses**,** subviral agents, and parasitic organisms.
- Explore the beneficial and harmful roles of fungi and microbes in lichens, mycorrhiza, and ecosystems.
- Apply translational diagnostics and One Health strategies to manage AMR and emerging infectious diseases.

UNIT-I **(18 Hours)**

Microbial Diversity and Classification: Microbial evolution and diversity; Microbial taxonomy and its relationship to phylogeny: Classical taxonomy, molecular taxonomy; classification of microorganisms: Bergey's manual of determinative bacteriology and systematic bacteriology; Bergey's manual of systematics of archaea and bacteria.

UNIT- II **(18 Hours)**

Bacteriology: Structure of bacteria (eubacteria and archaebacteria – basic) - Bacterial secretion systems (Sec, Tat, Type I–III) - Bacterial toxins (exotoxins and endotoxins – types and action) - Mechanism of bacterial pathogenesis - Transmission and reservoirs of infection - Bacterial adhesion and invasion of host cells - Basic concepts of host–pathogen interaction - Virulence factors and immune evasion

UNIT- III **(18 Hours)**

Virology: Origin of viruses (basic theories) - Structure and types of viruses (DNA and RNA viruses) - Subviral agents (viroids, prions, satellite viruses) - Cultivation and purification of viruses - Life cycle of viruses (lytic and lysogenic cycles) - Classification of viruses (Baltimore and ICTV systems) - Replication of DNA and RNA viruses.

UNIT- IV **(18 Hours)**

Mycology and Parasitology: Classification of fungi - Beneficial roles of fungi (enzymes, antibiotics, organic acids) - Harmful effects of fungi (mycotoxins, diseases) - Symbiotic associations (mycorrhiza, lichens) - General features of protozoa and helminths - Classification

of protozoa and helminths - Host–parasite interactions.

UNIT- V **(18 Hours)**

Microbiome in health and disease: Emerging and re-emerging infectious diseases (COVID-19, antimicrobial resistance) - Antimicrobial resistance (AMR) and resistance mechanisms - Antimicrobial agents (antibiotics, antivirals, antifungals – antiparasitic drugs antiprotozoal and antihelminthic)– Translational diagnostics (PCR, ELISA, rapid tests) - One Health concept and global health perspectives.

UNIT- VI

Microbiome and Health: Importance of microbial communities in Human, Animal, and Plant systems; Soil-Plant-Human microbiome links. Modulation: Impact of Diet and Environment on microbiome diversity. Metagenomics Tools: Using NCBI and MG-RAST for data analysis; creating OTU Mapping Files and metadata collection. Global Monitoring: Tracking daily news and research on AMR, COVID-19 updates, and microbial evolution.

Total Lecture Hours – 90

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Classify microorganisms using Bergey's Manual and molecular taxonomy to understand microbial phylogeny.
2. Analyze the molecular mechanisms of bacterial pathogenesis, including secretion systems and toxin actions.
3. Describe the structural types, cultivation methods, and replication cycles of DNA and RNA viruses.
4. Explain the symbiotic associations of fungi and the host-parasite interactions of protozoa and helminths.
5. Evaluate global health threats like AMR and COVID-19 using translational diagnostics and the One Health concept.
6. Critically evaluate and communicate recent advancements in microbiome science using bioinformatics tools (NCBI/MG-RAST) to map OTUs and analyze the integrated links between soil, plant, and human health.

TEXT BOOK(S)

1. Gerard J. Tortora, Berdell R. Funke, Christine L. (2025) Case. Recent edition widely used internationally for undergraduate microbiology courses. Pearson
2. Tortora, G. J., Funke, B. R., and Case, C. L. (2022). Microbiology: An introduction (13th ed.). Pearson.
3. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., and Stahl, D. A. (2021). Brock biology of microorganisms (16th ed.). Pearson.
4. Willey, J. M., Sherwood, L. M., and Woolverton, C. J. (2020). Prescott's microbiology

(11th ed.). McGraw-Hill Education.

5. Pelczar, M. J., Chan, E. C. S., and Krieg, N. R. (2017). Microbiology (5th ed.). McGraw-Hill Education.
6. Whitman, W. B. (Ed.). (2015–2023). Bergey's manual of systematic bacteriology (2nd ed., Vols. 1–5). Springer.
7. Arora, D. R., and Arora, B. (2021). Ananthanarayan and Paniker's textbook of microbiology (11th ed.). Universities Press.

REFERENCE BOOK(S)

1. Joan Slonczewski, John Foster, Erik Zinser. 2025. Excellent for modern microbiology, genomics and microbial evolution. W.W. Norton.
2. Brock Biology of Microorganisms (16th Edition, 2021) – *Madigan, Bender, et al.*
3. Prescott's Microbiology (12th Edition, 2022) – *Willey, Sandman, and Wood.*
4. The Human Microbiome Handbook (2020) – *Jason Tetro and Raymond Tellier.*
5. Jawetz, Melnick, & Adelberg's Medical Microbiology (28th Edition, 2019/2022 Reprint) – *Riedel, Morse, et al.*
6. Metagenomics: Methods and Protocols (3rd Edition, 2021) – *Wolfgang R. Streit and Rolf Daniel.*
7. ICTV Virus Taxonomy: Classification and Nomenclature of Viruses (Current Online Edition/Reports) – *ICTV.*
8. Bergey's Manual of Systematics of Archaea and Bacteria (Digital Edition/Latest Volumes) – *Wiley-Blackwell.*
9. The Gut Microbiome in Health and Disease (2022) – *Dirk Haller.*

E-RESOURCES

1. Microbe Online
2. https://journals.asm.org/journal/spectrum
3. https://pubmed.ncbi.nlm.nih.gov/
4. BMC Microbiology

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	POs										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1	2	2	3	3			3					3		3
CO2	1	2		3	3	3		3	3		2	3	3		
CO3	1			3	3	3		3	3	3		2	3		
CO4	1			3				3	3		2	3	3		
CO5	1	2	2	3	3	3		3	3			3	3		3

Strong -3; Medium -2; Low - 1

Semester: I- CC-II: Biological Macromolecules

Ins. Hours / Week: 6 **Course Credit: 4** **Course Code: P26MB102**

COURSE OBJECTIVES

- To understand the structure, classification, digestion and biological importance of carbohydrates, proteins and amino acids.
- To study the structure, properties and functions of lipids, fatty acids and nucleic acids.
- To gain knowledge about human endocrine glands, hormones and the role of phytohormones in plants.
- To learn the sources, functions and deficiency disorders of vitamins and minerals.
- To understand the composition, functions and coagulation of blood.

UNIT-I **(18 Hours)**

Carbohydrate: Definition, sources, classification, structure of glucose, biological significance, digestion and absorption. Proteins: Definition, sources, classification and structure of proteins (Primary, secondary, tertiary), Amino acids–structure- classification - essential and nonessential, protein and non-protein amino acids.

UNIT-II **(18 Hours)**

Lipids: Definition, sources, classification, structure, properties and functions, Fatty acids-saturated, unsaturated and essential fatty acids. Nucleic acids: Definition, structure, forms and functions of DNA. Types, structure and functions of RNA (mRNA, tRNA, rRNA).

UNIT-III **(18 Hours)**

Hormones: Definition, classification of hormones, Human- Endocrine glands – Pituitary, thyroids, Para thyroid, pancreas, adrenal, testis and ovary. Phytohormones: Structure and functions of auxin, gibberellins, cytokinins and abscissic acid.

UNIT-IV **(18 Hours)**

Vitamins: Definition, sources, deficiency syndromes and functions of Fat soluble vitamins (A, D, E and K) and Water-soluble vitamins (B complex and C). Minerals Zn, Ca, Iodine, Fe, and Mg.

UNIT-V **(18 Hours)**

Blood: Introduction, origin, composition, characterization, functions and coagulation of blood. General account and secondary metabolites. Major and accessory microbial pigments –

chlorophylls, carotenoids, phycobilins and anthocyanins.

UNIT – VI

Current Contours (Continuous Internal Assessment only): Applications of biomolecules in health and disease, Clinical importance of carbohydrates, proteins and lipids, Hormonal disorders and metabolic diseases, Nutritional importance of vitamins and minerals, Biochemical role of blood components, Industrial and medical applications of microbial pigments and secondary metabolites.

Total Lecture Hours - 90

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Gain the knowledge of structure and function of biological molecules.
2. Discuss the interrelationship between various biomolecules and consequences of deviation from normal.
3. Understand the structure and functions of blood, hormones and phytohormones.
4. Provide the information about basic metabolic regulators' characteristic features.
5. Able to explain the interrelationships among biological energy, functions and health.
6. Explain the structure, functions, clinical significance, and applications of biomolecules.

TEXT BOOKS

1. Freifelder, D. 2004. Molecular Biology, 2nd edition, Narosa Publishing House. New Delhi, India.
2. Campbell, M.K. 2007. Biochemistry, 5th edition, Cengage Learning India Pvt Ltd. Noida, Uttar Pradesh, India.
3. Voet, D., Voet, J. 2011. Bichemistry, 4th edition, John Wiley and Sons Inc. Hoboken, New Jersey, USA.
4. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A.F., Levine, M., Losick, R.M. 2013. Molecular Biology of the Gene, 7th edition, The Benjamin & Cummings Publishing Company. Menlo Park, California, USA.
5. Amit Kumar Nayak, Amal Kumar Dhara, Dilipkumar Pal, 2021, Biological Macromolecules: Bioactivity and Biomedical Applications, Elsevier Science & Technology Books, Cambridge, USA / UK.
6. J.M. Holt (2004), Energetics of Biological Macromolecules (Methods in Enzymology, Vol. 380), Academic Press, San Diego, USA.
7. Devlin, T.M. 2010. Text Book of Biochemistry with clinical correlation, 7th Edition, John Wiley & Sons. Hoboken, New Jersey, USA

REFERENCE BOOK(S)

1. Nelson, D.L., Cox, M.M. 2012. Lehninger Principles of Biochemistry. 6th edition, Mac Millan Eworth Publishers. London, United Kingdom.
2. Bender, D.A., Kennelly, P.J., Rodwell, V.M. 2015. Harpers Illustrated Biochemistry. 30th edition, The McGraw-Hill companies, Inc. New York, USA.
3. Lewin, B. 2013. Genes XI. Student edition, Jones & Bartlett Learning. Burlington, Massachusetts, USA.
4. Geoffrey L. Zubay 1998. Biochemistry, William C. 4th edition, Brown Publishers.
5. Berg, J.M., Tymoczko, J.L., Stryer, L., 2011. Biochemistry, 11th edition, W.H. Freeman and Company. New York, USA.
6. Bender, D.A. 2003. Nutritional biochemistry of vitamins, 2nd edition, Cambridge University Press. London.

E-RESOURCES

1. https://ocw.mit.edu/courses/biology/7-51-graduate-biochemistry-fall-2001/download-course-materials/
2. https://online-learning.harvard.edu/course/principles-biochemistry-1
3. https://pubs.acs.org/doi/abs/10.1021/ed084p1866
4. https://www.mooc-list.com/course/principles-biochemistry-edx
5. https://www.mooc-list.com/course/biochemical-principles-energy-metabolism-coursera

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	POs										PSOs				
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CO5	1	2		3	3	3	2	3	3	3			3		3

Strong -3; Medium -2; Low - 1

Semester: I- CP-I: General Microbiology and Biological Macromolecules (P)

Ins. Hours / Week: 6 **Course Credit: 4** **Course Code: P26MB103P**

COURSE OBJECTIVES

- Understand and apply the principles of sterility, sterilization, decontamination, and laboratory safety practices in microbiology laboratories.
- Prepare and use different types of culture media, cleaning solutions, and laboratory glassware for microbiological experiments.
- Develop skills in microscopic observation and identification of bacteria, fungi, yeast, and cyanobacteria using staining and visualization techniques.
- Apply micrometry techniques for counting and measuring microorganisms accurately.
- Understand the principles and applications of biochemical estimation methods for carbohydrates, proteins, amino acids, lipids, cholesterol, nucleic acids, pigments, and hemoglobin.

General Microbiology

1. Sterility control test
2. Principles and methods of sterilization, decontamination and laboratory fumigation, Preparation and use of glassware cleaning solutions.
3. Staining and direct microscopic observations of bacterial shape-cocci, rods and chains; fungal spore- mycelium, yeast budding
4. Preparation of media: Liquid and Solid media, Agar deep, slant and plate and soft agar.
5. Pure culture techniques - serial dilution - pour plate, spread plate, streak plate methods, decimal dilution and stab culture techniques.
6. Bacterial Staining methods - simple, Gram's, acid fast, flagella, capsule and spore.
7. Fungal Staining methods - Lacto-phenol cotton blue.
8. Motility of bacteria - Hanging drop and soft agar inoculation.
9. Enumeration of microorganisms from soil: Bacteria, Fungi and Actinomycetes, total count (Haemocytometer).
10. Isolation of cyanobacteria, actinomycetes and fungi.
11. Micrometry – counting & measurements of microbes

Biological Macromolecules

Quantification of Macromolecules

1. Carbohydrate reducing sugars - Anthrone method/Benedicts method.
2. Amino acids - Ninhydrin method
3. Protein - Lowry‟s method/ Biuret method
4. Cholesterol estimation - Acetic anhydride method,
5. Estimation of lipid.
6. DNA - Diphenylamine method
7. RNA - Orcinol method
8. Determination of Phosphorous content of nucleic acids - perchloric acid test.
9. Pigments (chlorophyll - carotenoids – phycobiliproteins) – Spectrophotometric
10. Estimation of Hemoglobin on Blood.
11. Immobilization of cell: RBC

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Apply microscopic techniques and staining methods for the identification and differentiation of microbes.
2. Acquire knowledge on the sterilization techniques
3. Learning the quantification of macromolecules in industrial point of view.
4. Describe the separation of industrially important molecules like pigments.
5. Applications of various instruments to analyse the quality of macromolecules in a solution.
6. Summarize the immobilization of Blood cells.

TEXT BOOKS

1. Bharti Arora. (2025). Practical Microbiology 3Ed. CBS Publishers & Distributors.
2. Dubey R.C. and Maheshwari D. K. (2022). Practical Microbiology. S. Chand Publisher, Bangalore
3. Cappuccimo, J. and Sherman, N. (2002). Microbiology: A Laboratory Manual, (6th Edition). Pearson Education, Publication, New Delhi.
4. Cullimore D. R. (2010). Practical Atlas for Bacterial Identification. (2nd Edition). - Taylor &Francis, New Delhi
5. Boyer, R. 2001. Modern Experimental Biochemistry, 3rd edition, Benjamin and Cummings Publishing Company Inc.

6. Wilson, K., Walker, J. 2000. Practical Biochemistry Principles and Techniques, 5th Edition, Cambridge University Press.
7. Palanivel P. 2013. Analytical Biochemistry and Separation Techniques – A laboratory manual. Twenty first century publications.
8. Rajan S and Selvi Christy R. (2015) Experiments in Microbiology. Anjana Books House, Chennai.

REFERENCE BOOK(S)

1. James G Cappuccino (2014) Microbiology – A Laboratory Manual. 10th edition, Pearson Education India.
2. Nizhny Novgorod. (2008) Laboratory manual on Biochemistry: Publishing House of Nizhny Novgorod State medical academy.
3. Shawn O' Farrell and Ryan T Ranallo. (2000) Experiments in Biochemistry: A Hands on Approach-A manual for the undergraduate laboratory, Thomson Learning, Inc., Australia.
4. Collee J. G., Fraser A.G. Marmion B. P. and Simmons A. (1996). Mackie & McCartney Practical Medical Microbiology. (14th Edition). Elsevier, New Delhi.
5. Jayaraman, J. 1981. Laboratory manual in Biochemistry, New Age International Publishers, New Delhi.
6. Plummer, D.T. 1987. An introduction to Practical Biochemistry, 3rd edition, Tata McGraw Hill, New Delhi.

E-RESOURCES

1. http://textbookofbacteriology.net/
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC149666/
3. https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/pages/lecture-notes/
4. Lehninger Principles of Biochemistry (8th Edition) By David L. Nelson and Michael M. Cox Book Free Download - StudyMaterialz.in
5. https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	POs										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1	2		3	3	3		3	3			3	3		
CO2	1			3	3			3	3		2	3	3		
CO3	1	2	3	3	3			3	3		2	3	3		
CO4	1	2		3	3			3	3		2	3	3	3	
CO5	1	2		3	3	3		3	3	3	2	3	3	3	

Strong -3; Medium -2; Low - 1

Semester: I- Discipline Centric Elective-I (Choice-1)- Virology

Ins. Hours / Week: 5 Course Credit: 4 Course Code: P26MBDE11A

COURSE OBJECTIVES

- To enhance understanding on the basics of viruses, virus discovery, properties, classification & replication of viruses.
- To provide a complete over- view of bacteriophages' diversity, typing, cultivation & applications.
- To describe representative animal viruses, their cultivation and investigations strategies.
- To present important plant viruses, their cultivation, control and investigations methods.
- To highlight emerging viruses, current status of controlled/ eradicated viruses, common control / preventive measures, and viral cancer.

UNIT-I (15 Hours)

Viruses and Fundamentals: Virus – Virion - Discovery of Viruses – Properties of Viruses – Classification of Viruses (LHT, Baltimore and ICTV) - Ultra structure of Viruses – Sub viral agents- viroids, prions, virusoids and satellite viruses – Replication of Viruses - Virus attachment, Initiation of infection, cellular receptor for viruses, entry of viruses, genome replication, assembly, Packaging signals, packaging of segmented genome, acquisition of an envelope, budding strategies.

UNIT-II (15 Hours)

Bacterial Viruses: Bacteriophages – Classification - Structure and life cycle - T4 Phage, MS2, Lambda Phage, Mu Phage, M13 Phage, P1 Phage – lytic and lysogenic life cycles - Bacteriophage typing, Phage therapy, Cyanophages, Mycoviruses (Mycophages), Rhizobiophages – Cultivation strategies of phages from sewage and other ecosystem – Importance of phages in pollution control.

UNIT-III (15 Hours)

Animal and Human Viruses: Classification - Structure, Multiplication, Pathogenesis, Diagnosis, Prevention and Treatment of following animal viruses – Papovaviridae (Human Papilloma Virus), Adenoviridae, Herpesviridae (Chicken Pox), Poxviridae (Human monkey pox), Hepadnaviridae (HBV), Picornaviridae (Polio Virus), Rhabdoviridae (Rabies virus),

Orthomyxoviridae (Swine- Flu), Pneumoviridae (HRSV), Reoviridae (Rota Virus), Retroviridae (HIV) Flaviviridae (Chikungunya virus) and Coronaviridae (SARS-CoV2) - Cultivation of human viruses- Embryonated eggs, Tissue culture and cell culture – Purification of viruses - Serological and immunological methods of diagnosis.

UNIT-IV **(15 Hours)**

Plant Viruses: Classification– TMV, CMV, CaMV & Geminiviruses. Transmission of plant viruses – Symptoms of viral infection in plants - Control of plant viral diseases - Cultivation of Plant viruses – Meristem culture –- Common viral diseases in paddy, cotton, tomato and sugar cane - Name of diseases, pathogens and symptoms. Generation of virus-free planting material.

UNIT-V **(15 Hours)**

Emerging Viruses, Oncogenic Virus and Control of Viruses: Control of Viruses - requirement of an effective vaccine, different ways of making vaccine, types of vaccine. Anti-viral drugs - Theories on origin of virus, evolution of new viruses, emerging viruses, Factors that drive viral emergence - viral cancer, transformation and oncogenesis-Virus-induced cancer, Avian leucosis retroviruses, Proviral DNA sequences, Proto-oncogenes, DNA tumor Viruses, the link between DNA virus biology and transformation. Current status of polio and small pox viruses.

UNIT-VI

Current Contours (Continuous Internal Assessment only): Advanced case studies from reliable sources, scientific models making / poster preparation on viral epidemics, viral transmissions, preventions, traditional methods of infection prevention shall be given as assignments and seminars. Group discussions in class rooms on methods of viral infection prevention/ control in a community and about emerging viruses. Pursuing a Swayam- NPTEL course on 'Techniques in virology' should be encouraged.

Total Lecture Hours - 75

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Acquire a strong knowledge on virus properties and multiplication cycle.
2. Be skilled with steps in bacterial, plant and animal virus infection, transmission, patterns of infection, virus virulence, and host defense against virus infection.
3. Upskill the methods of making virus vaccines and anti-viral drugs, factors of virus evolution, and emerging viruses.
4. Have an understanding of unusual viral infectious agents (sub-viral agents), virus mediated cellular transformation and oncogenesis.
5. A knowledge on methods of viral cultivation, purification and assays.

6. Demonstrate an understanding of viral diseases, modes of transmission, prevention and control measures.

TEXT BOOKS

1. Alan J. Cann. 2015. Principles of Molecular Virology. 6th edition, Academic press, California.
2. John Carter and Venetia Saunders. 2013. Virology: Principles and applications, 2nd Edition, John wiley and son's publishers, USA.
3. Roger Hull. Mathews' Plant Virology, 4th edition, Academic press- A Harcourt Science and technology company, New York. 2002.
4. Martinez J. Hewlett, David Camerini, David C. Bloom. 2021. Basic Virology, Fourth Edition, Wiley Blackwel.,New Jersey
5. Shilpa U. Nair 2015. Virology – A condensed review, 3rd edition, CBS Pulicahers & Distributor, New Delhi.
6. Saravanan. P. 2006. Virology. MJP Publishers,Chennai.
7. Baijayanthimala Mishra. 2025. Textbook of Medical Virology. 2nd edition; CBS Pulicahers & Distributors.
8. Rajan S and Kumaresan. S. 2007. Virology. Saras Publications.
9. Malik B.S. / Malik M. 2024. COURSE OBJECTIVES: & short answer questions in Vetrinary Virology. 2nd edition. CBS Pulicahers and Distributors.

REFERENCE BOOK(S)

1. Flint, S. J., Enquist, L. W., Racaniello, V. R., and Skalka, A. M. 2015. Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses, 4th ed. 944 pp. ASM Press, Washington, DC.
2. Dimmock. N.J and Eatson, A.J., Leppard, K.N. 2016. Introduction to Modern Virology. VII edition. Blackwell Scientific Publications, Oxford.7th Edition.
3. Kenneth M Smith. 1972. A text book of plant viral diseases, 3rd edition, Elsevier Inc, New York.
4. Maureen A Harrison and Ian F Rae. 2010. General techniques of cell cultures, Cambridge University Press, England.
5. Nicklin J, Greame Cook and Killington, R. 2003. Instant notes in Microbiology, 2nd Edition, Viva Books private Limited, New Delhi.
6. Michale J. Pelczar JR., ECS Chan, Noel R. Krieg. 2025. Pelczar Microbiology. 7th edition; EMP.
7. Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley & David A. Stahl. 2017. Brock Biology of Microorganisms. 14th edition. Pearson.

8. Rajan S and Selvichristy J. 2018. Essentials of Microbiology, CBS Publishers, New Delhi.
9. Robert I Krasner. 2002. The Microbial challenge: Human Microbe Interaction, American Society for Microbiology, 2nd edition, Washington.
10. Topley and Wilson's. 1990. Principles of Bacteriology, Virology and Immunity. VIII edition Vol. IV Virology, Edward Arnold, London.

E-RESOURCES

1. https://www.nature.com/scitable/topicpage/the-origins-of-viruses-14398218/
2. https://bsppjournals.onlinelibrary.wiley.com/doi/10.1111/j.1364-3703.2011.00752.x
3. https://www.sciencedirect.com/journal/virology
4. https://www.news-medical.net/health/What-is-Virology.aspx
5. https://www.sciencedirect.com/science/article/pii/S0160412019305410.
6. https://journal.hep.com.cn/fese/EN/article/downloadArticleFile.do?attachType=PDF&id=28677.
7. https://www.nature.com/scitable/topicpage/the-origins-of-viruses-14398218/
8. https://www.sciencedirect.com/journal/virology
9. https://www.news-medical.net/health/What-is-Virology.aspx
10. https://www.coursera.org/courses?query=virus.

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUCOME

CO	POs										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1			3	3	2	2	3	3	3	2	3	3	3	3
CO2	1	2	2	2	3	2	2	3	3	3	2	3	3	3	3
CO3	1	2	2	3	3	3	2	3	3	3	2	3	3	3	3
CO4	1	2		3	3			3	3		2	3	3		
CO5	1	2		3	3	3	2	3	3	3	2	3	3	3	3

Strong -3; Medium -2; Low - 1

Semester: I-Discipline Centric Elective- I(Choice-2)- Applied Biological Science

Ins. Hours / Week: 5 **Course Credit: 4** **Course Code: P26MBDEAAB**

COURSE OBJECTIVES

- To enable the students to understand the basics components of biology
- To understand the biological diversity, uniqueness and their characteristic features.
- To study the importance of biological sciences in human welfare
- To educate about the farm animals developmental principles and essential qualities
- To create an awareness as to ensure nature based activities and minimize usage of experimental animals.

UNIT – I **(15 Hours)**

Algae and Fungi: Thallophytes: Algae-General characteristics- Economic importance. Types of life cycle- Outline of various classifications. Fungi: General characteristics- Classifications and Economic importance

UNIT – II **(15 Hours)**

Cryptogamic Plants: General characteristics- Economic importance and outline of reproduction methods in Lichens, Bryophytes, Pteridophytes and Gymnosperms. Stelar evolution.

UNIT – III **(15 Hours)**

Phanerogamic Plants: Salient features of monocot and dicot. Taxonomy: Systems of classification, (Artificial, Phylogenetic and Natural). Morphometric diversity: Morphology; types of inflorescences. Technical description of flower and floral diagram and types of fruits. Economic importance.

UNIT – IV **(15 Hours)**

Invertebrates: General characteristics and outline classification up to classes in Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda and Echinodermata; Economic importance of invertebrates. General characters - a brief study on Star fish.

UNIT – V **(15 Hours)**

Vertebrates: Classification of Chordata – General characteristic features and Classification (up to the orders) – Prochordata, Pisces, Amphibia Reptilia, Aves and Mammalia- Economic importance of Vertebrates. Farm animals – Controlling of breeding animals.

UNIT –VI Current Contours (Continuous Internal Assessment only)

Bioluminescence. Principles of insect control: physical, mechanical, chemical, biological and integrated methods of pest control. Cell cultures and line lines.

Total Lecture Hours - 75

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Describe the general characteristics, classification and economic importance of algae and fungi.
2. Explain the characteristics, reproductive methods, and economic significance of cryptogamic plants.
3. Analyze the morphological features, classification systems, fruit types, and economic importance of monocotyledonous and dicotyledonous plants.
4. Classify major groups of invertebrates up to class level, explain their characteristic features, and evaluate their economic importance.
5. Illustrate the classification and characteristic features of vertebrates and their economic importance and breeding management in farm animals.
6. Apply knowledge of contemporary biological concepts such as bioluminescence, insect pest control methods in biological sciences and agriculture.

REFERENCES

TEXTBOOKS

1. Willey, J., Sherwood, L., and Woolverton, C. (2023). *Prescott's microbiology* (12th ed.). McGraw-Hill
2. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., and Losick, R. (2021). *Molecular biology of the gene* (8th ed.). Pearson
3. Taiz, L., Zeiger, E., Møller, I. M., and Murphy, A. (2023). *Plant physiology and development* (7th ed.). Oxford University Press
4. Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., and Orr, R. (2022). *Campbell biology* (12th ed.). Pearson
5. Willey, J., Sherwood, L., and Woolverton, C. (2023). *Prescott's microbiology* (12th ed.). McGraw-Hill
6. Rai, M., and da Silva, S. S. (2022). *Biofuels and bioenergy: Processes and technologies*. CRC Press

REFERENCE BOOKS

1. Snustad, D. P., & Simmons, M. J. (2021). *Principles of genetics* (8th ed.). Wiley
2. Raven, P. H., Evert, R. F., & Eichhorn, S. E. (2022). *Biology of plants* (9th ed.). W.H. Freeman
3. Guyton, A. C., & Hall, J. E. (2021). *Textbook of medical physiology* (14th ed.). Elsevier
4. Horneck, G., & Klaus, D. M. (2021). *Space microbiology*. Springer
5. Gupta, V. K., & Tuohy, M. G. (2023). *Biotechnology of biofuels and bioproducts*. Elsevier

E-RESOURCES

1. NCBI Microbiology Resources
2. ASM Microbe Library
3. CDC Microbiology Resources
4. WHO Health Topics
5. EMBL-EBI Training Portal

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	POs										PSOs				
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CO4	1			3	3	3		3	3			3	3		
CO5	1	2	2	3	3	3	2	3	3	3		3	3	3	3

Strong -3; Medium -2; Low - 1

Semester: I- Discipline Centric Elective -I-(Choice-3) – Microbial Ecology

Ins. Hours / Week: 5 **Course Credit: 4** **Course Code: P26MBDE11C**

COURSE OBJECTIVES

- To understand the principles, scope, and diversity of microbial ecology and the role of microorganisms in various ecosystems.
- To acquire knowledge about microbial interactions, biofilms, microbiomes, and ecological relationships among living organisms.
- To explain the role of microorganisms in biogeochemical cycles, environmental processes, and climate change.
- To develop practical understanding of modern molecular, microscopic, and bioinformatics techniques used in microbial ecology studies.
- To apply microbial ecological concepts in environmental management, agriculture, industry, public health, and bioremediation practices**.**

UNIT-I **(15 Hours)**

Scope, history and development of microbial ecology; microbial diversity including bacteria, archaea, fungi, protists and viruses; microbial habitats such as soil, water, air and extreme environments; ecological principles including niche, adaptation and population dynamics; microbial growth, survival strategies and stress responses; microbial evolution and phylogeny.

UNIT-II **(15 Hours)**

Microbial interactions including mutualism, commensalism, parasitism and competition; biofilms and quorum sensing; microbial food webs and trophic interactions; host–microbe interactions in plants, animals and humans including microbiome; community assembly and succession; microbial biogeography.

UNIT-III **(15 Hours)**

Biogeochemical cycles including carbon cycle (methanogenesis, decomposition), nitrogen cycle (nitrogen fixation, nitrification, denitrification), sulfur and phosphorus cycles; microbial energetics including phototrophy, chemolithotrophy and heterotrophy; soil microbiology and

rhizosphere ecology; aquatic microbial ecology including freshwater and marine systems; role of microbes in climate change including greenhouse gas production and carbon sequestration.

UNIT-IV (15 Hours)

Culture-dependent and culture-independent techniques; molecular methods including PCR, qPCR, DGGE and 16S rRNA sequencing; metagenomics, metatranscriptomics and metaproteomics; bioinformatics tools and microbial data analysis; microscopy and imaging techniques; stable isotope probing and tracer techniques; statistical and ecological modeling.

UNIT-V (15 Hours)

Bioremediation and biodegradation of pollutants including oil, heavy metals and plastics; wastewater treatment; agricultural microbiology including biofertilizers and biopesticides; industrial applications including bioenergy, biomining and biofuels; microbial ecology in public health including pathogens and antimicrobial resistance; microbiomes, synthetic ecology and microbiome engineering.

UNIT – VI Current Contours (Continuous Internal Assessment only)

Environmental monitoring using microbial indicators, Extremophiles and their industrial significance Artificial intelligence in microbial ecology, Microbial biodiversity conservation, Biosafety and ethical issues in microbial research.

Total Lecture Hours - 75

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Acquire knowledge in the field of Microbial Ecology and phylogeny
2. Identify the interactions of microbes with various environments
3. Recognize use of bigeochemical cycling in soil fertility
4. Evaluate the novel methods used in soil microbe analysis
5. Gain knowledge on bioremediation and biodegradation
6. To evaluate microbial ecology applications in environmental monitoring, industrial biotechnology, biodiversity conservation, artificial intelligence and biosafety practices.

TEXT BOOKS

1. Ronald M. Atlas and Richard Bartha. 2025. Microbial Ecology: Fundamentals and Applications. Pearson / Benjamin Cummings
2. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., and Stahl, D. A. (2021). *Brock Biology of Microorganisms* (16th ed.). Pearson.
3. Atlas, R. M., and Bartha, R. (2019). *Microbial Ecology: Fundamentals and Applications* (5th ed.). Pearson.
4. Kirchman, D. L. (2018). *Processes in Microbial Ecology* (2nd ed.). Oxford University

Press.

5. Prosser, J. I., (2019). *Principles of Microbial Ecology***.** Wiley-Blackwell.

REFERENCE BOOK(S)

1. Thompson, L. R., Sanders, J. G., and McDonald, D., (2017). A communal catalogue reveals Earth's multiscale microbial diversity. *Nature*, 551, 457–463.

2. Delgado-Baquerizo, M., Oliverio, A. M., and Brewer, T. E., (2018). A global atlas of the dominant bacteria found in soil. *Science*, 359(6373), 320–325.

3. Sunagawa, S., Coelho, L. P., and Chaffron, S., (2020). Structure and function of the global ocean microbiome. *Nature*, 348, 1261359.

4. Banerjee, S., Schlaeppi, K., and van der Heijden, M. G. A. (2018). Keystone taxa as drivers of microbiome structure and functioning. *Nature Reviews Microbiology*, 16, 567–576.

5. Trivedi, P., Leach, J. E., and Tringe, S. G., (2020). Plant–microbiome interactions: from community assembly to plant health. *Nature Reviews Microbiology*, 18, 607–621.

E-RESOURCES

1. **https://onlinecourses.nptel.ac.in**
2. **https://www.coursera.org**
3. **https://www.edx.org**
4. **https://www.ncbi.nlm.nih.gov**
5. **https://www.mg-rast.org**

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	POs										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1	2		3	3	3	2	3	3	3	2	3	3	3	
CO2	1	2	2	3	3	3	2	3	3	3	2	3	3	3	3
CO3	1	2	2	3	3	3	2	3	3	3	2	3	3	3	3
CO4	1	2	2	3	3	3	2	3	3	3	2	3	3	3	3
CO5	1	2	2	3	3	3	2	3	3	3	2	3	3	3	3

Strong -3; Medium -2; Low - 1

Semester: I- Generic Elective Course - 1-(Choice -1) Microbial Diversity and Extremophiles

Ins. Hours / Week: 5 **Course Credit: 3** **Course Code: P26MBGE11A**

COURSE OBJECTIVES

- Understand the vastness of microbial diversity across the three domains of life and the methods used to study unculturable microorganisms.
- Address challenges in understanding the physiological, structural, and molecular adaptations that allow life to thrive in extreme environments.
- Become a creative problem solver in utilizing extremophiles for novel biotechnological, industrial, and bioremediation applications.
- Understand the ecological roles of extremophiles and their significance in astrobiology and the origin of life.
- To understand the industrial and environmental applications of extremophiles and their biomolecules in biotechnology, biomining, bioremediation, pharmaceutical and commercial processes.

UNIT –I **(15 HOURS)**

Introduction to Microbial biodiversity: The Three Domains of Life (Archaea, Bacteria, Eukarya). Overview of microbial evolution and the universal phylogenetic tree. Morphological, physiological, and metabolic diversity of microorganisms. The concept of the "unculturable majority" and microbial dark matter. Introduction to culture-independent techniques (metagenomics) for exploring environmental diversity.

UNIT --II **(15 HOURS)**

Biology of Extremophiles: Definition and classification of extremophiles and polyextremophiles. Habitats of extremophiles: deep-sea hydrothermal vents, hot springs, hypersaline lakes, permafrost, subglacial lakes, and acidic mine drainage. The role of Archaea in extreme environments. Evolutionary significance of extremophiles and theories regarding the origin of life on early Earth.

UNIT -III **(15 HOURS)**

Thermophiles and Psychrophiles: Thermophiles and Hyperthermophiles: Molecular adaptations to high temperatures (membrane lipid composition, ether linkages in Archaea, thermostable proteins, chaperone proteins, and DNA reverse gyrase). Psychrophiles: Adaptations to freezing temperatures (cold-shock proteins, membrane fluidity maintenance, antifreeze proteins, and cryoprotectants).

UNIT -IV **(15 HOURS)**

Halophiles and Alkaliphiles: Halophiles: Osmoregulation mechanisms ("salt-in" vs. "compatible solute" strategies), bacteriorhodopsin, and photophosphorylation in Halobacterium. Acidophiles and Alkaliphiles: Mechanisms of intracellular pH homeostasis and specialized cell wall/membrane bioenergetics. Piezophiles (Barophiles): Adaptations to high hydrostatic pressure in the deep ocean. Polyextremophiles (e.g., *Deinococcus radiodurans* and radiation resistance).

UNIT - -V **(15 HOURS)**

Applications of Extremophiles: Industrial importance of extremozymes: Taq polymerase (PCR), thermostable amylases/proteases (detergents, food processing), and cold-adapted enzymes (biosensors, bioremediation in cold climates). Extremolytes and their applications in cosmetics and pharmaceuticals. Role of extremophiles in biomining (bioleaching of heavy metals) and the bioremediation of toxic wastes under extreme conditions.

UNIT - -VI

Current Contours (Continuous Internal Assessment only): Daily news and research papers on newly discovered extreme environments and astrobiology missions (e.g., Mars rovers, Europa Clipper). Public awareness of climate change impacts on extreme ecosystems (e.g., melting permafrost microbiomes). Computational analysis utilizing databases like the Extremophiles Database. Drafting a scientific model on how extremophile biology informs the search for extraterrestrial life.

Total Lecture Hours - 75

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Exploring the scope of microbial diversity, the Tree of Life, and modern taxonomic approaches.
2. To learn about the major extreme environments on Earth and the classification of extremophilic microorganisms.
3. To characterize the survival mechanisms of temperature-dependent extremophiles (thermophiles and psychrophiles).
4. Exploring the physiological adaptations of halophiles, alkaliphiles, acidophiles, and piezophiles.
5. Understanding the importance of extremozymes and extremolytes in industrial biotechnology.
6. To demonstrate knowledge of extremophiles in astrobiology, space research, and planetary protection.

REFERENCES

TEXTBOOKS

1. Horikoshi, K., Antranikian, G., Bull, A. T., Robb, F. T., & Stetter, K. O. (2021). *Extremophiles: Microbiology and biotechnology* (2nd ed.). Springer
2. Willey, J., Sherwood, L., & Woolverton, C. (2023). *Prescott's microbiology* (12th ed.). McGraw-Hill
3. Maier, R. M., Pepper, I. L., & Gerba, C. P. (2022). *Environmental microbiology* (4th ed.). Elsevier
4. Madigan, M., Bender, K., Buckley, D., Sattley, W., & Stahl, D. (2024). *Brock biology of microorganisms* (17th ed.). Pearson
5. Horneck, G., & Klaus, D. M. (2021). *Space microbiology*. Springer

REFERENCE BOOKS

1. Osborn, A. M., & Smith, C. J. (2020). *Molecular microbial ecology*. Garland Science

2. Atlas, R. M., and Bartha, R. (2021). *Microbial ecology: Fundamentals and applications* (5th ed.). Benjamin Cummings

3. Izard, J., and Rivera, M. C. (2021). *Metagenomics for microbiology*. Academic Press Rothschild, L. J., and Mancinelli, R. L. (2022). *Life at extremes: Environments, organisms and strategies for survival*. CABI Publishing

4. Hurst, C. J. (2023). *Manual of environmental microbiology* (5th ed.). ASM Press

E-RESOURCES

1. NCBI Microbial Genomes Resources
2. EMBL-EBI Metagenomics
3. NASA Astrobiology Program
4. Microbiology Society Resources
5. ASM Microbe Library
6. NCBI BLAST Tool
7. UniProt Protein Database
8. PDB Protein Data Bank
9. Coursera Environmental Microbiology Courses
10. edX Microbiology Courses

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	POs										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1			3	3	3		3		3			3		
CO2	1	2		3	3	3		3	3		2	3	3	3	
CO3		2		3	3			3	3			3	3	3	
CO4	1	2		3	3			3	3			3	3	3	
CO5	1	2		3	3	3		3	3			3	3	3	

Strong -3; Medium -2; Low - 1

Semester: I- Generic Elective Course -I- (Choice -2) Marine Microbiology

Ins. Hours / Week: 5 **Course Credit: 3** **Course Code: P26MBGE11B**

COURSE OBJECTIVES

- To understand the characteristics, classification, distribution and economic importance of microalgae.
- To learn the methods of isolation, cultivation, maintenance and harvesting of freshwater and marine microalgae.
- To study the applications of microalgae in food, nutraceutical, pharmaceutical, cosmetic and agricultural industries.
- To gain knowledge about the role of microalgae in environmental management, wastewater treatment and carbon sequestration.
- To understand the production of biofuels from microalgae and the concept of integrated algal biorefinery.

UNIT-I **(15 Hours)**

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

UNIT-II **(15 Hours)**

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.

UNIT-III **(15 Hours)**

Microalgae in food and nutraceutical applications - Algal single cell proteins. Cultivation of *Spirulina* and *Dunaliella.* Microalgae as Aquatic, Poultry and Cattle feed. Microalgal biofertilizers. Value-added products from microalgae. Pigments - Production of microalgal carotenoids and their uses. Phycobiliproteins - production and commercial applications. Polyunsaturated fatty acids as

active nutraceuticals. Microalgal secondary metabolites - Pharmaceutical and cosmetic applications.

UNIT-IV **(15 Hours)**

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

UNIT-V **(15 Hours)**

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.

UNIT -VI Current Contours (Continuous Internal Assessment only)

Recent advances in algal biotechnology; genetic engineering of microalgae; applications of bioinformatics and artificial intelligence in algal research; algae-based nanotechnology and biomaterials; commercialization of algal products; biosafety and ethical issues in algal applications; role of algae in sustainable development and bioeconomy.

Total Lecture Hours - 75

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Acquire knowledge in the field of microalgal technology and their characteristics
2. Identify the methods of algal cultivation and harvesting.
3. Recognize and recommend the use of microalgae as food, feed and fodder.
4. Evaluate the microalgae in phytoremediation.
5. Compare the recent applied research in these micro algal applications.
6. Learn about the recent advances in algal technology.

TEXT BOOKS

1. Lee R.E. (2008). Phycology. Cambridge University Press, England
2. Lele. S.S., Jyothi Kishen Kumar (2008). Algal bio process technology. New Age International P(Ltd), New Delhi
3. Das. Mihirkumar. Algal Biotechnology (2010). Daya Publishing House, New Delhi.
4. Sharma O.P. (2011). Algae. Tata McGraw-Hill Education, Uttar Pradesh

5. Shekh A., Schenk P., Sarada R. (2021). Microalgal Biotechnology. Recent Advances, Market Potential and Sustainability. Royal Society of Chemistry, United Kingdom

6. Jeyabalan Sangeetha, Svetlana Codreanu, Devarajan Thangadurai, 2023. Microalgal Biotechnology: Bioprospecting Microalgae for Functional Metabolites towards Commercial and Sustainable Applications. Apple Academic Press., Florida.

REFERENCE BOOK(S)

1. Andersen R.A. (2005). Algal culturing techniques. Academic Press, Elsevier, Amsterdam, Netherlands

2. Bux F. (2013). Biotechnological Applications of Microalgae: Biodiesel and Value-added Products. CRC Press, Boca Raton, Florida

3. Singh B., Bauddh K., Bux, F. (2015). Algae and Environmental Sustainability. Springer, New York

4. Das D. (2015). An algal biorefinery: An integrated approach. Springer, New York

5. Bux F. and Chisti Y. (2016). Algae Biotechnology: Products and Processes. Springer. New York.

6. Pau Loke Show, Wai Siong Chai, Tau Chuan Ling, 2024.Microalgae for Environmental Biotechnology: Smart Manufacturing and Industry 4.0 Applications, CRC Press, London.

E-RESOURCES

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

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	Pos										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1	2		3	3	3		3	3			3	3	3	
CO2	1			3		3		3	3			3	3	3	3
CO3	1	2		3	3	3	2	3	3		2	3	3	3	
CO4	1	2		3	3	3		3	3		2	3	3	3	
CO5	1	2		3	3	3	2	3	3	3	2	3	3	3	

Strong -3; Medium -2; Low - 1

Semester: I- Generic Elective Course – I-(Choice -3) Microbe in waste Management

Ins. Hours / Week: 5 **Course Credit: 3** **Course Code: P26MBGE11C**

COURSE OBJECTIVES

- To understand different types of wastes, their environmental impact, and the role of microorganisms in waste degradation and waste minimization.
- To acquire knowledge on microbial applications in organic waste management including composting, vermicomposting, mushroom cultivation, and biofertilizer production.
- To study the characteristics of wastewater and the role of microbes in various wastewater and sewage treatment processes.
- To understand the principles of bioremediation and microbial degradation of pollutants, hydrocarbons, and xenobiotic compounds for environmental sustainability.
- To gain knowledge on microbial technologies used in recycling wastes, biofuel production, biogas generation, and eco-friendly sustainable waste management practices.

UNIT-I: **(15 Hours)**

Types of waste – solid, liquid, agricultural and industrial waste; sources and environmental impact of wastes. Role of microbes in waste minimization and waste degradation. Overview of microbial ecology and biodegradation.

UNIT-II **(15 Hours)**

Microbes in organic waste Management: Microbial composting and vermicomposting of organic wastes. Mushroom cultivation using agricultural wastes. Microbial conversion of waste into biofertilizers and value-added products.

UNIT-III: **(15 Hours)**

Characteristics of wastewater and sewage. Role of microbes in wastewater treatment processes – primary, secondary and tertiary treatment. Activated sludge process, oxidation ponds and anaerobic digestion. Microbes in waste water management.

UNIT-IV **(15 Hours)**

Concept and types of bioremediation. Microbial degradation of pollutants, hydrocarbons and xenobiotics. Role of microbes in biogeochemical cycles and environmental sustainability.

UNIT-V **(15 Hours)**

Microbes in recycling of organic and industrial wastes. Microbial production of biogas, biofuels and other eco-friendly products from waste. Applications of microbial technology in sustainable waste management.

UNIT – VI Current Contours (Continuous Internal Assessment only – self study)

Role of microbes in degradation of pollutants, hydrocarbons and harmful chemicals. Microbial treatment of contaminated soil and water. Importance of microbes in biogeochemical cycles. Role of microorganisms in maintaining environmental sustainability and ecological balance.

Total Lecture Hours - 75

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Identify different types of wastes and their environmental effects.
2. Explain the role of microbes in waste degradation and recycling.
3. Understand microbial processes involved in composting and wastewater treatment.
4. Describe principles of bioremediation and xenobiotic degradation.
5. Recognize waste-to-wealth applications using microorganisms.
6. Understand the role of microorganisms in bioremediation, nutrient cycling and maintenance of environmental sustainability.

TEXT BOOKS

1. Vineet Kumar, Sartaj Ahmad Bhat, Sunil Kumar, Pradeep Verma, (2024). "Environmental Engineering and Waste Management" Springer Nature, USA.

2. Maulin P. Shah (2023) Modern Approaches in Waste Bioremediation Springer Publications, USA.

3. Prasenjit Debbarma, Saurabh Kumar, Deep Chandra Suyal, Ravindra Soni (2023). Microbial Technology for Sustainable E-waste Management, Springer Cham

4. Vineet Kumar, Joginder Singh (2022) Microbial Technologies for Wastewater Recycling and Management, CRC Press, New Delhi.

5. Vineet Kumar, Vinod Kumar Garg, Sunil Kumar (2022) Omics for Environmental Engineering and Microbiology Systems, CRC Press, New Delhi.

6. R.C. Dubey and D.K. Maheshwari, (2020) , Elements of Environmental Microbiology" S.Chand and Company, New Delhi.

7. Singh, B.D. (2020). "Environmental Biotechnology "Kalyani Publishers, New Delhi – 110002

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1. Raina M. Maier, Ian L. Pepper, Charles P. Gerba (2021) Environmental Microbiology Academic Press, Elsevier, 4th Edition, USA.
2. Indu Shekhar Thakur I.K . Revised Edition, (2020) ," Environmental Biotechnology, International Publishing House, India
3. Sunita J. Varjani, Deepak Pant, Baskar Gurunathan et al. (2018) Waste Bioremediation, Springer Publications, USA.
4. Anoop Singh, Shaili Srivastava, Dheeraj Rathore, Deepak Pant (2020), Environmental Microbiology and Biotechnology, Springer Singapore
5. Pankaj Kumar Arora (2020), Microbial Technology for Health and Environment, Springer Singapore

E-RESOURCES

1. https://www.researchgate.net/publication/372180196_Microbiology_of_waste?utm_source=chatgpt.com
2. https://www.researchgate.net/publication/353671340_Role_of_Microbes_and_Microbial_Consortium_in_Solid_Waste_Management?utm_source=chatgpt.com
3. https://www.open.edu/openlearncreate/course/view.php?id=2100&utm_source=chatgpt.com
4. https://biotech.iisuniv.ac.in/courses/subjects/applied-environmental-microbiology-2?utm_source=chatgpt.com
5. https://studybwwt.online/courses/2-microbiology-and metabolism/?utm_source=chatgpt.com

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	Pos										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1			3	3			3	3			3	3		
CO2		2		3	3	3		3	3			3	3	3	
CO3	1	2		3	3		2	3	3			3	3		
CO4	1			3	3	3		3	3				3	3	
CO5	1							3	3			3	3		

Strong -3; Medium -2; Low - 1

Semester: I- SEC-I- Probiotic Microbiology

Ins. Hours / Week: 2 **Course Credit: 2** **Course Code: P26SEMB11**

COURSE OBJECTIVES

- To understand the history, concepts, classification, and characteristics of probiotics, prebiotics, synbiotics, and human microbiota.
- To acquire knowledge on important probiotic microorganisms, their diversity, colonization, survival mechanisms, and host–microbe interactions in the gastrointestinal tract.
- To study the mechanisms of probiotic action including adhesion, antimicrobial activity, immunomodulation, and their role in human health and diseases.
- To gain practical knowledge on isolation, screening, characterization, safety evaluation, and quality control of probiotic microorganisms and products.
- To understand the industrial, pharmaceutical, nutraceutical, aquaculture, and future applications of probiotics

UNIT-I **(6 Hours)**

History and development of probiotics-Concept and characteristics of probiotics- Classification of probiotic microorganisms- Probiotics, prebiotics and synbiotics- Human microbiota and microbial ecology- Selection criteria for probiotic strains.

UNIT-II: **(6 Hours)**

Lactic acid bacteria and their significance- *Lactobacillus* and *Bifidobacterium* species- Yeast probiotics and next-generation probiotics- Gut microbiota composition and diversity- Colonization and survival in gastrointestinal tract- Host–microbe interactions.

UNIT-III **(6 Hours)**

Adhesion and colonization mechanisms- Antimicrobial metabolites produced by probiotics - Immunomodulatory effects- Gut–brain axis and probiotics- Role in gastrointestinal disorders - Probiotics in metabolic and inflammatory diseases.

UNIT-IV **(6 Hours)**

Isolation and screening of probiotic microorganisms- Phenotypic and molecular characterization - Acid and bile tolerance assays- Antimicrobial activity and safety evaluation- Genomic approaches in probiotic research- Quality control and standardization of probiotic products.

UNIT-V **(6 Hours)**

Probiotics in fermented foods and dai$_3$r$_4$y industries- Encapsulation and formulation

technologies - Probiotics in pharmaceuticals and nutraceuticals- Probiotics in aquaculture and animal health - Commercial probiotic products and regulations- Future prospects and challenges in probiotic industry.

Unit- VI

Current Contours (Continuous Internal Assessment only): Human microbiome projects and Earth microbiome projects- Personalized probiotics and precision nutrition- Microbiota and immune regulation- Gut microbiota and brain functions- Probiotics in cancer therapy and metabolic disorders- CRISPR and genetically engineered probiotics- Artificial intelligence in microbiome research.

Total Lecture Hours - 30

COURSE OUTCOMES

After the completion of the course, students should be able to,

1. Understand the diversity and physiology of probiotic microorganisms.
2. Explain the interaction between probiotics, gut microbiota and host health.
3. Analyze methods for isolation, characterization and evaluation of probiotics.
4. Evaluate the therapeutic, industrial and clinical applications of probiotics.
5. Interpret recent advances in probiotic research and microbiome studies.
6. Understand the applications of microbiome research, probiotics, CRISPR and artificial intelligence in human health and disease management.

TEXT BOOK(S)

1. Marchesi, J.R. (Editor). 2014. The Human Microbiota and Microbiome. CABI Publishing, Wallingford, Oxfordshire, UK. ISBN: 9781780640495.
2. Rao, V. and Rao, L. 2016. Probiotics and Prebiotics in Human Nutrition and Health. InTechOpen, London, United Kingdom. DOI: 10.5772/61113.
3. Padmanaban, S. and Balakrishnan, S. 2022. Good Microbes in Medicine, Food Production, Biotechnology, Bioremediation, and Agriculture. Wiley, United States.
4. Venketeshwer Rao & Leticia Rao. *Probiotics and Prebiotics in Human Nutrition and Health*. In Tech Open, London, United Kingdom. 2016. DOI: 10.5772/61113.
5. Lee, Y.K. and Salminen, S. 2009. Handbook of Probiotics and Prebiotics. Wiley, USA.

REFERENCE BOOK(S)

1. Bhatt, B., Patel, K., Lee, C.N. and Moochhala, S. 2024. The Microbial Blueprint: The Impact of Your Gut on Your Well-being. Partridge Publishing, Singapore.
2. Dua, K. 2024. Synbiotics in Human Health: Biology to Drug Delivery. Springer Nature, Singapore.

3. Floch, M.H. and Walker, W.A. 2008. Probiotics: A Clinical Guide. Manson Publishing, London, UK.
4. Tannock, G.W. 1999. Probiotic Foods in Health and Disease. Horizon Scientific Press, UK.
5. Tang, Y.W., Sussman, M. and Liu, D. 2015. Molecular Medical Microbiology. Academic Press, USA.
6. Kamal Dua .2024. Synbiotics in Human Health: Biology to Drug Delivery Springer Nature Singapore.

E-RESOURCES

1. https://www.coursera.org/learn/human-microbiome
2. https://www.youtube.com/watch?v=5DTrENdWvvM
3. https://www.youtube.com/watch?v=1sISguPDlhY
4. https://academic.oup.com/nar/article/50/D1/D808/6413603
5. https://www.nature.com/immersive/human-microbiome/index.html

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	Pos										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1			3	3			3	3	3		3	3	3	3
CO2	1	2		3	3	3	2	3	3	3		3	3	3	
CO3		2		3	3	3		3	3	3	2	3	3		
CO4	1	2		3	3			3	3			3	3		
CO5	1	2	2	3	3	3			3	3		3	3	3	

Strong -3; Medium -2; Low - 1

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE

(AUTONOMOUS)

SUNDARAKKOTTAI, MANNARGUDI–614016.

(For the Candidates admitted in the academic year 2026-2027)

DEPARTMENT OF MICROBIOLOGY

M.Sc., MICROBIOLOGY

Semester: I- VAC-1 Smart Microbiology: AI Tools and Applications

Ins. Hours / Week: - **Course Credit: 2** **Course Code: P26MBVA11**

COURSE OBJECTIVES

- To understand the basics and applications of AI in microbiology and life sciences.
- To learn biological databases and AI-assisted analysis of microbiological data.
- To understand AI techniques used in microbial image analysis and identification.
- To study AI applications in disease diagnosis, drug discovery and healthcare.
- To understand ethical issues and responsible use of AI in scientific research.

UNIT-I

Introduction to Artificial Intelligence (AI), Machine Learning, and Generative AI. Basic concepts of AI tools such as ChatGPT and their importance in microbiology, biotechnology, healthcare, and life sciences.

UNIT-II

Types of microbiological data including genomic, proteomic, clinical, and imaging data. Introduction to biological databases such as NCBI and PDB. Use of AI tools for literature search, summarizing scientific articles, and report preparation.

UNIT-III

Basic AI techniques including supervised and unsupervised learning. Introduction to image analysis in microbiology. AI-assisted identification of microbes, colony morphology, and microscopy image interpretation.

UNIT-IV

Applications of AI in disease diagnosis, pathogen detection, antimicrobial resistance prediction, microbiome analysis, drug discovery, vaccine development, and laboratory automation.

UNIT-V

Ethical issues and challenges of AI including bias, privacy, plagiarism, and responsible use of AI in academics and scientific research. Verification of AI-generated scientific information.

UNIT-VI Current Contours (Continuous Internal Assessment only):

AI-assisted mini project on a microbiology topic, Prompt writing activity using ChatGPT or similar AI tools, Comparison of AI-generated and textbook explanations, AI-based case study analysis and presentation.

Total Lecture Hours - 30

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Understand the fundamentals of Artificial Intelligence, Machine Learning, and Generative AI in microbiology.
2. Utilize AI tools for microbiological data analysis and scientific literature exploration.
3. Apply AI-based techniques for microbial image analysis and pattern recognition.
4. Explain the applications of AI in disease diagnosis, microbiome studies, and drug discovery.
5. Evaluate ethical concerns, limitations, and responsible use of AI in scientific research and academics.
6. Develop skills in AI-assisted scientific communication, prompt design, and mini-project execution.

TEXTBOOKS

1. Russell, S., and Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.
2. Goodfellow, I., Bengio, Y., and Courville, A. (2016). *Deep learning*. MIT Press.
3. Brown, T. A. (2020). *Gene cloning and DNA analysis: An introduction* (8th ed.). Wiley-Blackwell.
4. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., and Stahl, D. A. (2021). *Brock biology of microorganisms* (16th ed.). Pearson.
5. Prescott, L. M., Harley, J. P., and Klein, D. A. (2020). *Microbiology* (11th ed.). McGraw-Hill Education.
6. Kumar, V., Abbas, A. K., and Aster, J. C. (2020). *Robbins and Cotran pathologic basis of disease* (10th ed.). Elsevier.

REFERENCE BOOKS

1. Bishop, C. M. (2023). *Pattern recognition and machine learning*. Springer.
2. Murphy, K. P. (2022). *Probabilistic machine learning: An introduction*. MIT Press.
3. Charniak, E. (2018). *Introduction to artificial intelligence*. Pearson.
4. Lesk, A. M. (2019). *Introduction to bioinformatics* (5th ed.). Oxford University Press.
5. Pevsner, J. (2023). *Bioinformatics and functional genomics* (4th ed.). Wiley-Blackwell.
6. Zou, J., Huss, M., Abid, A., Mohammadi, P., Torkamani, A., and Telenti, A. (2019). *A primer on deep learning in genomics*. Nature Genetics, 51(1), 12–18.
7. Baldi, P., and Brunak, S. (2018). *Bioinformatics: The machine learning approach* (3rd ed.). MIT Press.

E-Resources

1. National Center for Biotechnology Information (NCBI)
2. PubMed
3. National Digital Library of India (NDLI)
4. NPTEL Courses
5. ScienceDirect
6. Google Scholar
7. OpenAI Documentation
8. European Bioinformatics Institute (EMBL-EBI)
9. Coursera – AI for Medicine and Biology Courses
10. Khan Academy – AI and Computing Resources

SEMESTER - II

Semester: II- CC-III– Microbial Physiology and Metabolism

Ins. Hours / Week: 6 **Course Credit: 4** **Course Code: P26MB204**

COURSE OBJECTIVES

- To provide the learners a strong base of bacterial cell physiology so as to impart them with the principal knowledge of functions of bacterial organelles
- To describe the anabolic and catabolic sections of metabolism deeply
- To impart the knowledge of extremophilic organisms and their merits
- To understand metabolic processes of energy substrates
- To teach unique physiological features like methanogenesis, bioluminescences and quorum sensing

UNIT-I **(18 Hours)**

Bacterial Cell Structure and Functions: Ultrastructure and differences between Prokaryotic and Eukaryotic cells – Exopolysaccharides, cytoplasmic membrane, Capsules, pili, fimbriae, Slime layer of prokaryotes. Bacterial cell wall - Biosynthesis of peptidoglycan - outer membrane, teichoic acid. Electron carriers – artificial electron donors – inhibitors uncouplers – energy bond – phosphorylation.

UNIT-II **(18 Hours)**

Microbial nutrients and Growth: Common nutrient requirements, Growth factors - nutritional groups/ types - Bacterial growth - Phases of growth curve – measurement of growth – calculations of growth rate – generation time – synchronous growth – induction of synchronous growth, synchrony index – factors influencing growth – Uptake of nutrients by the cell – Facilitated diffusion – Active transport – Group translocation, Iron uptake - Pinocytosis and Phagocytosis. Survival at extreme environments – starvation – Extremophiles: adaptative mechanisms in thermophilic, alkalophilic, osmophilic and psychrophilic organisms.

UNIT-III **(18 Hours)**

Phototrophy and Chemolithotrophy: Autotrophs - photosynthetic bacteria and green algae – heterotrophs – bacteria, fungi, myxotrophs. Photosynthetic and accessory pigments: Chlorophyll, bacteriochlorophyll, carotenoids, phycobilliproteins, fluorescence, phosphorescence, rhodopsin, Oxygenic and anoxygenic Photosynthesis– Autotrophic generation

of ATP. Fixation of CO_2. – C3, C4 pathways. Chemolithotrophy – Sulphur, Iron, Hydrogen, Nitrogen oxidations. Physiology and regulation - methanogenesis, bioluminescences and quorum sensing.

UNIT-IV **(18 Hours)**

Carbohydrate Metabolism and Fermentation: Glycolytic pathways – Embden – Meyerhoff pathway - the pentose phosphate pathway – the Entner Doudoroff pathway – the Tricarboxylic acid cycle – glyoxylate cycle. Electron Transport Chain. Substrate level phosphorylation – Oxidative phosphorylation and ATP synthesis – reverse TCA cycle – gluconeogenesis – lipid catabolism – beta oxidation. Anaerobic respiration – sulfur compounds – nitrate and carbon dioxide as electron acceptors. Homo and heterolactic acid fermentations. Fermentation by *Ruminococcus albus.*

UNIT-V **(18 Hours)**

Nitrogen Metabolism and Bacterial Sporulation: Biological nitrogen fixation – nitrogenase enzymes – structure and properties – 'nif' gene – regulation – functions. Assimilation of inorganic nitrogen –nitrate, nitrite – dinitrogen – ammonia. Cell division – endospore – structure – properties – germination. Microbial sporulation and morphogenesis: Bacteria including cyanobacteria and actinobacteria, fungi and algae.

UNIT- VI

Current Contours (Continuous Internal Assessment only): Chart preparation showing bacterial cell structure and functions of each part, biochemical pathways of Phototrophy and chemolithotrophy, Carbohydrate metabolism and Fermentation, and Nitrogen metabolism and bacterial sporulation - preparation of a biofertilizer using any one nitrogen fixing organism and a locally available carrier material – Quiz classes - short seminar presentations on the prepared charts.

Total Lecture Hours - 90

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Understand the functional principles of various bacterial cell structures.
2. Assimilate the mechanism of bacterial cell wall synthesis.
3. Differentiate the types of energy generating mechanisms among prokaryotes.
4. Understand the microbial adaptation on chemical-ecological processes.
5. Clearly understand carbohydrate and nitrogen metabolisms.
6. Understand bacterial cell structure, metabolism (phototrophy, chemolithotrophy, carbohydrate and nitrogen pathways), and apply knowledge through biofertilizer preparation and scientific presentation skills.

TEXT BOOK(S)

1. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., and Stahl, D. A. (2021). Brock biology of microorganisms (16th ed.). Pearson.
2. Willey, J. M., Sherwood, L. M., and Woolverton, C. J. (2020). Prescott's microbiology (11th ed.). McGraw-Hill Education.
3. Tortora, G. J., Funke, B. R., and Case, C. L. (2022). Microbiology: An introduction (13th ed.). Pearson.
4. Moat, A. G., Foster, J. W., and Spector, M. P. (2002). Microbial physiology (4th ed.). Wiley-Liss.
5. White, D., Drummond, J., and Fuqua, C. (2012). The physiology and biochemistry of prokaryotes (4th ed.). Oxford University Press.
6. Stanier, R. Y., Ingraham, J. L., Wheelis, M. L., and Painter, P. R. (2018). General microbiology (5th ed.). Macmillan.

REFERENCE BOOK(S)

1. Moat, A. G., Foster, J. W., and Spector, M. P. (2002). *Microbial physiology* (4th ed.). Wiley.Collee J.C. Duguid J.P. Foraser, A.C, Marimon B.P, (1996).
2. White, D., Drummond, J., and Fuqua, C. (2012). *The physiology and biochemistry of prokaryotes* (4th ed.). Oxford University Press.
3. Gottschalk, G. (1986). *Bacterial metabolism* (2nd ed.). Springer.
4. Reddy, S. R., and Reddy, S. M. (2022). *Microbial physiology* (2nd ed.). Scientific Publishers.
5. Poole, R. K., and Kelly, D. J. (Eds.). (1967–present). *Advances in microbial physiology*. Academic Press.
6. Stevens, A. M., Ditty, J. L., Parales, R. E., and Merkel, S. M. (2019). *Microbial physiology: Unity and diversity*. Wiley.

E-RESOURCES

1. https://microbeonline.com/
2. https://pubmed.ncbi.nlm.nih.gov/
3. https://microbe.net/resources/microbiology-web-resources/
4. https://www.microbes.info/resources
5. https://library.unimed.edu.ng/resources/subject-guides/fos/microbiology-e-resources/

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	POs										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1	2	2	3	3	3		3	3	3			3	3	3
CO2	1	2		3	3	3		3	3		2		3		
CO3	1	2		3	3			3	3		2		3	3	
CO4	1	2		3	3			3	3	3			3		
CO5	1	2		3	3			3	3	3			3		

Strong -3; Medium -2; Low - 1

Semester: II- CC-IV Microbial Genetics and Molecular Biology

Ins. Hours / Week: 6 **Course Credit: 4** **Course Code: P26MB205**

COURSE OBJECTIVES

- To impart the current updated knowledge on molecular genetics of prokaryotes, eukaryotic and phages in addition to the most essential fundamentals of the subject.
- To provide molecular details of genome replication, its damage and repair mechanisms
- To understand molecular regulation of gene expression in bacteria and phages
- To impart molecular mechanisms of gene transfer and their importance in natural evolution
- To describe the significance & processes behind mutations, other genetic changes, and about mutagens

UNIT-I **(18 Hours)**

Evidences for DNA as the genetic material (genome): Direct (Griffith, Avery *et.al.,* Hershey and Chase and bacterial conjugation) and Indirect experiments. Organization of genome: Prokaryotes – Eukaryotes: nucleus and nucleosomes, chromatin, chromosomes, heterochromatin, euchromatin, lamp brush and giant chromosomes. Central Dogma – Types of DNA Replication: Semi- conservative, Conservative & Dispersive; DNA replication models: Rolling circle, D-loop & Linear replication [uni- directional and bi- directional (Theta)] - Mechanism, enzymes and proteins of replication – Replication of RNA. Differences between prokaryotic and eukaryotic replication. phi X 174 (or ΦX174) replication. Plasmids – types and structure. Inhibitors of DNA replication – Causes & sources of DNA damage – DNA damage repair mechanisms: Excision repair, SOS repair and mismatch repair

UNIT-II **(18 Hours)**

DNA transcription process: initiation, elongation – termination. Synthesis of mRNA in prokaryotes and eukaryotes. Synthesis of rRNA and tRNA. Precursor mRNA processing – capping, polyadenylation and splicing. Inhibitors of transcription. Genetic code, Process of mRNA translation – initiation, elongation and termination. Post translation processing. Signal sequences and protein transport. Inhibitors of translation.

UNIT-III **(18 Hours)**

Genes organization in Prokaryotes and Eukaryotes - Introduction - Operon concept, *lac, trp,* arabinose operons, promoters and repressors. Regulation of gene expression – Transcriptional control – promoters, terminators, attenuators and anti-terminators; Induction and repression; The *lac* operon – catabolite repression; *trp* operon, two-components regulatory system. Translational control – ribosome binding, codon usage, antisense RNA; post-transcriptional gene silencing – RNAi. Regulation of gene expression in temperate phages.

UNIT-IV **(18 Hours)**

Bacterial Transformation – competence cells, regulation, general process; Transduction – general and specialized; Conjugation – Discovery, mechanism of F+ v/s F-, Hfr+ v/s F-, F' v/s F-, triparental mating, self-transmissible and mobilizable plasmids, pili. Linkage and genetic maps – genetic mapping of T4 phage. C- value paradox. Hardy Weinberg Equilibrium.

UNIT-V **(18 Hours)**

Mutation: genome & gene mutations types and molecular basis – Agents of mutation - Importance of mutations in evolution of species. Mutagens - Discovery of insertion sequences, complex and compound transposons – T10, T5, and retroposon – Nomenclature- Insertion sequences – Mechanism – Transposons of *E. coli*, Bacteriophage and Yeast. Isolation, analysis and detection methods of mutants. Uses of mutants. Importance of transposable elements in horizontal transfer of genes and evolution. Mobile genetic Elements – IS elements.

UNIT-VI

Current Contours (Continuous Internal Assessment only): Learners shall be given topics of the course to prepare a PPT and present a seminar as a commitment to understand the topics. They should be encouraged to take-up internship in research institutes; university departments, to attend summer trainings or training programs and to participate in workshops. Swayam- NPTEL courses on Basics of microbial genetics and molecular biology topics should be recommended for an enhanced understanding. Quiz events and round-table scientific chats / discussions (molecular aspects of COVID 19); open talk / literature seminar on upcoming molecular topics (biomedical tattoo, disorder due to mutation to the FGFR2 gene, CRISPR-Cas9, molecular medicine, synthetic biology, advanced techniques in molecular biology etc.,) should also be scheduled / assigned.

Total Lecture Hours - 90

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Have a complete bird- eye view of molecular biology and microbial genetics including advanced topics of the course.

2. Possess a deeper understanding of the central dogma of protein synthesis from DNA/ RNA replication to gene expression.
3. Describe the molecular mechanisms of gene expression regulation in prokaryotes, eukaryotes and phages.
4. Elaborate the gene transfer methods and proficiency on specific biological problems with genetic relevance.
5. Display the know- how of mutation, its diversity and all associated molecular events.
6. Self- create and self-evaluate the course proficiency.

TEXT BOOKS

1. Snyder, L., and Champness, W. (2018). *Molecular Genetics of Bacteria* (5th ed.). ASM Press.
2. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2017). *Molecular Biology of the Gene* (7th ed.). Pearson.
3. Brown, T. A. (2016). *Gene Cloning and DNA Analysis: An Introduction* (7th ed.). Wiley-Blackwell.
4. Lewin, B. (2019). *Genes XII*. Jones & Bartlett Learning.
5. Primrose, S. B., & Twyman, R. M. (2013). *Principles of Gene Manipulation and Genomics* (8th ed.). Wiley-Blackwell.

REFERENCE BOOKS

1. Doudna, J. A., & Charpentier, E. (2014). Genome editing using CRISPR-Cas systems. *Science*, 346(6213), 1258096.
2. Shendure, J., Balasubramanian, S., Church, G. M., et al. (2017). DNA sequencing at 40: past, present and future. *Nature*, 550, 345–353.
3. Van Dijk, E. L., Jaszczyszyn, Y., Naquin, D., & Thermes, C. (2018). The third revolution in sequencing technology. *Trends in Genetics*, 34(9), 666–681.
4. Lander, E. S. (2016). The heroes of CRISPR. *Cell*, 164(1–2), 18–28.
5. Zhang, F., Wen, Y., & Guo, X. (2014). CRISPR/Cas9 for genome editing. *Cell Bioscience*, 4, 1–12.

E-RESOURCES

1. https://www.ncbi.nlm.nih.gov
2. https://www.ebi.ac.uk
3. https://onlinecourses.nptel.ac.in
4. https://www.coursera.org
5. https://www.edx.org
6. https://www.genome.jp/kegg

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	Pos										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1	2		3	3			3	3				3		
CO2	1	2		3	3	3	2	3	3				3		
CO3	1	2		3	3	3	2	3	3			3	3		
CO4	1	2	2	3	3	3	2	3	3	3			3		3
CO5	1	2	2	3	3	3	2	3	3	3			3		3

Strong -3; Medium -2; Low - 1

Semester: II- CP-II: Microbial Physiology and Metabolism, Microbial Genetics and Molecular Biology (P)

Ins. Hours / Week: 6 **Course Credit: 4** **Course Code: P26MB206P**

COURSE OBJECTIVES

- To provide a fundamental knowledge and primary techniques of microbial genetics and molecular biology.
- To be able to isolate bacterial chromosomal DNA and plasmid DNA and RNA
- To skill- acquire the quality and quantity estimation of DNA / RNA/ Plasmids
- To upskill with blotting, agarose gel electrophoresis, SDS- PAGE & PCR
- To orient isolation of mutants and antibiotic-resistant bacterial isolates

Microbial Physiology and Metabolism

1. Colorimetric estimation of Protein (Biuret method/Lowry et. al. method)
2. Colorimetric estimation of amino acid (Ninhydrin method)
3. Carbohydrate fermentation tests: Glucose, Lactose, Sucrose and Mannitol.
4. Biochemical test to identify bacterial isolates - IMViC test, Oxidase test, Catalase test, Urease test, Hydrogen sulphide, coagulase, TSI test, Nitrate reduction test
5. Enzymatic hydrolysis of Starch, Gelatin, Casein & lipid.
6. Bacterial Growth curve: Cell count/viable count/absorbance (total count)
7. Measurement of Microbial growth –Turbidity methods – Determination of Generation time and Neubaur Counting chamber.
8. Studying the influence of osmotic pressure, pH, temperature, moisture, radiations, different chemicals, carbon and nitrogen sources.

Microbial Genetics and Molecular Biology

1. Isolation of Microbial DNA.
2. Isolation of Microbial RNA.
3. Isolation of antibiotic-resistant microbes.

4. Isolation of plasmids from *E. coli* (mini preparation).
5. Competent cell preparation and Bacterial transformation.
6. Polymerase Chain Reaction.
7. Generalized transduction in *E. coli*.
8. Characterization of plasmid DNA by agarose gel electrophoresis.
9. Restriction digestion.
10. Isolation of mutants by spontaneous mutation – Gradient plate technique.
11. Isolation of auxotrophic and antibiotic-resistant mutants by physical and chemical mutagens.
12. Demonstration: Blotting techniques (Southern, Northern, Western and Dot blotting's).

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Test and determine sugar fermenting/ utilizing abilities of different bacterial species.
2. Determine growth stages of a test bacterial species.
3. Evaluate the impact of various external components which would affect or effect microbial growth.
4. Cultivate anaerobic bacteria and thus will be able to grow such organisms.
5. Get a clear practical knowledge on instruments used in molecular biology lab.
6. Study about the Antibiotic resistance among microbes.
7. Understand the Transformation mechanisms.

TEXT BOOKS

1. Aneja KR (2017). Experiments in Microbiology, Plant pathology and Biotechnology. 5th Edition, New Age International Publishers, Chennai.

2. Dubey RC and Maheswari DK (2012). Practical Microbiology 3rd Edition, S. Chand & Company Ltd., New Delhi.

3. Sundararaj T. Microbiology laboratory manual. Revised and published by AswathySundararaj.No.5 First Cross Street, Thirumalai Nagar, Perungudi, Chennai.

4. Ram Reddy S.M and Reddy S.M, 2023, Microbiology a Laboratory Manual, 4th Edition, Scientific Publishers, Tamil Nadu.

REFERENCE BOOKS

1. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP, 2009. The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco

2. Brock T. D. and Madigan M.T., 2017. Biology of Microorganisms, Prentice Hall of India Pvt. Ltd, New Delhi.
3. De Robertis EDP and De Robertis EMF, 2006. Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
4. Gardner EJ, Simmons MJ, Snustad DP 2008. Principles of Genetics. 8th Ed. Wiley- India
5. Karp G 2010. Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc, US.

E-RESOURCES

1. https://www.frontiersin.org/books/Microbial_Physiology_and_Metabo
2. https://onlinelibrary.wiley.com/doi/book/10.1002/0471223867COU
3. https://sites.google.com/site/microbial physiologyoddsem/teaching-contents
4. https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition
5. https://onlinecourses.swayam2.ac.in/cec20_bt14/preview

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	Pos										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1			3	3			3	3				3		
CO2	1	2		3	3			3	3			3	3		
CO3	1	2		3	3			3	3			3	3	3	
CO4	1	2		3				3	3			3	3		
CO5	1	2		3				3	3			3			

Strong -3; Medium -2; Low - 1

Semester: II- Discipline Centric Elective -II (Choice – 1): Microbial Genomics and Proteomics

Ins. Hours / Week:4 **Course Credit: 4** **Course Code: P26MBDE22A**

COURSE OBJECTIVES

- Understand the structural organization of microbial genomes and the principles of whole-genome sequencing.
- Address challenges in analyzing global gene expression patterns using transcriptomic approaches.
- Become a creative problem solver in characterizing microbial proteomes and determining protein structures and functions.
- Understand the integration of comparative genomics and proteomics to study microbial evolution, pathogenicity, and complex environmental communities.
- To understand the applications of microbial genomics, proteomics and genome editing technologies in medicine, industry, agriculture and environmental microbiology.

UNIT-I **(12 Hours)**

Scope and significance of microbial genomics; genome sequencing projects; structure and organization of microbial genomes; prokaryotic and eukaryotic genome architecture; genome size, gene density, operons and regulons; comparative genomics and genome evolution; horizontal gene transfer and genome plasticity; functional genomics and annotation of microbial genomes; databases for genomic information.

UNIT-II **(12 Hours)**

DNA sequencing methods - Sanger sequencing and next-generation sequencing technologies; whole genome sequencing strategies - shotgun sequencing and hierarchical sequencing; sequence assembly and genome finishing; genome annotation - structural and functional annotation; transcriptomics - RNA sequencing and gene expression profiling; metagenomics and microbial community genomics; bioinformatics tools for sequence alignment, phylogenetic analysis and genome comparison. Modern genomics on large-scale molecular data and meta-omics approaches to analyze microbial communities.

UNIT-III **(12 Hours)**

Scope and importance of proteomics; protein structure and organization; proteome complexity

and dynamics; protein extraction and separation techniques- two-dimensional gel electrophoresis; mass spectrometry-based proteomics; protein identification and characterization; post-translational modifications; protein folding and stability; structural proteomics and functional proteomics.

UNIT-IV **(12 Hours)**

Advanced proteomic techniques - MALDI-TOF and LC-MS/MS; quantitative proteomics including label-based and label-free approaches; protein–protein interactions and interactomics; protein microarrays and high-throughput screening; bioinformatics tools for proteomic data analysis; databases for protein structure and function; systems biology approaches integrating genomics and proteomics; metabolomics and multi-omics integration.

UNIT-V **(12 Hours)**

Applications of microbial genomics in medicine, agriculture and environmental microbiology; pathogen genomics and molecular epidemiology; antimicrobial resistance and virulence gene analysis; industrial applications - enzyme discovery and metabolic engineering; proteomics in biomarker discovery, drug target identification and vaccine development; synthetic biology and genome editing technologies; microbiome studies and systems-level understanding of microbial communities.

UNIT – VI

Current Contours (Continuous Internal Assessment only): Recent advances in microbial genomics and proteomics; artificial intelligence and bioinformatics in omics research; personalized medicine and precision microbiology; ethical, legal and biosafety issues in genomics and proteomics; big data analysis and cloud computing in biological research; future perspectives of multi-omics and systems biology in healthcare, agriculture and industry.

Total Lecture Hours - 60

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Understand the concepts of genome sequencing projects, genome architecture and genomic databases.
2. Gain knowledge on DNA sequencing methods and bioinformatics tools.
3. Elucidate the importance of proteomics.
4. Analyze the advanced proteomics techniques and bioinformatics tools.
5. Evaluate the applications of genomics in various fields.
6. Understand modern applications of genomics, proteomics and AI in biology.

TEXT BOOKS

1. Glick, B. R., Pasternak, J. J., & Patten, C. L. (2025). *Molecular biotechnology: Principles and applications of recombinant DNA* (6th ed.). ASM Press.

1. Pevsner, J. (2015). *Bioinformatics and Functional Genomics* (3rd ed.). Wiley-Blackwell.
2. Liebler, D. C. (2002). *Introduction to Proteomics: Tools for the New Biology*. Humana Press.
3. Twyman, R. M. (2013). *Principles of Proteomics*. BIOS Scientific Publishers.
4. Primrose, S. B., and Twyman, R. M. (2013). *Principles of Gene Manipulation and Genomics* (8th ed.). Wiley-Blackwell.

REFERENCE BOOK(S)

1. Primrose, S. B., & Twyman, R. M. (2025). *Principles of genome analysis and genomics* (4th ed.). Wiley-Blackwell.
2. Shendure, J., Balasubramanian, S., Church, G. M., (2017). DNA sequencing at 40: past, present and future. *Nature*, 550, 345–353.
3. Van Dijk, E. L., Jaszczyszyn, Y., and Thermes, C. (2018). The third revolution in sequencing technology. *Trends in Genetics*, 34(9), 666–681.
4. Aebersold, R., & Mann, M. (2016). Mass-spectrometric exploration of proteome structure and function. *Nature*, 537, 347–355.
5. Zhang, Y., Fonslow, B. R., Shan, B., (2013). Protein analysis by shotgun proteomics. *Chemical Reviews*, 113(4), 2343–2394.
6. Cox, J., and Mann, M. (2011). Quantitative proteomics. *Nature Biotechnology*, 29, 190–200.

E-RESOURCES

1. https://www.ncbi.nlm.nih.gov
2. https://www.ebi.ac.uk
3. https://www.uniprot.org
4. https://www.genome.jp/kegg
5. https://onlinecourses.nptel.ac.in
6. https://www.coursera.org

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	Pos										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1	2		3	3	3	2	3	3	3		3	3		3
CO2	1	2		3	3	3	2	3	3	3		3	3		3
CO3	1	2		3	3	3	2	3	3	3		3	3		3
CO4	1	2		3	3	3	2	3	3	3		3	3		3
CO5	1	2	2	3	3	3	2	3	3	3	2	3	3		3

7. **Strong -3; Medium -2; Low - 1**

Semester: II- Discipline Centric Elective -II (Choice -2): Molecular Taxonomy and Phylogeny

Ins. Hours / Week: 4 **Course Credit: 4** **Course Code: P26MBDE22B**

COURSE OBJECTIVES

- Understand the evolutionary principles underlying molecular taxonomy and the microbial species concept.
- Address challenges in microbial identification using advanced molecular markers and genomic parameters.
- Become a creative problem solver in aligning sequences and calculating evolutionary distances.
- Understand the computational methods and algorithms used to construct, evaluate, and interpret phylogenetic trees.
- To understand the principles, tree types and software tools used in molecular phylogenetic analysis.

UNIT – I **(12 Hours)**

Introduction to microbial taxonomy – morphological, Biological Classification, Three Domain concept, biochemical and molecular taxonomy. Basic concepts of numerical taxonomy. Positive and negative aspects of each taxonomical method. Morphological phylogeny.

UNIT – II **(12 Hours)**

Chemotaxonomy - fatty acid, protein finger printing, Isozyme typing, pigments and polyamines. Biochemical phylogeny. Molecular taxonomy - G +C content, DNA –DNA hybridization, DNA – RNA hybridization, Plasmid profiles, RFLP, RAPD, AFLP, STRR and LTRR, REP –PCR, rRNA based DNA finger printing methods.

UNIT – III **(12 Hours)**

16S rRNA BASED FINGER PRINTING: Types of rRNA - 23s rRNA, 16S rRNA and 5S rRNA. Isolation of DNA, amplification of 16S rDNA using PCR technique, Cloning, transformation, Blue-white screening, Dot Blot/Southern blot hybridization using specific Probes. Sequencing of 23s rRNA, 16S rRNA and 5S rRNA. Importance of 16S rRNA in identification of prokaryotes. Methods of 16S rRNA / rDNA fingerprinting.

UNIT – IV **(12 Hours)**

Sequence Submission and Analysis Submission of rDNA sequences in GenBank – BankIt and Sequin guidelines. NCBI, EMBL, PDB and DDBJ – retrieving sequences. RNA structure prediction, Restriction enzyme patterns. Ribosomal Database Project - Designing primers and probes. Sequence comparison, alignment and data base searching – ClustalW, FASTA and BLAST. DNA barcoding.

UNIT – V **(12 Hours)**

Molecular Phylogeny: Introduction to Molecular phylogeny – tree terminology, software programs for making phylogenetic trees – MEGA, Phylib, RAPDistance. Cladogram, additive trees and ultrametric trees, rooted, unrooted trees and tree shapes.

UNIT – VI

Current Contours (Continuous Internal Assessment only): Sample collection – algae, lichen, etc. – monitoring algae diversity. Microalgae identification using manuals – program content free hand drawing of algae, cyanobacteria, lichen, bacteria's – phylogeny tree making using Clustal W and/or MEGA softwares.

Total Lecture Hours- 60

COURSE OUTCOME

After successful completion of the course, the students will be able to:

1. Understand the principles, theories, practices and applications of microbial taxonomy and molecular phylogeny.
2. Explain the current status, classification systems and modern approaches used in microbial taxonomy.
3. Analyze molecular data for phylogenetic inference and construct phylogenetic trees using suitable computational methods.
4. Apply state-of-the-art bioinformatics tools and databases for sequence retrieval, alignment, comparison and phylogenetic analysis.
5. Demonstrate knowledge of recombinant DNA technology, rRNA-based fingerprinting techniques and DNA sequence analysis for microbial identification and evolutionary studies.
6. Understand microbial diversity analysis using sampling, identification and phylogenetic tools.

TEXTBOOKS

1. Whitman, W. B. (Ed.). (2022). Bergey's manual of systematic bacteriology (3rd ed.). Springer
2. Nei, M., and Kumar, S. (2021). Molecular evolution and phylogenetics. Oxford University Press
3. Pevsner, J. (2023). Bioinformatics and functional genomics (4th ed.). Wiley
4. Lesk, A. M. (2023). Introduction to bioinformatics (6th ed.). Oxford University Press
5. Avise, J. C. (2022). Molecular markers, natural history and evolution (2nd ed.). Springer

REFERENCE BOOKS

1. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2025). *Brock biology of microorganisms* (17th ed.). Pearson.
2. Pelczar, M. J. (2025). *Microbiology* (7th ed.). EWP Publishers.
3. Tille, P. (2025). *Bailey & Scott's diagnostic microbiology* (16th ed.). Elsevier.
4. Brown, T. A. (2021). *Gene cloning and DNA analysis: An introduction* (8th ed.). Wiley-Blackwell.
5. Pevsner, J. (2024). *Bioinformatics and functional genomics* (4th ed.). Wiley-Blackwell.
6. Li, W.-J., Jiao, J.-Y., Salam, N., & Rao, M. P. N. (Eds.). (2025). *Modern taxonomy of bacteria and archaea: New methods, technology and advances*. Springer.

E-Resources

1. Protein Data Bank (PDB)
2. Coursera Bioinformatics Courses
3. https://www.mimuw.edu.pl/~lukaskoz/teaching/sad2/books/Molecular-Evolution-and-Phylogenetics.pdf.
4. https://www.cs.cmu.edu/~durand/Phylogenetics/Readings/Page - book.pdf
5. https://www.ncbi.nlm.nih.gov/books/NBK21122/

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	Pos										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1	2		3	3	3	2	3		3			3		3
CO2	1	2		3	3			3	3				3		3
CO3	1	2		3	3			3	3				3		3
CO4	1	2		3	3			3	3				3	3	
CO5	1	2	2	3	3	3	2	3	3	3			3	3	3

Strong -3; Medium -2; Low - 1

Semester: II- Discipline Centric Elective -II (Choice -3) : Bioinformatics

Ins. Hours / Week: 4 **Course Credit: 4** **Course Code: P26MBDE22C**

COURSE OBJECTIVES

- To understand biological databases and sequence alignment tools in bioinformatics.
- To learn methods of phylogenetic tree construction and evolutionary analysis.
- To understand computational approaches for protein structure prediction and molecular modelling.
- To study molecular descriptors and computational prediction of chemical properties and toxicity.
- To understand molecular docking techniques and genome-based drug discovery.

UNIT–I **(12 Hours)**

Introduction to Bioinformatics – Scope and Applications of Bioinformatics. Biological Data Mining – Exploration of Data Mining Tools. Cluster Analysis Methods and Data Visualization Techniques. Biological Data Management. Biological Algorithms – Biological Primary and Derived Databases. Sequence Databases and Structure Databases. Introduction to Sequence Alignment – Pairwise Sequence Alignment (PSA) and Multiple Sequence Alignment (MSA). BLAST and CLUSTALW. Scoring Matrices – Percent Accepted Mutation (PAM) and Blocks of Amino Acid Substitution Matrix (BLOSUM).

UNIT–II **(12 Hours)**

Phylogenetic Tree Construction – Concept of Dendrograms and 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 and Maximum Likelihood Method. Reliability of Phylogenetic Trees. Substitution Matrices and Evolutionary Models.

UNIT–III **(12 Hours)**

Computational Protein Structure Prediction – Secondary Structure Prediction. Homology Modelling, Fold Recognition and ab initio 3D Structure Prediction. Structure Comparison and Alignment. Prediction of Protein Function from Structure. Geometrical Parameters and Potential Energy Surfaces. Hardware and Software Requirements for Molecular Modelling. Molecular Graphics and Molecular File Formats. Molecular Visualization Tools and Applications.

UNIT–IV **(12 Hours)**

Prediction of Properties of Ligand Compounds. 3D Autocorrelation and 3D Morse Code. Conformation Dependent and Independent Chirality Codes. Comparative Molecular Field Analysis

(CoMFA). 4D QSAR and HYBOT Descriptors. Structure Descriptors and their Applications. Linear Free Energy Relationships. Quantitative Structure–Property Relationships (QSPR). Prediction of Toxicity of Chemical Compounds.

UNIT–V **(12 Hours)**

Introduction to Molecular Docking – Flexible and Rigid Docking. Target and Ligand Preparation. Solvent Accessibility and Surface Volume Calculation. Active Site Prediction and Docking Algorithms – Genetic and Lamarckian Algorithms. Docking Analysis – Molecular Interactions, Bonded and Non-bonded Interactions. Molecular Docking Software and Working Methods. Genome to Drug Discovery – Subtractive Genomics.

UNIT–VI: Current Contours (Continuous Internal Assessment only)

Introduction to Immunoinformatics – Scope and Applications. Immune System Databases and Computational Tools. Antigen Prediction and Epitope Mapping. T-cell and B-cell Epitope Prediction Methods. Vaccine Design Strategies and Reverse Vaccinology. Computational Approaches in Vaccine Development. Applications of Immunoinformatics.

Total Lecture Hours - 60

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Access to databases that provides information on nucleic acids and proteins.
2. Invent algorithms for sequence alignment
3. Construct phylogenetic tree.
4. Predict the structure of proteins
5. Design drugs by predicting drug ligand interactions and molecular docking.
6. Explain the principles and applications of immunoinformatics in antigen prediction, epitope mapping, and computational vaccine design.

TEXT BOOKS

1. Lesk A. M. (2002). Introduction to Bioinformatics. (4th Edition). Oxford University Press.London.

2. Lengauer T. (2008). Bioinformatics- from Genomes to Therapies (Vol-1).Wiley- VCH, London.

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, India.

4. Attwood, T.K. and Parry-Smith, D.J. (1999). Introduction to Bioinformatics. Addision Wesley Longman Limited, England.
5. Mount D.W., (2013).Bioinformatics sequence and genome analysis, 2nd edn.CBS Publishers, New Delhi.
6. Ismail H.D, 2023, Bioinformatics: A practical guide to next generation sequencing data analysis. 1st edition, Chapman and Hall / CRC, Boca Raton.
7. Shili Lin, Denise Scholtens, Sujay Datta, 2023. Bioinformatics Methods: From Omics to Next Generation Sequencing,, Chapman & Hall/CRC, USA. ISBN: 978-1498765152

REFERENCE BOOK(S)

1. Baxevanis A. D. and Ouellette F. (2004). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. (2nd Edition).
2. Bosu O. and Kaur S. (2007). Bioinformatics - Database, Tools, and Algorithms. Oxford University Press.
3. David W. M. (2001). Bioinformatics Sequence and Genome Analysis (2nd Edition). CBS Publishers and Distributors John Wiley and Sons**.** (Pvt.)Ltd.US
4. Xiong J, (2011). Essential bioinformatics, First south Indian Edition, Cambridge University Press, London.
5. Harshawardhan P.Bal, (2006). Bioinformatics Principles and Applications, Tata McGraw-Hill Publishing Company Limited. New Delhi.
6. Shili Lin, Denise Seholtems, Sujai Batta, 2023, Bioinformatics methods: from omics to next generation sequencing, 1st edition, Chapman and Hall / CRC, Boca Raton.
7. Tiratha Raj Singh, Hemraj Saini, Moacyr Comar Junior, 2024. Bioinformatics and Computational Biology: Technological Advancements, Applications, and Opportunities, Taylor & Francis, ISBN: 978-1032361581, United Kingdom.

E-RESOURCES

1. https://www.hsls.pitt.edu/obrc/
2. https://www.hsls.pitt.edu/obrc/index.php?page=dna
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1669712/
4. https://www.ebi.ac.uk/
5. https://www.kegg.jp/kegg/kegg2.html

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	Pos										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1	2		3	3			3	3				3		
CO2	1	2		3	3	3		3	3				3		
CO3	1	2		3	3	3	2	3	3				3		
CO4	1	2	2	3	3	3	2	3	3	3			3	3	3
CO5		2	2	3	3			3	3			3	3		

Strong -3; Medium -2; Low - 1

Semester: II- Generic Elective Course-II (Choice 1): Next Generation Microbiology

Ins. Hours / Week: 4 **Course Credit: 3** **Course Code: P26MBGE22A**

COURSE OBJECTIVES

- To understand the evolution of microbiology and acquire knowledge of advanced microscopic, analytical and automation techniques used in microbiological research.
- To gain insight into microbial genomics, next-generation sequencing, metagenomics and bioinformatics tools for studying microbial diversity and genome analysis.
- To develop knowledge on proteomics, metabolomics and systems biology approaches and their applications in disease diagnosis and biotechnology.
- To understand the principles of synthetic biology, genome editing and genetic engineering for designing engineered microbes with industrial and medical applications.
- To explore the applications of microbiology in healthcare, industry, environmental management and nanotechnology.

UNIT-I **(12 Hours)**

Evolution from classical to modern microbiology- Advanced microscopy: Confocal microscopy, Fluorescence microscopy, Electron microscopy- Flow cytometry and cell sorting- Biosensors in microbiology- Automation and high-throughput screening techniques.

UNIT-II **(12 Hours)**

Microbial genomics and genome organization- Next-generation sequencing (NGS) technologies- Metagenomics: Concepts, types (shotgun & amplicon sequencing) - Human microbiome and environmental microbiome- Bioinformatics tools for sequence analysis.

UNIT-III **(12 Hours)**

Introduction to proteomics and protein profiling- Techniques: 2D gel electrophoresis, mass spectrometry- Metabolomics: Concepts and analytical methods- Systems biology approach in microbiology- Applications in disease diagnosis and biotechnology.

UNIT-IV **(12 Hours)**

Principles of synthetic biology- CRISPR-Cas systems and genome editing- Gene cloning and expression systems- Design of engineered microbes- Applications in medicine, agriculture and industry.

UNIT-V **(12 Hours)**

Microbial applications in healthcare (vaccines, diagnostics)- Industrial microbiology and bioprocess technology- Environmental microbiology: Bioremediation and waste management- Nanotechnology in microbiology- Ethical issues, biosafety, and future prospects.

UNIT VI

Current Contours (Continuous Internal Assessment only)

Recent advances in microbiology- AI and bioinformatics in microbial research- Microbiome and personalized medicine- Emerging vaccines and diagnostics- Antimicrobial resistance- Environmental and industrial applications- Recent research trends and case studies.

Total Lecture Hours - 60

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Understand advanced microbial technologies
2. Gain knowledge of omics-based approaches
3. Apply modern microbiological tools in research and industry
4. Analyze microbial systems using interdisciplinary approaches
5. Describe about the waste management process.
6. To acquire knowledge on recent advances, emerging technologies and current research trends in modern microbiology.

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TEXT BOOKS

1. Verma, P., (2023). *Industrial Microbiology and Biotechnology: Emerging Concepts in Microbial Technology*. Singapore: Springer Nature.
2. Parray, J. A., Singh, N., and Li, W. J. (2025). *Computational Genomics and Structural Bioinformatics in Microbial Science*. London: Academic Press (Elsevier).
3. Henkin, T. M., and Peters, J. E. (2020). *Snyder and Champness Molecular Genetics of Bacteria* (5th ed.). Washington, DC: ASM Press.
4. Singh, V., Singh, A. K., Bhargava, P., and Joshi, M., (2020). *Engineering of Microbial Biosynthetic Pathways*. Singapore: Springer.
5. Rout, J. R., Kerry, R. G., and Dutta, A., (2022). *Biotechnological Advances for Microbiology, Molecular Biology, and Nanotechnology*. Florida: Apple Academic Press.

REFERENCE BOOK(S)

1. Willey, J. M., Sherwood, L. M., and Woolverton, C. J. (2020). *Prescott's Microbiology*

(11th edition.). New York: McGraw-Hill Education.

2. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., and Losick, R. (2018). *Molecular Biology of the Gene* (7th edition.). Boston: Pearson Education.

3. Liebler, D. C. (2019). *Introduction to Proteomics: Tools for the New Biology* (2nd edition.).New York: Humana Press.

4. Baldwin, G. S., Bayer, T. S., Dickinson, B. C., Ellis, T., Ginkel, M., and Kitney, R. I. (2022). *Synthetic Biology: A Primer* (Revised edition.). London: World Scientific Publishing.

5. Maier, R. M., Pepper, I. L., and Gerba, C. P. (2021). *Environmental Microbiology* (4th edition.). London: Academic Press.

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1. https://www.youtube.com/watch?v=1sISguPDlhY
2. https://www.classcentral.com/course/youtube-lecture-08-confocal-microscopy-427306
3. https://www.youtube.com/channel/UCTqLyJ-2uBIl0hHV9mD4pCQ/playlists
4. https://academic.oup.com/nar/article/50/D1/D808/6413603
5. https://www.nature.com/immersive/human-microbiome/index.html

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	Pos										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1			3	3			3	3				3	3	
CO2	1			3	3	3		3	3				3	3	
CO3	1			3	3	3		3	3				3	3	
CO4	1			3	3	3		3	3				3	3	
CO5	1			3	3	3		3	3				3	3	

Strong -3; Medium -2; Low - 1

Semester: II- Generic Elective Course - II :(Choice -2): Herbal Technology and Cosmetic Microbiology

Ins. Hours / Week:4 **Course Credit: 3** **Course Code: P26MBGE22B**

COURSE OBJECTIVES

- To understand the importance of herbs and Indian medicinal plants in traditional systems of medicine and their therapeutic applications.
- To learn the methods for collection, authentication and extraction of selected medicinal plants.
- To study the antimicrobial and antiviral activities of medicinal plants using laboratory techniques.
- To gain knowledge about cosmetic microbiology, preservation of cosmetics and the role of natural antimicrobial products in cosmetics.
- To understand microbial testing, validation methods and preservative efficacy in cosmetic products.

UNIT-I **(12 Hours)**

Herbs, Herbal medicine - Indian medicinal plants: Scope and Applications of Indian medicinal plants (locally used) in treating bacterial, fungal and viral diseases. Basic principles involved in Ayurvedha, Sidha, Unani and Homeopathy.

UNIT-II **(12 Hours)**

Collection and authentication of selected Indian medicinal plants: *Emblica officinalis, Phyllanthus amarus, Tinospora cordifolia, Andrographis paniculata, Piper longum, Ocimum sanctum, Azardirchata indica, Allium sativum.* Preparation of extracts- Hot and cold methods. Preparation of stock solutions.

UNIT-III **(12 Hours)**

Antimicrobial activity of selected Indian medicinal Plants: - In vitro determination of antibacterial and fungal activity of selected medicinal plants (*Azardirchata indica* and *Ocimum sanctum*) – Well-diffusion methods. MIC - Macro and micro dilution techniques. Antiviral activity.

UNIT-IV **(12 Hours)**

History of 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. (Soap, Face wash) - HACCP protocols in cosmetic microbiology.

UNIT-V **(12 Hours)**

Cosmetic microbiology test methods - Antimicrobial preservative efficacy, microbial content testing and biological toxicological testing. Validation methods - Bioburden and Pharmacopeial microbial assays. Preservatives of cosmetics.

UNIT – VI Current Contours (Continuous Internal Assessment only – self study)

Recent advances in herbal and cosmetic microbiology; herbal cosmetics and cosmeceuticals; quality control and standardization of herbal products; microbial contamination and safety evaluation of cosmetics; regulatory guidelines and biosafety aspects in herbal and cosmetic industries; applications of biotechnology in herbal product development; commercialization and entrepreneurship in herbal and cosmetic products.

Total Lecture Hours – 60

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Identify the applications of Indian medicinal plants in treating diseases.
2. Analyze and authenticate herbal plants.
3. Evaluate the antimicrobial activity of medicinal plants.
4. Describe the role of microorganisms and their metabolites in the preparation of cosmetics.
5. Validate procedures and biosafety measures in the mass production of cosmetics.
6. To gain knowledge on modern trends and applications in herbal and cosmetic microbiology.

TEXT BOOKS

1. Ayurvedic Formulary of India. (2011). Part 1, 2 & 3. Pharmacopoeia Commission for Indian Medicine and Homeopathy, Chennai. ISBN-10:8190648977.
2. Panda H. (2004). Handbook on herbal medicines. Asia Pacific Business Press Inc, New Delhi. ISBN: 8178330911.
3. Mehra P. S. (2019). A Textbook of Pharmaceutical Microbiology. Dreamtech Press, Darya Ganj ISBN 13:9789389307344.
4. Geis P. A. (2020). Cosmetic microbiology: A Practical Approach. (3rd Edition). CRC Press, Boca Raton, Florida ISBN:9780429113697
5. Brannan D. K. (1997). Cosmetic microbiology: A Practical Handbook. CRC Press, Boca Raton, Florida ISBN-10:0849337135.
6. Pattanayak, S., and Mishra, P**.** 2022. *Herbal Cosmetics: Science and Applications.* CRC Press, Boca Raton. ISBN: 978-1-032-12212-5.

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1. Indian Herbal Pharmacopoeia (2002). Vol. I &II Indian Drug Manufacturers Association, Mumbai.
2. British Herbal Pharmacopoeia.(1990).Vol.I. British Herbal Medicine Association, London.ISBN: 0903032090.

3. Verpoorte R. and Mukherjee, P. K. (2010). GMP for Botanicals: Regulatory and Quality issues on Phytomedicines. In GMP for botanicals: regulatory and quality issues on phytomedicines. (2nd edition). Saujanya Books, Delhi.ISBN-10:81-900788-5-2/8190078852. ISBN-13:978-81-900788-5-6/9788190078856.
4. Turner R. (2013). Screening methods in Pharmacology. Elsevier, Amsterdam ISBN:9781483264233.
5. 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.
6. Goyal, M. R. 2023. *Herbal Medicine for Healthcare: Evolution and Research Trends.* Apple Academic Press, New Jersey. ISBN: 978-1-77188-899-5.
7. Sivamani, R. K., Maibach, H. I., and Nasir, A. 2023. *Cosmetic Microbiology: Understanding and Controlling Microbial Contamination in Cosmetics.* Springer, Cham. ISBN: 978-3-031-22801-2.

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1. https://www.academia.edu/50236711/Modern_Extraction_Methods_for_Preparation_of_Bioactive_Plant_Extracts
2. https://www.nhp.gov.in/introduction-and-importance-of-medicinal-plants-and-herbs_mtl
3. https://pubmed.ncbi.nlm.nih.gov/17004305/
4. https://www.fda.gov/cosmetics/potential-contaminants-cosmetics/microbiological-safety-and-cosmetics
5. https://pubmed.ncbi.nlm.nih.gov/15156038/

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	Pos										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1	2		3	3	3	2	3	3			3	3		
CO2	1	2		3	3	3	2	3	3			3	3		
CO3	1	2		3	3	3	2	3	3			3	3		
CO4	1	2		3	3	3	2	3	3			3	3		
CO5	1	2		3	3	3	2	3	3			3	3	3	3

Strong -3; Medium -2; Low - 1

Semester: II- Generic Elective course -II (Choice -3): Forensic Science

Ins. Hours / Week: 4 **Course Credit: 3** **Course Code: P26MBGE22C**

COURSE OBJECTIVE

- To understand the basics and scope of forensic science.
- To gain knowledge on forensic laboratories and forensic microbiology.
- To study forensic serology and examination of biological evidence.
- To understand DNA profiling and forensic DNA analysis techniques.
- To learn the principles of forensic toxicology and poison analysis.

UNIT – I **(12 Hours)**

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.

UNIT – II **(12 Hours)**

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.

UNIT – III **(12 Hours)**

Forensic serology - Definition, identification and examination of body fluids - Blood, semen, saliva, sweat and urine. Forensic examination and identification of hair and fibre.

UNIT – IV **(12 Hours)**

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.

UNIT – V **(12 Hours)**

Forensic toxicology - Introduction and concept of forensic toxicology. Medico legal post mortem and their examination. Poisons - Types of poisons and their mode of action.

UNIT – VI Current Contours (Continuous Internal Assessment only – self study)

DNA Fingerprinting and Microbial Genetics - Postmortem Microbiology: Determining Time and Cause of Death - Environmental Forensics and Bioremediation.

Total Lecture Hours – 60

COURSE OUTCOME

After completion of this course, students will be able to:

1. Understand the fundamentals, history, scope and branches of Forensic Science.
2. Gain knowledge about forensic science laboratories and modern forensic techniques.
3. Learn the identification and examination of biological evidence such as blood, semen, saliva, hair and fibres.
4. Understand principles and applications of DNA Profiling and DNA fingerprinting.
5. Acquire knowledge on forensic toxicology, poisons and medico-legal postmortem examination.
6. Understand forensic applications of DNA, microbial genetics and environmental microbiology.

REFERENCE

TEXT BOOK

1. Sharma, B. R. (2014). Forensic science in criminal investigation and trials (5th ed.). LexisNexis India.
2. Saferstein, R. (2017). An introduction to forensic science (12th ed.). Pearson Education.
3. Reddy, K. S. N., and Murty, O. P. (2017). The essentials of forensic medicine and toxicology (34th ed.). Jaypee Brothers Medical Publishers.
4. Houck, M. M., and Siegel, J. A. (2015). Forensic biology. Academic Press.
5. Parikh, C. K. (2019). Parikh's textbook of medical jurisprudence, forensic medicine and toxicology (7th ed.). CBS Publishers & Distributors.

REFERENCE BOOK

1. Richard Saferstein. (2017). An introduction to forensic science (12th ed.). Pearson
2. B. R. Sharma. (2014). Forensic science in criminal investigation and trials (5th ed.). LexisNexis India
3. K. S. Narayan Reddy, & O. P. Murty. (2017). The essentials of forensic medicine and toxicology (34th ed.). Jaypee Brothers Medical Publishers
4. John M. Butler. (2015). Advanced topics in forensic DNA typing: Interpretation. Elsevier
5. Max M. Houck, & Jay A. Siegel. (2015). Fundamentals of forensic science (3rd ed.). Academic Press
6. David E. Newton. (2007). Forensic chemistry. Chelsea House Publishers
7. Curtis D. Klaassen. (2019). Casarett and Doull's toxicology: The basic science of poisons (9th ed.). McGraw Hill

8. Wilson and Walker. (2018). Principles and techniques of biochemistry and molecular biology (8th ed.). Cambridge University Press
9. National Institute of Open Schooling. (2020). Introduction to forensic science. NIOS
10. Directorate of Forensic Science Services. (2024). Forensic science laboratory services in India. DFSS Official Website

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2. https://www.ncbi.nlm.nih.gov/books/NBK234877/
3. https://www.elsevier.com/books/microbial-forensics/budowle/978-0-12-382006-8
4. https://www.researchgate.net/publication/289542469_Methods_in_microbial_forensics
5. https://cisac.fsi.stanford.edu/events/microbial forensics

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	Pos										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1	2		3	3	3		3	3				3		3
CO2	1	2	2	3	3	3	2	3	3	3			3		3
CO3	1	2	2	3	3	3	2	3	3	3			3		3
CO4	1	2	2	3	3	3	2	3	3	3			3	3	3
CO5	1	2	2	3	3	3	2	3	3	3			3	3	3

Strong -3; Medium -2; Low - 1

Semester: II- SEC-II : Microbes in Food Processing Technology

Ins. Hours / Week: 2 **Course Credit: 2** **Course Code: P26SEMB22**

COURSE OBJECTIVES

- Understand the principles and microbial aspects of food processing and preservation.
- Gain knowledge of food preservation methods and control of microbial spoilage.
- Learn the applications of microorganisms in fermented and functional foods.
- Understand novel food processing technologies and microbial safety measures.
- Acquire knowledge on food quality assurance, food safety and sustainable food processing.

UNIT-I **(6 Hours)**

Scope and principles of food processing; classification of foods and processing methods; unit operations in food processing; role of microorganisms in food processing and preservation.

UNIT-II: **(6 Hours)**

Thermal processing, refrigeration, freezing, drying and fermentation; hurdles in food preservation; microbial spoilage and preservation strategies in processed foods.

UNIT-III: **(6 Hours)**

Starter cultures and fermented foods; probiotics, prebiotics and functional foods; microbial enzymes in food industry; single cell protein and microbial biomass applications.

UNIT-IV: **(6 Hours)**

Novel processing methods – membrane processing, high-pressure processing, irradiation, pulsed electric field and packaging innovations; microbial safety considerations in modern processing.

UNIT – V **(6 Hours)**

Food quality assurance (HACCP, GMP, FSSAI); food-borne pathogens and detection; microbial conversion of food waste into value-added products and sustainable food processing.

UNIT – VI Current Contours (Continuous Internal Assessment only – self study)

Seminar, assignment, case study, preparation of fermented food products, microbial analysis of processed foods, industrial visit and mini project related to food processing and preservation.

Total Lecture Hours – 30

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Explain the principles, scope and different methods involved in food processing and preservation.
2. Describe thermal and non-thermal food preservation techniques and analyze microbial spoilage in processed foods.
3. Discuss the role of microorganisms in fermented foods, probiotics, microbial enzymes and single cell protein production.
4. Illustrate modern food processing technologies and evaluate their significance in ensuring microbial safety and food quality.
5. Apply concepts of food quality assurance, food safety standards and sustainable microbial technologies in food processing industries.
6. Develop practical skills in food processing, microbial analysis and quality assessment.

TEXT BOOKS

1. Sivasankar, B. (2009), *Food Processing and Preservation*, PHI Learning Pvt. Ltd., New Delhi.
2. Potter, N.N. and Hotchkiss, J.H. (2012), *Food Science*, Springer, New York.
3. Frazier, W.C. and Westhoff, D.C. (2013), *Food Microbiology*, McGraw Hill, New York.
4. Ramesh, M.N. (2016), *Food Processing Technology*, CBS Publishers & Distributors, New Delhi.
5. Jay, J.M., Loessner, M.J. and Golden, D.A. (2017), *Modern Food Microbiology*, Springer, New York.
6. Food Processing Technology Fellows, P. J. (2025). *Food processing technology: Principles and practice* (5th ed.). Woodhead Publishing.

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1. Food Microbiology Ray, B., and Bhunia, A. (2025). *Fundamental food microbiology* (6th ed.). CRC Press.

2. Fellows, P.J. (2017), *Food Processing Technology: Principles and Practice*, Woodhead Publishing, Cambridge.
3. Ramaswamy, H.S. and Marcotte, M. (2005), *Food Processing: Principles and Applications*, CRC Press, Boca Raton.
4. Tewari, G. and Juneja, V.K. (2008), *Advances in Thermal and Non-Thermal Food Preservation*, Wiley-Blackwell, Ames.
5. Rahman, M.S. (2020), *Handbook of Food Preservation*, CRC Press, Boca Raton.
6. Doyle, M.P. and Buchanan, R.L. (2013), *Food Microbiology: Fundamentals and Frontiers*, ASM Press, Washington DC.

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1. https://sites.google.com/a/uasd.in/ecourse/food-processing-technology
2. https://nptel.ac.in/courses/126105015
3. https://engineeringinterviewquestions.com/biology-notes-on-food-adulteration/food processing | Definition, Purpose, Examples, & Facts | Britannica
4. Food Processing Technology | Food News & Views Updated Daily (foodprocessing- technology.com)

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	Pos										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1			3	3	3		3	3			3	3		
CO2	1	2	2	3	3	3	2	3	3	3		3	3	3	3
CO3	1	2	2	3	3	3	2	3	3	3		3	3	3	3
CO4	1	2	2	3	3	3	2	3	3	3		3	3	3	3
CO5	1	2	2	3	3	3	2	3	3	3		3	3	3	3

Strong -3; Medium -2; Low - 1

Semester: II- NME-II: Human and Microbes

Ins. Hours / Week: 2 **Course Credit: 2** **Course Code: P26NMEMB21**

COURSE OBJECTIVES

- Understand the composition and functions of human microbiota in health.
- Gain knowledge on the metabolic and nutritional roles of microbiota.
- Learn the basics of immunity, allergic reactions and immunization.
- Understand the importance and applications of probiotics, prebiotics and synbiotics.
- Acquire knowledge on nutritional supplements and fermented food products.

UNIT-I: **(6 Hours)**

Introduction to Human Microbiota - Definition and classification of beneficial microbes. Composition and distribution of the normal microbiota. Establishment and development of microbiota in humans (from birth to adulthood). Role of microbiota in maintaining homeostasis.

UNIT-II: **(6 Hours)**

Role of Microbiota in Nutrition and Metabolism. Microbes in digestion of complex carbohydrates. Synthesis of vitamins (B12, K, biotin, folate). Regulation of metabolism and energy balance. Microbial metabolites: short-chain fatty acids (SCFAs), secondary bile acids.

UNIT-III: **(6 Hours)**

Immunity- Types of Immunity- Innate and Acquired Immunity. Allergic Reaction- Types of Allergic reaction - Immediate and Delayed. Immunization Schedule.

UNIT-IV: **(6 Hours)**

Probiotics, Prebiotics, and Synbiotics- Definition, types, and examples of probiotics (*Lactobacillus, Bifidobacterium*) health benefits. Role of prebiotics and synbiotics with examples. Regulation and safety of probiotic products.

UNIT-V: **(6 Hours)**

Nutritional supplements - *Spirulina* and *Chlorella*. *Saccharomyces cerevisiae* – bread, beer, wine, yogurt, cheese. Fermented products: curd, kefir, kimchi and sauerkraut.

UNIT – VI Current Contours (Continuous Internal Assessment only – self study)

Human microbiome projects and Earth microbiome projects. Microbes and immune regulations, gut microbiota and brain functions, metabolic disorders and dietary interventions. Microbiota in gastrointestinal issues.

Total Lecture Hours – 30

COURSE OUTCOME

After the completion of the course, students should be able to,

1. Understand the diversity and function of beneficial microbes in various body sites.
2. Explain the role of microbiota in nutrition, metabolism, and vitamin synthesis.
3. Interpret the interactions between microbiota and the immune system.
4. Analyze the use of probiotics, prebiotics, and synbiotics in health promotion.
5. Evaluate the applications of microbiota in disease therapy and prevention.
6. Understand the role of microbiota in human health, immunity and metabolic disorders.

TEXT BOOKS

1. Marchesi, Julian R. (Editor). The Human Microbiota and Microbiome. CABI Publishing, Wallingford, Oxfordshire, UK. 2014. ISBN: 9781780640495
2. Venketeshwer Rao & Leticia Rao. Probiotics and Prebiotics in Human Nutrition and Health. InTechOpen, London, United Kingdom. 2016. DOI: 10.5772/61113.
3. Alessio Abeltino, Duaa Hatem, Cassandra Serantoni.2024. Unraveling the Gut Microbiota: Implications for Precision Nutrition and Personalized Medicine.
4. Padmanaban S. and S. Balakrishnan.2022. Good Microbes in Medicine, Food Production, Biotechnology, Bioremediation, and Agriculture, Wiley, United States.

REFERENCE BOOK(S)

1. Charis M. Galanakis. Nutraceutical and Functional Food Components: Effects of Innovative Processing Techniques. Academic Press (Elsevier), London, UK. 2017. ISBN: 9780128052570.
2. Michael Wilson, Brian Henderson, Bacterial Disease Mechanisms: An Introduction to Cellular Microbiology, Second Edition. Cambridge University Press, Cambridge, UK. 2002. ISBN: 9780521790303.
3. Guarner, Francisco and Malagelada, J.R. Gut Flora in Health and Disease, The Lancet, Elsevier Ltd., London, UK. 2003.
4. Bharati Bhatt, Kadamb Patel, Chuen Neng Lee, Shabbir Moochhala.2024. The Microbial Blueprint: The Impact of Your Gut on Your Well-being. Partridge Publishing Singapore.
5. Kamal Dua .2024. Synbiotics in Human Health: Biology to Drug Delivery Springer Nature

Singapore.

E-RESOURCES

1. https://www.coursera.org/learn/human-microbiome
2. https://www.youtube.com/watch?v=5DTrENdWvvM
3. https://www.youtube.com/watch?v=1sISguPDlhY
4. https://academic.oup.com/nar/article/50/D1/D808/6413603
5. https://www.nature.com/immersive/human-microbiome/index.html

MAPPING WITH PROGRAM OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	POs										PSOs				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
CO1	1			3	3	3		3	3			3	3		
CO2	1	2	2	3	3	3	2	3	3	3		3	3	3	3
CO3	1	2	2	3	3	3	2	3	3	3		3	3	3	3
CO4	1	2	2	3	3	3	2	3	3	3		3	3	3	3
CO5	1	2	2	3	3	3	2	3	3	3		3	3	3	3

Strong -3; Medium -2; Low - 1