

SYLLABUS FOR THE

ACADEMIC YEAR

2026-2027

MANONMANIAM SUNDARANAR UNIVERSITY

TIRUNELVELI– 627 012

TAMILNADU, INDIA



**B.Sc. MICROBIOLOGY
(FOR AFFILIATED COLLEGES)**

**CURRICULUM
REVISED BASED ON REGULATIONS ON CHOICE BASED CREDIT SYSTEM
(CBCS) FOR UG DEGREE PROGRAMS
(Effective from the academic year 2026-2027 onwards)**

MANONMANIAM SUNDARANAR UNIVERSITY
ABHISHEKAPATTI, TIRUNELVELI– 627 012, TAMILNADU, INDIA
B.Sc. MICROBIOLOGY (CBCS PATTERN)
FOR AFFILIATED COLLEGES
(EFFECTIVE FROM THE ACADEMIC YEAR 2026-2027 ONWARDS)
BASED ON MSU DIRECTION

1. VISION AND MISSION OF THE UNIVERSITY

Vision

"To provide quality education to reach the un-reached"

Mission

- a) To conduct research, teaching and outreach programs to improve conditions of human living
- b) To offer a wide variety of off-campus educational and training programs, including the use of information technology, to individuals and groups
- c) To develop partnership with industries and government so as to improve the quality of the workplace and to serve as a catalyst for economic and cultural development
- d) To provide quality / inclusive education, especially for the rural and un-reached segments of economically downtrodden students including women, socially oppressed and differently abled.

2. PREAMBLE

The Under Graduation (UG) in Microbiology programme aims to make the student proficient in the field of Microbiology through the transfer of knowledge in the classroom as well as in the laboratory. The students will be encouraged to participate in discussions and deliver seminars on some topics. In the laboratory the student will first learn good laboratory practices and then get hands-on training on basic microbiological technique. The student will participate in field trips to industries that will facilitate his/her understanding of the practical aspects of the programme and to provide exposure to the Industrial production and gain employment. The Under Graduate (UG) degree in B.Sc., Microbiology creates wider opportunities in Educational, Research, Industrial, Medical and Environmental and Pharmaceutical sectors.

3. PROGRAMME EDUCATIONAL OUTCOMES (PEO)

In alignment with the Vision and Mission of the University, the following have been defined as the PEO for the graduates.

PEO1: Developing strong positive attitude to learn independently the concepts in the field of study

PEO2: Ensuring confidence among the learners to apply the knowledge and skills gained to solve real life issues

PEO3: Habituating ethical values among the learners to succeed in personal and professional life

4. PROGRAMME OUTCOMES (PO)

Programme Outcomes for the Under Graduate Degree Programmes of the University are articulated as under.

After the successful completion of Undergraduate Programme from the University, the learner should be able to

PO1: Comprehend the knowledge acquired and communicate the same to others

PO2: Analyze and compare the factual data / situation to comprehend and to critically evaluate to find solution to the problem ahead

PO3: Apply theories and philosophies learned in solving the problem in scientific manner

PO4: Think reflectively on the earlier activities and attempt for self-directed lifelong learning process

PO5: Understand multicultural existence and identify the means to prolong moral/ethical values in personal and professional life

PO6: Expose the learner to the digital technology to learn through multiple sources

PO7: Train the learner to be a responsible player in teams and impart leadership qualities in them.

5. PROGRAMME SPECIFIC OUTCOMES (POs)

On completion of the programme, graduates will be able to:

PSO 1: Core Knowledge of Microbial Diversity and Taxonomy

To enable students to understand the evolutionary history, cellular structures, and metabolic diversity of cellular (bacteria, archaea, fungi, algae, protozoa) and acellular (viruses, viroids, prions) microorganisms, and to accurately classify them using conventional phenotypic, genotypic, and modern molecular metrics like 16S rRNA sequencing.

PSO 2: Technical and Instrumental Competence

To train students in advanced analytical instrumentation, covering the working principles, calculations, and execution of basic tools (pH meters, autoclaves), advanced imaging/spectroscopy (SEM, TEM, UV-Vis, FTIR, MRI), and separation techniques (HPLC, Gas Chromatography, Gel Electrophoresis) for biological sample profiling.

PSO 3: Essential Laboratory and Diagnostic Skills

To cultivate hands-on proficiency in core microbiological practices, including stringent aseptic sterilization methods, custom media preparation, pure culture isolation, advanced staining protocols, metabolic identification (IMViC, TSI), and standard antibiotic sensitivity testing (AST).

PSO 4: Understanding Biochemical Concepts and Metabolic Pathways

To provide deep insight into the structure, structural classification, and dynamic roles of fundamental biomolecules (carbohydrates, lipids, proteins, amino acids) alongside an explicit grasp of microbial physiology, bioenergetics (cellular pathways like EMP, ED, TCA, and Fermentation), and photosynthesis.

PSO 5: Clinical Diagnostics and Pathology Correlates

To equip students with the ability to identify specific metabolic disorders (e.g., PKU, diabetes, hyperlipidemia), interpret critical organ function tests (renal, hepatic, pancreatic), map out diagnostic enzymology parameters, and recognize silkworm/mulberry pathologies (Pebrine, Grasserie) within allied sectors.

PSO 6: Public Health, Epidemiology, and Preventive Healthcare

To nurture a holistic view of community health through the study of social and preventive medicine, epidemiology, and public health indicators. Students will learn to analyze major infectious disease outbreaks (SARS, MERS, COVID-19), evaluate community risk/surveillance, and recognize the supplementary therapeutic roles of alternative medical systems (AYUSH).

PSO 7: Applied Skills, Nutrition, and Allied Entrepreneurship

To empower students to apply microbiological concepts to human wellness through lifecycle meal-planning, public health hygiene frameworks (WASH), and public nutrition policies, while concurrently developing specialized skills in commercial sericulture management, infrastructure planning, and rural entrepreneurship.

6. PROGRAMME DETAILS

6A. ELIGIBILITY:

A pass in Higher Secondary examinations or its equivalent in Science Stream with Biology / Botany / Zoology / Microbiology as one of the subjects or a subject from general stream papers (Biotechnology, Biochemistry, Microbiology) or vocational stream papers (covering Life Sciences, Agriculture chemicals, Agro based industries, Environment, Medical / Para medical, Agriculture, Apiculture, Aquaculture, Crop protection, Dairying, Floriculture and Medicinal plants, Farm mechanics and post-harvest techniques, Poultry, Plant protection, Sericulture and Apiculture, Soil conservation, Small farm management, Spices and plantation crops, Vegetable and fruits, Hospital care / Management, Ophthalmic, Medical lab technology, Dental studies, Forestry, Home science, Siddha, Nutrition and Dietetics, Nutritious meal organizer / Food Management and Child care / Agriculture practical - (Core / Interdisciplinary) is eligible to apply.

6B. QUALIFICATION NORMS FOR THE APPOINTMENT OF ASSISTANT PROFESSOR

Candidates fulfilling the following conditions shall be appointed as Assistant Professor.

- i) A M.Sc., / M.Phil. Degree in Microbiology / Applied Microbiology discipline (55% minimum) with Ph.D. or UGC-NET/ SLST / SLET.

6C. MEDIUM OF INSTRUCTION

The medium of instruction as well as examination will be in English

6D. DURATION OF THE PROGRAMME

The duration of the programme shall be for THREE consecutive years with SIX semesters.

6E. THEORY EXAMINATION

The external evaluation will be based on the examination to be conducted by the university at the end of each semester.

6F. PRACTICAL EXAMINATION

Practical examinations will be conducted every semester.

7. OUTCOME BASED EDUCATION - CHOICE BASED CREDIT SYSTEM

Outcome Based Education (OBE) is the order of the day in all Higher Education Institutions to emphasize quality mandate. Curriculum tailored with Choice Based Credit System (CBCS) for ensuring flexibility; Exposure to learning opportunities using the latest technological advancements to the learners for continuous lifelong learning; and Adoption of Revised Bloom's Taxonomy (RBT) in the assessment mechanism are essential to add value to the existing OBE. The current revision is aimed at providing scope for effective implementation of OBE by including Program Educational Outcomes, Program Outcomes, and Program Specific Outcomes in alignment to the vision and mission of the University. Courses need to be framed and mapped such that the compilation of the Outcomes of all Courses in the program ensures the attainment of the program outcomes in terms of RBT.

Each Course has to address a minimum of 4 PSOs

Level of contribution of the Course towards attaining PSOs

0 – No Contribution	1 – Low Level	2 – Medium Level	3 – High Level
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7A. SUMMARY MAPPING MATRIX

To see how these activities broadly cluster across UGC's 15 outcomes, primary impact distribution is given below:

NO	COURSE	LEARNING OUTCOMES
1	Industrial visits	Disciplinary Knowledge (1), Analytical Reasoning (5), Teamwork (7), Multi-cultural (12), Ethics (13)
2	Internship	Problem Solving (4), Digital Literacy (10), Self-Directed Learning (11), Leadership (14), Lifelong Learning (15)
3	Group Project	Critical Thinking (3), Analytical (5), Research Skills (6), Scientific Reasoning (8), Ethics (13)
4	Presentation & Viva Voce	Disciplinary Knowledge (1), Communication (2), Critical Thinking (3), Reflective Thinking (9)

8. EVALUATION

A. Each paper carries an internal component

B. There is a pass minimum of 50% for UG. external and overall components

Theory: External: internal Assessment = 75:25

Practical: External: Internal Assessment = 50:50

9. MEASUREMENT OF ATTAINMENT OF COURSE OUTCOME

The Course Outcomes (COs) are measured through the performance of learners by direct and indirect assessment methods for that particular course.

i. Internal Assessment (25 Marks)

COMPONENTS	MARKS
The average of the best two tests from the 3 compulsory tests	20 Marks
Assignment / Attention (Participation) in Class	05 Marks
Total	25 Marks

ii. Semester End Examinations (75 Marks)

a) EXTERNAL EXAMINATION

Theory External examination will be conducted for 3 hours at the end of each semester by the university for maximum of 75 marks. Questions will be taken based on Bloom's taxonomy.

Written exams, Practical, Project report, and Comprehensive Viva Voce

Note: In both Internal and Semester End Examinations

Lower Order Thinking (K1, K2, & K3) – 60 % in each part

Higher Order Thinking (K4, K5, & K6) – 40 % in each part

L. Semester End Examination Question Paper Pattern for the Theory Papers

- The Maximum Marks for Semester End Examination is 75 for UG.
- The question paper shall have three Parts with the maximum of 75 marks for three hours with the following break-up.

The question paper pattern for all theory papers shall be as follows

KNOWLEDGE LEVEL	SECTION	TYPE OF QUESTIONS	MARKS
(60 % K1, K2 &K3 40% K4, K5 & K6 WILL BE FOLLOWED IN ALL THE THREE SECTIONS)	Section –A	Multiple choice question (Three question from each unit)	10x1 = 10 Marks
	Section – B	Internal choice questions (one question from each unit)	5x5 = 25 Marks
	Section – C	Internal choice questions (one question from each unit)	5x8 = 40 Marks
TOTAL			75 Marks

b) PRACTICAL EXAMINATIONS

Microbiology is considered a highly practical-oriented programme because the discipline relies on hands-on manipulation to isolate, identify, and study microorganisms. Theoretical knowledge only explains concepts, but laboratory work is essential to visualize cells, understand microbial behavior, and develop diagnostic skills. The programme has fabricated to increase the practical skill of the students with 8 practical in the programme. There will be two practical which will be conducted at the end of each semester for maximum of 100 marks including 50 internal and 50 external marks. The duration of the practical examination will be 5 hours.

- The Maximum Marks for Practical Examination is 100 for UG.
- External Mark Components 50 Marks - Practical Examination and Record Marks
- Internal Mark 50 Marks.

The Internal Mark Distribution pattern for all practical papers shall be as follows

NO	COMPONENTS	MARKS	DURATION*
1	Major experiment	15 Marks	<i>Practical time: 5 hours* (10.00 AM – 4.00 PM (Including 1 Hour Lunch Break)</i>
2	Minor experiment	10 Marks	
3	Identification of spotters 4 x 2.5 Marks	10 Marks	
4	Record	10 Marks	
5	Viva-voce	05 Marks	
	Total	50 Marks	

* Based on the understanding of practical difficulties (*More time is consumed for Media preparation, Sterilization, Dispensing of media, Solidification of media, Inoculation and Incubation plates, Washing and Killing (Sterilization), proper and safe disposal of used materials and infectious biological samples*) in finishing the experiments / conducting the practical and feedback of students, staff and lab technicians it is decided to follow the old timing for conducting practical (5 Hours / Practical).

So, the Board **STRONGLY RECOMMENDS** to increase the practical timing from 3 hours to 5 Hours. Increase of timing is indispensable for smooth conduct of practical, effective execution and biological safety of the environment and health of the students and staff members.

c) COURSE PROJECT

1. During the final semester, Group Project work is assigned
2. It could be done in a group of 4 or 5 students related to issues pertaining to the area of Microbiology under the guidance of department faculty.
3. Student could be permitted to go for the collection of samples / data along with staff members
4. A Scientific report in the form of a thesis should be submitted.

The marks for Project shall be allotted in the following manner

Internal	External	Total
50 Marks	50 Marks	100 Marks

Note:

- i) Student should carry out group projects.
- ii) Project shall be allotted at the beginning of the V semester.
- iii) In house projects are encouraged.
- iv) Faculty members of the respective colleges must serve as guides
- v) Project report evaluation will be done and Viva-voce will be conducted by both the external examiner and the guide at the end of the FIFTH SEMESTER itself.
- vi) Dissertation have to be submitted 15 days before the actual schedule of the exam.
- vii) Evaluation of dissertation has to be done by the external examiner(s) appointed by the University for 50 Marks.

d) INDUSTRIAL AND INSTITUTIONAL VISIT

To give exposure on the scope and developments in the field of Microbiology for students, Industrial / Institutional visits are promoted. It helps the students to make themselves aware of the demands in the fields, expectations of the concerned and the qualifications to be developed in them. The report of the visit must be added to the practical record.

10. PASSING MINIMUM

The candidate shall be declared to have passed the examination if the candidates secure not less than 30 marks out of 75 marks in the semester examination in each theory course and in total (CIA mark + Theory Exam mark) not less than 40 marks.

The candidates shall be declared to have passed the examination if he/she secures not less than 40 marks in total (CIA mark + Practical Exam mark) with minimum of 18 marks out of 45 marks in the Practical Exam conducted by the University. There is no passing minimum for the record notebook. However, submission of the record notebook is necessary.

Candidate who does not obtain the required minimum marks for a pass in a Course/Practical shall be declared Re-Appear (RA) and the candidate has to appear and pass the same at a subsequent appearance.

11.QUESTION PAPER MODEL - END SEMESTER PRACTICAL AND THEORY EXAMINATION

11A. MODEL QUESTION PAPER – PRACTICAL



மனோன்மணியம் சுந்தரனார் பல்கலைக்கழகம்
Manonmaniam Sundaranar University
Reaccredited with 'A' Grade (CGPA 3.13 Out of 4.0) by NAAC (3rd Cycle)
Tirunelveli - 627 012, Tamilnadu, India.

UNIVERSITY PRACTICAL EXAMINATIONS NOVEMBER 2026

FIRST YEAR - I B.Sc., Microbiology

Subject Code:

Subject: LAB IN MICROBIAL PHYSIOLOGY AND METABOLISM

Time: 10.00 am -4.00 pm (5 Hours)

Max Marks: 50

1. Perform Antibiotic Sensitivity test using Disc diffusion technique and report your findings. **15 Marks**
2. Conduct catalase test with the given bacterial culture and report your findings. **10 Marks**
3. Comment on the following spotters **10 Marks**
 - a. Acid Fast Staining
 - b. Autoclave
 - c. Amoeba
 - d. Carbohydrate Fermentation
4. Record **10 Marks**
5. Viva-voce **05 Marks**

11B. MODEL QUESTION PAPER – THEORY

QUESTION CODE:

REGISTER NUMBER.....

B.Sc., (CBCS) DEGREE EXAMINATION NOVEMBER 2026

FIRST SEMESTER

MICROBIOLOGY

Elective - BIOINSTRUMENTATION

(For those who joined during 2026-2027)

Time: 3 Hours

Max.: 75 Marks

Q.NO	Course Outcome (CO)	Bloom's K level	SECTION – A (10 x 1 = 10 marks) Answer <u>ALL</u> Questions.
1	CO1	K1	What does a pH meter measure? a) Temperature b) Electrical conductivity c) Acidity or alkalinity of a solution d) Absorbance
2	CO1	K1	Who invented the autoclave? a) Joseph Lister b) Leeuwenhoek c) Charles Chamberland d) Louis Pasteur
3	CO1	K2	Why is infrared radiation used to study the vibrational spectrum of molecules? a) It measures atomic mass b) It detects molecular vibrations c) It produces X-rays d) It separates compounds
4	CO1	K2	What is the role of electrons in mass spectrometry. a) To ionize the sample molecules b) To cool the sample c) To separate proteins d) To measure pH
5	CO2	K3	A researcher wants to purify a mixture of pigments using adsorption on silica gel packed in a column. Which chromatographic technique should be selected? a) Gas chromatography b) Column chromatography c) HPLC d) Spectrophotometry
6	CO2	K3	A scientist needs to separate proteins according to their molecular size. Which technique should be applied? a) HPLC b) PAGE c) Gas chromatography

			d) Thin-layer chromatography
7	CO3	K4	A protein mixture contains molecules with similar molecular weights but different charges. Which electrophoretic technique would best separate them? a) SDS-PAGE b) Agarose gel electrophoresis c) Native PAGE d) Flame photometry
8	CO3	K4	BMRI is preferred over X-ray imaging for soft tissue examination because MRI: a) Uses ionizing radiation b) Provides better soft tissue contrast c) Is less expensive d) Requires no magnetic field
9	CO4	K5	You are establishing a diagnostic center for neurological disorders. Which combination of instruments would provide the most comprehensive diagnostic capability? a) MRI and PET Scan b) Flame Photometer and Colorimeter c) Geiger Counter and Electrophoresis Unit d) Spectrophotometer and Microscope
10	CO4	K6	To develop a complete laboratory protocol for protein analysis, which sequence of techniques would be most appropriate? a) Sample preparation → Electrophoresis → Data interpretation b) MRI → Electrophoresis → Flame photometry c) Radiation detection → MRI → Sample preparation d) Flame photometry → PET scan → Electrophoresis
SECTION – B (5 × 5= 25 Marks) Answer ALL Questions Choosing Either A or B			
11A	CO2	K3	Demonstrate how an autoclave is used for sterilizing laboratory materials.
11B	CO2	K3	Calculate and prepare 1 L of a one molar NaCl solution.
12A	CO1	K2	Explain the principle of UV spectroscopy
12B	CO3	K4	Use a colorimeter to estimate the concentration of a colored solution.
13A	CO2	K3	Explain the principle of paper chromatography
13B	CO1	K2	Demonstrate the separation of proteins using electrophoresis.
14A	CO4	K5	Evaluate the significance of ECG as a diagnostic tool compared to other cardiac imaging techniques
14B	CO4	K6	Develop a clinical case study where CT scan is the most

			appropriate diagnostic technique and justify its use.
15A	CO4	K5	Evaluate the effectiveness of spectrofluorimetry over UV-visible spectrophotometry for trace analysis
15B	CO4	K6	Develop an experimental setup using autoradiography to study DNA or protein synthesis.
SECTION – B (5 × 8= 40 Marks)			
Answer <u>ALL</u> Questions Choosing Either A or B			
16A	CO1	K2	Explain the principle and working mechanism of a pH meter.
16B	CO4	K5	Select suitable standard buffers for calibrating a pH meter and justify your choice.
17A	CO2	K3	Apply mass spectroscopy data to identify an unknown compound
17B	CO2	K3	Use an IR spectrum to identify functional groups present in an organic compound.
18A	CO1	K2	Explain the principle of thin layer chromatography.
18B	CO3	K4	Apply PAGE to separate proteins and interpret the results obtained
19A	CO3	K4	Analyze the instrumentation and working mechanism of MRI and explain how each component contributes to image formation.
19B	CO4	K6	Develop a clinical case study where PET scan is the most suitable diagnostic technique and justify its use.
20A	CO4	K5	Evaluate the reliability of flame photometry in estimating sodium and potassium ions in biological samples.
20B	CO4	K6	Develop a radiation-monitoring program for a laboratory using a Geiger-Müller counter and justify the protocol.

MANONMANIAM SUNDARANAR UNIVERSITY

Tirunelveli – 627012, INDIA

B.Sc., Microbiology (Colleges)

SEMESTER SYSTEM WITH CREDITS (CBCS PATTERN) SYLLABUS

12A. Credit Distribution of the Curriculum Design for UG Programme in Microbiology

Sem I	Credit	Sem II	Credit	Sem III	Credit	Sem IV	Credit	Sem V	Credit	Sem VI	Credit
1.1. Language - Tamil	3	2.1. Language - Tamil	3	3.1. Language – Tamil	3	4.1. Language - Tamil	3	5.1 Core Course – CC IX	4	6.1 Core Course – CC XIII	4
1.2 English	3	2.2 English	3	3.2 English	3	4.2 English	3	5.2 Core Course – CC X	4	6.2 Core Course – CC XIV	4
1.3 Core Course – CC I	5	2.3 Core Course – CC III	5	3.3 Core Course – CC V	4	4.3 Core Course – CC VII Core Industry Module	4	5.3 Core Course CC -XI	4	6.3 Core Course – CC XV	4
1.4 Core Course – CC II	4	2.4 Core Course – CC IV	4	3.4 Core Course – CC VI	4	4.4 Core Course – CC VIII	4	5.3 Core Course –/ Project with viva-voce CC -XII	4	6.4 Elective -VII Generic/ Discipline Specific	3
1.5 Elective I Generic/ Discipline Specific	4	2.5 Elective II Generic/ Discipline Specific	4	3.5 Elective III Generic/ Discipline Specific	4	4.5 Elective IV Generic/ Discipline Specific	4	5.4 Elective V Generic/ Discipline Specific	3	6.5 Elective VIII Generic/ Discipline Specific	3
				3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	2	4.6 Skill Enhancement Course SEC-5	2	5.5 Elective VI Generic/ Discipline Specific	3	6.6 Extension Activity	1
1.6 Ability Enhancement Compulsory Course (AECC)	2	2.6 Skill Enhancement Course –SEC-3	2					5.6 Ability Enhancement Course (AECC)	2	6.7 Ability Enhancement Course (AECC)	2

Soft Skill-1											
1.8 Skill Enhancement - (Foundation Course)	2	2.8 Ability Enhancement Compulsory Course (AECC) Soft Skill-2	2	3.7 Ability Enhancement Compulsory Course (AECC) Soft Skill-3	2	4.7 Ability Enhancement Compulsory Course (AECC) Soft Skill-4	2	5.5 Summer Internship /Industrial Training	1		
				3.8 E.VS	2	4.8 ,Value Based Education	2				
	23		23		24		24		25		21
	Total CreditPoints										140

12B. Template for Curriculum Design for UG Programme in Microbiology

SEMESTER SYSTEM WITH CREDITS (CBCS PATTERN) SYLLABUS

B.Sc. Microbiology

First Year Semester-I

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language	3	6
Part-II	English	3	6
Part-III	Core Courses 2 (CC1, CC2)	9	10
	Elective Course 1 (Generic / Discipline Specific) EC1	4	4
Part-IV	Skill Enhancement Course SEC1	2	2
	Foundation Course FC	2	2
		23	30

Semester-II

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language	3	6
Part-II	English	3	6
Part-III	Core Courses 2 (CC3, CC4)	9	10
	Elective Course 1 (Generic / Discipline Specific) EC2	4	4
Part-IV	Skill Enhancement Course -SEC2	2	2
	Skill Enhancement Course -SEC3 (Discipline Specific / Generic)	2	2
		23	30

Second Year Semester-III

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language	3	6
Part-II	English	3	6
Part-III	Core Courses 2 (CC5, CC6)	8	8
	Elective Course 1 (Generic / Discipline Specific) EC3	4	4
Part-IV	Skill Enhancement Course -SEC4 (Discipline Specific / Generic)	2	2
	EVS	2	2
	AEC – or Aquaculture	2	2
		24	30

Semester-IV

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language	3	6
Part-II	English	3	6
Part-III	Core Courses 2 (CC7, CC8)	8	8
	Elective Course 1 (Generic / Discipline Specific) EC4	4	4
Part-IV	Skill Enhancement Course -SEC5 (Discipline Specific / Generic)	2	2
	Value Education	2	2
	AEC or Apiculture	2	2
		24	30

Third Year Semester-V

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-III	Core Courses 3 (CC9, CC10, CC11)	12	15
	Core / Project with viva-voce (CC12)	4	5
	Elective Courses 2 (Generic / Discipline Specific) EC5, EC6	6	8
Part-IV	AEC or Mushroom Culture	2	2
	Internship / Industrial Training / Field Visit / Knowledge Updating	1	-
		25	30

Semester-VI

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-III	Core Courses 3 (CC13, CC14, CC15)	12	18
	Elective Courses 2 (Generic / Discipline Specific) EC7, EC8	6	10
Part-IV	AEC or Microbial Quality Control and Testing	2	2
Part V	Extension Activity	1	-
		21	30

B. Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	13	12	12	22	18	90
Part IV	4	4	6	6	3	2	25
Part V	-	-	-	-	-	1	1
Total	23	23	24	24	25	21	140

***Part I, II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.**

13. COURSE - PROGRAMME SPECIFIC OUTCOMES (PSOs) MAPPING (BASED ON THE COURSES OF FIRST YEAR ONLY)

No	Course	<i>PSO₁</i>	<i>PSO₂</i>	<i>PSO₃</i>	<i>PSO₄</i>	<i>PSO₅</i>	<i>PSO₆</i>	<i>PSO₇</i>	<i>Total</i>	<i>Average</i>	<i>Average*</i>
1	Core Major- Fundamentals of Microbiology and Microbial Diversity	2.75	2.50	2.50	2.25	1.25	1.75	1.25	14.25	2.03	2.00
2	Major Practical - Fundamentals of Microbiology and Microbial Diversity	2.00	2.25	3.00	1.25	0.50	1.25	0.75	11.00	1.57	2.00
3	Elective -Basic and Clinical Biochemistry	0.50	1.25	2.25	2.50	3.00	1.50	1.00	12.00	1.71	2.00
4	SEC-Social and Preventive Medicine	2.50	2.25	2.25	2.00	2.50	2.25	1.75	15.5	2.21	2.00
5	Foundation course- Basic Microbiology	3.00	1.75	2.75	1.50	0.00	0.50	1.50	11.00	1.57	2.00
6	Core Major - Microbial Physiology and Metabolism	2.50	1.25	2.25	3.00	1.75	1.50	1.25	13.50	1.92	2.00
7	Major Practical II - Microbial Physiology and Metabolism	2.50	1.75	3.00	1.50	1.25	0.00	0.00	10.00	0.70	1.00
8	Elective- Bioinstrumentation	1.25	3.00	2.25	2.25	2.75	1.00	1.25	13.75	1.96	2.00
9	SEC-Nutrition and Health Hygiene	2.25	2.25	2.00	2.25	2.25	2.00	2.25	15.25	2.17	2.00
10	SEC-Sericulture	0.75	0.50	0.25	0.25	1.75	1.00	1.25	05.75	00.82	1.00

B.Sc. MICROBIOLOGY

CORE COMPONENT SYLLABUS

SEMESTER I

Subject	Subject Name	Category	L	T	P	S	Cre	Inst.	Marks
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Code							dits	Hours	CIA	Ext ernal	Tot al
	FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY	Core Course – 1	Y	-	-	-	4	5	25	75	100

COURSE OUTCOMES (CO)

CO#	BLOOMS LEVEL	COURSE OUTCOME STATEMENTS
CO1	K1 & K2 (Remember & Understand)	Recall and explain the foundational concepts of microbiology, including historical milestones, taxonomic classification systems, the distinct structural characteristics of cellular and acellular microorganisms, and the fundamental principles of microbial growth, microscopy, and sterilization techniques.
CO2	K3 (Apply)	Apply appropriate classification frameworks, pure culture isolation methods, quantitative growth measurement techniques, staining protocols, and specific sterilization or disinfection procedures to solve practical problems in microbiological laboratory settings.
CO3	K4 (Analyze)	Analyze and compare the structural, genetic, and physiological differences between diverse microbial groups (Bacteria, Archaea, Eukarya, and acellular entities), the operational mechanisms of various advanced microscopes, and the efficacy of different physical and chemical antimicrobial agents.
CO4	K5 & K6 (Evaluate & Create)	Evaluate and design comprehensive experimental workflows, choosing optimal microscopy techniques, specialized culture media, and sterilization protocols for the conservation of microbial biodiversity, identification of novel strains using 16S rRNA sequencing, and management of microbial growth.

UNIT	Details	No.of Hours	
I	History and Evolution of Microbiology, Classification – Three kingdom, five kingdom, six kingdom and eight kingdoms. Identification of Microorganisms – Comparison of bacteria, archaea & eukarya – Introduction to taxonomy: phenotypic classification, phylogenetic classification, genotypic classification, 16S r RNA sequencing - Phylogenetic tree - Bergey's manual of systematic bacteriology Microbial biodiversity: Introduction to microbial biodiversity-ecological niche. Basic concepts of Eubacteria, Archaeobacteria and Eucarya. Conservation of Biodiversity.	12	
II	General characteristics of cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) and acellular microorganisms - (Viruses, Viroids, Prions), Differences between prokaryotic and eukaryotic microorganisms. Structure of Bacterial cell wall, cell membrane, capsule, flagella, pili, mesosomes, chlorosomes, phycobilisomes, spores, and gas vesicles. Structure of fungi (Mold and Yeast), Structure	12	

	of microalgae.		
III	Bacterial culture media and pure culture techniques. Mode of cell division, Quantitative measurement of growth. Anaerobic culture techniques.	12	
IV	Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM & SEM, Confocal microscopy, and Atomic Force Microscopy. Stains and staining methods.	12	
V	Sterilization–moist heat - autoclaving, dry heat – Hot air oven, radiation – UV, Ionization, filtration – membrane filter and disinfection, antiseptic; Antimicrobial agents.	12	
	Total	60	

Text Books

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

References Books

1	Jeffrey C. Pommerville., Alcamo’s Fundamentals of Microbiology (9 th Edition). Jones &Bartlett learning 2010.
2	Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5 th Edition., MacMillan Press Ltd
3	Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11 th Edition., Benjamin Cummings.
4	Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5 th Edition., McGraw Hill Publications.
5	Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13 th Edition Benjamin-Cummings Pub Co.

Web Resources

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

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or overview	
Application (K3)	Suggest idea/concept with examples, suggest formulae, solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

MAPPING	
<i>COURSE OUTCOMES (COs) Vs PROGRAMME OUTCOMES (POs)</i>	TOTAL SCORE

CO#	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	
CO1 (Outline/Describe)	3	1	0	2	1	1	1	9
CO2 (Apply/Observe)	2	2	3	2	1	1	2	13
CO3 (Analyze/Examine)	2	3	2	3	1	2	1	14
CO4 (Evaluate/Design)	3	3	3	3	2	3	3	20
Total PO Contribution	10	9	8	10	5	7	7	56
Average	2.5	2.25	2.0	2.5	1.25	1.75	1.75	14/66.66
<i>The values above represent the level of contribution: 3 (High), 2 (Medium), 1 (Low), and 0 (No Contribution).</i>								

MAPPING								
COURSE OUTCOMES (COs) Vs PROGRAMME SPECIFIC OUTCOMES (PSOs)								TOTAL SCORE
CO#	PSO ₁	PSO ₂	PSO ₃	PSO ₄	PSO ₅	PSO ₆	PSO ₇	
Course Outcomes (COs)	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	Total CO Score
CO1 (Remember & Understand)	3	2	2	2	1	2	1	13
CO2 (Apply)	2	3	3	2	1	1	1	13
CO3 (Analyze)	3	3	2	3	2	2	1	16
CO4 (Evaluate & Create)	3	2	3	2	1	2	2	15
Total PSO Score	11	10	10	9	5	7	5	57 / 84
Average of PSO Contribution	2.75	2.50	2.50	2.25	1.25	1.75	1.25	14.25 / 67.8
<i>The values above represent the level of contribution: 3 (High), 2 (Medium), 1 (Low), and 0 (No Contribution).</i>								

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total

	PRACTICAL I - FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY	Core Course II- Practical I	-	-	Y	-	4	5	50	50	100
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COURSE OUTCOMES (CO)

CO#	BLOOMS LEVEL	COURSE OUTCOME STATEMENTS
CO1	K1 & K2 (Remember & Understand)	Recall and explain the fundamental principles of microbiological laboratory safety, sterilization techniques, media preparation, and microscopic examination.
CO2	K3 (Apply)	Apply standard operating procedures for pure culture isolation, media formulation, and differential staining techniques to handle and visualize microorganisms.
CO3	K4 (Analyze)	Analyze microbial growth characteristics, staining results, and cultural diversity to differentiate and categorize unknown microbial specimens.
CO4	K5 & K6 (Evaluate & Create)	Evaluate the effectiveness of sterility controls and formulate comprehensive quality assurance protocols for media preparation and laboratory safety.

UNIT	Details	No.of Hours	
I	Cleaning of glass wares, Microbiological good laboratory practice and safety. Sterilization and assessment of sterility– Autoclave, hot air oven, and membrane filtration.	12	
II	Media preparation: liquid media, solid media, semi-solid media, agar slants, agar deeps, agar plates.	12	
III	Preparation of basal, differential, enriched, enrichment, transport, and selective media preparation- quality control of media, growth supporting properties, sterility check of media. Pure culture techniques: streak plate, pour plate, decimal dilution.	12	
IV	Culture characteristics of microorganisms: growth on different media, growth characteristics, and description. Demonstration of pigment production. Microscopy: light microscopy and bright field microscopy.	12	
V	Staining techniques: smear preparation, simple staining, Gram's staining and endospore staining. Study on Microbial Diversity using Hay Infusion Broth-Wet mount to show different types of microbes, hanging drop.	12	

	Total	60	
Text Books			
1	James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996.		
2	Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.		
3	Sundararaj T (2005). Microbiology Lab Manual (1 st edition) publications.		
4	Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ltd., Publishers, New Delhi.		
5	R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.		
References Books			
1	Atlas.R (1997). Principles of Microbiology, 2 nd Edition, Wm.C.Brown publishers.		
2	Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1 st Edition). Elsevier India		
3	Talib VH (2019). Handbook Medical Laboratory Technology. (2 nd Edition). CBS		
4	Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication.		
5	Lim D. (1998). Microbiology, 2 nd Edition, WCB McGraw Hill Publications.		
Web Resources			
1	http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403 .		
2	https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635		
3	https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf		
4	https://microbiologyinfo.com/top-and-best-microbiology-books/		
5	https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology		
Methods of Evaluation			
Internal Evaluation	Continuous Internal Assessment Test		50 Marks
	Assignments		
	Seminars		
	Attendance and Class Participation		
External Evaluation	End Semester Examination		50 Marks
	Total		100 Marks
Methods of Assessment			
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions		
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview		
Application	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe,		

n (K3)	Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

MAPPING

<i>COURSE OUTCOMES (COs) Vs PROGRAMME OUTCOMES (POs)</i>								TOTAL SCORE
CO#	PO₁	PO₂	PO₃	PO₄	PO₅	PO₆	PO₇	
CO1 (Outline/Describe)	3	1	1	1	1	1	1	9
CO2 (Apply/Observe)	2	2	3	2	2	1	2	14
CO3 (Analyze/Examine)	2	3	3	2	1	1	2	14
CO4 (Evaluate/Design)	3	3	3	3	3	2	3	20
Total PO Contribution	10	9	10	8	7	5	8	57/84
Average	2.50	2.25	2.50	2.0	1.75	1.25	2.0	14.25/67.85
<i>The values above represent the level of contribution: 3 (High), 2 (Medium), 1 (Low), and 0 (No Contribution).</i>								

MAPPING								
<i>COURSE OUTCOMES (COs) Vs PROGRAMME SPECIFIC OUTCOMES (PSOs)</i>								TOTAL SCORE
CO#	PSO₁	PSO₂	PSO₃	PSO₄	PSO₅	PSO₆	PSO₇	
Course Outcomes (COs)	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	Total Weightage
CO1 (Remember & Understand)	2	2	3	1	0	1	1	10
CO2 (Apply)	2	2	3	1	0	1	1	10
CO3 (Analyze)	3	2	3	2	1	1	0	12
CO4 (Evaluate & Create)	1	3	3	1	1	2	1	12
Total PSO Contribution	8	9	12	5	2	5	3	44
Average of PSO Contribution	2.00	2.25	3.00	1.25	0.50	1.25	0.75	11/52.38
<i>The values above represent the level of contribution: 3 (High), 2 (Medium), 1 (Low), and 0 (No Contribution).</i>								

Subject Code	Subject Name	Category	L	T	P	S	Cre dits	Inst. Hour s	Marks		
									CI A	Exte rnal	Total

	BASIC AND CLINICAL BIOCHEMISTRY	Elective Generic / Discipline Specific Elective-I	Y	-	-	-	3	4	25	75	100
COURSE OUTCOMES (CO)											
CO#	BLOOMS LEVEL	COURSE OUTCOME STATEMENTS									
CO1	K1 & K2 (Remember & Understand)	Recall and describe the structural classifications, general properties, and physiological functions of biomolecules (carbohydrates, lipids, proteins, and amino acids), along with the foundational concepts of clinical metabolism and organ function tests.									
CO2	K3 (Apply)	Apply knowledge of metabolic pathways and biochemical principles to explain the mechanisms, triggers, and physiological changes underlying various metabolic disorders and organ dysfunctions.									
CO3	K4 (Analyze)	Analyze clinical data, diagnostic enzyme profiles (AST, ALT, CK, aldolase, LDH), and organ function test parameters to differentiate between various hepatic, renal, pancreatic, and metabolic abnormalities.									
CO4	K5 & K6 (Evaluate & Create)	Evaluate complex biochemical profiles and patient diagnostic reports to formulate clinical inferences, assess the severity of metabolic disorders, and design comprehensive diagnostic strategies for disease monitoring.									
UNIT	Details									No.of Hours	
I	Biomolecules -Carbohydrate – General properties, function, structure, classification– monosaccharides (Glucose, Fructose, Galactose), Oligoaccharides (Sucrose, Maltose, Lactose) and polysaccharides (Starch, Glycogen,) and biological significance. Lipids – General properties, functions, structure, classification (Simple, Derived and Complex), Cholesterol, LDL, HDL – biological significance.									12	
II	Biomolecules - Amino acids – General properties, functions, structure, classification and biological significance. Proteins– General structure, Properties, functions, classification and biological significance.									12	
III	Disorders of Metabolism: Disorders of carbohydrate metabolism: diabetes mellitus,ketoacidosis, hypoglycemia, glycogen storage diseases, galactosemia and lactose intolerance. Disorders of lipid metabolism: hyperlipidemia, hyperlipoproteinemia, hypercholesterolemia, hypertriglyceridemia, sphingolipidosis.									12	
IV	Disorders of Metabolism: Disorders of amino acid									12	

	metabolism:alkaptonuria, phenylketonuria, phenylalaninemia, homocystineuria, tyrosinemia, aminoacidurias.		
V	Evaluation of organ function tests: Assessment and clinical manifestations of renal, hepatic, pancreatic, gastric and intestinal functions. Diagnostic enzymes: Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase.	12	
	Total	60	

Text Books	
1	Satyanarayana, U. and Chakrapani, U (2014). Biochemistry, 4 th Edition, Made Simple Publisher.
2	Jain J L, Sunjay Jain and Nitin Jain (2016). Fundamentals of Biochemistry, 7 th Edition, S Chand Company.
3	AmbikaShanmugam's (2016). Fundamentals of Biochemistry for Medical Students, 8 th Edition. Wolters Kluwer India Pvt Ltd.
4	Vasudevan. D.M.Sreekumari.S, Kannan Vaidyanathan (2019). Textbook Of Biochemistry for Medical Students. Kindle edition, Jaypee Brothers Medical Publishers
5	Jeremy M. Berg, Lubert Stryer, John L. Tymoczko, Gregory J. Gatto (2015). Biochemistry, 8 th edition. WH Freeman publisher.
References Books	
1	Amit Kessel & Nir Ben-Tal (2018). Introduction to Proteins: structure, function and motion. 2 nd Edition, Chapman and Hall.
2	David L. Nelson and Michael M. Cox (2017). Lehninger Principles of Biochemistry, 7 th Edition W.H. Freeman and Co., NY.
3	Lupert Stryer, Jeremy M. Berg, John L. Tymoczko, Gatto Jr., Gregory J (2019). Biochemistry. 9 th Edition, W.H. Freeman & Co. New York.
4.	Donald Voet, Judith Voet, Charlotte Pratt (2016). Fundamentals of Biochemistry: Life at the Molecular Level, 5 th Edition, Wiley.
5.	Joy PP, Surya S. and Aswathy C (2015). Laboratory Manual of Biochemistry, Edition 1., Publisher: Kerala agricultural university.
Web Resources	
1	https://www.abebooks.com › plp
2	https://kau.in/document/laboratory-manual-biochemistry
3	https://metacyc.org
4	https://www.medicalnewstoday.com
5	https://journals.indexcopernicus.com

MAPPING

COURSE OUTCOMES (COs) Vs PROGRAMME OUTCOMES (POs)	TOTAL
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								SCORE
CO#	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	
CO1 (Outline/Describe)	3	1	1	2	0	1	0	8
CO2 (Apply/Observe)	2	2	2	2	0	1	0	9
CO3 (Analyze/Examine)	2	3	3	2	1	2	1	14
CO4 (Evaluate/Design)	3	3	3	3	2	2	2	18
Total PO Contribution	10	9	9	9	3	6	3	49/84
Average	2.50	2.25	2.25	2.25	0.75	1.25	0.75	12.25/ 58.33
<i>The values above represent the level of contribution: 3 (High), 2 (Medium), 1 (Low), and 0 (No Contribution).</i>								

MAPPING								
<i>COURSE OUTCOMES (COs) Vs PROGRAMME SPECIFIC OUTCOMES (PSOs)</i>								TOTAL SCORE
CO#	PSO ₁	PSO ₂	PSO ₃	PSO ₄	PSO ₅	PSO ₆	PSO ₇	
CO1 (Outline/Describe)	1	1	1	3	3	1	1	11
CO2 (Apply/Observe)	1	1	2	3	3	1	1	12
CO3 (Analyze/Examine)	0	2	3	2	3	2	1	13
CO4 (Evaluate/Design)	0	2	3	2	3	2	1	13
Total PSO Contribution	2	6	9	10	12	6	4	49 / 84
Average of PSO Contribution	0.50	1.25	2.25	2.50	3.00	1.50	1.00	12.25/ 58.33
<i>The values above represent the level of contribution: 3 (High), 2 (Medium), 1 (Low), and 0 (No Contribution).</i>								

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total

	Social and Preventive medicine	Skill Enhancement Course SEC - 1 (NME)	Y	-	-	-	2	2	25	75	100
COURSE OUTCOMES (CO)											
CO#	BLOOMS LEVEL	COURSE OUTCOME STATEMENTS									
CO1	K1 & K2 (Remember & Understand)	Describe and explain the foundational concepts of social medicine, health determinants, healthcare delivery systems, national health programs, and the role of alternative medicine systems in disease prevention.									
CO2	K3 (Apply)	Apply principles of behavioral science, nutritional planning, environmental sanitation, and alternative medical practices (like Ayurveda, Unani, and Homeopathy) to address community health issues and manage disease prevention.									
CO3	K4 (Analyze)	Analyze health information data, environmental/occupational hazards, community risk factors, and epidemiological surveillance data to identify trends in communicable and non-communicable disease outbreaks.									
CO4	K5 & K6 (Evaluate & Create)	Evaluate and design comprehensive community health interventions, international health regulation compliance strategies, and precautionary response frameworks based on historical outbreak case studies (e.g., COVID-19, Ebola, SARS).									
UNIT	Details								No.of Hours		
I	Introduction to social medicine: History of social medicine-concepts of health and disease-social determinants of health and disease-Health and quality of life-Health information system- measures of population health-health policies.								6		
II	Health management: Applications of behavioral sciences and psychology in health management- nutritional programs for health management-water and sanitation in human health-national programs for communicable and non-communicable diseases- environmental and occupational hazards and their control.								6		
III	Health care and services: Health care of the community-information, education, communication and training in health-maternal & child health-school health services-Geriatrics-care and welfare of the aged-mental health-health services through general practitioners.								6		
IV	Preventive medicine: Introduction- role of preventive medicine- levels of prevention-Risk assessment in communities and vulnerable population –surveillance,								6		

	monitoring and reporting of disease outbreaks - forecasting and control measures in community setting – early detection methods.		
V	Prevention through alternate medicine: Unani, Ayurveda, Homeopathy, Naturopathy systems in epidemic and pandemic outbreaks. International health regulations. Infectious disease outbreak case studies and precautionary response during SARS and MERS coronavirus, Ebola and novel SARS-COV2 outbreaks.	6	
	Total	30	
Text Books			
1.	Park.K (2021). Textbook of preventive and social medicine, 26 th edition. Banarsidas Bhanot publishers.		
2.	Mahajan& Gupta (2013). Text book of preventive and social medicine, 4 th edition. Jaypeebrothers medical publishers.		
3.	Chun-Su Yuan, Eric J. Bieber, Brent Bauer (2006). Textbook of Complementary and Alternative Medicine. Second Edition. Routledge publishers.		
4.	Vivek Jain (2020). Review of Preventive and Social Medicine: Including Biostatistics. 12 th edition, Jaypee Brothers Medical Publishers.		
5.	Lal Adarsh Pankaj Sunder (2011). Textbook of Community Medicine: Preventive and Social Medicine, CBS publisher.		
References Books			
1	Howard Waitzkin, Alina Pérez, Matt Anderson (2021). Social Medicine and the coming Transformation. First Edition. Routledge publishers.		
2	GN Prabhakara (2010). Short Textbook of Preventive and Social Medicine. Second Edition. Jaypee publishers.		
3	Jerry M. Suls, Karina W. Davidson, Robert M. Kaplan (2010). Handbook of Health Psychology and BehavioralMedicine.Guilford Press.		
4	Marie Eloïse Muller, Marie Muller, MarthieBezuidenhout, KarienJooste (2006). Health Care Service Management. Juta and Company Ltd.		
5	Geoffrey Rose (2008).Rose's Strategy of Preventive Medicine: The Complete.OUP Oxford.		
Web Resources			
1	https://www.omicsonline.org/scholarly/social--preventive-medicine-journals-articles-ppts-list.php		
2	https://www.teacheron.com/online-md_preventive_and_social_medicine-tutors		
3	https://www.futurelearn.com		
4	https://www.healthcare-management-degree.net		
5	https://www.conestogac.on.health-care-administration-and-service-management		

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

MAPPING								
COURSE OUTCOMES (COs) Vs PROGRAMME OUTCOMES (POs)								TOTAL SCORE
CO#	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	
CO1 (Outline/Describe)	3	1	1	2	2	1	1	11
CO2 (Apply/Observe)	2	2	3	2	2	1	2	14
CO3 (Analyze/Examine)	2	3	3	3	1	3	2	17
CO4 (Evaluate/Design)	3	3	3	3	3	2	3	20
Total PO Contribution	10	9	10	10	8	7	8	62 /84
Average	2.50	2.25	2.50	2.50	2.0	1.75	2.0	15.50/73.80
The values above represent the level of contribution: 3 (High), 2 (Medium), 1 (Low), and 0 (No Contribution).								

MAPPING								
<i>COURSE OUTCOMES (COs) Vs PROGRAMME SPECIFIC OUTCOMES (PSOs)</i>								TOTAL SCORE
CO#	<i>PSO₁</i>	<i>PSO₂</i>	<i>PSO₃</i>	<i>PSO₄</i>	<i>PSO₅</i>	<i>PSO₆</i>	<i>PSO₇</i>	
CO1 (Outline/Describe)	1	0	0	1	1	3	2	8
CO2 (Apply/Observe)	1	0	0	1	2	3	3	10
CO3 (Analyze/Examine)	2	1	1	1	2	3	2	12
CO4 (Evaluate/Design)	1	1	1	1	2	3	3	12
Total PSO Contribution	5	2	2	4	7	12	10	42
Average of PSO Contribution	2.50	2.25	2.25	2.00	2.50	2.25	1.75	10.50/50.00
<i>The values above represent the level of contribution: 3 (High), 2 (Medium), 1 (Low), and 0 (No Contribution).</i>								

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst . Hours	Marks		
									CIA	Ext ern al	Tota l
	BASIC MICROBIOLOGY	Foundati on Course –	Y	-	-	-	2	2	25	75	100

COURSE OUTCOMES (CO)

CO#	BLOOMS LEVEL	COURSE OUTCOME STATEMENTS
CO1	K1 & K2 (Remember & Understand)	Explain the fundamental structural differences between prokaryotic and eukaryotic cells, summarize the principles of microbial taxonomy, and describe the basic methods used to identify microbes across various environments (soil, water, air, and food).
CO2	K3 (Apply)	Apply standard microbiological identification techniques and taxonomic classification guidelines (such as Bergey's Manual) to appropriately categorize microbes and utilize their beneficial properties in various life science applications.
CO3	K4 (Analyze)	Analyze the relationship between specific microbial cell structures and their biological functions, and compare various isolation and identification methods to determine the most effective approach for characterizing microbes from diverse sources.
CO4	K5 & K6 (Evaluate & Create)	Evaluate the ecological and industrial significance of specific microbes in different ecosystems, and design comprehensive, systematic protocols for isolating, classifying, and applying beneficial microorganisms to solve problems in the life sciences.

UNIT	Details	No.of Hours	
I	Prokaryotes and Eukaryotes. Difference between Prokaryotes and Eukaryotes. Bacteria- basic cell structure with examples. Microbial cell division and its types	6	
II	Scope, Importance and Applications of Microbes in different fields of Life science.	6	
III	Microbial Taxonomy, Bergeys Manual of Systematic Bacteriology.	6	
IV	Basic methods of Identifying Microbes from different sources and its importance	6	
V	Important microbes in soil, water, Air, Food and other sources	6	
	Total	30	

Course Outcomes

Text Books

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

References Books

1	Jeffrey C. Pommerville., Alcamo’s Fundamentals of Microbiology (9 th Edition). Jones & Bartlett learning 2010.
2	Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5 th Edition., MacMillan Press Ltd
3	Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11 th Edition., Benjamin Cummings.
4	Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5 th Edition., McGraw Hill Publications.
5	Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13 th Edition Benjamin-Cummings Pub Co.

Web Resources

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

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment

Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve

	problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

MAPPING

COURSE OUTCOMES (COs) Vs PROGRAMME OUTCOMES (POs)								TOTAL SCORE
CO#	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	
CO1 (Outline/Describe)	3	1	1	2	1	2	0	10
CO2 (Apply/Observe)	2	2	3	2	1	2	1	13
CO3 (Analyze/Examine)	2	3	2	2	1	2	1	13
CO4 (Evaluate/Design)	2	3	3	3	2	3	2	18
Total PO Contribution	9	9	9	9	5	9	4	54/84
Average	2.25	2.25	2.25	2.25	1.25	2.25	1.00	13.5/64.28

The values above represent the level of contribution: 3 (High), 2 (Medium), 1 (Low), and 0 (No Contribution).

MAPPING

COURSE OUTCOMES (COs) Vs PROGRAMME SPECIFIC OUTCOMES (PSOs)								TOTAL SCORE
CO#	PSO₁	PSO₂	PSO₃	PSO₄	PSO₅	PSO₆	PSO₇	
CO1 (Outline/Describe)	3	1	2	1	0	1	0	8
CO2 (Apply/Observe)	3	2	3	1	0	0	2	11
CO3 (Analyze/Examine)	3	2	3	2	0	0	1	11
CO4 (Evaluate/Design)	3	2	3	2	0	1	3	14
Total PSO Contribution	12	7	11	6	0	2	6	44
Average of PSO Contribution	3.00	1.75	2.75	1.50	0.00	0.50	1.50	11.00/52.38

The values above represent the level of contribution: 3 (High), 2 (Medium), 1 (Low), and 0 (No Contribution).

SEMESTER II

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
	MICROBIAL PHYSIOLOGY AND METABOLISM	Core Course III	Y	-	-	-	4	5	25	75	100

COURSE OUTCOMES (CO)

CO#	BLOOMS LEVEL	COURSE OUTCOME STATEMENTS
CO1	K1 & K2 (Remember & Understand)	Describe the fundamental concepts of microbial growth, nutritional categories, metabolic pathways, photosynthetic mechanisms, and modes of reproduction across diverse microorganisms.
CO2	K3 (Apply)	Apply principles of microbial physiology, nutrition, and environmental factors to solve problems related to growth control, transport systems, and metabolic utilization.
CO3	K4 (Analyze)	Outcome: Analyze the relationships between microbial structures, metabolic pathways, and environmental adaptations to differentiate between diverse physiological strategies.
CO4	K5 & K6 (Evaluate & Create)	Outcome: Evaluate the metabolic and reproductive efficiency of microorganisms and formulate optimized theoretical models or strategies for industrial, environmental, or laboratory applications.

Unit	Details	No.of Hours	
I	Physiology of microbial growth: Batch – continuous - synchronous cultures; Growth Curve and measurement method (turbidity, biomass, and cell count). Control of microbial growth.	12	
II	Nutrition requirements - Photoautotrophs, Photoorganotrophs, Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria), Chemoorganotrophs. Nutrition transport mechanisms – Passive diffusion and Active transport. Factors affecting microbial growth.	12	
III	An overview of Metabolism - Embden Meyerhof Pathway, Entner-Doudoroff Pathway, Pentose Phosphate Pathway, Tricarboxylic Acid Cycle. Electron Transport Chain and Oxidative Phosphorylation. ATP synthesis. Fermentation-Homolactic Fermentation, Heterolactic Fermentation, Mixed Acid Fermentation, Butanediol Fermentation.	12	
IV	Photosynthesis - An Overview of chloroplast structure. Photosynthetic Pigments, Light Reaction-Cyclic and non-cyclic Photophosphorylation.	12	

	Dark Reaction - Calvin Cycle.		
V	Bacterial reproduction - Binary fission, Budding, Reproduction through conidia, cyst formation, endospore formation. Fungi asexual and sexual reproduction, Microalgae reproduction. Asexual and sexual reproduction of protozoa.	12	
	Total	60	
Text Books			
1	Schlegel, H.G. (1993). General Microbiology.,7 th Edition, Press syndicate of the University of Cambridge.		
2	RajapandianK.(2010). Microbial Physiology, Chennai: PBS Book Enterprises India.		
3	MeenaKumari. S. Microbial Physiology, Chennai 1 st Edition MJP Publishers 2006.		
4	Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.		
5	S. Ram Reddy, S.M. Reddy (2008). Microbial Physiology. Anmol Publications Pvt Ltd.		
References Books			
1	Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.		
2	Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.		
3	Daniel R. Caldwell. (1995). Microbial Physiology & Metabolism Wm.C. Brown Communications, Inc. USA.		
4	Moat, A.G and J.W Foaster (1995). Microbial Physiology, 3 rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.		
5	BhanuShrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.		
Web Resources			
1	https://sites.google.com/site/microbialphysiologyoddsem/teaching-contents		
2	https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition		
3	https://onlinecourses.swayam2.ac.in/cec20_bt14/preview		
4	http://web.iitd.ac.in/~amittal/2007_Addy_Enzymes_Chapter.pdf		
5	https://www.frontiersin.org/microbial-physiology-and-metabolism		
Methods of Evaluation			
Internal Evaluation	Continuous Internal Assessment Test	25 Marks	
	Assignments		
	Seminars		
	Attendance and Class Participation		
External Evaluation	End Semester Examination	75 Marks	
	Total	100 Marks	
Methods of Assessment			
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions		
Understand/ Comprehend	MCQ, True/False, Short essays, Concept explanations, Short summary or overview		

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	MICROBIAL PHYSIOLOGY AND METABOLISM	CC IV-CORE PRACTICAL II	-	-	Y	-	4	5	50	50	100

COURSE OUTCOMES (CO)

CO#	BLOOMS LEVEL	COURSE OUTCOME STATEMENTS
CO1	K1 & K2 (Remember & Understand)	Demonstrate fundamental knowledge and explain the principles underlying microbial motility, staining techniques, enumeration methods, anaerobic cultivation, micrometry, and biochemical identification tests.
CO2	K3 (Apply)	Apply appropriate laboratory protocols to prepare microbial smears, perform distinct staining techniques, execute viable and direct cell counts, and carry out antibiotic sensitivity testing using standard strains.
CO3	K4 (Analyze)	Analyze bacterial growth curves, interpret morphological variations in algae, fungi, and protozoa via micrometry, and examine biochemical test results (including IMViC, TSI, and carbohydrate fermentation) to differentiate microbial characteristics.
CO4	K5 & K6 (Evaluate & Create)	Evaluate the efficacy of various pure culture maintenance strategies (such as the paraffin and stab culture methods) and design structured workflows for the systematic identification and preservation of unknown bacterial and mold cultures.

UNIT		Details		No.of Hours	
I		Motility demonstration: hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method. Staining techniques: Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining		12	
II		Direct counts – Direct cell count (Petroff-Hausser counting chamber), Turbidometry. Viable count - pour plate, spread plate. Bacterial growth curve.		12	
III		Anaerobic culture methods. Antibiotic sensitivity testing: Disc		12	

	diffusion test- quality control with standard strains.		
IV	Morphological variations in algae, fungi and protozoa. Micrometry: Demonstration of the size of yeast, fungal filaments and protozoa.	12	
V	Methods of bacterial identification- morphological, physiological, and biochemical methods - IMViC test, H2S, TSI, Oxidase, catalase, urease test, and Carbohydrate fermentation test. Maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture.	12	
	Total	60	
Text Books			
1	James G Cappucino and N. Sherman MB (1996). A lab manual Benjamin Cummins, New York.		
2	Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.		
3	Sundararaj T (2005). Microbiology Lab Manual (1 st edition) publications.		
4	Gunasekaran. P (2007). Laboratory manual in Microbiology. New age international publisher.		
5	Elsa Cooper (2018). Microbial Physiology: A Practical Approach. Callisto Reference publisher.		
References Books			
1	DavidWhite., James Drummond., Clay Fuqua (2012) Physiology and Biochemistry of Prokaryotes. 4th Ed. Oxford University Press, New York.		
2	Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.		
3	Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.		
4	Dawes, I.W and Sutherland L.W (1992). Microbial Physiology (2 nd edition), Oxford Blackwell Scientific Publications.		
5	Moat, A.G and J.W Foaster, (1995). Microbial Physiology, 3 rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.		
Web Resources			
1	https://sites.google.com/site/microbialphysiologyoddsem/teaching-contents		
2	https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition		
3	https://onlinecourses.swayam2.ac.in/cec20_bt14/preview		
4	https://www.studocu.com/microbial-physiology-practicals		
5	https://www.agr.hokudai.ac.jp/microbial-physiology		
Methods of Evaluation			
Internal Evaluation	Continuous Internal Assessment Test	50 Marks	
	Assignments		
	Seminars		
	Attendance and Class Participation		
External	End Semester Examination	50 Marks	

Evaluation		
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations.	

MAPPING								
<i>COURSE OUTCOMES (COs) Vs PROGRAMME OUTCOMES (POs)</i>								TOTAL SCORE
CO#	<i>PO₁</i>	<i>PO₂</i>	<i>PO₃</i>	<i>PO₄</i>	<i>PO₅</i>	<i>PO₆</i>	<i>PO₇</i>	
CO1 (Outline/Describe)	3	1	1	2	1	1	0	9
CO2 (Apply/Observe)	2	2	3	2	1	3	1	14
CO3 (Analyze/Examine)	2	3	3	2	1	2	1	14
CO4 (Evaluate/Design)	2	3	2	3	2	2	3	17
Total PO Contribution	9	9	9	9	5	8	5	54 /84
Average	2.25	2.25	2.25	2.25	1.25	2.00	1.25	13.5/64.28
<i>The values above represent the level of contribution: 3 (High), 2 (Medium), 1 (Low), and 0 (No Contribution).</i>								

MAPPING								
<i>COURSE OUTCOMES (COs) Vs PROGRAMME SPECIFIC OUTCOMES (PSOs)</i>								TOTAL SCORE
CO#	<i>PSO₁</i>	<i>PSO₂</i>	<i>PSO₃</i>	<i>PSO₄</i>	<i>PSO₅</i>	<i>PSO₆</i>	<i>PSO₇</i>	
CO1 (Outline/Describe)	3	2	3	2	1	0	0	11
CO2 (Apply/Observe)	2	2	3	1	1	0	0	9
CO3 (Analyze/Examine)	3	2	3	2	2	0	0	12
CO4 (Evaluate/Design)	2	1	3	1	1	0	0	8
Total PSO	10	7	12	6	5	0	0	40 / 84

Contribution								
Average of PSO Contribution	2.50	1.75	3.00	1.50	1.25	0.00	0.00	10/47.61
<i>The values above represent the level of contribution: 3 (High), 2 (Medium), 1 (Low), and 0 (No Contribution).</i>								

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
	BIO INSTRUMENTATION	Elective Generic /Discipline Specific Elective II	Y	-	-	-	3	4	25	75	100

COURSE OUTCOMES (CO)

CO#	BLOOMS LEVEL	COURSE OUTCOME STATEMENTS
CO1	K1 & K2 (Remember & Understand)	Understand the fundamental principles, instrumentation, and operational mechanisms of basic laboratory instruments, spectroscopic methods, chromatographic and electrophoretic separations, medical imaging modalities, and radiation detection techniques.
CO2	K3 (Apply)	Apply core biochemical principles and instrumentation techniques to perform calculations for reagent preparation, execute macromolecular separations, and utilize diagnostic imaging or radiation-based workflows effectively.
CO3	K4 (Analyze)	Analyze experimental data, spectral outputs, and structural/diagnostic images to differentiate between biological molecules, troubleshoot instrumental variations, and interpret analytical outcomes.
CO4	K5 & K6 (Evaluate & Create)	Evaluate the efficiency, limitations, and suitability of diverse analytical and imaging methodologies for complex biochemical challenges, and design comprehensive experimental or diagnostic protocols tailored to specific research or clinical requirements.

Unit	Details	No.of Hours	
I	Basic instruments: pH meter, Buffer of biological importance, Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator. Biochemical calculations- preparations of Molar solutions - Buffers- Phosphate, Acetate, TE, TAE- calculation of Normality, PPM- Ammonium sulphate precipitation.	12	
II	Spectroscopic Techniques: Spectroscopic Techniques: Colorimeter, Ultraviolet and visible, Infra-red and Mass Spectroscopy.	12	
III	Chromatographic and Electrophoresis Techniques: Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC. Electrophoresis Techniques: Starch Gel, AGE, PAGE.	12	
IV	Imaging techniques: Principle, Instrumentation and application of ECG, EEG, EMG, MRI, CT and PET scan radioisotopes.	12	
V	Fluorescence and radiation based techniques: Spectrofluorometer, Flame photometer, Scintillation counter, Geiger Muller counter, Autoradiography.	12	

	Total	60
Text Books		
1.	Jayaraman J (2011). Laboratory Manual in Biochemistry, 2 nd Edition. Wiley Eastern Ltd., New Delhi.	
2.	Ponmurugan. P and Gangathara PB (2012). Biotechniques.1 st Edition. MJP publishers.	
3	Veerakumari, L (2009). Bioinstrumentation- 5 th Edition -.MJP publishers.	
4	Upadhyay, Upadhyay and Nath (2002). Biophysical chemistry – Principles and techniques 3 rd Edition. Himalaya publishing home.	
5	Chatwal G and Anand (1989). Instrumental Methods of Chemical Analysis. S.Himalaya Publishing House, Mumbai.	
References Books		
1	Rodney.F.Boyer (2000). Modern Experimental Biochemistry, 3 rd Edition. Pearson Publication.	
2	SkoogA.,WestM (2014). Principles of Instrumental Analysis – 14 th Edition W.B.SaundersCo.,Philadephia.	
3	N.Gurumani. (2006). Research Methodology for biological sciences- 1 st Edition – MJP Publishers.	
4	Wilson K, and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology.7 th Edition. Cambridge University Press.	
5	Webster, J.G. (2004). Bioinstrumentation- 4 th Edition - John Wiley & Sons (Asia) Pvt.Ltd,Singapore.	
Web Resources		
1	http://www.biologydiscussion.com/biochemistry/centrifugation/centrifugeintroduction- n- types- uses-and-other-details-with-diagram/12489	
2	https://www.watelectrical.com/biosensors-types-its-working-andapplications/	
3	http://www.wikiscales.com/articles/electronic-analytical-balance/ Page 24 of 75	
4	https://study.com/academy/lesson/what-is-chromatography-definition-typesuses.html	
5	http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
	Nutrition & Health Hygiene	Skill Enhancement Course - SEC-2 (NME)	Y	-	-	-	2	2	25	75	100

COURSE OUTCOMES (CO)

CO#	BLOOMS LEVEL	COURSE OUTCOME STATEMENTS
CO1	K1 & K2 (Remember & Understand)	Describe and explain the fundamental concepts of nutrition, macro/micronutrients, life cycle dietary requirements, nutritional disorders, public health policies, and hygiene principles.
CO2	K3 (Apply)	Apply the principles of meal planning, diet chart formulation for different life stages, and hygiene/sanitation practices to promote health and prevent nutritional deficiencies.
CO3	K4 (Analyze)	Analyze the relationship between improper diets and health disorders, the impact of environmental determinants on public health, and the effectiveness of national health policies and organizations.
CO4	K5 & K6 (Evaluate & Create)	Evaluate nutritional status and health strategies within a community, and design comprehensive, culturally appropriate nutrition intervention plans and public health education programs.

Unit	Details	No. of Hours
I	Nutrition – definition, importance, Good nutrition, and mal nutrition; Balanced Diet: Basics of Meal Planning. Carbohydrates, Lipids, Proteins and Vitamins –functions, dietary sources, effects of deficiency. Macro and micro minerals –functions, effects of deficiency; food sources of Calcium, Potassium, and Sodium; food sources of Iron, Iodine, and Zinc. Importance of water– functions, sources, requirements and effects of	5

	deficiency		
II	Nutrition for Life Cycle: Balanced diet - Normal, Pregnant, lactating women, Infancy, young children Adolescents, Adults, and the Elderly; Diet Chart; Nutritive value of Indian foods.	5	
III	Improper diets: Definition, Identification, Signs and Symptoms - malnutrition, under-nutrition, over-nutrition, Protein Energy Malnutrition, obesity; Nutritional Disease and Disorder - hypertension, diabetes, anemia, osteomalacia, cardiovascular disease.	5	
IV	Health - Determinants of health, Key Health Indicators, Environment health & Public health; Health-Education: Principles and Strategies. Health Policy & Health Organizations: Health Indicators and National Health Policy of Govt. of India; Functioning of various nutrition and health organizations in India.	5	
V	Hygiene – Definition; Personal, Community, Medical and Culinary hygiene; WASH (Water, Sanitation and Hygiene) programme. Rural Community Health: Village health sanitation & Nutritional committee. Community & Personal Hygiene: Environmental Sanitation and Sanitation in Public places.	5	
	Total	25	

Text Books	
1.	Bamji, M.S., K. Krishnaswamy & G.N.V. Brahmam (2009) Textbook of Human Nutrition (3rd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
2.	Swaminathan (1995) Food & Nutrition (Vol I, Second Edition) The Bangalore Printing & Publishing Co Ltd., , Bangalore
3	SK. Halder (2022). Occupational Health and Hygiene in Industry. CBS Publishers.
4	Acharya, Sankar Kr, Rama Das, Minati Sen (2021). Health Hygiene and Nutrition Perception and Practices. Satish Serial Publishing House
5	Dass (2021). Public Health and Hygiene, Notion Press
References Books	
1	VijayaKhader (2000) Food, nutrition & health, Kalyan Publishers, New Delhi
2	Srilakshmi, B., (2010) Food Science, (5 th Edition) New Age International Ltd., New Delhi
3	Arvind Kumar Goel (2005). A College Textbook of Health & Hygiene, ABD Publishers

4	Sharma D. (2015). Textbook on Food Science and Human Nutrition. Daya Publishing House.	
5	Revilla M. K. F., Titchenal A. and Draper J. (2020). Human Nutrition. University of Hawaii, Manoa.	
Web Resources		
1	National Rural Health Scheme: https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=969&lid=49	
2	National Urban Health Scheme: https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=970&lid=137	
3	Village health sanitation & Nutritional committee https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=149&lid=225	
4	Health Impact Assessment - https://www.who.int/hia/about/faq/en/	
5	Healthy Living https://www.nhp.gov.in/healthylivingViewall	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand / Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyse (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
	SERICULTURE	Skill Enhancement Course - SEC-3	Y	-	-	-	2	2	25	75	100

COURSE OUTCOMES (CO)

CO#	BLOOMS LEVEL	COURSE OUTCOME STATEMENTS
CO1	K1 & K2 (Remember & Understand)	Identify and describe the distribution of sericulture in India, the taxonomy and biology of mulberry varieties, the life cycle stages of silkworms, common silkworm diseases/pests, and the basic equipment required for establishing an insectary.
CO2	K3 (Apply)	Apply standard cultivation, crop protection, and rearing practices to manage mulberry crops and silkworms effectively, utilizing prescribed cocoon assessment methods and post-harvest processing technologies.
CO3	K4 (Analyze)	Analyze the relationships between silkworms and their pathogens, differentiating between the symptoms, modes of infection, and nature of damage caused by various diseases, pests, and predators in both mulberry and non-mulberry silkworms.
CO4	K5 & K6 (Evaluate & Create)	Evaluate environmental control parameters and building specifications to design an optimized insectary facility, and formulate a comprehensive business project plan for entrepreneurship and rural development in sericulture.

Unit	Details	No.of Hours	
I	General introduction to Sericulture, its distribution in India. Botanical distribution and taxonomical characters of mulberry varieties and species. Biology of Mulberry plant and Mulberry crop cultivation and protection.	5	
II	Silkworm- biology-morphology of silkworm. Life cycle of silkworm-egg, larva, pupa, and moth.	5	
III	Silkworm pathology: Introduction to Parasitism, Commensalism, Symbiosis and Parasite relationship - Mulberry Silkworm Diseases: Introduction, types, Pebrine, Grasserie, Muscardine, Flacherie, Symptoms and Pathogens, Mode of Infection, Prevention and Control -Non – mulberry silkworm diseases: Pebrine, Bacterial and viral diseases. Brief Account of Pests and Predators of Silkworms, Nature of damage and control measures.	5	

IV	Rearing of silkworm. Cocoon assessment and processing technologies. Value added products of mulberry and silkworms.	5	
V	Entrepreneurship and rural development in sericulture: Planning for EDP, Project formulation, Marketing, Insectary facilities and equipments: Location, building specification, air conditioning and environmental control, furnishings and equipment, sanitation and equipment, subsidiary facilities.	5	
	Total	25	

Text Books

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

References Books

1	S. Morohoshi (2001). Development Physiology of Silkworms 2 nd Edition, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi
2	Hamamura, Y (2001). Silkworm rearing on Artificial Diet. Oxford & IBH publishing Co., Pvt. Ltd. NewDelhi.
3	M.Johnson, M.Kesary (2019). Sericulture, 5 th . Edition. Saras Publications.
4	Manisha Bhattacharyya (2019).Economics of Sericulture, Rajesh Publications.
5	Muzafar Ahmad Bhat, Suraksha Chanotra, Zafar Iqbal Buhroo, Abdul Aziz and Mohd. Azam (2020).A Textbook on Entrepreneurship Development Programme in Sericulture, IP Innovative Publication.

Web Resources

1	https://egyankosh.ac.in › bitstream
2	https://archive.org › details › SericultureHandbook
3	https://www.academic.oup.com
4	https://www.sericulture.karnataka.gov.in
5	https://www.silks.csb.gov.in

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

MAPPING								
<i>COURSE OUTCOMES (COs) Vs PROGRAMME OUTCOMES (POs)</i>								TOTAL SCORE
CO#	<i>PO₁</i>	<i>PO₂</i>	<i>PO₃</i>	<i>PO₄</i>	<i>PO₅</i>	<i>PO₆</i>	<i>PO₇</i>	
CO1 (Outline/Describe)	3	1	0	1	1	1	0	7
CO2 (Apply/Observe)	2	2	2	2	2	1	2	13
CO3 (Analyze/Examine)	2	3	3	2	1	1	1	13
CO4 (Evaluate/Design)	3	3	2	3	3	2	3	19
Total PO Contribution	10	9	7	8	7	5	6	52/84
Average	2.50	2.25	1.75	2.00	1.75	1.25	1.50	13.00 / 61.90
<i>The values above represent the level of contribution: 3 (High), 2 (Medium), 1 (Low), and 0 (No Contribution).</i>								

MAPPING								
<i>COURSE OUTCOMES (COs) Vs PROGRAMME SPECIFIC OUTCOMES (PSOs)</i>								TOTAL SCORE
CO#	<i>PSO₁</i>	<i>PSO₂</i>	<i>PSO₃</i>	<i>PSO₄</i>	<i>PSO₅</i>	<i>PSO₆</i>	<i>PSO₇</i>	
CO1 (Outline/Describe)	1	0	0	0	2	1	2	6
CO2 (Apply/Observe)	0	1	1	0	2	0	3	7
CO3 (Analyze/Examine)	2	0	0	1	3	2	1	9

[illegible]