

**Shree Manibhai Virani & Smt. Navalben Virani Science College, Rajkot  
(Autonomous)**

**Affiliated to Saurashtra University, Rajkot**

**BOARD OF STUDIES – MICROBIOLOGY**

**11<sup>th</sup> Meeting of Board of Studies in Microbiology**

**Program: B.Sc. Microbiology**

**Date: 28.04.2022**

**Time: 11.00 am**

**Mode: Hybrid**

**Details of Meeting:**

<b>Mode of Meeting</b>	Hybrid - Online and Offline
<b>Date</b>	28 <sup>th</sup> April 2022
<b>Time</b>	11.00am
<b>Platform for online participation</b>	Google Meet
<b>Venue and Link Details with ID, Password etc</b>	VSC – 11 <sup>th</sup> Microbiology BoS – 28/04/2022 Thursday, April 28 <sup>th</sup> - 11:00am – 12:30pm Join with Google Meet <a href="https://meet.google.com/taq-qeeu-fyy">https://meet.google.com/taq-qeeu-fyy</a>
<b>Venue for off-line meeting</b>	Microbiology Department, Shree M. & N. Virani Science College, Rajkot

## Agenda

1. Introductory remarks by the Chairperson
  - Confirmation of MoM & ATR of previous BoS held on 18/12/2021
  - Departmental activities and updates
2. Scheme of Learning and Evaluation for Sem.-3 of B.Sc. Microbiology
3. Syllabi of all theory & practical courses of Sem.-3 of B.Sc. Microbiology program
4. Syllabi & evaluation norms of Part-III: Career Oriented Course/s (COC) offered by the Department
5. Question paper pattern for all theory & practical courses of Sem.-3 of B.Sc. Microbiology program
6. List of paper setters and examiners for all theory & practical courses of B.Sc. Microbiology program
7. Revision of Methods of Evaluation and Tools for the course 21UMBCC102 – Microbial Growth and Control – Semester – I of B.Sc. Microbiology program.
8. Any other agenda with permission of the Chair

### BoS Members:

S.No.	Name	Membership	Presence/Absence
1.	Dr. Neepa Pandhi	Head of Department, Chairperson	Present
2.	Prof. Datta Madamwar	Subject Expert, VC Nominee	Absent
3.	Dr. Mehul Dave	Subject expert, AC Nominee	Present – Online
4.	Dr. Chitra Bhattacharya	Subject expert, AC Nominee	Present
5.	Dr. Madhavi Joshi-Bagtharia	Industry Representative	Present – Online
6.	Dr. Vasant Jadeja	Faculty Member	Present
7.	(Dr.) Lt. Hemangi Bhatt	Faculty Member	Present
8.	Dr. Hitarth Bhatt	Faculty Member	Present
9.	Dr. Rajesh Patel	Meritorious PG Alumni	Present – Online

### **Minutes of Meeting:**

The Board of Studies in Microbiology met as indicated above and discussed on the aforementioned Agenda. Sharing the expertise of all the members and with very proactive inputs, the members unanimously resolved the following:

1. MoM of previous BoS held on 18/12/2021 was confirmed by the esteemed members of the board
2. Scheme of Learning and Evaluation for 3<sup>rd</sup> Sem. of B.Sc. Microbiology programme was **discussed & framed. – (Enclosure – I)**  
The above will be effective for students admitted from **AY 2021-22 & onwards**
3. Syllabi of all theory & practical courses of Sem.-III of B.Sc. Microbiology programme were **discussed & framed. – (Enclosure – II)**

**New Courses introduced:** Bioinstrumentation techniques – Semester - III

**New Components Introduced:**

1. Inter Disciplinary Course – Semester - II
2. Core Enrichment – 1: Concept to Practice Course – Semester III
3. Core Enrichment – 2 – Internship 1 – Semester III

**Courses Removed:** 19UMBCC301 – Biostatistics and Bioinformatics

**Courses Modified:** 21UMBCC301- Applied and Environmental Microbiology

The above will be effective for students admitted from **AY 2021-22& onwards**

4. Syllabi & evaluation norms of Part-III: Career Oriented Course (COC) offered by the department were **discussed & framed. - (Enclosure –III)**

**List of courses where syllabus is modified 20% & more** in terms of content:

- a. Applied and Environmental Microbiology

**List of the courses whose title got changed:**

- a. Applied and Environmental microbiology

The detailed syllabi in the new format for adoption of OBE indicating course outcomes with K levels, pedagogical & assessment tools as appended

The above will be effective for students admitted from **AY 2021-22& onwards**

5. List of Paper Setter and Examiner for the 3<sup>rd</sup> Semester courses were discussed and finalized as indicated in **(Enclosure – IV)**
6. Question paper pattern for 2<sup>nd</sup> Semester theory & practical courses were discussed and finalized **(Enclosure – V)**

<b>Sr. No.</b>	<b>Name</b>	<b>Membership</b>	<b>Signature</b>
1.	Dr. Neepa Pandhi	Head of Department, Chairperson	Present
2.	Dr. Datta Madamwar	Subject Expert, VC Nominee	Absent
3.	Dr. Mehul Dave	Subject expert, AC Nominee	Present – Online
4.	Dr. Chitra Bhattacharya	Subject expert, AC Nominee	Present
5.	Dr. Madhavi Joshi-Bagtharia	Industry Representative	Present – Online
6.	Dr. Vasant Jadeja	Faculty Member	Present
7.	(Dr.) Lt. Hemangi Bhatt	Faculty Member	Present
8.	Dr. Hitarth Bhatt	Faculty Member	Present
9.	Dr. Rajesh Patel	Meritorious PG Alumni	Present – Online



**Sarvodaya Kelavani Samaj Managed**  
**Shree Manibhai Virani & Smt. Navalben Virani Science College, Rajkot**  
**(Autonomous)**

**Affiliated to Saurashtra University, Rajkot**

Reaccredited at the “A” Level (CGPA 3.28) by NAAC

“STAR” College Scheme & Status by MST-DBT

A College with Potential for Excellence – CPE (Phase - II) by UGC

Accredited at the G-AAA Highest Grade ‘A-1’ Level by KCG, Govt. of Gujarat

UGC-DDU KAUSHAL Kendra

GPCB-Government of Gujarat approved Environmental Audit Centre

## **SCHEME OF LEARNING AND EVALUATION**

**Of**

## **B. Sc. MICROBIOLOGY**

**(W.e.f June 2021)**

**Shree Manibhai Virani and Smt. Navalben Virani Science College, Rajkot**  
**(Autonomous)**  
**Affiliated to Saurashtra University, Rajkot**  
**Department of Microbiology**

**B. Sc. MICROBIOLOGY**  
**Regulations for Students Admitted from A.Y. 2021-2022 & Onwards**

**ELIGIBILITY**

Candidate who has passed Higher Secondary Certificate (10+2) examination with Science subjects in respective streams of Gujarat State or any other examination recognized as equivalent thereto with a good academic record, shall be eligible for admission, subject to such other conditions prescribed by the Parent University and State Government from time to time. All admissions are provisional and subject to the approval of Parent University.

**LATERAL ENTRY**

Candidates seeking admission directly in third semester of B.Sc. Microbiology must have passed examination of Diploma in Pharmacy or relevant subjects will be eligible for admission. A result of this type of candidate will be declared by considering his/her marks of semester 3 to 6 in aggregate and accordingly class will be awarded.

**DURATION OF THE PROGRAMME**

The Program

1. Shall extend over a period of three years comprising of six semesters for lateral entrants
2. Comprises of two semesters in one academic year wherein each semester normally will be of minimum 90 teaching days.

**CHOICE BASED CREDIT SYSTEM (CBCS)**

The CBCS provides an opportunity for the students to choose courses from the prescribed courses based on their interest. Mainly, each course is worth a certain number of credit points, determined by different criteria including learning outcome, contact hours etc.

The following mechanism is adopted for the purpose of computation of credits earned by the students:

- |  |            |
|--|------------|
| a) 1 hour instruction of Theory        | = 1 Credit |
| b) 2-3 hours instruction of Tutorial   | = 1 Credit |
| c) 2-3 hours instructions of Practical | = 1 Credit |

**OUTCOME BASED EDUCATION (OBE)**

Outcome based education is based on revised Bloom Taxonomy and is a learner-centric teaching and learning methodology in which the course delivery and assessment are planned to achieve stated

objectives and outcomes. It focuses on measuring students performance i.e. outcomes at different levels. OBE method of learning is adopted.

### **STRUCTURE OF THE PROGRAMME**

UG program shall have a curriculum comprising theory and practical (separate / in built with theory) courses with a specified syllabus. The curriculum of the program is a blend of Language Courses, Core Courses, Interdisciplinary Courses (IDC), Discipline Specific Electives (DSE), Trans-disciplinary Electives (TDE) and Ability Enhancement Courses (AEC) shall be offered.

### **MEDIUM OF INSTRUCTION AND EXAMINATIONS**

The medium of instruction and examinations shall be English, except for courses on Languages other than English.

### **EVALUATION**

The evaluation shall generally comprise of Continuous Internal Assessment (CIA) and Semester End Examination (SEE) with percentage weightage as specified below, unless specified otherwise in the Scheme of Learning and Evaluation.

<b>Components</b>	<b>Theory Courses</b>	<b>Practical Courses</b>
Continuous Internal Assessment (CIA)	Varies from 30 percent to 60 percent based on the nature of course.	Varies from 40 percent to 100 percent based on the nature of course.
Semester End Examination (SEE)	Varies from 70 percent to 40 percent based on the nature of course.	Varies from 40 percent to 60 percent based on the nature of course.

### **COMPLETION OF PROGRAM TO EARN THE DEGREE CERTIFICATE**

The University shall publish the result after evaluation and with the recommendations of Result Passing Board at the end of each semester. On approval / ratification of the results by the Academic Council, the student will be recommended to Governing Body for the award of the degree provided that the student have earned all the credits towards mandatory course / components as mentioned in Scheme of Learning and Evaluation.

### **MINIMUM QUALIFICATION FOR APPOINTMENT OF FACULTY MEMBER**

As per norms of UGC and./or other related Regulatory body

**Shree Manibhai Virani and Smt. Navalben Virani Science College, Rajkot  
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**Department of Microbiology  
B. Sc. MICROBIOLOGY**

**VISION OF THE DEPARTMENT**

Our vision is to produce highly qualified and competent microbiologists with expertise in all the relevant areas, to develop and maintain a strong and supportive research programme to complement our national needs while strengthening local relevance and to rise as centre of excellence and knowledge in the subject of Microbiology

**MISSION OF THE DEPARTMENT**

The Mission of Microbiology Department is to promote good quality education, research and to provide the most rigorous and inspiring training in the discipline of Microbiology with greater significance of application in all relevant areas. The Department strives to educate and mentor students to:

- Acquire practical skills necessary for operation and maintenance of small and medium scale industry and research institute,
- Be aware of the role of microorganisms in various aspects of life processes and understand their importance in agriculture, environment, food, health, and other areas,
- Apply microbiological techniques and technologies to the betterment of human life, environment and national economy,
- Contribute to the pursuit of knowledge by contributing meaningfully in the area of Research in Microbiology

**OBJECTIVES OF THE PROGRAMME**

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

1. This programme will enable students to understand the basic anatomy, physiology, diversity, and genetics of microorganisms including viruses, bacteria, protozoa, algae and fungi, and exploit their interactions with environment and human beings.
2. The Curriculum is designed to impart to students the skill to operate basic and advanced instruments used for analysis of various biomolecules.
3. This programme will enable students to acquire knowledge on the Microbiology, Cell Biology, Microbiology, Immunology, Bioprocess Technology and Molecular Biology to enable them to understand emerging and advanced concept in modern biology and help them to take their career in this field.
4. After completion of the programme, the students will be able to acquire the necessary theoretical and practical competencies in Microbiology to enable them to undertake higher studies in recognized Institutions of advance learning and engage gainful self-employment.
5. The Programme is intended to help the students to be the innovative and versatile personalities in the field of Life Science with quality education and provide the skilled manpower required by Research and Development, Institutions of Higher Learning and Industry.



## GRADUATE ATTRIBUTES

- **Academic excellence:** Ability to identify key questions, research and pursue rigorous evidence-based arguments.
- **Critical Thinking and Effective communications:** Analysis and evaluation of information to form a judgment about a subject or idea and ability to effectively communicate the same in a structured form.
- **Global Citizenship:** Mutual understanding with others from diverse cultures, perspectives and backgrounds
- **Life Long Learning:** Open, curious, willing to investigate, and consider new knowledge and ways of thinking

## PROGRAM EDUCATIONS OBJECTIVES (PEOs)

This programme will produce Graduates who will attain following PEOs after few years of graduation	
<b>PEO 1</b>	: <b>Core competency:</b> will develop the competency to pursue higher education, successful professional career, or be an entrepreneur with synergistic combination of the knowledge and skills of Microbiology and allied sciences
<b>PEO 2</b>	: <b>Breadth of knowledge:</b> will show the ability to critically analyse scientific data, drawing objective conclusions from it and apply this knowledge to independently design, and execute small research problems with the help of integrated knowledge of Microbiology and other domains for societal and human welfare.
<b>PEO 3</b>	: <b>Preparedness:</b> will have the potential to take any task or assignment in the capacity of a leader or team member in the chosen occupations or careers and will reflect an aptitude and ability for contribution in academics, entrepreneurship, and research, equipped with good communication skills.
<b>PEO 4</b>	: <b>Professionalism:</b> will possess strong professional ethics and expertise to fulfil moral duties towards their profession, community, society and nation at large.
<b>PEO 5</b>	: <b>Learning environment:</b> will show readiness for lifelong learning necessary to meet the ever evolving professional, social and personal demands through ethical, interpersonal and team skills.

## PROGRAM OUTCOMES:

After completion of the B.Sc. Microbiology programme, the Graduate will be able to:		
<b>PO 1</b>	:	<b>Domain knowledge:</b> Demonstrate an understanding of fundamental principles of Microbiology, its applications and scope, along with an ability to identify beneficial and harmful role of microorganisms for the benefit of Science and Society
<b>PO 2</b>	:	<b>Problem analysis:</b> Accurately identify and critically analyse pertinent problems in the field of Applied Microbiology and various domains of Biological sciences.
<b>PO 3</b>	:	<b>Design/development of solutions:</b> Search for and successfully arrive at viable conclusions/solutions pertaining to various aspects of life sciences using right approach and appropriate tools and techniques
<b>PO 4</b>	:	<b>Conduct investigations of complex problems:</b> Ability to investigate any complex problems related to Microbiology and other life science with the use of appropriate experimental tools/techniques/equipment.
<b>PO 5</b>	:	<b>Modern tool usage:</b> Understand standard operating procedures, safety measures and acquire in-depth technical competence to handle the basic laboratory instruments, and develop the skills to locate and retrieve scientific information with modern data search tools.
<b>PO 6</b>	:	<b>The Microbiologist and Society:</b> Demonstrate the ability to understand the role of scientific developments in a changing world from the disciplinary perspective as well as in relation to its professional and everyday use, with an insight into one's role in society and act in an honest and consistent manner based on a strong sense of self and personal values.
<b>PO 7</b>	:	<b>Environment and sustainability:</b> Analyse the impact of scientific and technological advances on the environment and society and the need for sustainable development.
<b>PO 8</b>	:	<b>Ethics:</b> Commitment to professional ethics and responsibilities.
<b>PO 9</b>	:	<b>Individual and team work:</b> Exhibit the potential to effectively accomplish tasks as a leader or a member of a team as well as independently in multidisciplinary settings.
<b>PO 10</b>	:	<b>Communication:</b> Communicate effectively in spoken and written forms as well as through digital media with scientific community, society, and fellow mates.
<b>PO 11</b>	:	<b>Project management and finance:</b> Demonstrate knowledge and scientific understanding to design a research project and manage its execution to generate new scientific insights, innovations in Microbiology research and exhibit organizational skills for able management of time and resources.
<b>PO 12</b>	:	<b>Life-long learning:</b> Able to recognize the need to undertake life-long learning and acquire the capacity to build on critical thinking skills for periodic updating of scientific knowledge and its application.

## PROGRAM SPECIFIC OUTCOMES (PSOs) for B. Sc. Microbiology programme

After completion of the programme, the Graduate will:	
<b>PSO1</b>	: Acquire knowledge on the fundamentals of Microbiology for sound and solid base which enables them to understand the emerging and advanced concepts in life sciences
<b>PSO2</b>	: To equip the students with knowledge, skill and inspiration to pursue higher education and research in Microbiology and allied fields in reputed institutes at national and international level.
<b>PSO3</b>	: Be able to understand fundamental principles of Microbiology to find innovative solutions for environment, agriculture, and health related issues at local and global level.
<b>PSO4</b>	: Apply the knowledge of Microbiology, preferably with the synergistic application of basic understanding of other allied fields, for finding sustainable ethical solutions to existing global problems in compliance to the SDGs
<b>PSO5</b>	: Become competent and eligible to appear in various competitive exams, getting placement in government and private sectors of academia, research and industries, and become a successful Microbiologist serving the Nation.

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**Department of Microbiology**

**B. Sc. MICROBIOLOGY**

**SCHEME OF LEARNING AND EVALUATION**

**For the students admitted from the A.Y. 2021-22 & onwards**

<b>Semester-I</b>									
Course Code	Course	Contact Hrs/wk.			SEE Duration Hrs	Maximum Marks			Credits
		T	Tu	P		CIA	SEE	Total	
<b>Part-I</b>									
21ULCEN101	English-I – Development of Functional English	3	-	-	3	40	60	100	3
	<b>Part-I Total</b>	<b>3</b>	<b>0</b>	<b>0</b>		<b>40</b>	<b>60</b>	<b>100</b>	<b>3</b>
<b>Part-II</b>									
21UMBCC101	<b>Core1:</b> Fundamentals of Microbiology (F1)	4	-	-	3	30	70	100	4
21UMBCC102	<b>Core2:</b> Microbial Growth and Control (F2)	4	-	-	3	30	70	100	4
21UMBID101	<b>IDC-1: Zoology-1 Systematics and Anatomy</b>	3	-	-	3	30	70	100	3
21UMBCC103	<b>Core Practical-1</b> Basic Microbial Techniques	-	-	6	6#	40	60	100	4
21UMBID102	<b>IDC- Practical - 1: Zoology-1: Systematics and Anatomy</b>	-	-	6	3	40	60	100	2
	<b>Core Enrichment – 1: Concept to Practice Course</b>		1	-	-	(20)	Evaluation at the end of Semester - IV		
	<b>Part-II Total</b>	<b>11</b>	<b>1</b>	<b>12</b>		<b>170</b>	<b>330</b>	<b>500</b>	<b>17</b>
<b>Part-III: Ability Enhancement Courses</b>									
21AESD101	<b>AECC I:</b> Introduction to SDG (online course)	-	-	-	-	-	-	Remarks	Audit course
	<b>AECC II:</b> Environmental Conservation and Sustainable Development	1	-	-	-	Evaluation at the end of 2 <sup>nd</sup> Semester			-

	<b>AECC III: Human Values for Holistic Living</b>	1	2*	-	-	Evaluation at the end of 2 <sup>nd</sup> Semester			-
	<b>FS 3: Career Acceleration Programme</b>	2*							
	<b>Part-III Total</b>	<b>2</b>	<b>-</b>	<b>-</b>		<b>100</b>	<b>0</b>	<b>0</b>	<b>0</b>
	<b>Total (Part-I to Part-III)</b>	<b>16</b>	<b>1</b>	<b>12</b>	<b>-</b>	<b>210</b>	<b>390</b>	<b>600</b>	<b>20</b>
		<b>29</b>				<b>600</b>			

# 3hrs on day1 and 3 hrs on day 2;

\* Beyond Academic hours

( ) Final evaluation for 100 marks be made at the end of Semester IV, which include 20 marks CIA in Semesters I, II, and III each, and of 40 marks in Semester IV.

Semester-II									
Course Code	Course	Contact Hrs/wk.			SEE Duration hrs	Maximum Marks			Credits
		T	Tu	P		CIA	SE E	Total	
<b>Part-I</b>									
21ULCEN201	English II – Functional English	3	-	-	3	40	60	100	3
	<b>Part-I Total</b>	<b>3</b>	<b>0</b>	<b>0</b>		<b>40</b>	<b>60</b>	<b>100</b>	<b>3</b>
<b>Part-II</b>									
21UMBCC201	<b>Core3:</b> Microbial Taxonomy and diversity (F)	4	-	-	3	30	70	100	4
21UMBCC202	<b>Core4:</b> Basic Biochemistry (F)	4	-	-	3	30	70	100	4
21UMBCC203	<b>Core 5:</b> Cell Structure and Organization (F)	4	-	-	3	30	70	100	4
21UMBID201	<b>IDC-2:</b> Botany – Medicinal Botany	3	-		3	30	70	100	3
21UMBCC204	<b>Core Practical - 2</b> Microbial Diversity and Biochemistry	-	-	6	6#	40	60	100	2
21UMBID202	<b>IDC-2:</b> Practical: Botany	-	-	6	3	40	60	100	2
	<b>Core Enrichment – 2: Concept to Practice Course</b>		1		-	(20)	Evaluation at the end of Semester - IV		
	<b>Part-II Total</b>	<b>15</b>	<b>1</b>	<b>12</b>		<b>200</b>	<b>400</b>	<b>600</b>	<b>19</b>
<b>Part-III: Ability Enhancement Courses</b>									
21xxx	<b>AECC II:</b> Environmental Conservation and Sustainable Development	1	-	-	-	Remarks			2
21xxxx	<b>AECC III:</b> Human Values for Holistic Living	1	2*	-	-	Remarks			3
	<b>FS 3:</b> Career Acceleration Programme	2*							
	<b>Part-III Total</b>	<b>2</b>	<b>-</b>	<b>-</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>
	<b>Total (Part-I to Part-III)</b>	<b>20</b>	<b>1</b>	<b>12</b>	<b>-</b>	<b>240</b>	<b>460</b>	<b>700</b>	<b>27</b>
		<b>33</b>				<b>700</b>			

# 3 hrs on day1 and 3 hrs on day 2;

\* Beyond Academic hours

(Final evaluation for 100 marks be made at the end of Semester IV, which include 20 marks CIA in Semesters I, II, and III each, and of 40 marks in Semester IV.)

Minimum one-month internship pertaining to learning for concept to practice/prototype or product development for start-up/mini and final semester project/skilling in the summer vacation/combination of semester break and summer vacation in industry/premier research institute/NGO, etc.

Semester–III									
Course Code	Course	Contact Hrs /wk.			SEE Duration hrs	Maximum Marks			Credits
		T	Tu	P		CIA	SEE	Total	
<b>Part – I</b>									
	English III –	3	-	-	3	40	60	100	3
	<b>Part-I Total</b>	<b>3</b>	<b>0</b>	<b>0</b>		<b>40</b>	<b>60</b>	<b>100</b>	<b>3</b>
<b>Part–II</b>									
21UMBCC301	<b>Core 6:</b> Applied and Environmental Microbiology	4	-	-	3	30	70	100	4
21UMBCC302	<b>Core 7:</b> Agricultural Microbiology	4	-		3	30	70	100	4
21UMBCC303	<b>Core 8:</b> Bioinstrumentation Techniques	4	-		3	30	70	100	4
21UMBIDC301	<b>DSE 1: Sustainability and Conservation (Zoology-2)</b>	3	-	-	3	30	70	100	3
21UMBCC304	<b>Core practical – 3 – Applied and Analytical Microbiology</b>	-	-	6	6	40	60	100	2
21UMBIDC302	<b>DSE 1: Practical Sustainability and Conservation (Zoology-2)</b>	-	-	6	3	40	60	100	2
<No course code>	<b>Core Enrichment – 3: Concept to Practice Course</b>		1	-	-	20	Evaluation at the end of Semester - IV		
	<b>Core Enrichment 2: Internship 1</b>	-	-	-		100		100	1
	<b>Part-II Total</b>	<b>15</b>	<b>1</b>	<b>12</b>		<b>300</b>	<b>400</b>	<b>700</b>	<b>20</b>
<b>Part-III: Ability Enhancement Courses</b>									
	<b>FS 3: Career Acceleration Programme (CAP)</b>	-	2	-					Audit course
	<b>Part-III Total</b>	-	2	-		0	0	0	
	<b>Total (Part-I to Part-III)</b>	<b>18</b>	<b>3</b>	<b>12</b>	<b>-</b>	<b>340</b>	<b>460</b>	<b>800</b>	<b>23</b>
		<b>33</b>				<b>800</b>			



Semester– IV									
CourseCode	Course	Contact Hrs/wk.			SEEDu rationh rs	Maximum Marks			Credits
		T	T u	P		CIA	SEE	Total	
<b>Part – I</b>									
	English IV –	3	-	-	3	40	60	100	3
	<b>Part-I Total</b>	<b>3</b>	<b>0</b>	<b>0</b>		<b>40</b>	<b>60</b>	<b>100</b>	<b>3</b>
<b>Part–II</b>									
21UMBCC401	<b>Core 9:</b>	4	-	-	3	30	70	100	4
21UMBCC202	<b>Core10:</b>	4	-		3	30	70	100	4
	<b>Coreelective 1:&lt;1&gt; &lt;2&gt;</b>	4	-		3	30	70	100	4
	<b>TDE 1</b>	2	-	-	3	30	70	100	2
	<b>DSE:2 –</b>	3	-	-	3	30	70	100	3
	<b>Core Practical – 4 –</b>			6	6	40	60	100	3
21UMBCC403	<b>Core elective Practical</b>			4	3	40	60	100	2
	<b>DSE:2 – Practical</b>			6	3	40	60	100	2
21xxx	<b>Core Enrichment – 1: Concept to Practice Course</b>		1	-	-	40	-	100	-
	<b>Part-II Total</b>	<b>17</b>	<b>1</b>	<b>18</b>		<b>270</b>	<b>530</b>	<b>800</b>	<b>24</b>
<b>Part-III: Ability Enhancement Courses</b>									
<no subject code>	<b>FS 3:Career Acceleration Programme (CAP)</b>	-	2	-					Audit course
	<b>Part-III Total</b>	<b>0</b>	<b>2</b>	<b>0</b>					
	<b>Total (Part-I to Part-III)</b>	<b>20</b>	<b>3</b>	<b>18</b>	<b>-</b>	<b>310</b>	<b>590</b>	<b>900</b>	<b>27</b>
		<b>37</b>				<b>900</b>			

Minimum one month internship pertaining to learning for concept to practice/prototype or product development for start-up/mini and final semester project/skilling in the summer vacation/combination of

semester break and summer vacation in industry / premier research institute/ NGO etc.



<b>Semester–VI</b>									
<b>Course Code</b>	<b>Course</b>	<b>Contact Hrs /wk.</b>			<b>SEE Duration hrs</b>	<b>Maximum Marks</b>			<b>Credits</b>
		<b>T</b>	<b>Tu</b>	<b>P</b>		<b>CIA</b>	<b>SEE</b>	<b>Total</b>	
<b>Part–II(Project + a Compulsory course/ Advanced Courses + a Compulsory course)</b>									
	<b>Core 15: (Compulsory course)</b>	5	-	-	3	30	70	100	5
	<b>Core 16:</b>	5	-	-	3	30	70	100	5
	<b>Core – 17:</b>	5	-	-	3	30	70	100	5
	<b>Core Practical – 6 – Skill Training / Start up</b>	-	-	9	6	40	60	100	4
	<b>Core Enrichment 5: Project / Dissertation</b>	-	-	20				300	14
		<b>24/25</b>						<b>400</b>	<b>19</b>
	<b>Part-II Total</b>							<b>400</b>	<b>19</b>
<b>Total Marks:400</b>									

**It is expected that student should spend \*4hrs each day for 6 days**

### Formation of Part-III

Course Code	Semester	Course / Component	Contact Hrs	No. of Courses	Credit/ Course	Total Credits
<b>A. Ability Enhancement Course (AEC)</b>						
<b>(i) Ability Enhancement Compulsory Course (AECC)</b>						
	I	<b>AECCI:</b> Introduction to SDG (online course)	-	1	Remarks	Audit Course
	I & II	<b>AECC II:</b> Environmental Conservation and Sustainable Development	1 Hr / Week / Semester	1	1+1	2
	I & II	<b>AECC III:</b> Human Values for Holistic Living	1 T + 2 Tu /Week /Semester	1	1+1+1	3
					<b>Sub Total</b>	<b>5 + Audit course</b>
<b>(ii) Skill Enhancement Course (SEC)</b>						
As per common list	Any Semester between II –V/VII	<b>SEC-I</b> *Value Added Courses	40 Hrs	1	1	1
	Any Semester between III – V/VII	<b>SEC-II</b> **Co-Curricular Course	80 to 120 Hrs	1	2	2
					<b>Sub Total</b>	3
<b>B. Finishing School</b>						
<b>FS I to FS IV Compulsory to Earn Degree.</b>						
	I	<b>FS I:</b> Student Induction Program	3 weeks Phase 1, Phase 2, Phase 3	-	Remark	Audit course
	Across I & II Semesters	<b>FS II:</b> Fundamentals of Design Thinking (Online/Offline)	40 to 60 Hrs	1	Remark	Audit course
	Semesters I to V / VII	<b>FS III:</b> Career Acceleration	2 Hrs / Week /Semester	As per syllabus	Remarks	Audit course

		Programme – CAP (Placement Training)				
	Semester V (3 yrs program) Semester VI (4 yrs program)	<b>FS IV:</b> Community Engagement	Twice a month	1	Remarks	Audit course
<b>FS V to FS VIII Options for Advanced Learners</b>						
	Any semester from II to V/VII	<b>FS V:</b> Indian & Foreign Languages	-	Any number of courses	Remarks	Audit course
	Any semester from II to V/VII	<b>FS VI:</b> Any number of Online course(s) from select MOOC platforms	-	Any number of courses	Remarks	Credit as per provider/ audit course
	Any semester from III to V/VII	<b>FS VII:</b> Advanced Design Thinking	-	1	Remarks	Audit course
	Any semester from I to VI/VIII	<b>FS VIII:</b> <b>#Extra Credit Course</b> Any number of courses from any UG program across the College	Self-study	Any number of courses	As per course offered	As per credit(s) earned across all courses opted

**\*Value Added Courses** - Option to student to choose at least 1 from a list of courses offered by any department across the Institution.

**\*\*Co-Curricular Courses** - Option to students to choose 1 from a list of courses offered by any department across the Institution.

# Student may opt for any course of the odd/even prevailing semester from any UG program across the Institution with the following guidelines:

- a. Attending class not mandatory.
- b. May be mentored by the course teacher.
- c. Preparation through self-study.
- d. CIA not mandatory; evaluated for total marks at the end of the semester.
- e. Indicates options to appear for the course through examination application and payment of

examination fees of that course.

- f. Credits earned through each course indicated in the consolidated mark sheet as extra credits; not included for CGPA, percentage marks and classification.

**TOTAL MARKS & CREDIT DISTRIBUTION TO EARN THE DEGREE**

S. No	PART	Total Marks	Total Credits
1.	<b>PART I:</b> Language Course	400	12
2.	<b>PART II:</b> Core, IDC, DSE, TDE	4000	128
3.	<b>PART III:</b> AECC-I, II & III SEC- I & II FS I, II, III & IV	Remarks	08 + Credit audit
<b>TOTAL</b>		<b>4400</b>	<b>148</b>

**VALUE ADDED COURSES (VAC) COURSES OFFERED BY THE DEPARTMENT**

Sr. No.	Course Code	Course Title	Course Duration	Credits
1	21UMBVA01	Mushroom Cultivation	40 Hrs	1

**CO-CURRICULAR COURSE (CCC) OFFERED BY THE DEPARTMENT**

Sr. No.	Course Code	Course Title	Course Duration	Credits
1	21UMBCCC1	Biofertilizers	80 Hrs	1

### Syllabus – Semester – III

Department: **Microbiology**Programme: **B.Sc. Microbiology**

Course Code	Course Title (AP)	Credits
21UMBCC301	Core 6: Applied and Environmental Microbiology	4 Credits

#### Course Description:

Applied and Environmental Microbiology is appropriate for students with some background in the fundamentals of the omnipresent microbes in biosphere. This course introduces the basic principles of food microbiology, normal flora of food and their role in the food production and preservation. It also introduces with the microbial flora present in our surroundings. This course explores the impact of microbes on environment. From this subject student will be able to identify the challenges in food production. They also be aware with the distribution pattern of microbes into the atmosphere.

#### Course Objectives:

This course is designed to provide instruction about

1. General principles of food, dairy and water Microbiology.
2. Food spoilage, food preservation and food commodities;
3. Processing in dairy for milk and milk product;
4. Fundamentals of drinking water and waste water treatment;
5. Overview of Air Microbiology
6. Role of microbes in environmental processes

<b>Course Outcomes:</b> Upon completion of this course, the learner will be able to		
CO No.	CO Statement	Blooms taxonomy Level (K1 to K4)
CO <sub>1</sub>	Understand and apply General principles of food Microbiology and role of microbes in various types of food production, food spoilage, food preservation and food commodities.	K2& K3
CO <sub>2</sub>	Understand and apply the principles of milk preservation, and processing in day to day life	K2& K3
CO <sub>3</sub>	Comprehend the principle of water purification and	K3



	appreciate the use of latest technology in the field	
CO <sub>4</sub>	Identify various stages of waste water treatment and solid waste management and its implication in the health and sanitation	K3
CO <sub>5</sub>	Relate the role of microbes in air and environmental processes	K2

Course Content	Hours
<b>Unit –1 Food Microbiology</b>	<b>10hrs</b>
<ul style="list-style-type: none"> <li>• Microbial flora of fresh food &amp; Microbial spoilage of foods: Fresh foods &amp; Canned foods</li> <li>• Food Borne infection &amp; intoxication: Role of <i>S.aureus</i>, <i>C.botulinum</i> &amp; <i>Salmonella</i> Spp. in food poisoning</li> <li>• Preservation of foods: General principles &amp; methods of food preservation</li> <li>• Microbiological examination of food; Introduction to AGMark</li> <li>• Brief introduction about fermented foods: Pickles, Sauerkraut, Silage, Sausages &amp; Bread Microorganisms as food: Single Cell Protein, Mushrooms and Functional foods</li> </ul>	
<b>Unit –2 Dairy Microbiology and Probiotic / Microbiology of dairy products</b>	<b>10hrs</b>
<ul style="list-style-type: none"> <li>• Milk as a medium, normal flora of milk, Types of microorganisms in milk: Biochemical types, Pathogenic types, Temperature types</li> <li>• Spoilage of milk &amp; milk products</li> <li>• Microbial analysis of milk: SPC, Direct count, MBRT, Resazurin test, Grading of milk</li> <li>• Fermented milk Beverages &amp; Manufactured Dairy Products: Concept of Starter Culture, Cheese, Yogurt, Buttermilk, Acidophilus milk, Kefir</li> <li>• Preservation of milk and milk products: Principles &amp; methods of preservation</li> </ul>	
<b>Unit – 3 Air Microbiology</b>	<b>10hrs</b>
<ul style="list-style-type: none"> <li>• Air flora - Concept of transient air flora, droplet, droplet nuclei, and aerosols.</li> <li>• Monitoring and control of air flora of Hospitals, Aseptic filling areas, Research laboratories, Industries – Food and Pharmaceutical</li> <li>• Air pollution: Chemical pollutants and their sources in air</li> <li>• Methods of Air sampling</li> <li>• Air borne infections.</li> </ul>	
<b>Unit-4 –Water Microbiology</b>	<b>10hrs</b>
<ul style="list-style-type: none"> <li>• Microbiology of drinking water: Sanitary survey, Bacteriological evidence of</li> </ul>	

<p>pollution: Coliforms and microorganisms other than coliforms.</p> <ul style="list-style-type: none"> <li>• Sampling techniques of water &amp; Bacteriological analysis: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests</li> <li>• Process of Water purification: Sedimentation, Filtration use of Sand filters, Disinfection and BIS standards for drinking water quality.</li> <li>• Microbiology of Waste water: Chemical and Microbial Characteristics of waste water, B.O.D., C.O.D. as indicator of quality of waste water</li> <li>• Waste water treatment &amp; Disposal - Single Dwelling Process &amp; Municipal Treatment - Primary Treatment, Secondary Treatment, Advanced &amp; final treatment., Solid waste processing: Anaerobic Sludge digestion &amp; Composting.</li> </ul>	
<b>Unit –5 Environmental Microbiology</b>	<b>10hrs</b>
<ul style="list-style-type: none"> <li>• Types of Pollutants, Sources &amp; Effect on ecology</li> <li>• Pollution by pesticides, Biomagnifications of pesticide &amp; their Biological control</li> <li>• Brief account on Water pollution (by Oil, Detergent, Heavy metal &amp; industrial effluent) &amp; their Biological control.</li> <li>• Role of microbes in Carbon cycle, Sulphur cycle and Winogradsky's column.</li> <li>• Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction.</li> </ul>	

#### **Text Books:**

- Frazier, W.C., Westhoff, D.C. (1978). Food Microbiology. Tata McGraw-Hill Publishing Company. (UNIT: 1)
- Prajapati, J.B. (1995). Fundamentals of Dairy Microbiology: Ekta Publication, India (UNIT: 2)
- Microbiology by Pelczar M.J. & Chain E.C.S. : 5th edition (UNIT:3 & 4)
- Prescott, M.J., Harley, J.P., Klein, D.A. (2002). Microbiology, 5th Edition. New York: WCB Mc GrawHill publication. (UNIT: 5)

#### **Reference Books:**

- Manay, S., Shadaksharaswami, M. (2008). Foods: Facts and Principles. New Delhi: New Age Publishers.
- Meyer, L.H. (2004). Food Chemistry. New Delhi: New Age Publishers.
- Frobisher, M. (1974). Fundamentals of Microbiology. 9<sup>th</sup> Edition. Philadelphia, PA: W. B. Saunders Company.
- Swaminathan, M. (1990). Food Science, Chemistry and Experimental Foods. Mysore: Bappco Book Publishing Company.

- Jay, J.J., Loessener, M.J., Golden, D.A. (2005). Modern Food Microbiology: Springer publication.

#### **Pedagogic tools:**

- Chalk and Board
- PPT and Videos.
- Assignment
- Class Activity: Think-Pair-Share / Class Test

#### **Suggested reading / E-resources**

- NPTEL :: Biotechnology - Microbiology

#### **Suggested MOOCs**

- General Microbiology - Course (swayam2.ac.in)
- Food Microbiology and Food Safety - Course (swayam2.ac.in)

#### **Methods of assessing the course outcomes**

Components of CIA: 30 marks

<b>Sr. No.</b>	<b>Component</b>	<b>Content</b>	<b>Duration (if any)</b>	<b>Marks</b>	<b>Sub Total</b>
A	Test 1	1 <sup>st</sup> & 2 <sup>nd</sup> Units	1 <sup>1/2</sup> hours	30	05
	Test 2	Units 3,4,5	3 hours	70	15
B	Assignment-1	Any topic from the syllabus	By the end of 8 <sup>th</sup> week	20	05
C	Assignment-2	Any topic from the syllabus	Before 2 <sup>nd</sup> CIA	20	05
<b>Grand Total</b>					<b>30</b>

## Syllabus – Semester – III

Department: **Microbiology**

Programme: **B.Sc. Microbiology**

Course Code	Course Title (AP)	Credits
19UMBCC302	Core 7: Agricultural Microbiology	4 Credits

### Course Description:

Agriculture Microbiology covers the study of Soil Biology & Chemistry, Sustainable agricultural practices, Beneficial and harmful microbes in agriculture, and Veterinary Microbiology. From this subject student will be able to learn opportunities and challenges in the field of agriculture microbiology. This course is segregated into different units elucidating soil formation, physical & chemical properties of soil, organic farming, biopesticides, biofertilizers, integrated pest management, GMO, phytoremediation, Beneficial sea weeds, plant diseases by bacteria, fungi, nematode and viruses, microbial diseases of farm animals, zoonotic diseases and vaccination of farm animals.

### Course Objectives:

1. To understand the soil formation process and the role of soil in agriculture
2. To gain knowledge on the mechanism of different groups of agriculturally important microorganisms
3. To know the complex interaction between agriculture system and micro-organism.
4. Understand the beneficial as well as harmful role of microbes in Agriculture.
5. To introduce micro-organism in agricultural system for building a pathway for sustainable agriculture

<b>Course Outcomes:</b> Upon completion of this course, the learner will be able to		
CO No.	CO Statement	Blooms taxonomy Level (K1 to K4)
CO1	Understand the formation process, profiling and microbial diversity of soil	K2
CO2	Identify the group of Plant Growth Promoting Rhizobacteria	K3
CO3	To learn and apply different organic farming strategies, biopesticides and biofertilizers for sustainable agriculture	K3

CO4	Comprehend the diseases and prevention measures for farm animals	K2
CO5	To Learn and apply isolation techniques to isolates different agriculturally important microbes	K3

Course Content	Hours
<b>Unit 1: Soil Biology &amp; Chemistry</b>	<b>10 hrs</b>
<ul style="list-style-type: none"> <li>• Introduction to soil.</li> <li>• Formation of soil- weathering of rocks, pedogenesis</li> <li>• Soil profile and microbial diversity of soil</li> <li>• Rhizosphere and Rhizoplane</li> <li>• Edaphic factors-Physical and chemical properties of soil</li> </ul>	
<b>Unit 2: Sustainable agricultural practices</b>	<b>10 hrs</b>
<ul style="list-style-type: none"> <li>• Organic farming: Introduction, components, Pros &amp; Cons</li> <li>• Biofertilizers: Types, advantages and disadvantages</li> <li>• Biopesticides: Types, advantages and disadvantages</li> <li>• Plant Growth Promoting Rhizobacteria: Introduction and mechanisms</li> <li>• Integrated Pest Management</li> </ul>	
<b>Unit 3: Beneficial role of microbes in Agriculture</b>	<b>10 hrs</b>
<ul style="list-style-type: none"> <li>• GMO – Definition, history and Current status</li> <li>• Microbial Techniques in Crop improvement</li> <li>• Phytoremediation: Introduction, Types, Advantages and Disadvantages</li> <li>• Beneficial Sea weeds: Introduction and its uses</li> <li>• Plant – microbes’ interactions</li> </ul>	
<b>Unit 4: Harmful effects of microbes in Agriculture</b>	<b>10 hrs</b>
<ul style="list-style-type: none"> <li>• General Mechanism, Propagation and control of plant diseases</li> <li>• Plant diseases by Bacteria-<i>Xanthomonas citrii</i></li> <li>• Plant diseases by viruses - TMV</li> <li>• Plant diseases by fungi – <i>Fusarium oxysporum</i></li> <li>• Plant pathogenic Nematods – Root knot nematodes, Root lesion nematode, Cyst nematode</li> </ul>	
<b>Unit 5: Overview of Veterinary Microbiology</b>	<b>10 hrs</b>
<ul style="list-style-type: none"> <li>• Introduction to Veterinary Microbiology</li> <li>• Microbial diseases of farm Animals: CJD, FMD, Mastitis</li> <li>• Zoonotic diseases and its management</li> <li>• Vaccines for farm animals: vaccination schedule, modes of administration and side effects</li> </ul>	

### **Text Books:**

1. Alexander, M. (1991). Introduction to Soil Microbiology: Krieger Publication. (UNIT:1)
2. Motsara, M.R. Bhattacharyya, P., Srivastava, B. (1995). Biofertilizer- Technology, Marketing and Usage. New Delhi: Fertilizer Development & Consultant Organization. Rangaswami, G., Bagyaraj, D.J. (1992). Agricultural Microbiology. New Delhi: Asia Publishing House.(UNIT: 2)
3. Subba Rao, N.S. (1999). Biofertilizers in Agriculture and Agro forestry. New Delhi: Oxford & IBH. (UNIT: 2,3)
4. Subba Rao, N.S. (1995). Soil Microorganisms and Plant Growth. New Delhi: Oxford &IBH.(UNIT:4)
5. Sharma S.N. Adlakha S.C (1996) Textbook of Veterinary Microbiology. Vikas Publications.(UNIT:5)

### **Reference Books:**

1. Dirk, J., Elas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology. New York: Marcel Dekker INC.
2. Ramanathan, N., Muthukaruppan, S.M. (2005). Environmental Microbiology. Annamalai Nagar: Om Sakthi Pathipagam.
3. Waiter, M.J., Morgan, N.L., Rocky, J.S., Higton, G. (1999). Industrial Microbiology: An Introduction: Wiley-Blackwell publication.

### **Pedagogic tools:**

- Chalk and Board
- PPT and Videos.
- Assignment
- Class Activity: Class Test

### **Suggested reading / E-resources**

- NPTEL :: Biotechnology - Microbiology
- <https://sites.google.com/a/uasd.in/ecourse/agricultural-microbiology>

### **Suggested MOOCs**

- Economic viability of Indian agriculture.  
[https://onlinecourses.swayam2.ac.in/aic21\\_ge22/preview](https://onlinecourses.swayam2.ac.in/aic21_ge22/preview)

### **Methods of assessing the course outcomes**

Components of CIA: 30 marks

<b>Sr. No.</b>	<b>Component</b>	<b>Content</b>	<b>Duration (if any)</b>	<b>Marks</b>	<b>Sub Total</b>
A	Test 1	1 <sup>st</sup> & 2 <sup>nd</sup> Units	1 <sup>1/2</sup> hours	30	05
	Test 2	Units 3,4,5	3 hours	70	15
B	Assignment-1	Any topic from the syllabus	By the end of 8 <sup>th</sup> week	20	05
C	Assignment-2	Any topic from the syllabus	Before 2 <sup>nd</sup> CIA	20	05
<b>Grand Total</b>					<b>30</b>

## Syllabus – Semester – III

Department: **Microbiology**

Programme: **B.Sc. Microbiology**

Course Code	Course Title (AD)	Credits
21UMBCC303	Core 8: Bioinstrumentation Techniques	4 Credits

### Course Description:

Many analytical techniques are routinely used in Microbiology. This subject will be equally beneficial to various scientific areas including, life science, chemical science, material science, environmental science etc. Learning Analytical Techniques is not just a requirement but, absolutely essential. This is because, the understanding of the subject mainly comes from the strong basis of the experiments and techniques based on the theories. This subject deals with various techniques, their principles, operation, application etc., like Spectroscopy, Chromatography, Electrophoresis, Centrifugation, Biosensors and Nanotechnology.

### Course Objectives:

After successfully completing this course the student should be able to:

1. Understand the working principle of various analytical techniques in the field of Bioscience
2. To comprehend theories and operation of these techniques
3. Apply these techniques in experiments, research and industry
4. Assess the applicability of all the techniques and can make use of appropriate technique for his work

<b>Course Outcomes:</b> Upon completion of this course, the learner will be able to		
CO No.	CO Statement	Blooms taxonomy Level (K1 to K4)
CO1	To understand the principle of various bioanalytical techniques.	K2
CO2	To comprehend the operational details of the instrumentation used in Microbiology.	K2
CO3	To experiment with various techniques for varied analysis of varied biomolecules.	K3



CO4	To analyse the limitations and creative use of techniques for solving of research problem.	K4
CO5	To assess the applicability of the techniques to solve societal problems like detection of pollution, food adulteration, etc.	K5

Course Content	Hours
<b>Unit 1: Introduction to some basic Analytical Technique in Biosciences</b>	<b>10hrs</b>
<ul style="list-style-type: none"> <li>• Colorimetry and Spectrophotometry</li> <li>• Flame Photometry and its applications</li> <li>• Applications of Radioisotopes in biosciences</li> <li>• Atomic spectroscopy: Principles and application of Atomic Absorption/Emission Spectrometer</li> <li>• Microtomy – sectioning</li> </ul>	
<b>Unit 2: Chromatography</b>	<b>10hrs</b>
<ul style="list-style-type: none"> <li>• Chromatography: Theories and Principles</li> <li>• Paper and Thin layer Chromatography</li> <li>• Affinity and Ion Exchange Chromatography</li> <li>• Partition and Size Exclusion Chromatography</li> <li>• Gas Chromatography and High-Performance Liquid Chromatography, HPTLC</li> </ul>	
<b>Unit 3: Electrophoresis</b>	<b>10hrs</b>
<ul style="list-style-type: none"> <li>• Electrophoresis: General principles, Horizontal &amp; Vertical Gel electrophoresis, Isoelectric focusing</li> <li>• Paper Electrophoresis</li> <li>• Gel Electrophoresis: PAGE and AGE and PFGE,</li> <li>• Capillary Electrophoresis</li> <li>• Immunoelectrophoresis &amp; Immuno blotting.</li> </ul>	
<b>Unit 4: Centrifugation</b>	<b>10hrs</b>
<ul style="list-style-type: none"> <li>• Centrifugation techniques- Basic principles.</li> <li>• Types of rotors.</li> <li>• Preparative and analytical centrifugation: Instrumentation and application.</li> <li>• Ultracentrifugation methods.</li> <li>• Density gradient centrifugation.</li> </ul>	
<b>Unit 5 Advanced techniques</b>	<b>10hrs</b>
<ul style="list-style-type: none"> <li>• Nanobiotechnology: Concept and applications.</li> <li>• FTIR Spectroscopy: Basic Principles and Applications.</li> <li>• Principle and applications of NMR.</li> <li>• Biosensor: Introduction, Principle and ideal characteristics.</li> <li>• Components of Biosensor, Types of transducers and applications</li> </ul>	

### **Text Books:**

1. Purohit, S.S. (2007). Microbiology-Fundamentals and Applications, 6<sup>th</sup> Edition. New Delhi: Agrobios Publications. (UNIT 1 – 5)
2. Chatwal R.G., Anand, S.K. (2012). Instrumental Methods of Chemical Analysis. Mumbai: Himalaya publication

### **Reference Books:**

1. Westhead D.R., Parish J.H., Twyman, R.A. (2002). Instant notes in Bioinformatics. Taylor and Francis publications.
2. Andreas, D. B., Ouellette, B.F.F. (2004). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition: Wiley publication.
3. Wilson, K., Walker, J. (2010). Practical Biochemistry – Principle and Technique, 7<sup>th</sup> Edition. Cambridge: Cambridge University Press.
4. Freifelder, D. (1982). Physical Biochemistry: Application to Biochemistry and Molecular biology, 2nd edition. San Francisco: W.H. Freeman and company.
5. Sadashivam, S., Manickam, A. (2004). Biochemical methods, 2nd edition. New Delhi: New Age International (P) Limited.
6. Oser, B.L. (2006). Hawk's physiological chemistry. 14th Ed. New York, NY: McGraw-Hill Book Company.
7. Boyer, R.F. (2002). Modern Experimental Biochemistry. San Francisco: Benjamin Cummings Publ. Company.
8. Williams, B.D., Wilson, K. (1981). A Biologist's Guide to Principles and Techniques of Practical Biochemistry. London: Edward Arnold publications.
9. Upadhyay, A., Upadhyay, K., Nath, N. (2009). Biophysical Chemistry: Principles and techniques. Mumbai: Himalaya publication

### **Pedagogic tools:**

- Chalk and Board
- PPT and Videos.
- Assignment
- Class Activity: Think-Pair-Share / Class Test

### **Suggested reading / E-resources**

- NPTEL: Bioanalytical Techniques and Bioinformatics.
- Chromatography- Biology LibreTexts

- Biochemistry and Molecular biology virtual Lab, Amrita Vishwa Vidyapeetham. (vlab.amrita.edu)

### Suggested MOOCs

- Analytical Techniques - Course (<https://swayam.gov.in/>)
- Basics of Fluorescence Spectroscopy - Course (<https://swayam.gov.in/>)

### Methods of assessing the course outcomes

Components of CIA: 30 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 <sup>st</sup> & 2 <sup>nd</sup> Units	1 <sup>1/2</sup> hours	30	05
	Test 2	Units 3,4,5	3 hours	70	15
B	Assignment-1	Any topic from the syllabus	By the end of 8 <sup>th</sup> week	20	05
C	Assignment-2	Any topic from the syllabus	Before 2 <sup>nd</sup> CIA	20	05
<b>Grand Total</b>					<b>30</b>

219UMBCC304	Core Practical –Applied and Analytical Microbiology	6hrs/wk	3 Credits
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### Course objectives:

The course will impart

1. Technical skill for enumeration of soil, food and milk microbes
2. Understanding about the role of microbes in agriculture and food
3. Knowledge about the properties of microbes which make them important in nature .
4. To develop skills, through lab experiments, in some of the specific methodologies used in the study of modern food and dairy microbiology
5. Statistical Skills and the basic experimental know how about biostatistics and bioinformatics

### List of Practicals

1. Estimation of Protein by Bradford method
2. Circular paper Chromatography of Amino acids
3. Ascending paper chromatography of sugars
4. Thin Layer Chromatography of Amino acids
5. Agarose Gel Electrophoresis of DNA
6. SDS PAGE of Protein
7. Centrifugation techniques
8. Microtome usage, sectioning and staining
9. Enumeration of different kinds of microorganisms in soil – qualitative and quantitative methods
10. Study of degradation of organic matter.
11. Isolation of rhizosphere microorganisms – Isolation of nitrogen fixing microorganisms. *Rhizobium, Azospirillum and Azotobacter*
12. Isolation of Phosphate solubilizing bacteria from soil.
13. Observation of mycorrhiza roots.
14. Isolation and identification of microorganisms involved in food spoilage
15. Isolation of microorganisms from milk and milk products and their identification
16. Standard qualitative analysis of milk
17. Methylene Blue Reduction Time test for milk
18. Estimation of Dissolved oxygen.
19. Isolation and identification of coli forms from Water by Presumptive, Confirmed & Completed test.
20. Determination of air flora and air density from indoor & outdoor sources.
21. Designing Winogradsky's column for the study of Chemolithotrophs (Demonstration)

## Reference Books:

1. Jayaraman, J. (2011). Laboratory Manual in Biochemistry: New Age International Private Limited. India
2. Sawhney S.K., Singh, R. (2005). Introductory Practical Biochemistry: Alpha Science International.
3. Adams M.R., Moss, M.O. (2008). Food Microbiology. 2<sup>nd</sup> Edition: Royal Society of Chemistry.
4. Banwart, G.J. (1989). Basic Food Microbiology: Springer publications.
5. Doyle, M.P., Buchanan, R.L. (1997). Food Microbiology: Fundamentals and Frontiers: ASM publication.
6. Joshi, V.K., Pandey, A. (1999). Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2. Emakulam: Educational Publishers & Distributors.
7. Prajapati, J.B. (1995). Fundamentals of Dairy Microbiology: Ekta Publication.
8. Garbult, J. (1997). Essentials of Food Microbiology: Hodder Arnold publication.
9. Wood, B.J. (2012). Microbiology of Fermented Foods. Volume I and II: Elsevier Applied Science Publication.
10. Robinson, R.K. (2002). Dairy Microbiology Handbook: Wiley-Blackwell publication.

## DEPARTMENT OF MICROBIOLOGY

PART III – SEC – IICO-CURRICULAR COURSES

(To be offered from Semester – III – IV)

21UMBCOC1	<b>Biofertilizer</b>	<b>80 hrs Duration</b>	<b>1 Credits</b>
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**Course Profile:**

Constant use of land leads to loss of its fertility and thus the fertility needs to be replenished. The deficiency of any one or more nutrients in the soil may impair the growth and development of plants. Macro elements like nitrogen, phosphorous and potassium are required in larger quantities. CHEMICAL fertilizers like nitrogen, and phosphorous are applied to the land so that it regains its fertility. Materials of biological origin commonly used to maintain and improve soil fertility are called biofertilizers. These are categorized as Manures and Biofertilizers. Manures are organic wastes that after partial decay are added to the soil to increase crop productivity. Microorganisms that enrich the soil in nutrients by their biological activity are biofertilizers. Main sources are bacteria, cyanobacteria and fungi. Use of biofertilizers is one of the important components of integrated nutrient management, as they are cost effective and renewable source of plant nutrients to supplement the chemical fertilizers for sustainable agriculture.

**Employment Opportunities:****a. Job Prospects:**

1. As production in charge in Biofertilizer Producing Industry
2. In R&D Department of Biofertilizer Producing Industry
3. Agriculture Department of Government
4. National Institutes engaged in research on Biofertilizers

**b. Entrepreneur:**

1. Biofertilizer Production
2. Biofertilizer Marketing
3. Agro-consultant

**Duration of course:**

The course shall extend over a period of Two Semester for 80 Hours. The course will normally commence in the month of July - August of every academic year.

**Course Objectives:**

The Course is designed:

- To demonstrate the techno-economic viability of the biofertilizer to students.
- To introduce rural based economically viable & self income generation production of Biofertilizer.

- To demonstrate the effectiveness of biofertilizer cultural practices in the farmers fields for enhanced crop productivity
- To create self-employment opportunities for students

**UNIT I: Introduction** **10hrs**

- Definition of Biofertilizer and brief History
- General account of the microbes used as Biofertilizer for various crop plants
- Advantages of Biofertilizer over chemical fertilizers.
- Mechanism of ability of the organisms to work as Biofertilizer
- Methods of application

**UNIT II: N<sub>2</sub> Biofertilizer** **15hrs**

- Types and Characteristics
- Host-Rhizobium interaction
- N<sub>2</sub>-fixation in root-nodules
- N<sub>2</sub>-fixation in soil by free living microbes
- Production

**UNIT III: Azolla & BGA Bio fertilizers** **10hrs**

- Characteristics
- N<sub>2</sub>-fixation process
- Production
- Methods of application
- Types of crops for application

**UNIT IV: Mycorrhizae and : PSB Bio fertilizer (Phosphate solubilising Bacteria)** **15hrs**

- Importance and types of mycorrhizae inoculum in agriculture
- Isolation and mass production of AM and VAM , their mass production and field applications
- Isolation and Characterization of PSB
- Mechanism of phosphate solubilisation
- Production and Methods of application

**UNIT V: Quality control of Bio fertilizers** **10hrs**

- Introduction of FCO specifications for bio fertilizers
- Sampling procedure
- Method of analysis and Standards of bio fertilizers as per BIS
- Biostability, Storage, shelf life, quality control and marketing of product bio fertilizer
- Introduction to IPM

## Practical

20 Hrs

1. Isolation of Nitrogen fixing bacteria from soil
2. Isolation of Rhizobium from root-nodules.
3. Isolation of Phosphate solubilizing bacteria from soil.
4. Isolation of VAM fungi from soil. (Demonstration).
5. Microbial limit test for PSB market fertilizer product.
6. Preparation of Biofertilizer at laboratory level and their pot testing
7. Prepare chart for fertilizer classification with chemical formula and Nutrient content.

## Text Books

- Purohit, S.S., P.R. Kothari and S.K. Mathur, 1993. Basic and Agricultural Biotechnology, Agro Botanical Pub. India.
- Subba Rao, N. S. 1988. Biological nitrogen fixation: recent developments, Mohan Pramlani for Oxford and IBH Pub. Co. (P) Ltd., India.
- Somani, L.L., S.C. Bhandari, K.K. Vyas and S.N. Saxena. 1990. Biofertilizers, Scientific Publishers - Jodhpur.
- Tilak, K.V.B. 1991. Bacterial Biofertilizers, ICAR Pub., New Delhi.

## Reference books

- Bio fertilizers –Vyas &Vyas( Ekta Publication).
- Bio fertilizers– Arun Sharma.
- Practical Microbiology–R. C. Dubey and D. K. Maheshwari
- Fertilizer Control Order–1985 amended up to June, 2011
- Subba Rao, N.S., G.S. Venkataraman and S. Kannaiyan 1993. Biological nitrogen fixation, ICAR Pub., New Delhi.

## Examinations:

The course carries 1 credit and the students will be evaluated continuously based on their participation in learning experiences, theory, and evaluation through tests and assignments and will also be evaluated at the end of course under CEE which will be 100% internal. The pattern of evaluation with percentage weightage will be as specified below:

<i>Theory Courses</i>		<i>Practical Courses</i>	
Continuous Internal Evaluation (CIE)	30%	Continuous Internal Evaluation (CIE)	40%
Course End Exam (CEE)	70%	Course End Exam (CEE)	60%

## Evaluation norms: Theory

S.No	Components			
	CIE	Marks	CEE	Marks
1	Assignment – 1	05	Semester End Test (after	70



			2 <sup>nd</sup> Semester)	
2	Assignment – 2	05		
3	Internal Test – 1	10		
4	Internal Test – 2	10		
<b>TOTAL</b>		<b>30</b>		<b>70</b>

### Evaluation norms: Practical

S. No	Components			
	CIE	Marks	CEE	Marks
1	Internal practical – I - MCQ	10	Semester End Test (after 2 <sup>nd</sup> Semester)	30
2	Internal Practical – II – Short Answer Questions	10		
<b>TOTAL</b>		<b>20</b>		<b>30</b>

## Change in the Scheme of Assessment for Semester – 1 course – 21UMBCC102

Course Code	Course Title (F)	Credits
21UMBCC102	Core 2: Microbial Growth and Control - (F 2)	4 Credits

### Methods of Assessment & Tools:

Components of CIE: 30 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 <sup>st</sup> 2 units	1 <sup>1/2</sup> hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 70)	
B	Assignment			04	10
C	Class activity			06	
<b>Grand Total</b>					<b>30</b>
<b>Assignment</b>		<ul style="list-style-type: none"><li>• Power point presentation of given topic</li><li>• Chart preparation</li></ul>			
<b>Class activity</b>		<ul style="list-style-type: none"><li>• Quiz</li><li>• Class Test</li><li>• Seminars</li><li>• Group Discussion</li></ul>			

This scheme of assessment is to be changed and the following scheme is to be adopted to make the assessment scheme of all the courses same

### Methods of assessing the course outcomes

Components of CIA: 30 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 <sup>st</sup> & 2 <sup>nd</sup> Units	1 <sup>1/2</sup> hours	30	05
	Test 2	Units 3,4,5	3 hours	70	15
B	Assignment-1	Any topic from the syllabus	By the end of 8 <sup>th</sup> week	20	05
C	Assignment-2	Any topic from the syllabus	Before 2 <sup>nd</sup> CIA	20	05
<b>Grand Total</b>					<b>30</b>