V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
(Belonging to Virudhunagar Hindu Nadars)
An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai
Reaccredited with 'A++' Grade (4th Cycle) by NAAC
VIRUDHUNAGAR
Quality Education with Wisdom and Values

OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM REGULATIONS AND SYLLABUS
(with effect from Academic Year 2025 - 2026)

V.V.Vanniaperumal College for Women, Virudhunagar, established in 1962, offers 13 UG Programmes (Aided), 13 UG Programmes (SF), 13 PG Programmes and 6 Ph.D. Programmes. The curricula for all these Programmes, except Ph.D. Programmes, have been framed as per the guidelines given by the University Grants Commission (UGC) &Tamil Nadu State Council for Higher Education (TANSCHE) under Choice Based Credit System (CBCS) and the guidelines for Outcome Based Education (OBE).

The Departments of Commerce, English, History, Mathematics, Biochemistry and Tamil upgraded as Research Centres offer Ph.D. Programmes as per the norms and regulations of Madurai Kamaraj University, Madurai and do not come under the purview of CBCS.

A. CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose Courses from the prescribed Courses. The CBCS is followed as per the guidelines formulated by the UGC. The performance of students is evaluated based on the uniform grading system. Computation of the Cumulative Grade Point Average (CGPA) is made to ensure uniformity in evaluation system.

List of Programmes in which CBCS/Elective Course System is implemented

UG PROGRAMMES

Arts & Humanities	:	History (E.M. & T.M.), English, Tamil
Physical & Life Sciences	:	Mathematics, Zoology, Chemistry, Physics, Biochemistry, Home Science - Nutrition and Dietetics, Costume Design and Fashion, Microbiology, Biotechnology, Computer Science, Information Technology, Data Science, Computer Applications and Computer Applications - Graphic Design
Commerce & Management	:	Commerce, Commerce (Computer Applications), Commerce (Professional Accounting), Business Administration

PG PROGRAMMES

Arts & Humanities	:	History, English, Tamil
Physical & Life Sciences	:	Mathematics, Physics, Chemistry, Biochemistry, Home Science - Nutrition and Dietetics, Biotechnology, Computer Science and Computer Applications (MCA) *
Commerce & Management	:	Commerce, Business Administration (MBA) *

* AICTE approved Programmes

OUTLINE OF CHOICE BASED CREDIT SYSTEM – UG

1. Core Courses
2. Elective Courses
   - Generic Elective Courses
   - Discipline Specific Elective Courses (DSEC)
   - Non Major Elective Courses (NMEC)
3. Skill Enhancement Courses (SEC)
4. Environmental Studies (EVS)
5. Value Education
6. Self Study Courses (Online)
7. Extra Credit Courses (Self Study Courses) (Optional)

List of Non Major Elective Courses (NME)
(2023-2024 onwards)

UG PROGRAMMES

Name of the Course	Course Code	Semester	Department
Introduction to Tourism	23UHIN11	I	History(EM)
Indian Constitution	23UHIN21	II	History(EM)
சுற்றுலா ஓர் அறிமுகம்	23UHIN11	I	History (TM)
இந்திய அரசியலமைப்பு	23UHIN21	II	History(TM)
Popular Literature and Culture	23UENN11	I	English
English for Professions	23UENN21	II	
பேச்சுக்கலைத்திறன்	23UTAN11	I	Tamil
பயன்முறைத் தமிழ்	23UTAN21	II	
Practical Banking Basic Accounting Principles	23UCON11 23UCON22	I II	Commerce (Aided)
Financial Literacy-I Financial Literacy -II	23UCON12 23UCON21	I II	Commerce (SF)
Self-Employment and Startup Business Fundamentals of Marketing	23UCCN11 23UCCN21	I II	Commerce CA (SF)

Women Protection Laws	23UCPN11	I	Commerce (Professional Accounting)
Basic Labour Laws	23UCPN21	II	
Basics of Event Management	23UBAN11	I	Business Administration
Business Management	23UBAN21	II	
Quantitative Aptitude I	23UMTN11	I	Mathematics
Quantitative Aptitude II	23UMTN21	II	
Physics for Everyday life -I	23UPHN11	I	Physics
Physics for Everyday life -II	23UPHN21	II	
Food Chemistry	23UCHN11	I	Chemistry
Drugs and Natural Products	23UCHN21	II	
Ornamental fish farming and Management	23UZYN11	I	Zoology
Biocomposting for Entrepreneurship	23UZYN21	II	
Foundations of Baking and Confectionery	23UHSN11	I	Home Science – Nutrition and Dietetics
Basic Nutrition and Dietetics	23UHSN21	II	
Nutrition and Health	23UBCN11	I	Biochemistry
Life Style Diseases	23UBCN21	II	
Social and Preventive Medicine	23UMBN11	I	Microbiology
Nutrition & Health Hygiene	23UMBN21	II	
Herbal Medicine	23UBON11	I	Biotechnology
Organic farming and Health Management	23UBON21	II	
Basics of Fashion	23UCFN11	I	Costume Design And Fashion
Interior Designing	23UCFN21	II	
Office Automation	23UCSN11	I	Computer Science
Introduction to Internet and HTML 5	23UCSN21	II	
Office Automation	23UITN11	I	Information Technology
Introduction to HTML	23UITN21	II	
Introduction to HTML	23UCAN11	I	Computer Applications
Fundamentals of Computers	23UCAN21	II	
Introduction to HTML	23UGDN11	I	Computer Applications - Graphic Design
Fundamentals of Computers	23UGDN21	II	
Organic Farming	23UBYN11	I	Botany
Nursery and Landscaping	23UBYN12		
Mushroom Cultivation	23UBYN21	II	
Medicinal Botany	23UBYN22		
Cadet Corps for Career Development I	23UNCN11	I	National Cadet Corps
Cadet Corps for Career Development II	23UNCN21	II	

B. OUTCOME BASED EDUCATION (OBE) FRAMEWORK

The core philosophy of Outcome Based Education rests in employing a student - centric learning approach to measure the performance of students based on a set of pre-determined outcomes. The significant advantage of OBE is that it enables a revamp of the curriculum based on the learning outcomes, upgrade of academic resources, quality enhancement in research and integration of technology in the teaching –learning process.

It also helps in bringing clarity among students as to what is expected of them after completion of the Programme in general and the Course in particular. The OBE directs the teachers to channelize their teaching methodologies and evaluation strategies to attain the PEOs and fulfill the Vision and Mission of the Institution.

Vision of the Institution

The founding vision of the Institution is to impart Quality Education to the rural womenfolk and to empower them with knowledge and leadership quality.

Mission of the Institution

The mission of the Institution is to impart liberal education committed to quality and excellence. Its quest is to mould learners into globally competent individuals instilling in them life-oriented skills, personal integrity, leadership qualities and service mindedness.

B.1 Programme Educational Objectives, Programme Outcomes and Programme Specific Outcomes

It is imperative for the institution to set the Programme Educational Objectives (PEOs), Programme Outcomes (POs) and Course Outcomes (COs), consistent with its Vision and Mission statements. The PEOs and the POs should be driven by the mission of the institution and should provide distinctive paths to achieve the stated goals. The PEOs for each Programme have to fulfill the Vision and Mission of the Department offering the Programme.

Vision of the Department of Microbiology

Our vision is to produce highly qualified and competent students in all areas of the Microbiology. To empower students by developing human capabilities through quality education, making them responsible citizens who can work for the advancement of the society.

Mission of the Department of Microbiology

To produce skilled graduates to be lifelong learner by offering solid theoretical and practical foundations in various disciplines of microbiology and educating them about their professional and ethical responsibilities.

B.1.1 Programme Educational Objectives (PEOs)

PEOs are broad statements that describe the career and professional achievements that the Programme is preparing the graduates to achieve within the first few years after graduation. PEOs are framed for each Programme and should be consistent with the mission of the Institution.

Programme Educational Objectives (PEOs) of B.Sc., Microbiology Programme

The Programme Educational Objectives of B.Sc. Microbiology Programme are to prepare the students

PEO1: To undertake the concept of Microbiology for pursuing higher studies, successful career in medical laboratories, Medical coding sectors, pharmaceutical industries, Food industries and as successful teachers in schools and colleges.

PEO2: To employ their practical skills in Genetics, Molecular Biology, Immunology, Bioinformatics, Industrial, Food, Agricultural and Clinical Microbiology.

PEO3: To excel their capabilities through the use of new technologies to meet societal demands in research and effectively function as an entity in an environment with ethical values

Key Components of the Mission Statement	PEO1	PEO2	PEO3
Skilled graduates	✓	✓	-
theoretical and practical foundations	✓	✓	-
professional and ethical responsibilities.	-	-	✓

B.1.2 Programme Outcomes (POs)

POs shall be based on Graduate Attributes (GAs) of the Programme. The GAs are the attributes expected of a graduate from a Programme in terms of knowledge, skills, attitude and values. The Graduate Attributes include Disciplinary Knowledge, Communication Skills, Critical Thinking, Problem Solving, Analytical Reasoning, Research Related Skills, Co-operation/Team Work, Scientific Reasoning, Reflective Thinking, Information/Digital Literacy, Multicultural Competence, Moral and Ethical Awareness/Reasoning, Leadership Qualities and Lifelong Learning.

On successful completion of the Programme, the students will be able to

1 apply effectively the acquired knowledge and skill in the field of Arts, Physical Science, Life Science, Computer Science, Commerce and Management for higher studies and employment. (*Disciplinary Knowledge*)

2 articulate innovative thoughts and ideas proficiently in both in spoken and written forms. (*Communication Skills)*

3 identify, formulate and solve problems in real life situations scientifically /

systematically by adapting updated skills in using modern tools and techniques. (*Scientific Reasoning and Problem Solving)*

4 critically analyse, synthesize and evaluate data, theories and ideas to provide valid suggestions through assignments, case studies, Internship and projects for the fullfillment of the local, national and global developmental needs. (*Critical Thinking and Analytical Reasoning)*

5 use ICT in a variety of self-directed lifelong learning activities to face career challenges in the changing environment. (*Digital Literacy, Self - directed and Lifelong Learning)*

6 self-manage and function efficiently as a member or a leader in diverse teams in a multicultural society for nation building. (*Co-operation/Team Work and Multicultural Competence)*

7 uphold the imbibed ethical and moral values in personal, professional and social life for sustainable environment. (*Moral and Ethical Awareness)*

B.1.3 Programme Specific Outcomes (PSOs)

Based on the Programme Outcomes, Programme Specific Outcomes are framed for each UG Programme**.** Programme Specific Outcomes denote what the students would be able to do at the time of graduation. They are Programme specific. It is mandatory that each PO should be mapped to the respective PSO.

On completion of B.Sc. Microbiology Programme, the students will be able to

PO1 - *Disciplinary Knowledge*

PSO 1.a: apply the acquired knowledge about the basic concepts in various disciplines of Microbiology incorporated with knowledge in related courses for higher studies and employment.

PSO 1.b: demonstrate the techniques, tools and scientific procedures, follow safety measures and interpret the results in the field of Microbiology / chemistry and biology.

PO2 – *Communication Skills*

PSO 2: communicate the strategies in Microbiology effectively to upgrade their career as academicians, lab technicians, medical coders and quality control experts in various organizations.

PO3 – *Scientific Reasoning and Problem Solving*

PSO 3.a: explain and elaborate the sustainable development of microbes, their classification, metabolic processes and their molecular mechanisms in a systematic way.

PSO 3.b: make use of the knowledge and skill to handle various basic and analytical instruments used in microbiology laboratories for analyzing microbial diversity and molecular mechanisms.

PO4 – *Critical Thinking and Analytical Reasoning*

PSO 4.a: interpret the applications of biological sciences with molecular techniques to manipulate biological systems and produce novel products to meet the societal needs.

PSO 4.b: evaluate various diseases and their transmission, treatment, control and preventive methods with the help of modern techniques and involve in research activities in the field of medical laboratory and pharmaceutical industries.

PO5 – *Digital Literacy, Self - Directed and Lifelong Learning*

PSO 5: make use of ICT in their career for self-directed and lifelong learning in newly emerging disciplines of Microbiology and their area of interest.

PO6 – *Co-operation/Team Work and Multicultural Competence*

PSO 6: work in a team with team spirit or lead with entrepreneurial aspects and recent updates in course contents.

PO7 –*Moral and Ethical Awareness*

PSO 7: uphold and develop scientific responsibility towards social and ethical in the laboratory works of Microbiology.

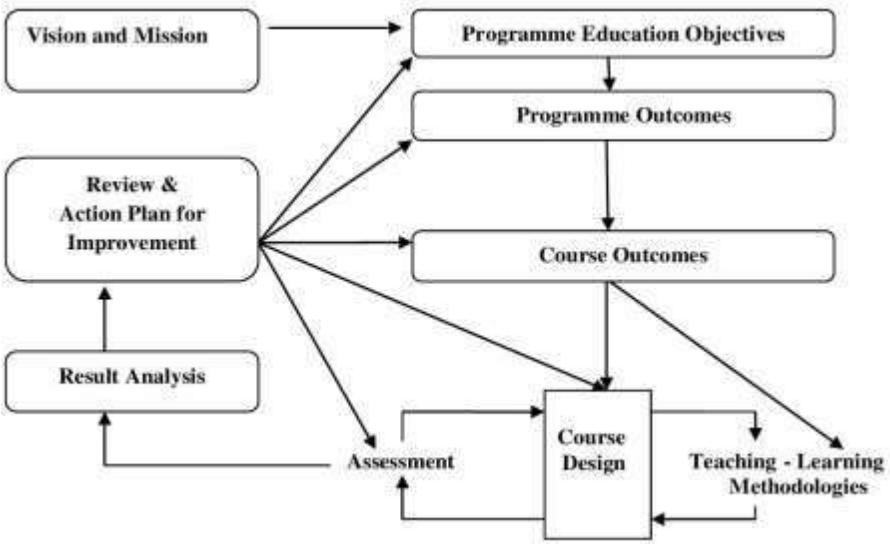
PO-PEO Mapping Matrix

Attainment of PEOs can be measured by a PO-PEO matrix. PEOs should evolve through constant feedback from alumnae, students, industry, management, *etc.* It is mandatory that each PEO should be mapped to at least one of the POs.

PEOs / POs/PSOs	PEO1	PEO2	PEO3
PO1/PSO1.a	-	✓	✓
PO1/PSO1.b	✓	✓	✓
PO2/PSO2.a	✓	✓	-
PO2/PSO2.b	✓	✓	-
PO3/PSO3	-	✓	✓
PO4/PSO4.a	-	✓	✓
PO4/PSO4.b	✓	✓	-
PO5/PSO5	✓	✓	-
PO6/PSO6	-	✓	✓
PO7/PSO7	-	-	✓

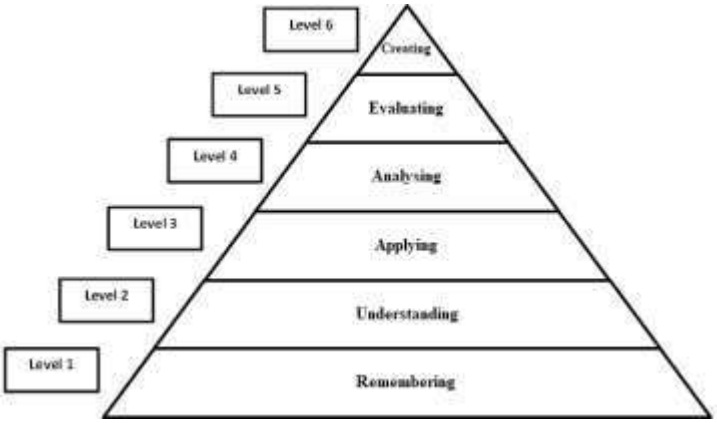
B.1.4 Course Outcomes (COs)

Course Outcomes are narrow statements restricted to the Course contents given in five units. Course Outcomes describe what students would be capable of, after learning the contents of the Course. They reflect the level of knowledge gained, skills acquired and attributes developed by the students after learning of Course contents. COs are measurable, attainable and manageable in number. COs contribute to attain POs in such a way that each CO addresses at least one of the POs and also each PO is reasonably addressed by adequate number of COs.



It is important to determine the methods of assessment. A comprehensive assessment strategy may be outlined using the revised Bloom's Taxonomy levels.

BLOOM'S TAXONOMY



CO – PO Mapping of Courses

After framing the CO statements, the COs framed for each Course is mapped with POs based on the relationship that exists between them. The COs which are not related to any of the POs is indicated with (-), signifying Nil. Measurement Mapping is based on Four Points Scale [High (H), Medium (M), Low (L) and Nil (-)]. For calculating weighted percentage of contribution of each Course in the attainment of the respective POs, the weights assigned for H, M and L are 3, 2and 1 respectively.

CO-PO/PSO Mapping Table (Course Articulation Matrix)

PO/PSOs / COs	PO1/ PSO1	PO2/ PSO2	PO3/ PSO3	PO4/ PSO4	PO5/ PSO5	PO6/ PSO6	PO7/ PSO7
CO1							
CO2							
CO3							
CO4							
CO5							

ELIGIBILITY FOR ADMISSION

The candidate should have passed the Higher Secondary Examination conducted by the Board of Higher Secondary Education, Tamil Nadu or any other equivalent examination accepted by the Academic Council with Biology as one of the subjects in Higher Secondary Course.

DURATION OF THE PROGRAMME

The candidates shall undergo the prescribed Programme of study for a period of three academic years (six semesters).

MEDIUM OF INSTRUCTION

English

COURSES OFFERED

Part I	:	Tamil/Hindi Course
Part II	:	English
Part III	:	Core Courses
		Elective Courses • Generic Elective Courses • Discipline Specific Elective Courses
		Self Study Course - online
Part IV	:	Skill Enhancement Courses (SEC)
		Elective Courses (NMEC)
		Environmental Studies Value Education
		Field Project/Internship
		Self Study Course - online
Part V	:	National Service Scheme/ Physical Education/ Youth Red Cross Society/ Red Ribbon Club/ Science Forum/ Eco Club/ Library and Information Science/ Consumer Club/ Health and Fitness Club/ National Cadet Corps/ Rotaract Club

B.2 EVALUATION SCHEME

B.2.1. PART II

Components	Internal Assessment Marks	Summative Examination Marks	Total Marks
Theory	15	60	100
Practical	5	15	
Assignment	5	-	

Three Periodic Tests - Average of the best two will be considered

B.2.2. Part I & PART III - Core Courses, Elective Courses (Generic, DSEC)

Components	Internal Assessment Marks	External Examination Marks	Total Marks
Theory	25	75	**100**

INTERNAL ASSESSMENT

Distribution of Marks

Theory

Mode of Evaluation			**Marks**
Periodic Test		:	15
Assignment	K3 Level	:	5
Quiz	K1 Level	:	5
Total		**:**	**25**

Three Periodic Tests - Average of the best two will be considered

Two Assignments - Better of the two will be considered

Three Quiz Tests - Best of the three will be considered

Practical

Mode of Evaluation		**Marks**
Practical Test*	:	30
Record & Performance	:	10
Total	**:**	**40**

*Average of the two Practical Tests will be considered

Question Pattern for Internal Tests **Duration: 2 Hours**

Section	**Questions No.**	**Types of Question**	**No. of Questions**	**No. of Questions to be answered**	**Marks for each Question**	**Total Marks**
A	1 - 4	Multiple Choice	4	4	1	4
B	5 -6	Internal Choice - Either … or Type	3	3	7	21
C	8 -9	Internal Choice - Either… or Type	2	2	10	20
					Total	**45***

*The total marks obtained in the Periodic Test will be calculated for 15 marks

SUMMATIVE EXAMINATION

Question Pattern **Duration: 3 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 -10	Multiple Choice	10	10	1	10
B	11 - 15	Internal Choice – Either …or Type	5	5	7	35
C	16 - 18	Internal Choice – Either… or Type	3	3	10	30
					Total	**75**

PROJECT

Assessment by Internal Examiner Only

Internal Assessment

Distribution of Marks

Mode of Evaluation	:	Marks
Project work and Report	:	60
Presentation and Viva –Voce	:	40
Total	:	100

B.2.3 PART IV - Skill Enhancement Courses, Non Major Elective Courses and Foundation Course

B.2.3.1 FOUNDATATION COURSE

INTERNAL ASSESSMENT
Distribution of Marks
Theory

Mode of Evaluation			**Marks**
Periodic Test		:	15
Assignment	K2 Level	:	5
Quiz	K1 Level	:	5
Total		**:**	**25**

Three Periodic Tests - Average of the best two will be considered

Two Assignments - Better of the two will be considered

Three Quiz Tests - Best of the three will be considered

Question Pattern for Periodic Tests **Duration: 1 Hour**

Section	Q.No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 3	Internal Choice - Either …or Type	3	3	5	15
B	4	Internal Choice – Either …or Type	1	1	10	10
	Total					**25***

*The total marks obtained in the Periodic Test will be calculated for 15 marks

SUMMATIVE EXAMINATION

Mode of Evaluation		Marks
Summative Examination	:	50
Online Quiz (Multiple Choice Questions - K2 Level)	:	25
Total	**:**	**75**

Question Pattern **Duration: 2 Hours**

Section	Q.No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Internal Choice - Either … or Type	5	5	6	30
B	6 - 7	Internal Choice – Either… or Type	2	2	10	20
	Total					**50**

B.2.3.2 Skill Enhancement Course - Entrepreneurial skills

INTERNAL ASSESSMENT ONLY
Distribution of Marks

Mode of Evaluation		Marks
Periodic Test	:	15
Assignment	:	5
Quiz	:	5
Model Examinations	:	60
Online Quiz(Multiple Choice Questions - K2 Level)	:	15
Total	**:**	**100**

Question Pattern for Periodic Tests **Duration: 1 Hour**

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q. No.(1- 3)	Internal Choice – Either Or Type	3	3	6	18
B Q. No.(4)	Internal Choice – Either Or Type	1	1	12	12
Total					**30**

*The total marks obtained in the Periodic Test will be calculated for 15 marks

Two Periodic Tests - Better of the two will be considered

Two Assignments - Better of the two will be considered

Two Quiz Tests - Better of the two will be considered

Question Pattern for Model Examination **Duration: 2 Hours**

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q. No.(1-5)	Internal Choice – Either Or Type	5	5	6	30
B Q. No.(6- 8)	Internal Choice – Either Or Type	3	3	10	30
Total					**60**

B.2.3.3 Skill Enhancement Courses/ Non Major Elective Courses

INTERNAL ASSESSMENT

Distribution of Marks

Theory

Mode of Evaluation			Marks
Periodic Test		:	15
Assignment	K3 Level	:	5
Quiz	K2 Level	:	5
Total		**:**	**25**

Three Periodic Tests - Average of the best two will be considered

Two Assignments - Better of the two will be considered

Three Quiz Tests - Best of the three will be considered

Question Pattern for Periodic Tests **Duration: 1 Hour**

Section	Q.No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 3	Internal Choice - Either …or Type	3	3	5	15
B	4	Internal Choice – Either …or Type	1	1	10	10
	Total					**25***

*The total marks obtained in the Periodic Test will be calculated for 15 marks

SUMMATIVE EXAMINATION

Mode of Evaluation		Marks
Summative Examination	:	50
Online Quiz (Multiple Choice Questions - K2 Level)	:	25
Total	**:**	**75**

Question Pattern **Duration: 2 Hours**

Section	Q.No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Internal Choice - Either … or Type	5	5	6	30
B	6 - 7	Internal Choice – Either… or Type	2	2	10	20
	Total					**50**

B.2.4 PART IV- ENVIRONMENTAL STUDIES / VALUE EDUCATION

INTERNAL ASSESSMENT ONLY

Evaluation Pattern

Mode of Evaluation		Marks
Periodic Test	:	15
Assignment - K3 Level	:	10
Online Quiz (Multiple Choice Questions - K2 Level)	:	25
Poster Presentation - K3 Level		10
Report - K3 Level		10
Model Examination	:	30
Total	**:**	**100**

Three Assignment - Best of the three will be considered

Question Pattern for Periodic Tests **Duration: 1 Hour**

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q. No.(1- 3)	Internal Choice – Either Or Type	3	3	6	18
B Q. No.(4)	Internal Choice – Either Or Type	1	1	12	12
Total					**30***

Two Periodic tests - Better of the two will be considered
The total marks obtained in the Periodic test will be calculated for 15 marks

Question Pattern for Model Examination **Duration: 2 ½ Hours**

Section	Q.No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Internal Choice - Either … or Type	5	5	6	30
B	6 - 8	Internal Choice – Either… or Type	3	3	10	30
	Total					**60***

*The total marks obtained in the Model Examination will be calculated for 30 marks

B. 2. 5 PART IV- Internship / Industrial Training

- Internship / Industrial Training is mandatory for all the Students
- **Internship:** Students have to involve in a designated activity, working in an organization under the guidance of an identified mentor for a period of 15 days.
- **Industrial Training:** Student has to undertake in-plant training in industries individually or in group for a period of 15 days.
- Internship / Industrial Training must be done during the fourth semester holidays
- **Internal Assessment only.**

Mode of Evaluation		Marks
Onsite Learning/Survey	:	50
Report	:	25
Viva-Voce	:	25
Total		**100**

B.2.6 SELF STUDY COURSE

B.2.6.1 PART III - Discipline Specific Quiz – Online

- Assessment by Internal Examiner only
- Question Bank is prepared by the Faculty Members of the Departments for all the Core and Elective Courses offered in all the Semesters.
- No. of Questions to be taken 700.
- Multiple Choice Question pattern is followed.
- Online Test will be conducted in VI Semester for 100 Marks.
- Model Examination is conducted after two periodic tests.

Distribution of Marks

Mode of Evaluation		Marks
Periodic Test	:	25
Model Examination	:	75
	:	**100**

Two Periodic Tests - Better of the two will be considered

B.2.6 .2 PART IV - Practice for Competitive Examinations – Online

Assessment by Internal Examiner only

- Question Bank prepared by the Faculty Members of the respective Departments will be followed.
- Multiple Choice Question pattern is followed.
- Online Test will be conducted in V Semester for 100 Marks.
- Model Examination is conducted after two periodic tests.

Subject wise Allotment of Marks

Subject		Marks
Tamil	:	10
English	:	10
History	:	10
Mathematics	:	10
Current affairs	:	10
Commerce, Law & Economics	:	10
Physical Sciences	:	10
Life Sciences	:	15
Computer Science	:	5
Food and Nutrition	:	5
Sports and Games	:	5
Total	**:**	**100**

Distribution of Marks

Mode of Evaluation		Marks
Periodic Test	:	25
Model Examination	:	75
Total	**:**	**100**

Two Periodic Tests - Better of the two will be considered

B.2.7. Part V – Extension Activities

INTERNAL ASSESSMENT ONLY

Distribution of Marks

Mode of Evaluation		Marks
Attendance	:	5
Performance	:	10
Report/Assignment/Project/Camp/Practical	:	10
Total	**:**	**25***

*The marks obtained will be calculated for 100 marks

B.2.8 EXTRA CREDIT COURSES (OPTIONAL)

2.8.1 Extra Credit Course offered by the Department.

Assessment by Internal Examiner Only (To be conducted along with the III Periodic Test)

Distribution of Marks

Mode of Evaluation		Marks
Quiz (Multiple Choice Questions)	:	25
Model Examination	:	75
Total	**:**	**100**

Question Pattern for Model Examination

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q.No.(1-5)	Internal Choice-Either or Type	5	5	7	35
B Q.No.(6-9)	Internal Choice-Either or Type	4	4	10	40
				Total	**75**

2.8.2 Extra credit Course offered by MOOC (Massive Open Online Course)

- The Courses shall be completed within the first V Semesters of the Programme.
- The allotment of credits is as follows **(Maximum of 10 credits)**

4weeks Course	- 1 credit
8 weeks Course	- 2 credits
12 weeks Course	- 3 credits

ELIGIBILITY FOR THE DEGREE

- The candidate will not be eligible for the Degree without completing the prescribed Courses of study, lab work, *etc.,* and a minimum Pass marks in all the Courses.
  - No Pass minimum for Internal Assessment for all the Courses.
  - Pass minimum for External Examination is 27 marks out of 75 marks for Core Courses, Elective Courses (Generic Elective, DSEC Courses)
  - Pass minimum for External Examination is 18 marks out of 50 marks for Skill Enhancement Courses and Non Major Elective Courses (NMEC).
  - The aggregate minimum pass percentage is 40.
  - Pass minimum for External Practical Examination is 21 marks out of 60 marks.
- **Attendance**
  a) The students who have attended the classes for 76 days (85%) and above are permitted to appear for the Summative Examinations without any condition.
  b) The students who have only 60-75 days (66% - 84%) of attendance are permitted to appear for the Summative Examinations after paying the required fine amount and fulfilling other conditions according to the respective cases.
  c) The students who have attended the classes for 59 days and less – upto 45 days (50% - 65%) can appear for the Summative Examinations only after getting special permission from the Principal.
  d) The students who have attended the classes for 44 days or less (<50%) cannot appear for the Summative Examinations and have to repeat the whole semester.
    - For Part V in UG Programmes, the students require 75 % of attendance to get a credit.
    - For Certificate, Diploma, Advanced Diploma and Post Graduate Diploma Programmes, the students require 75% of attendance to appear for the Theory/Practical Examinations.

B.3 ASSESSMENT MANAGEMENT PLAN

An Assessment Management Plan that details the assessment strategy both at the Programme and the Course levels is prepared. The continuous assessment is implemented using an assessment rubric to interpret and grade students.

B.3.1 Assessment Process for CO Attainment

Assessment is one or more processes carried out by the institution that identify, collect and prepare data to evaluate the achievement of Course Outcomes and Programme Outcomes. Course Outcome is evaluated based on the performance of students in the Continuous Internal Assessments and in End Semester Examination of a Course. Target levels of attainment shall be fixed by the Course teacher and Heads of the respective departments.

Direct Assessment (Rubric based) - Conventional assessment tools such as Term Test, Assignment, Quiz and End Semester Summative Examination are used.

Indirect Assessment – Done through Course Exit Survey.

CO Assessment Rubrics

For the evaluation and assessment of COs and POs, rubrics are used. Internal assessment contributes 40% and End Semester assessment contributes 60% to the total attainment of a CO for the theory Courses. For the practical Courses, internal assessment contributes 50% and Semester assessment contributes 50% to the total attainment of a CO. Once the Course Outcome is measured, the PO can be measured using a CO-PO matrix.

CO Attainment

Direct CO Attainment

Course Outcomes of all Courses are assessed and the CO – wise marks obtained by all the students are recorded for all the assessment tools. The respective CO attainment level is evaluated based on set attainment rubrics.

Target Setting for Assessment Method

For setting up the target of internal assessment tools, 55% of the maximum mark is fixed as target. For setting up the target of End Semester Examination, the average mark of the class shall be set as target.

Formula for Attainment for each CO

Attainment = Percentage of students who have scored more than the target marks

$$\text{Percentage of Attainment} = \frac{\text{Number of Students who scored more than the Target}}{\text{Total Number of Students}} \times 100$$

Attainment Levels of COs

Assessment Methods	**Attainment Levels**	
Internal Assessment	Level 1	50% of students scoring more than set target marks in Internal Assessment tools
	Level 2	55% of students scoring more than set target marks in Internal Assessment tools
	Level 3	60% of students scoring more than set target marks in internal Assessment tools
End Semester Summative Examination	Level 1	50% of students scoring more than average marks in End Semester Summative Examination
	Level 2	55% of students scoring more than average marks in End Semester Summative Examination
	Level 3	60% of students scoring more than average marks in End Semester Summative Examination

Indirect CO Attainment

At the end of each Course, an exit survey is conducted to collect the opinion of the students on attainment of Course Outcomes. A questionnaire is designed to reflect the views of the students about the Course Outcomes.

Overall CO Attainment= 75% of Direct CO Attainment + 25 % of Indirect CO Attainment

In each course, the level of attainment of each CO is compared with the predefined targets. If the target is not reached, the Course teacher takes necessary steps for the improvement to reach the target.

For continuous improvement, if the target is reached, the Course teacher can set the target as a value greater than the CO attainment of the previous year.

B.3.2 Assessment Process for Overall PO Attainment

With the help of CO - PO mapping, the PO attainment is calculated. PO assessment is done by giving 75% weightage to direct assessment and 25% weightage to indirect assessment. Direct assessment is based on CO attainment, where 75% weightage is given to attainment through End Semester Examination and

25% weightage is given to attainment through Internal assessments. Indirect assessment is done through Graduate Exit Survey and participation of students in Co-curricular/ Extra curricular activities.

PO Assessment Tools

Mode of Assessment	Assessment Tool	Description
Direct Attainment (Weightage -75%)	CO Assessment	This is computed from the calculated CO Attainment value for each Course
Indirect Attainment (Weightage - 25%)	Graduate Exit Survey 10%	At the end of the Programme, Graduate Exit Survey is collected from the graduates and it gives the opinion of the graduates on attainment of Programme Outcomes
	Co-curricular/ Extra-curricular	For participation in Co-curricular/Extra-curricular activities during the period of their study.

Programme Articulation Matrix (PAM)

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7
Average Direct PO Attainment								
Direct PO Attainment in percentage								

Indirect Attainment of POs for all Courses

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
Graduate Exit Survey							
Indirect PO Attainment							

Attainments of POs for all Courses

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
Direct Attainment (Weightage - 75%)							
Indirect Attainment (Weightage - 25%)							
Overall PO Attainment							

Overall PO Attainment= 75% of Direct PO Attainment +
25% of Indirect PO Attainment (Graduate Exit Survey & Participation in Co- curricular and Extra curricular Activities)

Expected Level of Attainment for each of the Programme Outcomes

POs	Level of Attainment
Attainment Value ≥70%	Excellent
60% ≤ Attainment Value < 70%	Very Good
50% ≤ Attainment Value < 60%	Good
40% ≤ Attainment Value < 50%	Satisfactory
Attainment Value <40%	Not Satisfactory

Level of PO Attainment

Graduation Batch	Overall PO Attainment (in percentage)	Whether Expected Level of PO is Achieved? (Yes/No)

B.3.3 Assessment Process for PEOs

The curriculum is designed so that all the Courses contribute to the achievement of PEOs. The attainment of PEOs is measured after 5 years of completion of the Programme only through indirect methods.

Target for PEO Attainment

Assessment Criteria	Target (UG)	Target (PG)
Record of Employment	15% of the class strength	30% of the class
Progression to Higher Education	50% of the class strength	5% of the class
Record of Entrepreneurship	2% of the class strength	5% of the class

Attainment of PEOs

Assessment Criteria & Tool	Weightage
Record of Employment	10
Progression to Higher Education	20
Record of Entrepreneurship	10
Feedback from Alumnae	30
Feedback from Parents	10
Feedback from Employers	20
Total Attainment	**100**

$$\text{Percentage of PEO Attainment from Employment} = \frac{\text{Number of Students who have got Employment}}{\text{Target}} \times 100$$

$$\text{Percentage of PEO Attainment from Higher Education} = \frac{\text{Number of Students who pursue Higher Education}}{\text{Target}} \times 100$$

$$\text{Percentage of PEO Attainment from Entrepreneurship} = \frac{\text{Number of Students who have become Entrepreneurs}}{\text{Target}} \times 100$$

Expected Level of Attainment for each of the Programme Educational Objectives

POs	Level of Attainment
Attainment Value ≥70%	Excellent
60% ≤ Attainment Value < 70%	Very Good
50% ≤ Attainment Value < 60%	Good
40% ≤ Attainment Value < 50%	Satisfactory
Attainment Value <40%	Not Satisfactory

Level of PEO Attainment

Graduation Batch	Overall PEO Attainment (in percentage)	Whether Expected Level of PEO is Achieved? (Yes/No)

C. PROCESS OF REDEFINING THE PROGRMME EDUCATIONAL OBJECTIVES

The College has always been involving the key stakeholders in collecting information and suggestions with regard to curriculum development and curriculum revision. Based on the information collected the objectives of the Programme are defined, refined and are inscribed in the form of PEOs. The level of attainment of PEOs defined earlier will be analyzed and will identify the need for redefining PEOs. Based on identified changes in terms of curriculum, regulations and PEOs, the administrative system like Board of Studies, Academic Council and Governing Body may recommend appropriate actions. As per the Outcome Based Education Framework implemented from the Academic Year 2020 -2021, the following are the Programme Structure, the Programme Contents and the Course Contents of B.Sc. Microbiology Programme.

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BACHELOR OF SCIENCE MICROBIOLOGY (2024)

Programme Structure - Allotment of Hours and Credits
For those who join in the Academic Year 2023-2024

Components	Semester						Total Number of Hours (Credits)
	I	II	III	IV	V	VI	
Part I : Tamil /Hindi	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24 (12)
Part II : English	6 (3)	6(3)	6 (3)	6 (3)	-	-	24 (12)
Part III : Core Courses, Elective Courses & Self Study Course							
Core Course	5 (5)	5 (5)	5 (5)	5 (5)	6(6)	6 (5)	32 (31)
Core Course	-	-	-	-	6 (6)	6 (5)	12 (11)
Core Course Practical	5(3)	5(3)	5 (3)	4 (3)	5 (4)	6(4)	30(20)
Core Course Project	-	-	-	-	1 (1)	-	1 (1)
Elective Course (DSEC)	-	-	-	-	5(3)	5 (3)	10 (6)
Elective Course (DSEC Practical)	-	-	-	-	5(3)	5(3)	10(6)
Elective Course I (Allied)	4(4)	4(4)	4(4)	4(4)	-	-	16(16)
Elective Course I Practical I(Allied)	-	-	-	-	-	-	-
Elective Course II(Allied)	-	-	-	-	-	-	-
Elective Course II Practical II(Allied)	-	-	-	-	-	-	-
Self Study Course	-	-	-	-	-	0 (1)	0 (1)
Part IV : Skill Enhancement Courses, Elective Courses, Ability Enhancement Compulsory CoursesSelf Study Course &Internship/ Industrial Training							
SEC	2 (2)	-	1 (1)	2 (2)	-	-	5(5)
SEC	-	2 (2)	2 (2)	2 (2)	-	2 (2)	8 (8)
Elective Course(NME)	2 (2)	2 (2)	-	-	-	-	4 (4)
AECC - Value Education	-	-	-	-	2 (2)	-	2 (2)
AECC - Environmental Studies	-	-	1 (0)	1 (2)	-	-	2 (2)
Self Study Course	-	-	-	-	0 (1)	-	0 (1)
Internship/ Industrial Training	-	-	-	-	0 (1)	-	0 (1)
Part V : Extension Activities	-	-	-	-	-	0 (1)	0 (1)
Total	**30 (22)**	**30 (22)**	**30 (21)**	**30 (24)**	**30 (27)**	**30 (24)**	**180 (140)**
Extra Credit Course (Self Study Course)	-	-	-	-	0(2)	-	0(2)

DSEC: Discipline Specific elective Course; SEC-Skill Enhancement Course;

AECC-Ability Enhancement Compulsory Courses

B.Sc., MICROBIOLOGY-2024
PROGRAMME CONTENT
SEMESTER V

S.No.	Components		Title of the Course	Course Code	Hours Per Week	Credits	Exam. Hours	Marks		
								Int.	Ext.	Total
1	**Part III**	Core Course -9	Bacteriology and Mycology	23UMBC51	6	6	3	25	75	100
2		Core Course -10	Virology and Parasitology	23UMBC52	6	6	3	25	75	100
3		Core Course- 11 Practical - V	Medical Microbiology Practical	23UMBC51P	5	4	3	40	60	100
4		Core Course– 12 Project	Project	23UMBC53PR	1	1	-	100	-	100
5		Discipline Specific Elective	Recombinant DNA Technology/ Nanobiotechnology	23UMBE51/ 23UMBE52	5	3	3	25	75	100
6		Discipline Specific Elective	Biosafety and Bioethics/ Food Microbiology	23UMBE53/ 23UMBE54	5	3	3	25	75	100
		Self-Study Course	Practice for Competitive Examinations - Online	23UGCE51	-	1	-	100	-	100
7	**Part IV**		Value Education	23UGVE51	2	2	2	100	-	100
9		Internship/ Industrial Training	Internship	23UMBI51	-	1	-	100	-	100
				Total	**30**	**27**				**900**

Extra Credit Course – (Self-Study Course)	Industrial Microbiology	23UMBO51	**-**	**2**	**3**	**100**	**-**	**100**

B.Sc., MICROBIOLOGY-2024
PROGRAMME CONTENT
SEMESTER VI

S.No.	Components		Title of the Course	Course Code	Hours Per Week	Credits	Exam. Hours	Marks		
								Int.	Ext.	Total
1	**Part III**	Core Course -13	Environmental and Agriculture Microbiology	23UMBC61	6	5	3	25	75	100
2		Core Course -14	Food, Dairy and Probiotic Microbiology	23UMBC62	6	5	3	25	75	100
3		Core Course- 15 Practical - VI	Environmental, Agriculture and Food Microbiology Practical	23UMBC61P	6	4	3	40	60	100
5		Discipline Specific Elective	Pharmaceutical Microbiology/ Bioinformatics	23UMBE61/ 23UMBE62	5	3	3	25	75	100
6		Discipline Specific Elective	Entrepreneurship and Bio-business/ Biological Pest Management	23UMBE63/ 23UMBE64	5	3	3	25	75	100
		Self-Study Course	Discipline Specific Quiz - online	23UMBQ61	-	1	-	100	-	100
7	**Part IV**	Professional Competency SEC-7	Microbial Quality Control and Testing	23UMBS61	2	2	2	100	-	100
8	**Part V**	Extension Activities	Extension Activities		-	1	-	100	-	100
				Total	**30**	**24**				**800**

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Semester - V	**BACTERIOLOGY AND MYCOLOGY**	Hours/Week: 6	
Core Course – 9		Credits: 6	
Course Code **23UMBC51**		Internal 25	External 75

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: recall the importance of normal flora of human body and acquire knowledge on the process of infectious disease. (K1)

CO2: classify the various bacterial and fungal pathological events during the progression of an infectious disease and apply the underlying mechanisms of spread of disease. (K2)

CO3: **e**xplain disease-causing ability of microorganisms and compare their modes of infection, symptoms, diagnosis and control. (K2)

CO4: apply human-microbe interaction to obtain in-depth knowledge on diseases and the mechanism behind the disease process. (K3)

CO5: identify the types of microbes caused in humans and categorize the modes of infection, pathogenesis and treatment. (K3)

UNIT I

History- Classification of Medically Important Microbes - Koch's, and River's postulates- A brief account on the normal microbial flora of the healthy human body.

Host-pathogen interactions**:** Definitions of infection, invasion, primary and opportunistic pathogens, pathogenicity, virulence, toxigenicity, carriers, endemic, epidemic, pandemic diseases and epidemiology. Putative virulence factors of human pathogens - Infectious disease cycle. Collection and transport of clinical specimens for bacterial and fungal infections. (18 Hours)

UNIT II

Medically important Gram Positive infections - Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases - Streptococcal infections (*Streptococcus pyogenes*, *Streptococcus faecalis*), Staphylococcal infections (*Staphylococcus aureus*), Tetanus (*Clostridium tetani*), Diphtheria (*Corynebacterium diphtheriae*), Anthrax (*Bacillus anthracis*), Tuberculosis (*Mycobacterium tuberculosis*), Leprosy (*Mycobacterium leprae*). (18 Hours)

UNIT III

Medically important Gram-Negative infections - Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention, and treatment of the following bacterial diseases - Meningitis (*Klebsiella pneumoniae, Neisseria meningitidis*), Typhoid (*Salmonella typhi, Salmonella paratyphi*), Cholera (*Vibrio cholerae*), Bacillary dysentery (*Shigella dysenteriae*). Sexually Transmitted disease: Syphilis (*Treponema pallidum*), Gonorrhoea (*Neisseria gonorrhoeae*). Nosocomial infections: Definition, importance, and their control (*Pseudomonas aeruginosa*). (18 Hours)

UNIT IV

Medically important Fungi - Classification of medically important fungi: Superficial mycoses: Pityriasis versicolor, Tinea nigra, Piedra. Cutaneous mycoses: *Microsporum* spps. *Trichophyton* spps., and *Epidermophyton floccosum*. Subcutaneous mycoses: Chromoblastomycosis, Sporotrichosis. Systemic Mycoses: Blastomycosis, Histoplasmosis. Opportunistic Infections: Candidiasis, Cryptococcosis, Zygomycosis. Mycotoxins: Aflatoxin**.** (18 Hours)

UNIT V

Antimicrobial agents -General characteristics and mode of action of antibacterial agents - Modes of action with an example for each: Inhibitor of nucleic acid synthesis - Inhibitor of cell wall synthesis - Inhibitor of cell membrane function - Inhibitor of protein synthesis - Inhibitor of metabolism. Antifungal agents- Mechanism of action of Amphotericin B & Griseofulvin.

(18 Hours)

Text Books	
1	Tom Parker, M. Leslie H. Collier. (1990). Topley&Wilson's Principles of Bacteriology, Virology and Immunity, 8th Edition. London: Edward Arnold.
2	Greenwood, D., Slack, R.B. and Peutherer, J.F. (2012) Medical Microbiology, 18thEdition. Churchill Livingstone, London.

3	Finegold, S.M. (2000) Diagnostic Microbiology, 10th Edition. C.V. Mosby Company, St. Louis.
4	Ananthanarayanan, R. and Jayaram Panicker C.K. (2020) Text book of Microbiology. Orient Longman, Hyderabad.
5	Jagdish Chander (2018). Textbook of Medical Mycology, 4th edition, Jaypee brothers' medical publishers.
References Books	
1	Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC.
2	Kevin Kavanagh, (2018). Fungi Biology and Applications 3rd Edition. Wiley Blackwell publishers.
3	C.J. Alexopoulos, C.W. Mims, M. Blackwell, (2007). Introductory Mycology, 4th edition. Wiley publishers.
4	A.J. Salle (2007). Fundamental principles of bacteriology, fourth edition, Tata McGraw-Hill Publications.
5	Christopher C. Kibbler, Richard Barton,Neil A. R. Gow, Susan Howell,Donna M. MacCallum, Rohini J. Manuel (2017). Oxford Textbook of Medical Mycology. Oxford University Press.
Web Resources	
1	http://textbookofbacteriology.net/nd
2	https://microbiologysociety.org/members-outreach-resources/links.html
3	http://mycology.cornell.edu/fteach.html
4	https://www.adelaide.edu.au/mycology/
5	https://www.isham.org/mycology-resources/mycological-links

Course Code 23UMBC51	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	PSO 1.a	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4.a**	**PSO 4.b**	**PSO 5**	**PSO 6**	**PSO 7**
CO1	3	3	3	2	3	1	3	1	1	3
CO2	3	3	3	1	3	1	3	1	1	2
CO3	3	3	2	1	3	2	2	1	1	2
CO4	3	2	2	1	3	1	3	1	1	2
CO5	2	2	3	2	3	3	2	1	1	2

Strong – 3 Medium – 2 Low – 1

Mrs.M.M.Fatima Mansoora
Head of the Department i/c

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Course Designer

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Semester - V	**VIROLOGY AND PARASITOLOGY**	Hours/Week:6	
Core Course – 10		Credits: 6	
Course Code **23UMBC52**		Internal 25	External 75

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: recall the basic structure, properties and classification of emerging & re-emerging viruses, protozoans. (K1)

CO2: explain about the infections caused by intestinal worms, nematodes and helminthes. (K2)

CO3: infer the causative agents of diseases, concepts of exploitation of host cells for reproduction, assessment parameter of their severity, diagnosis and treatments (K2)

CO4: identify the methods of infection, cultivation methods and interaction with host organisms. (K3)

CO5: compare the evolution and determine how to prevent it or stop its spread. (K3)

UNIT I

General Properties, replication and Classification of viruses (Baltimore classification), Cultivation of viruses- in animals, embryonated eggs and tissue culture, Virus purification assays - collection and transport of clinical specimens for viral infections.

(15 Hours)

UNIT II

Viral diseases with reference to symptoms, pathogenesis, transmission, prophylaxis and control – Arboviruses (Flavi virus), Picorna viruses (Polio virus and Rhinovirus), Hepatitis viruses (HAV, HBV, HCV, HDV, HEV), Rabies virus, Orthomyoviruses (Influenza

virus) and Paramyxoviruses (Mumps and Measles virus), Pox viruses (Variola, Vaccinia), Herpes viruses (Herpes simplex, Varicella zoster), Adenoviruses, Rotaviruses and HIV viruses. Oncogenic viruses (Human Papilloma virus): Introduction, characteristics of transformed cells, mechanism of viral oncogenesis and clinical manifestations. (20 Hours)

UNIT III

Emerging and re-emerging viral infections (SARS, Swine flu, Ebola, Dengue, Chikungunya- and Corona) – causes, spread and preventive measures. Detection of viruses in clinical specimens – Serological and Molecular diagnosis of virus infections – Antiviral agents, Interferons and Viral Vaccines, Immunization schedules. (15 Hours)

UNIT IV

General introduction to Medical Parasitology, Classification of medically important parasites. Morphology, life cycle, pathogenesis, clinical features, laboratory diagnosis, prevention and treatment of diseases caused by the following organisms: *Entameobahistolytica*, flagellates (*Giardia lamblia, Leishmania donovani*), Sporozoa-*Plasmodium* sp. (20 Hours)

UNIT V

Introduction to Helminthes, Platyhelminthes, *Taenia, Fasciola, Paragonimus, Schistosoma*spps. Nemathelminthes– Ascaris, *Ankylostoma, Enterobius, Trichuris, Trichinella, Wuchereria, Dracanculus.* Collection, transport and examination of specimen Laboratory techniques in parasitology Examination of faeces for ova and cyst by direct wet mount and iodine wet mount, Concentration methods (Floatation and Sedimentation techniques), Examination of blood for parasites. Cultivation of parasites. (20 Hours)

Text Books

1. Rajan, S., (2007). Medical microbiology, MJP publisher.
2. Jeyaram Paniker, C.K. (2006). Text Book of Parasitology Jay Pee Brothers, NewDelhi.
3. Arora, D.R. and Arora B. (2002). Medical Parasitology, 1st Edition CBS Publishers & Distributors, New Delhi.
4. Chatterjee (1986). Medical Parasitology. Tata McGraw Hill, Calcutta.
5. Parija S. C. (1996). Text Book of Medical Parasitology. 4th edition, Orient Longman, All India Publishers & Distributors.

References Books

1. Jawetz, E., Melnick, J.L. and Adelberg, E.A. (2000). Review of Medical Microbiology, 19th Edition. Lange Medical Publications, U.S.A.
2. Ananthanarayan, R. and Jeyaram Paniker, C.K. (2009). Text Book of Microbiology, 8thEdition. Orient Longman, Chennai.
3. Conrat HF, Kimball PC and Levy JA. (1988). Virology. 2nd edition. Prentice Hall, Englewood Cliff, New Jersey.
4. Topley& Wilsons's (1990). Principles of Bacteriology, Virology and Immunity, 8th Edition, Vol. III Bacterial Diseases, Edward Arnold, London.
5. Finegold, S.M. (2000). Diagnostic Microbiology, 10th Edition. C.V. Mosby Company, St.Louis.

Web Resources

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4047123/
2. https://www.ncbi.nlm.nih.gov/pubmed/21722309
3. https://www.sciencedirect.com/science/article/pii/S2211753919300193
4. https://cmr.asm.org/content/30/3/811
5. https://www.nejm.org/doi/full/10.1056/NEJMoa1811400

Course code 23UMBC52	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	PSO 1.a	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4.a**	**PSO 4.b**	**PSO 5**	**PSO 6**	**PSO 7**
CO1	3	3	2	3	3	1	3	1	3	3
CO2	3	3	3	3	3	1	2	1	2	2
CO3	3	3	2	3	3	1	3	2	2	2
CO4	3	3	3	2	2	1	2	1	2	2
CO5	3	3	3	3	1	1	3	-	1	1

Strong – 3 Medium – 2 Low – 1

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B.Sc. Microbiology

(for those who join in 2023 - 2024)

Semester - V	**MEDICAL MICROBIOLOGY PRACTICAL**	Hours/Week: 5	
Core Course – 11 Practical -V		Credits: 4	
Course Code **23UMBC51P**		Internal 40	External 60

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: demonstrate methods to observe and measure microorganisms by standard microbiological techniques. (K2)

CO2: infer pathogenic microorganisms in the laboratory set-up and interpret their sensitivity towards commonly administered antibiotics. (K2)

CO3: apply experimental tools to cultivate and characterize clinically important pathogens. (K3)

CO4: identify the appropriate laboratory techniques to isolate and characterize medically important bacteria, fungi, viruses and parasites. (K3)

CO5: make use of various staining techniques, culture methods, and biochemical tests to identify the presence of microbes in various clinical specimens. (K3)

UNIT I

1. Collection and Transport of Clinical specimens.
2. Simple, Differential and Special staining of Clinical materials.
3. Culture techniques used to isolate microorganisms. (15 Hours)

UNIT II

4. Identification of bacterial pathogens by their biochemical reactions.
5. Antifungal susceptibility testing by disc-diffusion technique and determination of Minimum Inhibitory Concentration, MLC. (15 Hours)

UNIT III

6. Diagnosis of viral diseases (ROTA virus) by strip method.
7. Identification of Viruses in Slides/Smears/Spotters. Demonstration of Negri bodies (Staining).
8. Cultivation of Viruses in Embryonated eggs – Amniotic, Allantoic, Yolk sac routes and Chorio-allantoic membrane. (15 Hours)

UNIT IV

9. Microscopic identification of medically important Fungi – KOH and Lactophenol cotton Blue staining.
10. Slide culture techniques for fungal Identification
11. Identification of Dermatophytes.
12. Germ tube test, Carbohydrate fermentation and assimilation tests for Yeasts. **(**15 Hours)

UNIT V

13. Direct Examination of Faeces – wet mount and Iodine mount – Demonstration of Protozoan cysts and Helminthes eggs.
14. Concentration techniques of stool specimen – Floatation and Sedimentation methods.
15. Examination of blood for Malarial parasites – thin and thick smear preparations.
16. Identification of Medically important parasites in slides / specimens as spotters.
17. Diagnostic laboratory visit and report submission on clinical specimen analysis.

(15 Hours)

Text Books	
1.	Dubey, R.C. and Maheswari, D.K. (2020). S. Chand Publishers. ISBN-13: 978-8121921534, ISBN-10: 8121921538.
2.	K.R. Aneja (2017). Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology. 5th Edition. New Age International Publishers. ISBN-10: 9386418304, ISBN-13: 978-9386418302.
3	Collee, J.G., Fraser, A.G., Marnion, B.P. and Simmons, A. (1996). Mackie & McCartney Practical Medical Microbiology. 14th Edition. Elsevier. ISBN-10: 813120393X, ISBN-13: 978-8131203934.
4	Prince CP (2009). Practical Manual of Medical Microbiology, Ist edition, Jaypee digital publishing.
5	James H. Jorgensen, Karen C. Carroll, Guido Funke, Michael A. Pfaller, Marie Louise Landry, Sandra S. Richter, David W. Warnock (2015). Manual of Clinical Microbiology, 11th Edition, ASM press.
References Books	
1	Patricia M. Tille (2021). Bailey & Scott's Diagnostic Microbiology, 15th Edition. Elsevier.

	ISBN-10: 0323681050, ISBN-13: 978-0323681056.
2	Monica Cheesbrough (2006). District Laboratory Practice in Tropical Countries. Part 1. 2nd Edition. Cambridge University Press. ISBN-10: 0521171571, ISBN-13: 978-0521171571.
3	Michael A. Pfaller (ed.) (2015). Manual of Clinical Microbiology. Vol. 1 and 2. 11th Edition. ASM Press. ISBN-10: 9781555817374, ISBN-13: 978-1555817374.
4	Josephine A. Morello, Paul A. Granato and Helen EckelMizer (2002). Laboratory Manual and Workbook in Microbiology. 7th Edition. The McGraw Hill Company. ISBN: 0-07-246354-6.
5	Rowland, S.S., Walsh, S.R., Teel, L.D. and Carnahan, A.M. ((1994). Pathogenic and Clinical Microbiology: A Laboratory Manual. Lippincott Williams & Wilkins. ISBN-10: 0316760498, ISBN-13: 9780316760492.
Web Resources	
1	https://www.microcarelab.in/media/microcarelab.in/files/Sample-Collection-Manual.pdf
2	http://ssu.ac.ir/cms/fileadmin/user_upload/Daneshkadaha/pezeshki/microb/file_amuzeshi/Lab_QA_Microbiology_QA.pdf
3	https://www.academia.edu/11977315/Basic_Laboratory_Procedures_in_Clinical_Bacteriology
4	https://cmr.asm.org/content/31/3/e00062-17.full.pdf
5	https://microbiologyinfo.com/techniques-of-virus-cultivation/

Course Code 23UMBC51P	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	PSO 1.a	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4.a**	**PSO 4.b**	**PSO 5**	**PSO 6**	**PSO 7**
CO1	3	3	3	1	2	1	3	1	2	3
CO2	2	2	3	1	3	3	3	1	1	3
CO3	3	3	2	1	2	2	2	1	2	3
CO4	3	2	2	1	2	1	3	1	1	3
CO5	2	2	3	2	3	2	2	1	2	3

Strong – 3 Medium – 2 Low – 1

Mrs. M.M.Fatima Mansoora

Head of the Department i/c

Mrs. M.M.Fatima Mansoora

Course Designer

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VIRUDHUNAGAR
Quality Education with Wisdom and Values

B.Sc. Microbiology

(for those who join in 2023 - 2024)

Semester - V	**PROJECT**	Hours/Week: 1
Core Course – 12 Project		Credits: 1
Course Code **23UMBC53PR**		Internal 100

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: explain the problems which are related to microorganisms and frame objective of the study in consultation with mentor. (K2)

CO2: infer appropriate Microbiological methods and lab equipment. (K2)

CO3: build the research skills involved in expectation of Microbiological Proposal. (K3)

CO4: choose the relevant experiments, conduct experiments and record data. (K3)

CO5: apply the research report and its oral demonstrations. (K3)

Students are expected to select a project in the field of Microbiology, Biotechnology and related interdisciplinary fields. Two students can do one project. Minimum pages for project report should be 20 pages. Two typed copies of the report on the completed project will be submitted to the Controller of Examination through the Head of the Department in the month of November during V Semester. Evaluation will be done internally.

Project work & Report -60Marks

Presentation & Viva-Voce -40Marks

Course Code 23UMBC53PR	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	PSO 1.a	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4.a**	**PSO 4.b**	**PSO 5**	**PSO 6**	**PSO 7**
CO1	3	2	1	3	-	3	-	-	3	2
CO2	3	1	1	3	1	3	2	1	3	1
CO3	3	2	2	3	-	3	-	1	3	1
CO4	3	2	2	3	1	3	-	1	3	1
CO5	3	1	1	3	-	3	-	1	3	-

Mrs.M.M.Fatima Mansoora
Head of the Department i/c

Mrs.M.M.Fatima Mansoora
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B.Sc.,Microbiology
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Semester - V	**RECOMBINANT DNA TECHNOLOGY**	Hours/Week: 5	
Elective Course -1 DSEC-1		Credits: 3	
Course Code **23UMBE51**		Internal 25	External 75

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: recall the fundamental concepts, tools, and milestones of genetic engineering including recombinant DNA technology, gene transfer methods, and cloning vectors. (K1)

CO2: explain the application of molecular biology techniques such as DNA isolation, PCR, electrophoresis, blotting and DNA sequencing across various genetic engineering processes. (K2)

CO3: illustrate the use of enzymes, vectors and artificial gene transfer techniques in the development and screening of recombinant organisms. (K2)

CO4: apply biotechnological techniques in plant and animal systems including tissue culture, micro propagation, protoplast culture and maintenance of cell lines for research and industrial purposes. (K3)

CO5: identify the societal, agricultural and medical applications of genetic engineering technologies including transgenic organisms, gene therapy, monoclonal antibodies and GM crops. (K3)

UNIT I

Milestones in rDNA Technology – Gene Manipulation-Steps involved in Gene Cloning. Isolation of Chromosomal and Plasmid DNA. Restriction endonuclease - Discovery, Types, Mode of action-Application of Ligase, DNA polymerase, DNA Modifying enzymes and Topoisomerases. Use of Linkers and Adapters. (15 Hours)

UNIT II

Artificial Gene Transfer methods- Calcium Chloride Induction, Electroporation, Microinjection, Biolistic method, Liposome and Viral-mediated delivery. Cloning vectors – Properties and Applications - Plasmid Based Vectors- Natural Vectors-pSC101 and pMB1.Artificial Vectors- pBR322 and pUC. Phage Based Vectors- Lambda phage. Hybrid Vectors, Phagemid, Cosmid, BAC and YAC. Screening of Recombinants. Genomic DNA and cDNA library-Construction and Screening. (15 Hours)

UNIT III

Molecular Tools- PCR- Types. Gel Electrophoresis- AGE and PAGE Blotting Techniques-Southern, Western & Northern. DNA sequencing methods-Sanger's and Automated method. Recent Trends in Genetic Engineering- Targeted Genome Editing- ZFNs, TALENs, CRISPRs. Gene Targeting-Knock-in &Knock-outs. DNA Finger Printing.

(15 Hours)

UNIT IV

Plant Biotechnology – Media, Growth Regulators and Equipment for Plant Tissue Culture-Explant Culture- Micro propagation- Callus and Protoplast Culture-Production of Bio-Active Secondary Metabolites by Plant Tissue Culture -Agrobacterium and Crown Gall Tumors - Ti Plasmid and Ri Plasmid – Animal Biotechnology-Principles of Animal Cell Culture, Media and Equipment for Animal Cell Culture – Primary and Secondary Cultures-Cell Lines- Types, Establishment and Maintenance of Cell Lines. (15 Hours)

UNIT V

Applications of Genetic Engineering - Transgenic Animals – Mice and Sheep-Recombinant Cytokines and their use in the Treatment of Animal infections- Monoclonal Antibodies in Therapy- Vaccines and their Applications in Animal Infections - Human Gene Therapy-Germ line and Somatic Cell Therapy -*Ex-vivo* Gene Therapy-SCID (Severe Combined Immuno Deficiency) – *In-vivo* Gene Therapy- CFTR (Cystic Fibrosis Transmembrane Regulator) –Vectors in Gene Therapy-Viral and Non-Viral Vectors. Transgenic Plants– Bt Cotton, Bt Corn, Round Ready soybean, Flavr Savr Tomato and Golden Rice. (15 Hours)

Text Books	
1.	Brown T.A. (2016). Gene Cloning and DNA Analysis. 7thEdition. John Wiley and Jones, Ltd.
2.	Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and

	Applications of DNA Technology. 3rd Edition. John Wileys and Sons Ltd.
3.	Keya Chaudhuri (2013). Recombinant DNA technology. The Energy and Resources Institute
4.	Siddra Ijaz, Imran UlHaq (2019). Recombinant DNA Technology. Cambridge Scholars Publishing.
5.	Monika Jain (2012). Recombinant DNA Techniques: A Textbook, I Edition,Alpha Science International Ltd
References Books	
1.	Maloy S. R., Cronan J.E. Jr. and FreifelderD.(2011). Microbial Genetics. 2nd Edition. Narosa Publishing Home Pvt Ltd.
2.	Glick B. R. and Patten C.L.(2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press.
3.	Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition. Pearson New International Edition.
4.	Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria,4th Edition. ASM Press Washington-D.C. ASM Press.
5.	James D.Watson, Michael Gilman, Jan Witkowski, Mark Zoller (1992). Recombinant DNA. Scientific American Books
Web Resources	
1	https://www.britannica.com/recombinant-DNA-technology
2	https://www.byjus.com/recombinant-dna-technology
3	https://www..rpi.edu
4	https://www..ncbi.nlm.nih.gov
5	https://www.le.ac.uk/recombinant-dna-and-genetic-techniques

Course Code 23UMBE51	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	PSO 1.a	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4.a**	**PSO 4.b**	**PSO 5**	**PSO 6**	**PSO 7**
CO1	3	2	1	3	-	3	-	-	3	2
CO2	3	1	1	3	1	3	2	1	3	1
CO3	3	2	2	3	-	3	-	1	3	1
CO4	3	2	2	3	1	3	-	1	3	1
CO5	3	2	1	3	-	3	-	2	3	1

Strong – 3 Medium – 2 Low – 1

Mrs.M.M.Fatima Mansoora
Head of the Department i/c

Mrs.K.Bervin
Course Designer

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B.Sc. Microbiology
(2023-2024 onwards)

Semester - V	**NANOBIOTECHNOLOGY**	Hours/Week: 5	
DSEC -2		Credits: 3	
Course Code **23UMBE52**		Internal 25	External 75

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: relate the basic concepts of Nanotechnology- Biotechnology for biomedical application. [K1]

CO2: expalin the production and Characterisation Techniques of nanomaterials and their influences on human health .[K2]

CO3: outline the nanomedicine in drug delivery based on classification and assess their Environmental risks. [K2]

CO4: apply the characterized nanomaterials in treating diseases and their impact in Environment. [K3]

CO5: develop the application of classified nanomaterials and comment their toxic effects. [K3]

UNIT I

History and Scope of Nanotechnology- Basics- Nanobiotechnological devices: Nanorobot and Nanoshell. Nanoparticle – Introduction – Morphology, Classification and Properties of Nanoparticles (15 Hours)

UNIT II

Nanoparticles: Carbon nanotubes, Dendrimers, Quantum dots, Gold nanoparticles, Silver nanoparticles, liposomes and their applications- Synthesis of Nanoparticles- physical, chemical and Biological Sources (Plants, bacteria and Fungi).

(15 Hours)

UNIT III

Characterisation of Nanoparticles: Ultra Violet Spectroscopic analysis, X-ray diffraction and energy dispersive, Scanning Electron Microscope, Transmission Electron Microscope, Fourier Transform Infrared Spectroscopy, Atomic Force Microscopy.

(15 Hours)

UNIT IV

Biomedical application of Nanoparticles – Drug delivery System: Dendrimers, Hydrogel - Quantum dot technology in Cancer Treatment and cell repair Machines. Nanocomposite: uses and Application .Biosensor - Diagnostic Imaging techniques.

(15 Hours)

UNIT V

Health and Environmental impacts of Nanotechnology: Routes of entry of Nanomaterials in the body - Toxic mechanisms - Toxicological Health Effects by nanoparticles – Integrated concept of risk assessment - Environmental implications of nanoparticles. (15 Hours)

TEXT BOOKS

1. SubbiahBalaji. (2010).*Nanobiotechnology,* 1st edition.New Delhi: MJP Publishers.
2. ManasiKarkare. (2017).*Nanotechnology,* 1st edition.New Delhi: I.K.International Publishing House Pvt. Ltd.

REFERENCE BOOKS

1. Shanmugam, S. (2011).*Nanotechnology,* 1st edition.New Delhi: MJP Publishers.
2. Pradeep, T. (2013).*Nano: The essentials,* 1st edition.New York: McGraw Hill Publications.

Course Code (23UMBE52)	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4b**	**PSO 5**	**PSO 6**	**PSO 7**
CO 1	3	1	3	1	2	3	2	2	1	2
CO 2	3	1	2	1	3	2	1	2	-	-
CO 3	3	2	2	3	2	3	1	1	-	-
CO 4	2	2	2	1	2	2	1	1	-	-
CO 5	1	1	2	2	1	3	2	1	1	-

Strong – 3 Medium – 2 Low – 1

Mrs.M.M.Fatima Mansoora
Head of the Department i/c

Mrs.M.M.Fatima Mansoora
Course designer

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B.Sc. Microbiology
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Semester - V	**BIOSAFETY & BIOETHICS**	Hours/Week: 5	
Elective Course - 2 DSEC-2		Credits: 4	
Course Code **23UMBE53**		Internal 25	External 75

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: recall safety control measures related to chemical, biological, and physical laboratory hazards and apply personal protective equipment (PPE) effectively. (K1)

CO2: illustrate about genetically modified organisms (GMOs), hazardous materials, safe handling and disposal techniques in microbiological settings. (K2)

CO3: show ethical reasoning skills to critically evaluate moral problems and biosafety concerns arising in microbiological and biotechnological research. (K2)

CO4: identify contemporary bioethical issues in microbiology and biotechnology and engage in constructive academic discussions on their societal impact. (K3)

CO5: apply knowledge of intellectual property rights and patent systems to explore career opportunities in R&D, patent law and biotech entrepreneurship. (K3)

UNIT I

Basics of Biosafety - Laboratory Hazards and Hazard symbols. Definitions on Biohazard, Biosafety and Biosecurity. Biohazard- LAI, BP. Biohazard Classification. Biological Risk Groups. Need and application of biosafety. Good Laboratory Practices (GLP), Good Manufacturing Practices (GMP). (15 Hours)

UNIT II

Hazardous materials in Biotechnology - Categories of Waste in the Biotechnology Laboratories, Biohazardous waste and their disposal and treatments, Issues in use of GMO's - risk for animal, human, agriculture and environment owing to GMO. Hazardous materials, First aid in Laboratories. (15 Hours)

UNIT III

Biological Safety Containment in Laboratory - Primary and secondary containments - Physical and biological containment. Types of biosafety containments (level I, II, III), PPE, Biosafety guidelines in India - Roles of Institutional Biosafety Committee, RCGM, GEAC.

(15 Hours)

UNIT IV

Introduction and need of Bioethics - Ethical implications of biotechnological products and techniques. Ethical Issues in human cloning, human genome project, prenatal diagnosis, agriculture and animal rights. Social and ethical implications of biological weapons.

(15 Hours)

UNIT V

IPR, Patents and Patent laws - Intellectual property rights. Methods of application of patents and Legal implications. Biodiversity and farmer rights, Objectives of the patent system, Basic principles and general requirements of patent law, Biotechnological inventions and patent law. Legal development-Patentable subjects and protection in biotechnology. The patenting of living organisms. (15 Hours)

Text Books
Usharani .B, S Anbazhagi, C K Vidya, (2019). Biosafety in Microbiological Laboratories- 1st Edition, Notion Press, ISBN-101645878856
Satheesh.M.K.,(2009). Bioethics and Biosafety- 1st Edition, J. K International Publishing House Pvt. Ltd: Delhi, ISBN :9788190675703
DeepaGoel and ShominiParashar, (2013). IPR, Biosaftey and Bioethics- 1st Edition, Pearson education: Chennai, ISBN-13: 978-8131774700
Rajmohan Joshi (2006). Biosafety and Bioethics. Gyan Books publisher.
Sateesh. M.K. (2013). Bioethics and Biosafety. i.K. International pvt,Ltd.
References Books
Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management, India, IN: Cengage Learning India Private Limited, ISBN-10: 9386668572
Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights, India, IN: PHI learning Private Limited, ISBN : 9788120349896
Ahuja, V K. (2017). Law relating to Intellectual Property Rights, India, IN: Lexis Nexis, ISBN-10: 8131251659.

Edited by Sylvia Uzochukwu, Nwadiuto (Diuto) Esiobu, Arinze Stanley Okoli, Emeka Godfrey Nwoba, EzebuiroNwagboChristpeace, Charles OluwaseunAdetunji, Abdulrazak B. Ibrahim, Benjamin EwaUbi (2022). Biosafety and Bioethics in Biotechnology-Policy, Advocacy, and Capacity Building,1st edition. CRC Press
Sree Krishna. V (2007). Bioethics and Biosafety in Biotechnology. New age international publishers.
Web Resources
Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf.
World Intellectual Property Organisation. (2004). WIPO Intellectual propertyHandbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf.
https://www..niehs.nih.gov/bioethics
https://www.sist.sathyabama.ac.in
https://www.longdom.org/bioethics-and-biosafety

Course Code 23UMBE53	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7
CO1	2	2	-	-	-	1	2	2	-	2
CO2	2	1	2	2	3	3	2	3	-	1
CO3	2	3	2	3	2	2	1	3	-	3
CO4	2	3	2	3	2	3	3	3	-	2
CO5	2	3	2	3	2	2	3	3	3	2

Strong– 3 Medium– 2 Low–1

Mrs. M.M.Fatima Mansoora — Ms.K.Kavyaa

Head of the Department i/c — **Course Designer**

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B.Sc. Microbiology
(2023-2024 onwards)

Semester - V	**FOOD MICROBIOLOGY**	Hours/Week: 5	
DSEC -4		Credits: 3	
Course Code **23UMBE54**		Internal 25	External 75

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: relate the basics of food spoilage and its effect in human as well as in food factory [K1]

CO2: explain the significance of various factors involved in survival and retardation of food borne microbes [K2]

CO3: outline the role of microbes and its' detection in food packaging process [K2]

CO4: develop the method of food quality and nutrient enhancement by controlling the microbes [K3]

CO5: apply the methodology to overcome recent day's obstacles in food processing industry [K3]

UNIT I

Introduction to Food Microbiology: Scope of Food microbiology, General characteristics of Microorganisms in Food. Food as substrate for microorganisms: Intrinsic – pH, water activity, Redox potential, nutrient content, food additives and bio preservatives-bacteriocins. (15 Hours)

UNIT II

Extrinsic factors affecting growth and survival of microorganisms in foods: High temperature – classification of thermal processes (D value, Z value and F value), Heat penetration - Pasteurization, Canning & Baking. Low temperature – concepts of cold sterilization, changes during Freezing, storage, thawing, Lyophilization& Cryogenic freezing. Radiation – ionizing & non-ionizing radiation. Drying – sun drying & dehydration methods, Treatments of foods before and after drying. (15 Hours)

UNIT III

General principles underlying food spoilage: Sources, causes of deterioration and preventing methods of food spoilage in various foods like vegetables, bread, egg, meat, milk.

(15 Hours)

UNIT IV

Food borne infection: Bacterial (Salmonellosis) and Viral (hepatitis). Food borne intoxication: Bacterial (Botulism and Staphylococcal food poisoning), Mycotoxin (Patulin). Applications of Probiotics and prebiotics. (15 Hours)

UNIT V

Methods for detection of microorganisms in food: Physical, Chemical& Immunological assays. Food quality evaluation: Total quality control and total quality management. Microbiological quality standards in food: India - FDA, Agmark & FSSAI.

(15 Hours)

TEXT BOOK

Frazier, WC., & Westhoff, DC. (2012). *Food Microbiology*, 4th edition. New York: McGraw-Hill.

REFERENCE BOOKS

1. Adams, MR., & Moss, MO. (2005). *Food Microbiology*, 2nd edition. Bengaluru: New age International Pvt Ltd publications.
2. Jay, J.M. (2000). *Modern Food Microbiology*, 4th edition. New York: Aspen publishers.
3. Bibek Ray, (2005). Fundamental Food Microbiology, 3rd edition, New York: CRC press.
4. https://www.wikipedia.org

Course Code (23UMBE54)	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4b**	**PSO 5**	**PSO 6**	**PSO 7**
CO 1	3	1	2	3	3	3	1	2	1	2
CO 2	3	2	2	3	3	2	1	2	1	2
CO 3	3	2	3	2	2	1	2	1	1	1
CO 4	2	1	1	1	1	2	1	1	1	1
CO 5	1	2	2	2	2	2	1	1	1	2

Strong – 3 Medium – 2 Low – 1

Mrs.M.M.Fatima Mansoora
Head of the Department i/c

Mrs.M.M.Fatima Mansoora
Course designer

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B.Sc. Microbiology
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Semester - V	**INTERNSHIP**	Hours/Week: -
Internship/ Industrial Training		Credits: 1
Course Code **23UMBI51**		Internal 100

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: relate their theoretical insights with hands –on experience. (K2)

CO2: develop technical skills to their respective field of study. (K3)

CO3: build the attributes such as observational skills, team spirit and inter personal skills through the site visit. (K3)

CO4: make use of written communication skills acquired through internship/field project. (K3)

CO5: analyze the observations, results and communicate their academic and technological knowledge appropriately oral means. (K4)

Guidelines/ Regulations:

- Each student must go for Internship training in a reputed Research Laboratory / Clinical Laboratory/Hospitals/ Biotech Farms/Research Institute.
- Students should produce the completion certificate after the completion of Internship period.
- A report of 10-15 pages must be submitted by each student after the completion of the Internship period.
- Internal Viva-voce examination will be conducted.
- Students with diverse disabilities must complete a 10 day internship programme at their preferred places.

Course Code 23UMBI51	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	2	3	3	-	3	2
CO2	3	1	3	3	1	3	1
CO3	3	2	3	3	1	3	1
CO4	3	2	3	3	1	3	1
CO5	3	1	3	3	1	3	-

Mrs.M.M.Fatima Mansoora
Head of the Department i/c

Mrs.M.M.Fatima Mansoora
Course Designer

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B.Sc. Microbiology
(for those who join in 2023 - 2024)

Semester - V	**INDUSTRIAL MICROBIOLOGY**	Hours/Week: -
Extra Credit Course		Credits: 1
Course Code **23UMBO51**		Internal 100

COURSE OUTCOMES
On Completion of the Course, the students will be able to

CO1: understand the design of various fermenters and types of fermentation process.

CO2: describe the various factors that influence the fermentation process.

CO3: gain knowledge on screening strategies and strain improvement techniques of industrially important microbes.

CO4: construct the large-scale fermentation and downstream processing.

CO5: analyze commercial production of fermentation products.

UNIT I

Design of fermentors - Basic fermentor, components of basic fermentor, various designs of fermentors- lift- tube fermentor, fixed-bed reactor, fluidized bed reactor.

UNIT II

Fermentation types: batch, fed batch, continuous, aerobic, anaerobic and solid state fermentation.

UNIT III

Industrially important microorganisms -Screening strategies for industrially important microorganisms - strain improvement by classical and recombinant methods.

UNIT IV

Large scale fermentation and downstream processing - inoculum preparation, inoculum built-up, scale up of microbial fermentation - Downstream processing: precipitation, centrifugation, filtration and chromatographic purification

UNIT V

Major products of Industrial Microbiology - Single cell proteins: Cultivation of *Spirulina*- Industrial enzymes (amylase), alcoholic fermentation (beer), antibiotics (penicillin), organic acid (citric acid), amino acid (glutamate), and vitamins (B_{12}) - Quality assurance (*fssai*) and quality control of fermented products.

TEXT BOOK

1. Patel, A.H, (2010). *Industrial Microbiology, 2/e*, Macmillan India Limited.

REFERENCES

1. Stanbury, O.F., Whittaker, A., and Hall, S.J. (1997). *Principles of Fermentation Technology, 2/e,* Aditya Books (P) Ltd.,New Delhi.
2. L.E.Cassida, JR., (1999). *Industrial Microbiology, 2/e,* New Age International (P) Limited Publishers.
3. Siva kumar, P.K. (2010). *An Introduction to Industrial Microbiology, 1/e,* S.Chand & company Ltd.

Mrs.M.M.Fatima Mansoora
Head of the Department i/c

Mrs.M.M.Fatima Mansoora
Course Designer

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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VIRUDHUNAGAR
Quality Education with Wisdom and Values

B.Sc. Microbiology
(for those who join in 2023 - 2024)

Semester - VI	**ENVIRONMENTAL AND AGRICULTURE MICROBIOLOGY**	Hours/Week: 6	
Core Course –13		Credits: 5	
Course Code **23UMBC61**		Internal 25	External 75

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: recall the role of microorganisms in soil, water, air, and extreme environments, along with their significance in nutrient cycling. (K1)

CO2: explain microbial interactions in ecosystems, including nitrogen fixation, symbiosis, and microbial succession in decomposition. (K2)

CO3: describe the principles of water and soil microbiology, waterborne diseases, bioremediation, and environmental pollution control measures. (K2)

CO4: apply the harmful and beneficial aspects of microorganisms in soil, water, environment, and ecosystem. (K3)

CO5: develop knowledge of microbial processes in controlling environmental pollution and enhancing soil fertility through biofertilizers and biocontrol agents. (K3)

UNIT I

Microorganisms and their Habitats: Structure and function of ecosystems - Soil profile and soil microflora - Microbial succession in decomposition of soil organic matter - Role of microorganisms in elemental cycles in nature: Carbon, Nitrogen. Aquatic Environment: Microflora of fresh water and marine habitats - Atmosphere: Aero microflora, Assessment of air quality, Enumeration of microorganism in air, Air sanitation. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Environmental Protection Agency (EPA) - role in environmental protection. (18 Hours)

UNIT II

Water potability: Sources and types of water: surface ground, stored, distilled, mineral and de-mineralized water and their pollution - Biological indicators of water Pollution - Eutrophication. Conventional Bacteriological standards of Water Quality - MPN index, coliform test, Membrane filtration – BOD & COD - Advanced molecular methods for water analysis - Water borne diseases - Central Pollution Control Board (CPCB) standards**.**

(18 Hours)

UNIT III

Microbial Interactions: Rhizosphere microflora - Concepts of Nitrogen fixation: Symbiotic and asymbiotic nitrogen fixers - Brief account of microbial interactions: Symbiosis, neutralism, commensalism, competition, Ammensalism, Synergism, parasitism, and predation - Biocontrol agents –.Bacterial (*Bacillus thuringiensis*), Viral (NPV), Fungal (*Beauveria bassiana*). (18 Hours)

UNIT IV

Waste treatment and bioremediation: Solid waste management: Sources and types of solid waste, composting, production of biogas - Liquid waste management: Primary, secondary, and tertiary sewage treatment - Bioremediation and waste management: Need and scope of bioremediation, Degradation of hydrocarbons (oil spills), Heavy metals (Chromium & lead) and Xenobiotics (PCB). (18 Hours)

UNIT V

Plant pathology: Mode of entry of pathogens - Microbial enzymes, toxins, growth regulators and suppressor of plant defense in plant diseases - Plant defense mechanisms - Bacterial diseases: Citrus canker, Blight of paddy - Viral diseases: TMV & CMV - Fungal diseases: Red rot of sugarcane &Tikka disease - Plant disease management. (18 Hours)

Text Books	
1.	Joseph C. Daniel. (2006). Environmental aspects of Microbiology 2nd Edition. BrightSun Publications.
2.	Pradipta. K.M. (2008). Textbook of Environmental Microbiology.I.K.Publishing. House.
3.	Ramanathan, and Muthukaruppan SM. (2005). Environmental Microbiology. OmSakthiPathipagam, Annamalai Nagar.
4.	K. Vijaya Ramesh.(2004).Environmental Microbiology. 1st Edition. MJP Publishers.
5.	SubbaRao.N.S.(2017). Soil Microbiology.4th Edition. Oxford and IBH Publishing Pvt.Ltd.

References Books	
1	Dirk, J. Elasas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology, Marcel Dekker INC, New York, Hong Kong.
2	EcEldowney S, Hardman D.J., Waite D.J., Waite S.(1993). Pollution: Ecology and Biotreatment – Longman Scientific Technical.
3	Mitchel, R.(1992). Environmental Microbiology. Wiley –John Wiley and Sons. Inc. Publications, New York.
4	Clescri, L.S., Greenberg, A.E. and Eaton, A.D.(1998). Standard Methods for Examination of Water and Wastewater, 20thEdition. American Public Health Association.
5	Atlas, R.M. and Bartha, R.(1992). Microbial Ecology: Fundamentals andApplications, 2nd Edition. The Benjamin / Cummings Publishing Co.,Redwood City, CA.
Web Resources	
1	https://nptel.ac.in/courses/126105016
2	https://www.classcentral.com/course/swayam-plant-pathology-and-soil-health-14236
3	https://www.wasteonline.org.uk/resources/InformationSheets/WasteDisposal.htm
4	https://plantpath.cornell.edu/labs/enelson/PDFs/Hill_et_al_2000.pdf
5	https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2389.2005.00781.x

Course Code 23UMBC61	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	PSO 1.a	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4.a**	**PSO 4.b**	**PSO 5**	**PSO 6**	**PSO 7**
CO1	2	1	1	2	1	2	-	-	1	1
CO2	2	2	1	3	1	3	-	1	1	1
CO3	3	3	2	3	3	1	3	1	3	2
CO4	2	3	-	4	1	1	3	1	2	3
CO5	3	3	3	3	3	3	3	1	3	3

Strong – 3 Medium – 2 Low – 1

Mrs.M.M.Fatima Mansoora
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B.Sc. Microbiology
(for those who join in 2023 - 2024)

Semester - VI	**FOOD, DAIRY AND PROBIOTIC MICROBIOLOGY**	Hours/Week: 6	
Core Course -14		Credits: 5	
Course Code **23UMBC62**		Internal 25	External 75

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: relate the basics of food as a substrate for microbes. (K1)

CO2: infer the principles, types of food spoilage and preservation techniques. (K2)

CO3: explain the uses of probiotics, prebiotics, and functional dairy foods for health benefits, spoilage of milk and its products. (K2)

CO4: identify the diseases caused by food, testing methods, and the significance of antimicrobial agents. (K3)

CO5: apply the novel preventive techniques and the role of regulatory agencies in food safety. (K3)

UNIT – I

Food as a substrate for microorganisms-. Microorganisms important in food microbiology; Molds, yeasts and bacteria -General Characteristics - Classification and importance. Principles of food preservation - Asepsis - Removal of microorganisms, - High temperature - Low temperature - Drying - Food additives. Nanoscience in food preservation; microencapsulation. (20 Hours)

UNIT - II

Contamination and spoilage of food products -Food borne infections (Bacillus cereus, Salmonellosis, Shigellosis, *Listeria monocytogenes* and *Campylobacter jejuni*) and intoxications – (*Staphylococcus aureus, Clostridium botulinum, Clostridium perfringens* and mycotoxins) Food borne disease outbreaks - newly emerging pathogens. Conventional and

Novel technology in control of food borne pathogens and preventive measures - Food sanitation - plant sanitation - Employees' health standards. Regulatory Agencies &criteria for food safety. (18 Hours)

UNIT - III

Microflora of raw milk - sources of contamination. Spoilage and preservation of milk and milk products. -antimicrobial systems in raw milk. Importance of biofilms, their role in transmission of pathogens in dairy products and preventive strategies. (16 Hours)

UNIT – IV

Food fermentations: Indian Pickles Bread, vinegar, fermented vegetables (sauerkraut), fermented dairy products (yoghurt, cheese, Acidophilus Milk, Kefir, Koumiss). Oriental fermented foods- Miso –Tempeh Natto, Idli Spoilage and defects of fermented dairy products - Functional fermented foods and nutraceuticals, bioactive proteins and bioactive peptides, genetically modified foods. (16 Hours)

UNIT - V

Probiotic microorganisms, concept, definition safety of probiotic microorganisms, legal status of probiotics Characteristics of Probiotics for selection: stability maintenance of probiotic microorganisms. Role of probiotics in health and disease: Mechanism of probiotics. Application of bacteriocins in foods. Biopreservation. Prebiotics: concept, definition, criteria, types and sources of prebiotics, prebiotics and gut microflora - Prebiotics and health benefits: mineral absorption, immune response, cancer prevention, elderly health and infant health, prebiotics in foods. (20 Hours)

Text Books

1. Frazier WC and West off DC. (2017). Food microbiology. 5th Edition TATA McGraw Hill Publishing Company Ltd. New Delhi.
2. Adams, M.R., Moss, M.O. (2018). Food Microbiology 1stedition. New Age Publishers by New Age International (P) Ltd., Publishers.
3. Dubey. R.C. (2014). Advanced Biotechnology. S. Chand publishers.
4. Banwart GJ. (1989). Basic food microbiology, Chapman & Hall, New York.
5. Sugumar D. (1997). Outlines of dairy technology, Oxford University press. 1997.

References Books

1. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th Edition, CBS Publishers and Distributors, Delhi, India.

2. Prescott, Harley and Klein Wim. (2008). Microbiology, 7th Edition McGraw Hill Publications.
3. Robinson, R. K. (2002). Dairy Microbiology Handbook - The Microbiology of Milk and Milk Products (Third Edition), A John Wiley & Sons, Inc., New York.
4. Yuankunlee, Sepposalminen. (2008). Handbook of probiotics and prebiotics Second Edition. A John Wiley & Sons publication Inc.
5. Dharumaurai Dhansekaran, Alwarappan Sankaranarayanan. (2021). Advances in Probiotics Microorganisms in Food and Health 1st Edition. eBook ISBN:9780128230916.

Web Resources

1. https://www.researchgate.net/publication/15326559_A_Dynamic_Approach_to_Predicting_BacterialGrowth_in_Food/link/5a1d2e02aca2726120 b28eba/download
2. https://www.fda.gov/food/laboratory-methods-food/bam-foodsamplingpreparation-sample-homogenate
3. https://www.researchgate.net/publication/243462186_Foodborne_diseases_in_India_A_review.
4. https://www.researchgate.net/publication/228662659_Fermented_Dairy_Products_Starter_Cultures_and_Potential_Nutritional_Benefits/link/000084160cf23f86393d5764/download
5. https://www.fda.gov/food

Course Code 23UMBC62	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7
CO1	2	3	2	1	1	1	1	1	3	3
CO2	3	2	3	3	2	1	2	1	2	2
CO3	3	3	2	3	1	1	2	1	2	2
CO4	3	3	3	2	2	2	3	1	2	2
CO5	3	3	3	3	2	2	2	1	2	1

Strong – 3 **Medium – 2** **Low – 1**

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Ms.M.Vijayalakshmi
Course Designer

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B.Sc. Microbiology
(for those who join in 2023 - 2024)

Semester - VI	**ENVIRONMENTAL, AGRICULTURE AND FOOD MICROBIOLOGY PRACTICAL**	Hours/Week: 6	
Core Course – 15 Practical -VI		Credits: 4	
Course Code **23UMBC61P**		Internal 40	External 60

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: explain the concept of identification of microorganisms from soil, plants, food, fermented food, milk and dairy products. (K2)

CO2: infer the probiotic, extracellular enzyme producing, pathogenic and nitrogen fixing microorganisms by microbiological and chemical methods. (K2)

CO3: make use of the standard protocol for evaluate the quality of the food products and various samples. (K3)

CO4: apply the experimental results to the prescribed standards by the statutory bodies (K3)

CO5: identify the flora of fruits, vegetables, milk, plants and soil then solve their findings related to the experimental works. (K3)

UNIT I

Physical, chemical, and microbiological assessment of water and potability test for water. Physical – Color, pH, Chemical - alkalinity, acidity, DO, BOD, COD, Microbiological – MPN index (Presumptive, Completed and Confirmatory test), Study of air microflora by settle plate method. (20 Hours)

UNIT II

Isolation and identification of bacteria and fungi from fruits and vegetables, Direct microscopic count of milk. Methylene blue reductase test and Resazurin test, Microbiological examination of milk by SPC. (15 Hours)

UNIT III

Isolation of extracellular enzyme producers –Amylase, protease, lipase, Microbiological assay of antibiotics by cup plate method and other methods, Isolation of *Rhizobium*/ *Azotobacter*/ phosphate solubilizing organisms, Preparation of biofertilizers – Demonstration (20 Hours)

UNIT IV

Study of plant pathogens- Tikka Disease, Red rot of sugarcane, Citrus canker, Blight of paddy. Study of fungi - *Mucor, Curvularia, Alternaria, Rhizopus, Aspergillus* (20 Hours)

UNIT V

Isolation of constituent flora of fermented milk. Growth of probiotic LAB in broth, milk and whey. Preparation of probiotic fermented milks like dahi, yoghurt, lassi and whey drink. Effect of prebiotics on the growth of LAB in milk and broth. Survivability of probiotic organisms in fermented milks. Antimicrobial potential of the functional dairy products.

(15 Hours)

Text Books

1. Cappucino J and Sherman N.(2010). Microbiology: A Laboratory Manual. 9th Edition. Pearson Education Limited.
2. Kannan. N. (1996). Laboratory manual in General Microbiology. Palani Publications.
3. Dubey R C and Maheswari. D K (2002). Practical Microbiology. S. Chand Publishing.
4. Neelima Garg, K.L. Garg, K.G. Mukerji (2010).Laboratory Manual of Food Microbiology, Wiley publication.
5. Aneja, KR. (2010). Experiments in Microbiology, Plant pathology and Biotechnology. New Age International (P) Limited.

References Books

1. Christon J. Hurst Editor in Chief, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, Linda D. Stetzenbach (2007). Manual of Environmental Microbiology, Third Edition, Wiley publication.
2. James G Cappucino and Natalie Sherman. (2016). Microbiology – A laboratory manual. 4th Edition. The Benjamin publishing company, New York.

3. Marylynn V. Yates, Cindy H. Nakatsu, Robert V. Miller, Suresh D. Pillai 2016). Manual of Environmental Microbiology, 4th Edition, ASM press.
4. Burns, Richard G (2005). Environmental Microbiology, A Laboratory Manual, 2nd Edition .Lippincott Williams & Wilkins, Inc.
5. Ian Pepper, Charles Gerba, Jeffrey Brendecke (2004). Environmental Microbiology-A laboratory manual, Elsevier.

Web Resources

1. https://micobenotes.com/fields-of-microbiology/
2. https://bio.libretexts.org
3. https://www.google.com
4. https://www.sfamjournals.onlinelibrary.wiley.com
5. https://www.degruyter.com

Course Code 23UMBC61P	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7
CO1	3	3	3	3	2	1	3	1	3	3
CO2	3	3	3	3	3	1	3	1	3	3
CO3	3	3	3	1	2	1	1	1	3	3
CO4	3	3	1	1	1	-	2	-	2	2
CO5	3	3	2	1	2	1	2	-	2	2

Strong – 3 Medium – 2 Low – 1

Mrs. M.M.Fatima Mansoora
Head of the Department i/c

Ms.M.Vijayalakshmi
Course Designer

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B.Sc. Microbiology

(for those who join in 2023-2024)

Semester - VI	**PHARMACEUTICAL MICROBIOLOGY**	Hours/Week: 5	
Elective Course - 3 DSEC-3		Credits: 3	
Course Code **23UMBE61**		Internal 25	External 75

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1 label the ecological distribution of microorganisms in pharmaceutical environments and control strategies of contamination in sterile manufacturing units. (K1)

CO2 explain the modes of microbial contamination and spoilage in pharmaceutical products and compare various sterilization techniques for product safety. (K2)

CO3 illustrate the microbial production of antibiotics and therapeutic enzymes, and examine the pharmaceutical applications of biosensors and immobilized enzymes. (K2)

CO4 develop quality control policies for immunological products including vaccines, immunodiagnostics and sterility testing procedures. (K3)

CO5 apply knowledge of GMP, GLP and international quality standards to ensure pharmaceutical product safety through quality assurance and validation processes. (K3)

UNIT I

Introduction to Pharmaceutical microbiology: Ecology of microorganisms in pharmaceutical industry: Atmosphere, water, normal flora of workers, raw materials, packaging, building, equipment and their control measures; Design and layout of sterile manufacturing. (15 Hours)

UNIT II

Microbial contamination and spoilage of pharmaceutical products: Microbial aspects of pharmaceutical products; Sterilization of pharmaceutical products: Heat, gaseous, radiation

and filtration; Contamination and Spoilage of Pharmaceutical products: sterile injectable and non-injectable, ophthalmologic preparation. (15 Hours)

UNIT III

Production of antibiotics: Production of antibacterial – Penicillin, Tetracycline; antifungal – Griseofulvin, Amphotericin; antiparasitic agents – Artemesin, Metronidazole; Semi-synthetic antibiotics and anticancerous agents; Additional application of microorganisms in pharmaceutical sciences: Enzymes- Streptokinase, L-asperginase and clinical dextrin; Immobilization procedures for pharmaceutical applications (liposomes); Biosensors in pharmaceuticals. (15 Hours)

UNIT IV

Production of immunological products and their quality control: Vaccines - DNA vaccines, multivalent vaccines; Vaccine clinical trials; Immunodiagnostics - immuno sera and immunoglobulin; Quality control in Pharmaceutical: In – Process and Final Product Control; Sterility tests. (15 Hours)

UNIT V

Quality Assurance and Validation: Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry; Regulatory aspects of quality control; Quality assurance and quality management in pharmaceuticals – BIS (IS), ISI, ISO, WHO and US certification. (15 Hours)

Text Books

1. Chand Pasha Kedernath. (2021). Text book of Pharmaceutical Microbiology. Ramnath Publisher.
2. Hugo WB and Russell AD. (2004).Pharmaceutical Microbiology VII edition. Blackwell Scientific Publication, Oxford.
3 Franklin,DJ. and Snow, GA. (2013). Biochemistry of antimicrobial action.Chapman& Hall.
4 Kuntal Das (2019). Pharmaceutical Microbiology, second edition, NiraliPrakashan.
5 PriyatamaPowar, ShitalNimbargi, VaijayantiSapre (2020). Pharmaceutical Microbiology, I edition, Technical publications.

References Books

1	Handa, S.S. and Kapoor, V.K. (2022) .Pharamcognosy. 4thEdition.VallabhPrakashanPublishers,New Delhi.
2	Kokate, C.K., Durohit, A.P. and Gokhale, S.R.,(2002). Pharmacognosy. 12thedition NiraliPrakasham Publishers, Pune.
3	S. P. Vyas & V. K. Dixit.(2003). Pharmaceutical Biotechnology. CBS Publishers & Distributors, New Delhi.
4	Wallis, T.E. (2005). Text book of Pharmacognosy. 5th edition. CBS publishers and distributors, New Delhi.
5	Garrod, L.P., Lambert, HP. And C'Grady, F. (1973). Antibiotics and Chemotherapy. (eds). Churchill Livingstone.
Web Resources	
1	https://www.pharmapproach.com/introduction-to-pharmaceutical-microbiology/
2	https://www.iptsalipur.org/wp-content/uploads/2020/08/BP303T_PMB_UNIT_I.pdf
3	https://www.pharmanotes.org/2021/11/pharmaceutical-microbiology-b-pharma.html
4	https://snscourseware.org/snscphs/notes.php?cw=CW_604b15c6313c5
5	https://www.thermofisher.com

Course Code 23UMBE61	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	PSO 1.a	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4.a**	**PSO 4.b**	**PSO 5**	**PSO 6**	**PSO 7**
CO1	3	3	2	2	1	3	2	3	-	2
CO2	3	3	2	3	3	2	2	1	-	1
CO3	3	3	2	3	3	2	2	1	1	1
CO4	2	2	3	2	3	2	1	2	1	1
CO5	2	3	3	2	3	2	2	1	1	3

Strong– 3 Medium– 2 Low–1

Mrs. M.M.FatimaMansoora — Ms.K.Kavyaa

Head of the Department i/c — **Course Designer**

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B.Sc. Microbiology
(2023-2024 onwards)

Semester - VI	**BIOINFORMATICS**	Hours/Week: 5	
DSEC -6		Credits: 3	
Course Code **23UMBE62**		Internal 25	External 75

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: relate the basic parts of computer and its significance in data abstraction from biological data bases [K1]

CO2: Explain the type's biological database, tools used to integrate the alignments and data interpretation for macromolecules.[K2]

CO3: Infer the methodologies used in bioinformatics and its application in recent day's research activities [K2]

CO4: construct the structure related prediction as well as the evolutionary aspects of analysis for interpreting the results in an accurate and meaningful way [K3]

CO5: apply the overall techniques for the betterment of human survival and also develop skills about creating new bioinformatics tools [K3]

UNIT I

History and development of computers; generations of computers, Input devices: Keyboard and mouse, Modern input devices: OMR, MICR, Bar code reader, Output devices: Visual display unit (LCD & LED), Printers: (Dot Matrix and Laser), Storage devices: primary memory (RAM and ROM), Secondary memory: Magnetic storage (Hard disk), Optical storage: (CD & DVD), Solid state storage: (Pen drive & memory card). (15 Hours)

UNIT II

Bioinformatics: Introduction, Scope and objectives, Introduction of Database related programs (brief description): DBMS, RDBMS & SQL and Classification of biological databases (generalized & specialized). **(**15 Hours)

UNIT III

Nucleotide sequence databases: NCBI - GenBank, EMBL and DDBJ, Sequence submission methods and tools (Bankit), sequence retrieval systems (Entrez), Pairwise alignment: gap penality, scoring matrices, alignment methods (Dot plot & Dynamic programming), Multiple sequence alignment (Progressive alignment), Useful programs: BLAST, FASTA and Clustal-W, Significance of sequence alignments. (15 Hours)

UNIT IV

Protein databases: Sequence file formats and tools: PIR, Swiss Prot, Tr-EMBL and Expasy, Derived databases: Prosite, Pfam and PRINTS. Protein structural databases: PDB, Protein structural classification databases: CATH and SCOP, Secondary structure prediction: Chou Fasman, GOR. (15 Hours)

UNIT V

Carbohydrate structure database: CCSD, Glycome DB, Metabolic databases: KEGG, Specialized database: EST & BRENDA, Literature Data Bank (PubMed).Evolutionary analysis: Cladistic methods (Maximum parsimony and Maximum likelihood) and Phenetic methods (UPGMA and Neighbor Joining). Phylogenetic analysis tools - Phylip. (15 Hours)

TEXT BOOKS

1. Sundaralingam, R., and Kumaresan,V. (2008). *Bioinformatics*, 1st edition. Nagarcoil: Saras Publication.

2. Ignacimuthu, S.J. (2009). *Basic Bioinformatics*, 1st edition. New Delhi: Narosa Publishing House.

3. Rajaraman,V. (2010). *Fundamentals of computers*, 5th edition. New Delhi: PHI Learning Pvt Ltd.

REFERENCE BOOKS

1. Teresa Attwood, K., & David parry smith, J. (2006). *Introduction to Bioinformatics*,1st edition. London: Dorling Kindersley Pvt, Ltd.

2. Kuppuswamy, C. (2006). *Bioinformatics*, 1st edition. New Delhi: Dominant Publishers.

3. Subramanian, C. (2006). *A textbook of bioinformatics*, 8th edition. New Delhi: Dominant Publishers.

4. Srinivasa Rao, D. (2010). *Bioinformatics*, 1st edition. Hyderabad: Biotech Pharma publications.

5. Ignacimuthu, S.J. (2009). *Basic Bioinformatics*, 1st edition. New Delhi: Narosa Publishing House.

6. https://www.wikipedia.org

Course Code (23UMBE62)	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4b**	**PSO 5**	**PSO 6**	**PSO 7**
CO 1	3	1	2	2	3	1	1	3	2	1
CO 2	2	2	1	1	2	2	2	1	1	1
CO 3	3	2	3	1	2	3	3	1	1	1
CO 4	2	2	1	1	2	2	2	2	1	2
CO 5	2	2	1	1	2	1	1	1	1	2

Strong – 3 Medium – 2 Low – 1

Mrs.M.M.Fatima Mansoora
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Mrs.M.M.Fatima Mansoora
Course designer

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B.Sc. Microbiology

(for those who join in 2023-2024)

Semester - VI	**ENTREPRENEURSHIP AND BIO-BUSINESS**	Hours/Week: 5	
Elective Course - 4 DSEC-4		Credits: 3	
Course Code **23UMBE63**		Internal 25	External 75

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: tell the fundamentals of bio-entrepreneurship including business development processes, types of ownership and government schemes supporting biotech start-ups. (K1)

CO2: explain the entrepreneurial opportunities in agricultural and industrial biotechnology along with associated challenges, market strategies, and essential requirements. (K2)

CO3: demonstrate product development in biotechnology including stem cells, therapeutic proteins, fermented products, biofertilizers, biopesticides and assess their commercial viability. (K2)

CO4: apply the principles of project and technology management in building and scaling biotech businesses including proposal writing, funding mechanisms and case studies of successful start-ups. (K3)

CO5: Make use the role of systems biology, biosensors and modern technologies in enhancing agricultural biotech applications and sustainable bio-business solutions. (K3)

UNIT I

Bio Entrepreneurship: Introduction to bio-business, SWOT analysis of bio-business. Ownership, Development of Entrepreneurship; Stages in entrepreneurial process; Government schemes and funding. Small scale industries: Definition; Characteristics; Need and rationale. (15 Hours)

UNIT II

Entrepreneurship Opportunity in Agricultural Biotechnology: Business opportunity, Essential requirement, marketing, strategies, schemes, challenges and scope-with case study on Plant cell and tissue culture technique, polyhouse culture. Herbal bulk drug production, Nutraceuticals, value added herbal products. Bioethanol production using Agricultural waste,

Algal source. Integration of system biology for agricultural applications. Biosensor development in Agriculture management. (15 Hours)

UNIT III

Entrepreneurship Opportunity in Industrial Biotechnology**:** Business opportunity, Essential requirement, marketing strategies, schemes, challenges, and scope- Pollution monitoring and Bioremediation for Industrial pollutants. Integrated compost production-microbe enriched compost. Bio pesticide/ insecticide production. Biofertilizer. Single cell protein. (15 Hours)

UNIT IV

Therapeutic and Fermented products: Stem cell production, stem cell bank, production of monoclonal/polyclonal antibodies, secondary metabolite production – antibiotics, probiotic and prebiotics. (15 Hours)

UNIT V

Project Management, Technology Management and Startup Schemes: Building Biotech business challenges in Indian context-biotech partners (BIRAC, DBT, Incubation centers. etc.,), operational biotech parks in India. Indian Company act for Bio business-schemes and subsidies. Project proposal preparation, Successful start-ups-case study.

(15 Hours)

Text Books	
1.	Craig Shimasaki. (2014). Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Academic Press.
2.	Ashton Acton, O. (2012). Biological Pigments– Advances in Research and Application Scholorly Editions: Atlanta, Georgia.
3.	Jennifer Merritt, Jason Feifer (2018). Start Your Own Business, 7th edition, Entrepreneur Press publisher.
4.	Peter F. Drucker (2006). Innovation and Entrepreneurship. Harper Business publisher.
5.	Leah Cannon (2017). How to Start a Life Science Company: A Comprehensive Guide for First-Time Entrepreneurs. International Kindle paperwhite.
References Books	
1	Crueger, W, and Crueger. A.(2000). Biotechnology: A Text Book of Industrialmicrobiology,

	2nd Edition, Sinauer Associates: Sunderland.Mass.
2	Paul S Teng. (2008). Bioscience Entrepreneurship in AsiaWorld Scientific Publishing Company.
3	Charles E. Bamford, Garry D. Bruton (2015). ENTREPRENEURSHIP: The Art, Science, and Process for Success, 2nd Edition, McGraw Hill publisher.
4	Yali Friedman (2014). Building Biotechnology: Biotechnology Business, Regulations, Patents, Law, Policy and Science 4th Edition, Logos press publication.
5	Stephanie A. Wisner (2022). Building Backwards to Biotech: The Power of Entrepreneurship to Drive Cutting-Edge Science to Market, International Kindle paper white.
Web Resources	
1	https://www.bio-rad.com/webroot/web/pdf/lse/literature/Biobusiness.pdf
2	https://www.crg.eu/biobusiness-entrepreneurship
3	https://www.entrepreneur.com
4	https://www.birac.nic.in
5	https://www.springer.com

Course Code 23UMBE63	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	PSO 1.a	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4.a**	**PSO 4.b**	**PSO 5**	**PSO 6**	**PSO 7**
CO1	2	3	2	2	1	3	2	3	-	2
CO2	2	2	2	1	2	2	2	1	-	1
CO3	3	2	2	1	1	2	2	1	1	1
CO4	2	2	3	2	1	2	1	2	1	1
CO5	2	3	3	-	-	2	2	1	1	3

Strong – 3 Medium – 2 Low – 1

Mrs. M.M.Fatima Mansoora — **Head of the Department i/c**

Mrs. K.Bervin — **Course Designer**

Curriculum for B.Sc. Microbiology

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai
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VIRUDHUNAGAR
Quality Education with Wisdom and Values

B.Sc. Microbiology
(2023-2024 onwards)

Semester - VI	**BIOLOGICAL PEST MANAGEMENT**	Hours/Week: 5	
DSEC -8		Credits: 3	
Course Code **23UMBE64**		Internal 25	External 75

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: recall the history, theory, practice and science of biological control.[K1]

CO2: explain the scientific studies and concepts related to biological control.[K2]

CO3: outline the current and future roles of biological control with in context of agricultural and natural ecosystem. [K2]

CO4: the types of biological control agents of insects and their biology.[K3]

CO5: apply the ecological principles of plant pests by parasitoids, predators and entomopathogenic nematodes to manage pest problems.[K3]

UNIT I

Introduction to biological control- Definition, need of biocontrol agents. Predators, parasitods and Pathogens as biocontrol agents- Importation, Conservation and augmentation. Economics of biocontrol. (15Hours)

UNIT II

Biopesticides- Microbes used in biopesticides. Bacterial pesticides – *Bacillus sphaericus* and *Pseudomonas aeruginosa* as biocontrol agents, benefits and limitations.

(15Hours)

UNIT III

Viral insecticides –Granulo virus and CPV as biocontrol agents, benefits and limitations. Fungal pesticides –*Trichoderma* and *Metarhizium anisopliae* as biological control agents, potentials and limitations.

(15Hours)

UNIT IV

Microsporidia –Nosemapyrausta as biocontrol agent, potentials and limitations. Insect parasitic nematodes – Steinernema and heterorhabditis as biopesticides ,benefits and limitations. Protozoa in insect control. Biological control of weeds – Bioherbicides.

(15Hours)

UNIT V

Integrated pest management – Definition, Need for IPM, Methods of IPM, Components and benefits of IPM. Genetic engineering in biological control.

(15Hours)

TEXTBOOK

1.Chaube, H.S.,&Pundhir,V.S. (2005). *Crop diseases and their management,* 1st edition. New Delhi: Prentice Hall of India Pvt. Ltd.

REFERENCE BOOKS

1. Van Driesche, G., & Bellows, Jr. TS. (1996). *Biological control – Guide to its applications,* New York: Springer.
2. Ronald Atlas, M., & Richard Bartha. (1997). *Microbial Ecology,* 4thedition.San Francisco: Benjamin/Cummings Science Publishing.
3. Sharma, PD. (2006).*Plant Pathology,* 1stedition.NewDelhi:Narosa Publishing House Pvt. Ltd.
4. Helmut Fritz Van Embden, & Service, MW. (2004). *Pest and vector control,* Chennai: Cambridge University Press.

Course Code (23UMBE64)	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4b**	**PSO 5**	**PSO 6**	**PSO 7**
CO 1	3	1	2	3	3	3	1	2	1	2
CO 2	3	2	2	3	3	2	1	2	1	2
CO 3	3	2	3	2	2	1	2	1	1	1
CO 4	2	1	1	1	1	2	1	1	1	1
CO 5	1	2	2	2	2	2	1	1	1	2

Strong – 3 Medium – 2 Low – 1

Mrs.M.M.Fatima Mansoora
Head of the Department i/c

Mrs.M.M.Fatima Mansoora
Course designer

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B.Sc. Microbiology

(for those who join in 2023-2024)

Semester - VI	**MICROBIAL QUALITY CONTROL AND TESTING**	Hours/Week: 2	
Professional Competency **SEC-7**		Credits: 2	
Course Code 23UMBS61		Internal 25	External 75

COURSE OUTCOMES

On Completion of the Course, the students will be able to

CO1: recall the concept, historical background and traditional microbiological methods involved in microbial quality control along with GLP and GMP. (K1)

CO2: tell the principles, functions and safe handling procedures of key instruments used in quality control and quality assurance including disinfection methods. (K1)

CO3: demonstrate good practices in culture media preparation then explain selective and differential media for detection of specific microorganisms. (K2)

CO4: interpret microbiological tests used in pharmaceutical product quality evaluation including sterility testing, bioburden and pyrogen tests. (K2)

CO5: apply the principles of HACCP and microbial quality standards in food and water using rapid and conventional detection methods. (K3)

UNIT I

Microbial quality control: Introduction, Definition and History. Standard Methods involved in assessment of microbial quality control. Q.A and Q.C - definitions and importance. Traditional Microbiological Quality Controlling methods: TVC, APC and serial dilution techniques. Good laboratory practices, Good microbiological practices. (6 Hours)

UNIT II

Instruments in QC & QA**:** Principle involved, working conditions, uses and precautions of Real-Time PCR system (rapid microbial identification and quantification), air sampler (monitoring air quality), contact plates (RODAC), Luminometer (Hygiene

monitoring). ELISA. Methodology of Disinfection, Autoclaving & Incineration.

(6 Hours)

UNIT III

Culture media used in QC and QA**:** Design of specialized media for identification of pathogens. Good laboratory practices in culture media preparation: raw material, water, pH.Uses of media. Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Mannitol salt agar, EMB agar, McConkey Agar, Saboraud Agar. (6 Hours)

UNIT IV

Determining Microbes in Pharmaceutical Samples**:** Sterility testing for pharmaceutical products, Bioburden, pyrogen test, in process and final process control.

(6 Hours)

UNIT V

HACCP for Food Safety and Microbial Standards: Hazard analysis of critical control point (HACCP) - Principles, flow diagrams. Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water. Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centers. (6 Hours)

Text Books

1 W.B.Hugo&A.D.Russell. (1998). Pharmaceutical Microbiology.6thEdition. Blackwell scientific Publications.

2 Kulkarni A. K. Bewoor V. A. ()QualityControl,Wiley India Pvt. Ltd,

3 ChandrakantKokare (2016). Pharmaceutical Microbiology, 1st Edition, Nirali Publication.

4 Brown.M.R.W. (2017). Microbiological Quality Assurance A Guide Towards Relevance and Reproducibility of Inocula,1st Edition. CRC press.

5 Dev Raj Rakesh Sharma And V K Joshi (2011).Quality Control For Value Addition In Food Processing, New India Publishing Agency.

References Books

1 Rosamund M. Baird, Norman A. Hodges, Stephen P. Denyer. (2000). Handbook of Microbiological Quality Control in Pharmaceuticals and Medical Devices. 1st Edition, CRC Press.

2 Konieczka, (2012). Quality Assurance and Quality Control in the Analytical Chemical Laboratory A Practical Approach (Hb), Routledge, Taylor and Francis group.

3 Singh Gajjar, Budhrani, Usman. (2021). Quality Control And Quality Assurance (M.Pharm)SVikas And Company.

4 David Roesti, Marcel Goverde (2019). Pharmaceutical Microbiological Quality

Assurance and Control: Practical Guide for Non-Sterile Manufacturing, Wiley publication.

5 Amihud Kramer Bernard A. Twigg(2017). Quality Control For The Food Industry Fundamentals & Applications (Vol.1) 3rd Edition, MEDTEC publication.

Web Resources

1 https://www.study.com/microbiology-quality-control-testing-definition-procedures.

2 https://www.sigmaaldrich.com

3 https://www.coursera.org

4 https://www.atcc.org

5 https://www.fao.org

Course Code 23UMBS61	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7
CO1	2	2	-	-	-	1	2	2	-	2
CO2	2	1	2	2	3	3	2	3	-	1
CO3	2	3	2	3	2	2	1	3	-	3
CO4	2	3	2	3	2	3	3	3	1	2
CO5	2	3	2	3	2	2	3	3	3	2

Strong– 3 Medium– 2 Low–1

Mrs. M.M.FatimaMansoora
Head of the Department i/c

Ms. K.Kavyaa
Course Designer