

**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,  
CHHATRAPATI SAMBAHAJINAGAR.**



**CIRCULAR NO.SU/Revised B.Sc./NEP/72/2024**

It is hereby inform to all concerned that, the Revised syllabi prepared by the Board of Studies/Ad-hoc Boards and recommended by the Dean, Faculty of Science & Technology, **Academic Council at its meeting held on 08 April 2024 has accepted** the following **Revised syllabi of Bachelor of Science** under the Faculty of Science & Technology **as per Norms of National Education Policy-2020 and as per Government Letter dated 13 March 2024** run at the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1.	B.Sc.Botany	Ist and IInd semester
2.	B.Sc.Biotechnology	Ist and IInd semester
3.	B.Sc.Zoology	Ist and IInd semester
4.	B.Sc.Agrochemical and Fertilizer	Ist and IInd semester
5.	B.Sc.Geology	Ist and IInd semester
6.	B.Sc.Environmental Science	Ist and IInd semester
7.	B.Sc.Home Science	Ist and IInd semester
8.	B.Sc.Diary Science and Technology	Ist and IInd semester
9.	B.Sc.Automobile Technology	Ist and IInd semester
10.	B.Sc.Physics	Ist and IInd semester
11.	B.Sc.Chemistry	Ist and IInd semester
12.	B.Sc.Analytical Chemistry	Ist and IInd semester
13.	B.Sc.Polymer Chemistry	Ist and IInd semester
14.	B.Sc.Electronics	Ist and IInd semester
15.	B.Sc.Forensic Science & Cyber Security	Ist and IInd semester
16.	B.Sc.Microbiology	Ist and IInd semester
17.	B.Sc.Fisheries Science	Ist and IInd semester
18.	B.Sc.Mathematics	Ist and IInd semester
19.	B.Sc.Forensic Science	Ist and IInd semester
20.	B.Sc.Information Technology	Ist and IInd semester
21.	B.Sc.Horticulture	Ist and IInd semester
22.	B.Sc.Networking & Multimedia	Ist and IInd semester
23.	B.Sc.Biochemistry	Ist and IInd semester
24.	B.Sc.Industrial Chemistry	Ist and IInd semester
25.	B.Sc.Bioinformatics	Ist and IInd semester

26.	B.Sc.Instrumentation Practice	Ist and IInd semester
27.	B.Sc.Non-Conventional and Conventional Energy	Ist and IInd semester
28.	B.Sc.Statistics	Ist and IInd semester
29.	Bachelor of Computer Application	
30.	B.Sc.Computer Science (Degree)	Ist and IInd semester
31.	B.Sc.Computer Science (Optional)	Ist and IInd semester

This is effective from the Academic Year 2024-25 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,  
Aurangabad-431 004.  
REF.NO.SU/2024/25588-96  
Date:- 29.04.2024.

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**Deputy Registrar,**  
**Academic Section**

**Copy forwarded with compliments to :-**

- 1] **The Principal of all concerned Colleges,**  
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

**Copy to :-**

- 1] **The Director, Board of Examinations & Evaluation,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajnagar.
- 2] The Section Officer,[B.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajnagar.
- 3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajnagar.
- 4] The Programmer [Computer Unit-2] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajnagar.
- 5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajnagar.
- 6] The Public Relation Officer, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajnagar.
- 7] The Record Keeper, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajnagar.



**Dr. Babasaheb Ambedkar Marathwada University**  
**Chhatrapati Sambhajinagar- 431001**



**B.Sc. Degree Programme**

**(Three Year / Four Years (Hons) / Four Years (Hons with Research))**

**Course Structure and**  
**Syllabus for B. Sc. 1<sup>st</sup> Year**

**(Revised)**

**(AS PER NEP-2020)**

**Subject (Major): Microbiology**

**Effective from 2024-25**

*Paalot*



**Structure of B. Sc. (Three / Four Years Honours / Honours with Research Degree) Programme with Multiple Entry and Exit Options**

**Subject (Major): .....**

**BSc First Year: 1<sup>st</sup> Semester**

Course Type	Course Code	Course Name	Teaching Scheme ( Hrs / Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major ( Core) M1 Mandatory	DSC-1/ MBN111	Fundamentals of Microbiology	2		2		2+2 = 4
	DSC-2/ MBN 121	Practical based on DSC-1		4		2	
Major ( Core) M2 Mandatory	DSC-1		2		2		2+2 = 4
	DSC-2	Practical based on DSC-1		4		2	
Major ( Core) M3 Mandatory	DSC-1		2		2		2+2 = 4
	DSC-2	Practical based on DSC-1		4		2	
Generic / Open Elective ( GE/OE) (Choose any two from pool of courses) <b>It should be chosen compulsorily from the faculty other than that of Major</b>	GE/OE-1/ MBN113	To be chosen from other faculty	2		2		2
SEC ( Skill Enhancement Courses) (Choose any one from pool of courses)	SEC-1/ MBN114	1) Biosafety	1		1		2
	MBN 115	2) Water Analysis					
	SEC-2/ MBN 122	Practical based on SEC-1		2		1	
AEC, VEC, IKS	AEC-1	English ( Common for all the faculty)	2		2		2+2 =4
	IKS-1	Choose any one from pool of courses	2		2		
OJT/ FP/CEP/CC/RP	CC-1	Health and Wellness ( Common for all the faculty)		4		2	2
			13	18	13	09	22

**GE/OE -1 : Microbial Biotechnology** ( This course will be available for the students from other faculty)

*Basel*



## BSc First Year: 2<sup>nd</sup> Semester

Course Type	Course Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major ( Core) M1 Mandatory	DSC-3/ MBN 211	Microbial Techniques	2		2		2+2 = 4
	DSC-4/ MBN 221	Practical based on DSC-3		4		2	
Major ( Core) M2 Mandatory	DSC-3		2		2		2+2 = 4
	DSC-4	Practical based on DSC-3		4		2	
Major ( Core) M3 Mandatory	DSC-3		2		2		2+2 = 4
	DSC-4	Practical based on DSC-3		4		2	
Generic / Open Elective ( GE/OE) (Choose any two from pool of courses) It should be chosen compulsorily from the faculty other than that of Major	GE/OE-2/ MBN 212	To be chosen from other faculty	2		2		2
VSC ( Vocational Skill Courses) (Choose any one from pool of courses)	VSC-1/ MBN 213	1) Pathology-1	1		1		2
	MBN 214	2) Sustainable Agriculture - 1					
	VSC-2/ MBN 222	Practical based on VSC-1		2		1	
AEC, VEC, IKS	AEC-1	English ( Common for all the faculty)	2		2		2+2 =4
	VEC-1	Constitution of India ( Common for all the faculty)	2		2		
OJT/ FP/CEP/CC/RP	CC-2	Yoga Education / Sports and Fitness ( Common for all the faculty)		4		2	2
			13	18	13	09	22
Exit Option : Award of UG Certificate in 3 Majors with 44 credits and an additional 4 credits of core NSQF course / Internship OR continue with Major and Minor							

**GE/OE-2 : Food Fermentation** ( This course will be available for the students from other faculty)



Students will have to choose any three subjects as a **Major 1, Major 2, Major 3**, from Basket 1 under the Faculty of Science and Technology.

Students will be having three subject options of equal credits (instead of Major and / or minor verticals) in the first year. Students will have to select / declare choice of one subject as a **major subject** in the beginning of second year out of three major options M1, M2 and M3 (which were opted in the first year).

### **Detailed Illustration of Courses included in 1<sup>st</sup> and 2<sup>nd</sup> semester:**

1) **Major (Core)** subject are mandatory.

DSC-1 : This is a 2 credit theory course corresponding to Major ( core) subject

DSC-2 : This is a 2 credit practical course based on DSC-1

DSC-3 : This is a 2 credit theory course corresponding to Major ( core) subject

DSC-4 : This is a 2 credit practical course based on DSC-3

2) **Generic / Open Elective (GE/OE):** (Needs to be chosen (any two) from pool of courses available at respective college). **These courses should be chosen compulsorily from faculty other than that of Major.**

GE/OE -1 : This is a 2 credit theory course should be chosen compulsorily from faculty other than that of Major.

GE/OE -2 : This is a 2 credit theory course should be chosen compulsorily from faculty other than that of Major.

3) **SEC (Skill Enhancement Courses) :** Choose any one from pool of courses. These courses needs to be designed to enhance the technical skills of the students in specific area.

**SEC-1 :** This is a 1 credit theory course to enhance the technical skills of the students in specific area.

**SEC-2 :** This is a 1 credit practical course based on SEC-1.

4) **VSC (Vocational Skill Courses) :** Choose any one from pool of courses. These courses should be based on Hands on Training corresponding to Major (core) subject.

**VSC-1 :** This is a 1 credit theory course based Hands on Training corresponding to Major ( core) subject.

**VSC-2 :** This is a 1 credit practical course based on VSC-1

5) **AEC (Ability Enhancement courses):** The focus of these courses should be based on linguistic and communication skills.

**AEC-1 : English**



This is a 2 credit theory course based on linguistic proficiency. It will be common for all the faculty.

**AEC-2 : English**

This is a 2 credit theory course based on linguistic proficiency. It will be common for all the faculty.

- 6) **IKS (Indian Knowledge System)** : The courses related to traditional and ancient culture of India will be included in this section. The respective college will have to choose one of the courses from the pool of courses designed by the University.

**IKS-1 : To be chosen from the pool of courses designed by the University**

This is a 2 credit theory course based on Indian Knowledge System. It will be common for all the faculty

- 7) **VEC (Value Education Courses)**: The courses such as understanding India, Environmental Science / Education, Digital and Technological solutions etc will be part of Value Education Courses.

**VEC-1 : Constitution of India**

This is a 2 credit theory course based on value education. It will be common for all the faculty

- 8) **CC (Curricular Courses)**: The courses such as Health and wellness, Yoga education, Sports and Fitness, Cultural activities, NSS/NCC, Performing Arts.

**CC-1 : Health and Wellness**

This is a 2 credit practical course based on Co-curricular activities. It will be common for all the faculty

**CC-2 : Yoga education / Sports and Fitness**

This is a 2 credit practical course based on Co-curricular activities. It will be common for all the faculty



## **General Guidelines for Course Selection**

- 1) The Major subject is the discipline or course of main focus, bachelors degree shall be awarded in that discipline / subject.
- 2) Students will have to choose any three subjects as a Major 1, Major 2, Major 3, from **Basket 1** under the Faculty of Science and Technology (based on the available options in the respective college).
- 3) Students will be having three subject options of equal credits (instead of Major and / or minor verticals) in the first year.
- 4) In the beginning of second year, students will have to select / declare choice of **one major subject** and **one minor subject** from three major options **M1, M2 and M3 (which were opted in the first year)**
- 5) Once the students finalize their **Major Subject** and **Minor Subject** in the beginning of the second year of the programme, they shall pursue their further education in that particular subject as their **Major and Minor** subjects. Therefore, from second year onwards curriculum of the Major and Minor subjects shall be different.
- 6) Students are required to select **Minor subject** from **other discipline of the same faculty**
- 7) Students are required to select **Generic /Open Elective** (vertical 3 in the credit framework) **compulsorily from the faculty different than that of their Major / Minor subjects.**
- 8) Vocational Skill Courses and Skill Enhancement Courses (VSC and SEC) shall be related to the Major subject
- 9) Curriculum of Ability Enhancement Courses (AEC), Value Education Courses (VEC), Indian Knowledge System (IKS), and Co-curricular Courses (CC) will be provided by the University separately.



## **Programme Educational Objectives (PEOs) :**

Programme Educational Objectives (PEOs) for the Bachelor of Science Curriculum under the National Education Policy 2020:

1. **Mastery of Discipline-Specific Knowledge:** Graduates of the Bachelor of Science program will demonstrate a deep understanding of fundamental principles, theories, and methodologies in their chosen scientific discipline, enabling them to analyze complex problems, propose innovative solutions, and contribute to advancements in their field.
2. **Interdisciplinary Proficiency:** Graduates will possess the ability to integrate knowledge and skills from multiple scientific disciplines, fostering a holistic approach to problem-solving and innovation. They will be equipped to address multifaceted challenges by drawing upon diverse perspectives and methodologies.
3. **Critical Thinking and Analytical Skills:** Graduates will develop strong critical thinking abilities, enabling them to evaluate information rigorously, analyze data effectively, and make informed decisions based on evidence. They will demonstrate proficiency in applying logical reasoning and scientific methods to solve problems and generate new knowledge.
4. **Leadership and Innovation:** Graduates will demonstrate leadership qualities and entrepreneurial mindset, capable of initiating and driving positive change in their organizations and communities. They will exhibit creativity, resilience, and adaptability, harnessing innovation to address complex challenges and seize opportunities for growth and advancement.
5. **Global Citizenship and Cultural Sensitivity:** Graduates will possess a global perspective and cultural sensitivity, recognizing the interconnectedness of diverse communities and the importance of collaboration across borders. They will engage in cross-cultural dialogue, embrace diversity, and contribute to the advancement of knowledge and understanding on a global scale.

These Programme Educational Objectives serve as guiding principles for the Bachelor of Science curriculum, reflecting our commitment to nurturing well-rounded graduates who are prepared to excel in their careers, contribute to society, and lead meaningful lives in a rapidly changing world.



### Programme Outcomes (POs) :

The National Education Policy (NEP) 2020 for India emphasizes several key aspects for Bachelor of Science (B.Sc.) programs, aiming to produce graduates who are not only well-versed in their respective disciplines but also equipped with skills necessary for holistic development and employability. While specific program outcomes may vary between institutions and disciplines within B.Sc. programs, here are some common outcomes aligned with NEP 2020:

- **PO1. The citizenship and society:** Apply broad understanding of ethical and professional skill in science subjects in the context of global, economic, environmental and societal realities while encompassing relevant contemporary issues.
- **PO2. Environment and sustainability:** Apply broad understanding of impact of science subjects in a global, economic, environmental and societal context and demonstrate the knowledge of, and need for sustainable development.
- **PO3. Ethics:** Apply ability to develop sustainable practical solutions for science subject related problems within positive professional and ethical boundaries.
- **PO4. Individual and team work:** Function effectively as a leader and as well as team member in diverse/ multidisciplinary environments.
- **PO5. Communication:** Communicate effectively on complex science subject related activities with the scientific community in particular and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO6. Project management and finance:** Demonstrate knowledge and understanding of the first principles of science and apply these to one's own work as a member and leader in a team, to complete project in any environment.
- **PO7. Life-long learning:** Recognize the need for lifelong learning and have the ability to engage in independent and life-long learning in the broadest context of technological change.

These program outcomes align with the broader goals of NEP 2020 to transform higher education in India and prepare students for the challenges and opportunities of the 21st century. Board of Studies designing B.Sc. curricula are encouraged to incorporate these outcomes into their program objectives and learning outcomes.



## Programme Specific Outcomes (PSOs):

PSO1. **Domain knowledge:** Acquire knowledge and gain understanding of concepts in microbiology and its applications in various fields.

PSO2. **Problem Analysis:** Applying the knowledge acquired to explore the world of microbes and analysing the specific benefits.

PSO3. **Design Development of solutions:** Design/ develop solutions for problems at varied complexity in various areas of Microbiology to address changing challenges in various industries and environment thereby developing keen interest in research.

PSO4. **Conduct Investigation of complex problems:** Use established knowledge and methods to design of experiments, analyze resulting data statistically and interpret the same to provide valid conclusions for applied research.

PSO5. **Modern tools:** Create, select, and apply appropriate techniques, resources, and relevant IT tools including prediction and modelling to complex related activities with clear understanding of the limitations for solving real world problems.



**DSC-1/MBN 111 : Fundamentals of Microbiology**

Total Credits : 02

Total Contact Hours : 30 Hrs

Maximum Marks : 50

**Learning Objectives of the Course:**

The students will gain knowledge about the Development of Microbiology as a scientific discipline, also they will know the principles of microscopy, taxonomy and kinds of different microorganisms.

**Course Outcomes (CO's)**

After successful completion of this course, students are expected to:

**CO1: Understanding the History of Microbiology:** Gain knowledge on Historical perspectives of Microbiology.

**CO2: Microscopy Techniques:** understand the concepts of Microscopy and get acquainted to various microscopic methods.

**CO3: Taxonomy and Classification:** Understand the concept of taxonomy, familiarize with classification systems and characteristics of bacteria used for classification.

**CO4: General Characteristics of Microorganisms:** Know general features of various kinds of microorganisms

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	<b>History and Scope of Microbiology:</b> a. Definition and concepts b. Discovery of microorganisms: Contribution of Antony Van Leeuwenhoek. c. Spontaneous generation theory: Aristotle's view, Charles Darwin view. Controversy over spontaneous generation e. Recognition of the microbial role in diseases: Koch's postulates, a. Aseptic surgery & Pure culture concept f. Discovery of microbial effects on organic and inorganic matter. g. Recognition of the microbial role in fermentation: Contribution of Louis Pasteur	10 Hrs
II	<b>Microscopy:</b> a. Introduction of Magnification, resolving power, depth of focus, focal length, numerical aperture. b. Principle, Ray Diagram and Working of ( (Phase contrast microscope, Dark field microscope , Fluorescence Microscope, SEM and TEM).	10 Hrs
III	<b>Taxonomy of microorganisms.</b> a. Taxonomic rank. b. Major characteristics used in taxonomy (Morphological, Physiological, Immunological, Metabolic). Compositions of proteins, Composition of nucleic acids, Nucleic acids hybridization, Nucleic acid sequencing, 16S rDNA. c. Classification system d. Numerical taxonomy. e. Bergey's manual of systematic Bacteriology, General characteristics enlisting all parts with major characters and examples in brief. f. General characteristics of Microorganisms in brief (Fungi, Algae, Actinomycetes, Mycoplasma, Rickettsia, Archaeobacteria, Protozoa, Viruses)	10 Hrs

**Text Books:**



1. Dubey RC and Maheswari D K "A text of Microbiology" (2012)
2. Powar C B and Dagainawala H F. "General Microbiology volume 1 and 2"
3. Geeta Sumbali and Mehrotra RS "Principles of Microbiology" (2009)

#### Reference Books:

1. Hans G. Schlegel. "General Microbiology"
2. R.Y. Stayner "General Microbiology".
3. Crabtree, & Martin Frobisher "Fundamentals of Microbiology"
4. A.J. Salle "Fundamentals of Bacteriology"
5. Robert F Boyd (1984). General microbiology.
6. Prescott L M, J P Harley and D A Klein "Microbiology".
7. Ingraham J.L. and Ingraham C.A "Introduction to Microbiology"

Sl. No.	Topics / actual contents of the syllabus	Contact Hours
I	History and Scope of Microbiology a. Definition and concepts b. Discovery of microorganisms: Contribution of Antony Van Leeuwenhoek c. Spontaneous generation theory: Aristotle's view, Charles Darwin view d. Controversy over spontaneous generation e. Recognition of the microbial role in disease: Koch's postulates f. Aseptic surgery & Pure culture concept g. Discovery of microbial effects on organic and inorganic matter h. Recognition of the microbial role in fermentation: Contribution of Louis Pasteur	10 Hrs
II	Microscopy a. Introduction of Magnification, resolving power, depth of focus, focal length, numerical aperture b. Principle, Ray Diagram and Working of (i) Phase contrast microscope, Dark field microscope, Fluorescence Microscope, SEM and TEM	10 Hrs
III	Taxonomy of microorganisms a. Taxonomic rank b. Major characteristics used in taxonomy: Morphological, Physiological, Immunological, Metabolic, Composition of proteins, Composition of nucleic acids, Nucleic acids hybridization, Nucleic acid sequencing, 16S rDNA c. Classification system d. Numerical taxonomy e. Bergey's manual of systematic bacteriology: General characteristics containing all parts with major characters and examples in hand f. General characteristics of Microorganisms in brief: Fungi, Algae, Actinomycetes, Mycetozoa, Ribozyme, Archaeobacteria, Protozoa	10 Hrs



Total Credits : 02

Total Contact Hours : 60 Hrs

Maximum Marks : 50

- i) The students will Get acquainted with many microbiological instruments.
- ii) They will develop understanding of basic microbiological experimental procedures.
- iii) They will acquire understanding of sterilization, incubation, inoculation etc..

**Course Outcomes ( COs) :**

CO1: Gain knowledge on Historical perspectives of Microbiology  
CO2: Understand the concepts of Microscopy and get acquainted to various microscopic methods  
CO3: Understand the concept of taxonomy, familiarize with classification systems and characteristics of bacteria used for classification.  
CO4: Know general features of various kinds of microorganisms

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	<div>1. Microscopy- Different parts of compound microscope. Use and care of compound microscope.</div> <div>2. Preparation of Standard Operating Procedures (SOPs) for common microbiology laboratory instruments: Introduction to Laboratory equipment, Construction, Operation and utility of laboratory equipment.</div> <div><div><div>1 Autoclave</div><div>2 Hot air oven</div><div>3 Incubator</div><div>4 pH meter</div><div>5 Centrifuge</div></div><div><div>6 Colorimeter/Spectrophotometer</div><div>7 Anaerobic jar</div><div>8 Seitz filter</div><div>9 Laminar air flow</div></div></div>	10 Hrs
II	<div>1.Staining methods: Monochrome, Negative and Gram's staining</div> <div>2.Disinfection &amp; discarding techniques in laboratory</div> <div>3. Introduction of: Wire loop, Agar, Agar slant apparatus, Incubators, Pasteurization, Radiations</div>	10 Hrs
III	Study tour to related laboratories /industries	10 Hrs

**Text Books:**

1. Aneja, K. R. "Experiments in Microbiology" 3rd edition, Wishwa Prakashan, NewDelhi (1996)
2. Parija, S. C.. "Textbook of Practical Microbiology, 1st edition, Ahuja Publishing House, New Delhi. (2005)

**Reference Books:**

1. Atlas, R. M. (1997). Principles of Microbiology, 2nd edition, W. M. T. Brown Publishers.
2. Cappucino, J. & Sherman, N. (2010). Microbiology: A Laboratory Manual, 9th edition, Pearson Education Limited, New Jersey.
3. Prescott L M, J P Harley and D A Klein "Microbiology".
4. Ingraham J.L. and Ingraham C.A "Introduction to Microbiology"



**SEC -1/MBN 113 : Biosafety**

Total Credits : 01

Total Contact Hours : 15 Hrs

Maximum Marks : 50

**Learning Objectives of the Course:**

The students will gain knowledge about the various biotechnological concepts viz:

- i. Biosafety guidelines,
- ii. Biohazards,
- iii. GMO,
- iv. Risk analysis etc.

**Course Outcomes ( COs ) :**

On completion of the course, students shall be able to:

**CO1: Understanding Biosafety Principles:** Students will develop a comprehensive understanding of the principles and importance of biosafety in laboratory and industrial settings. They will learn about the risks associated with biological materials and the need for containment measures.

**CO1: Biohazard and Biosafety Levels:** Students will become familiar with the classification of biohazards and the guidelines and regulations for working with different types of biological agents, including bacteria, viruses, genetically modified organisms, and toxins.

**CO3: GMOs and LMOs:** Students will understand the principles and regulations surrounding the use of genetically modified organisms (GMOs) and living modified organisms (LMOs). They will be aware of the ethical, environmental, and regulatory considerations associated with GMOs and LMOs.

**CO4: Risk Assessment:** Students will be able to conduct risk assessments to determine the potential hazards associated with specific biological materials, research projects, or biotechnological processes

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	<b>Biosafety:</b> Introduction; History, biosafety issues in Microbiology, Mol. Biology, biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms	5 Hrs
II	Biosafety Guidelines Biosafety guidelines and regulations (National and International); GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs;	5 Hrs
III	Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol.	5 Hrs

**Text Books:****Reference Books:**

1. Introduction to Plant Biotechnology, H S Chawla 2. M K Sateesh.
2. Bioethics and Biosafety. Kindle Edition 3. Shomini Parashar, Deepa Goel IPR, Biosafety and Bioethics Pearson India 2013



**SEC -1/MBN 114 : Water Analysis**

Total Credits : 01

Total Contact Hours : 15 Hrs

Maximum Marks : 50

**Learning Objectives of the Course:**

The students will gain knowledge about the various biotechnological concepts viz:

- i. Understand water quality parameters.
- ii. Learn the physical, chemical and biological characteristics.

**Course Outcomes ( COs ) :**

**CO1:** Students will gain knowledge related to water microbiology, properties and standard quality of water. They will also learn the various water borne diseases.

**CO2:** will get to know the various methods used in water sample collection/treatment and the different tests for determining the quality of water.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	<b>Water Microbiology</b> Water as a major component of environment. Types, properties, and uses of water. Microorganisms of different water bodies. Standard qualities of drinking water. Water borne pathogens & diseases: <i>Shigella</i> , <i>E. coli</i> , <i>Vibrio</i> , <i>Salmonella</i> , <i>Rotavirus</i> , <i>Entamoeba</i> .	5 Hrs
II	<b>Water Analysis</b> Microbiological Analysis of Water Sample Collection, Treatment, and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests..	5 Hrs
III	Water for pharmaceutical use- types of water- potable water, water for injection , water for preparation of extracts, Water used for cleaning/rinsing of equipment, containers and closures	5 Hrs

**Text Books:****Reference Books:**

1. Brock Biology of Microorganisms. 14th edition. Madigan MT, Martinko JM and Parker J. (2014) Pearson/ Benjamin Cummings
2. Environmental Microbiology. 2nd edition, Maier RM, Pepper IL and Gerba CP. (2009). Academic Press.
3. Environmental Microbiology of Aquatic & Waste systems. Okafor, N (2011). 1st edition, Springer, New York.
4. USP 1231 & ISO 10500 EPA guidelines



**SEC 2/MBN 122 : Biosafety (Practical Based on MBN113)**

Total Credits : 01

Total Contact Hours : 30 Hrs

Maximum Marks : 50

**Learning Objectives of the Course:**

The students will gain knowledge about;

- i. The biosafety guidelines,
- ii. Biohazards,
- iii. GMO,
- iv. Risk analysis by using personal protective equipments.

**Course Outcomes ( COs) :**

**CO1: Understanding Biosafety Principles:** Students will get to know the importance of biosafety in laboratory and industrial settings. They will learn about the risks associated with biological materials and the need for containment measures through properly handling of lab equipment.

**CO2: Biohazard and Biosafety Levels:** Students will become familiar the guidelines and regulations for working with different types of biological agents, including bacteria, viruses, genetically modified organisms, and toxins.

**CO3: Disposable lab consumables:** Simultaneously students will get to know the proper disposal of lab consumables.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	a. Personal safety in Laboratory using Personal Protective Equipment b. Biosafety: Handling of Pipette while pipetting /glassware, Hazardous Chemicals c. Pre and Post care while handling the Pathogens. d. Precautions while handling lab equipments such as blender, centrifuge, inoculating loops, absorbent cotton. e. Proper use and removal of potentially contaminated gloves and disposal of lab consumables.	30 Hrs

**Text Books:****Reference Books:**

5. Brock Biology of Microorganisms. 14th edition. Madigan MT, Martinko JM and Parker J. (2014) Pearson/ Benjamin Cummings
6. Environmental Microbiology. 2nd edition, Maier RM, Pepper IL and Gerba CP. (2009). Academic Press.
7. Environmental Microbiology of Aquatic & Waste systems. Okafor, N (2011). 1st edition, Springer, New York.
8. USP 1231 & ISO 10500 EPA guidelines



**SEC 2/MBN 123: Water Microbiology (Practical Based on MBN114)**

Total Credits : 01

Total Contact Hours : 30 Hrs

Maximum Marks : 50

**Learning Objectives of the Course:**

Understand water quality parameters by performing practical in laboratory.

**Course Outcomes ( COs ) :**

**CO1:** Students will gain knowledge related to water microbiology, properties and standard quality of water by performing various test in laboratory.

**CO2:** Will get to know the various methods used in water sample collection/treatment and the different tests for determining the quality of water.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	1. Microbiological examination of water (Drinking water, Supply water, Pond water and Sewage): a) Presumptive test b) Confirmatory test c) Completed test: for coliform ii) IMViC reaction. 2. MPN 3. Measurement of TDS in water and ORP	30 Hrs

**Text Books:****Reference Books:**

9. Brock Biology of Microorganisms. 14th edition. Madigan MT, Martinko JM and Parker J. (2014) Pearson/ Benjamin Cummings
10. Environmental Microbiology. 2nd edition, Maier RM, Pepper IL and Gerba CP. (2009). Academic Press.
11. Environmental Microbiology of Aquatic & Waste systems. Okafor, N (2011). 1st edition, Springer, New York.
12. USP 1231 & ISO 10500 EPA guidelines



<b>This course will be available for the students from other faculty</b>		
<b>GE/OE -1/MBN 112 : Microbial Biotechnology</b>		
<b>Total Credits : 02</b>	<b>Total Contact Hours : 30 Hrs</b>	
<b>Maximum Marks : 50</b>		
<b>Learning Objectives of the Course:</b>		
The students will gain knowledge about the various biotechnological concepts viz:		
i. microbial products, ii. GEMs, iii. bioprocess, iv. downstream processing etc.		
<b>Course Outcomes ( COs ) :</b>		
After completion of the course, students will be able to -		
<b>CO1: Microbial Diversity and Functionality:</b> Students will gain an understanding of the diverse microorganisms used in biotechnology and their specific functions. This includes knowledge of bacteria, fungi, and viruses and their roles in bioprocessing and bio-product development.		
<b>CO2: Bioprocess Engineering:</b> Students will learn the principles of bioprocess engineering, including fermentation techniques and optimization of microbial growth conditions.		
<b>CO3: Bioproduct Development:</b> Students will be able to develop and evaluate microbial-based products.		
<b>Module No.</b>	<b>Topics / actual contents of the syllabus</b>	<b>Contact Hours</b>
<b>I</b>	<b>Microbial Biotechnology and its Applications</b> <ul style="list-style-type: none"> <li>Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology.</li> <li>Use of prokaryotic and eukaryotic microorganisms in biotechnological applications Genetically engineered microbes for industrial application: Bacteria and yeast.</li> </ul>	<b>10 Hrs</b>
<b>II</b>	<b>Downstream processes</b> Microbial product purification: filtration, ion exchange & affinity chromatography techniques, Immobilization methods and their application: Whole cell immobilization	<b>10 Hrs</b>
<b>III</b>	<b>A. Microbes for Bioenergy</b> Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture.  <b>B. Regulatory</b> Patents, Copyrights, Trademarks, Publication of Research	<b>10 Hrs</b>
<b>Reference Books:</b> <ol style="list-style-type: none"> <li>Biotechnology: Rehm and Reid.</li> <li>Comprehensive biotechnology: Murray Moo Young.</li> <li>Microbial Technology vol I and II by Pepler</li> <li>Microbiology and technology of fermented foods: R. W. Hutkins Blackwell publishing</li> </ol>		



# BSc First Year: 2<sup>nd</sup> Semester

BSC-3AMBN 311 : Microbial Techniques				Total Credits : 03	Total Contact Hours : 36 Hrs
Maximum Marks : 50					
Learning Objectives of the course: The students will gain knowledge about the various microbiological techniques viz.					
i. Sterilisation					
ii. Development of pure culture					
iii. Enumeration of microorganisms etc.					
Course Outcomes (COs):					
After successful completion of this course, students are expected to:					
CO1: Define and explain the key concepts of sterilisation and disinfection, including types of agents, spectrum of activity, mode of action, and application.					
CO2: Apply pure culture techniques to isolate, enumerate, and cultivate microorganisms, using a variety of culture media and methods.					
CO3: Perform and interpret common staining procedures for the microscopic observation of microorganisms.					
Module No.	Topics / actual contents of the module	Contact Hours			
1	<p><b>Sterilization and Disinfection</b></p> <p>a. Definition and Concept Sterilization, Disinfection, Germicide, Antiseptic, Bacterostatic.</p> <p>b. Physical Methods i. Dry Heat- Hot air oven, Incineration ii. Moist Heat- Pasteurization, Canning, Boiling, Autoclaving</p> <p>c. Chemical sterilizing agents: Spectrum, Mode of action, Application. Imitations with one example of each.</p> <p>i. Phenolics ii. Alcohols iii. Halogens iv. Heavy metals v. Quaternary ammonium vi. Compounds Aldehydes vii. Gases- Sulphur dioxide, Ethylene oxide and B propionates.</p> <p><b>Pure Culture Techniques</b></p> <p>a. Definition and significance</p> <p>b. Methods for isolation of pure culture- i. Streak plate method ii. Pour plate method iii. Spread plate method</p>	10 Hrs			
2	<p><b>Media and Culture Techniques</b></p> <p>a. Properties of a good culture medium</p> <p>b. Age, Properties and applications</p> <p>c. Role of Buffers in culture media</p> <p>d. Definition and examples</p> <p>i. Living media: Enrichment, Check on eggs, Tissue culture</p> <p>ii. Non-living media: Natural, Semi-synthetic &amp; Synthetic</p>	10 Hrs			



DSC-3/MBN 211 : Microbial Techniques		
Total Credits : 02	Total Contact Hours : 30 Hrs	
Maximum Marks : 50		
<b>Learning Objectives of the Course:</b> The students will gain knowledge about the various microbiological techniques viz: i. Sterilisation, ii. Development of pure culture, iii. Enumeration of microorganisms etc.		
<b>Course Outcomes ( COs ) :</b> After successful completion of this course, students are expected to: <b>CO1:</b> Define and explain the key concepts of sterilization and disinfection, including types of agents, spectrum of activity, mode of action, and applications. <b>CO2:</b> Apply pure culture techniques to isolate, enumerate, and cultivate microorganisms, using a variety of culture media and methods. <b>CO3:</b> Perform and interpret common staining procedures for the microscopic observation of Microorganisms.		
Module No.	Topics / actual contents of the syllabus	Contact Hours
I	<b>Sterilization and Disinfection</b> a. Definition and Concept: Sterilization, Disinfection, Germicide, Antiseptics, Bacteriostatic, Bactericidal b. Physical Sterilizing agents: i. Dry Heat- Hot air oven, Incineration ii. Moist Heat- Pasteurization, Canning, Boiling, Autoclaving c. Chemical sterilizing agents: Spectrum, Mode of action, Application, Limitations with one example of each i. Phenolics, ii. Alcohols, iii. Halogens, iv. Heavy metals, v. Quaternary ammonium, vi. Compounds, Aldehydes. vii. Gases- Sulfur dioxide, Ethylene oxide and $\beta$ propiolactone. <b>Pure Culture Techniques</b> a. Definition and significance b. Methods for isolation of pure culture- i. Streak plate method, ii. Pour plate method, iii. Spread plate methods.	10 Hrs
II	<b>Basics of cultivation of microorganisms</b> a. Properties of a good culture medium. b. Agar: Properties and applications c. Role of Buffers in culture media d. Definition and concept i. Living media: Embryonated chicken eggs, Tissue culture ii. Non-living media: Natural, Semi-synthetic & Synthetic	10 Hrs



	<p>e. Types of culture media based on their specific use w.r.t. role of media ingredients (with example of each type), Selective, Differential, Enriched, Enrichment, Assay, Minimal, Maintenance &amp; Transport media.</p> <p>f. Cultivation of anaerobes (two methods)</p> <ol style="list-style-type: none"> <li>Candle jar method</li> <li>Anaerobic jar Method</li> </ol>	
<b>III</b>	<p><b>Stains and Staining Methods</b></p> <ol style="list-style-type: none"> <li>Definition: Stain, Dye, Chromogen, Chromophore, Auxochrome, Acidic stain, Basic stain, Staining reagent: Primary stain, Secondary stain, Mordant and Decolourizer</li> <li>Fixation of smear: Physical and Chemical methods</li> <li>Physico-chemical basis of staining.</li> <li>Staining methods: Principle, application and methodology <ol style="list-style-type: none"> <li>Simple Staining: Monochrome and Negative staining</li> <li>Differential staining: Gram's and Acid-fast staining</li> <li>Structural/Special staining: Cell wall, Capsule, Spore, Flagella</li> <li>Staining of fungi</li> </ol> </li> </ol> <p><b>Techniques for enumeration of microorganisms:</b></p> <ol style="list-style-type: none"> <li>Direct: Direct Microscopic Count, Colony count,</li> <li>Indirect: Measurement by turbidometry, cell mass</li> </ol>	<b>10 Hrs</b>

**Text Books:**

- Dubey RC and Maheswari D K "A text of Microbiology" (2012)
- Powar C B and Dagainawala H F. "General Microbiology volume 1 and 2"
- Geeta Sumbali and Mehrotra RS "Principles of Microbiology" (2009)

**Reference Books:**

- Microbiology Principle and Explorations; Jacquelyn G. Black, John|Willey & Sons,
- Microbiology; Tortora, Funke, Case, Pearson Education India
- Prescott's Microbiology; McGraw Hill
- Brock Biology Of Microorganisms, Microbiology; Madigan Michael T., Pearson Education
- A Textbook of Microbiology: R.C. Dubey & D.K. Maheshwari, S Chand & Co. Ltd.
- Microbiology: Fundamentals and Applications; S.S. Purohit, Agrobios (India)
- Fundamental Principles of Bacteriology; A.J. Salle, Tata McGraw-Hill Publishing Company Ltd.
- Microbiology: Michael J. Pelczar, E.C.S. Chan, Noel R. Krieg, McGraw Hill Education
- Handbook of Media, Stains and Reagents in Microbiology: A.M. Deshmukh, Oxford Pub.
- A Handbook of Elementary Microbiology: H.A. Modi, Shanti Prakashan
- A Text book of Microbiology; Kanika Sharma, Ane Books Pvt., Ltd.
- General Microbiology volume 1 and 2 by Powar CB and Dagainawala, Himalaya Publishing House
- Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology; K.R. Aneja, New Age International Private Limited
- Microbiology; Dr. R.P. Singh, Kalyani Publishers



**DSC-4/MBN 221 : Lab Course based on MBN 211**

Total Credits : 02

Total Contact Hours : 60 Hrs

Maximum Marks : 50

**Learning Objectives of the Course:**

- i) The students will Get acquainted with many microbiological instruments.
- ii) They will develop understanding of basic microbiological experimental procedures.
- iii) They will acquire understanding of bacterial staining procedures

**Course Outcomes ( COs ) :**

After successful completion of this course, students are expected to:

**CO1:** Stain the bacterial structures using special staining techniques.**CO2:** Able to prepare different cultivation media for microorganisms.**CO3:** Enumerate microflora from different ecological samples.**CO4:** Validate and evaluate instruments and disinfectant.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Structural staining: <ol style="list-style-type: none"> <li>i. Cell wall staining (Chance's method)</li> <li>ii. Capsule staining (Maneval's method)</li> <li>iii. Spore staining (Schaeffer and Fulton's method)</li> <li>iv. Bacterial Flagella staining (Patel, Kulkani &amp; Gaikwad's method)</li> </ol>	10 Hrs
II	<ul style="list-style-type: none"> <li>• Hanging drop technique.</li> <li>• Measurement of size of cells by micrometry</li> <li>• Preparation of cultivation Media               <ol style="list-style-type: none"> <li>i. Nutrient Broth &amp; Agar</li> <li>ii. MacConkeys Broth and Agar</li> <li>iii. Potato Dextrose Agar</li> </ol> </li> </ul>	10 Hrs
III	<ul style="list-style-type: none"> <li>• Cultivation of Microorganisms from Air, water and Soil</li> </ul>	10 Hrs

**Text Books:**

1. Aneja, K. R. "Experiments in Microbiology" 3rd edition, Wishwa Prakashan, New Delhi (1996)
2. Parija, S. C.. "Textbook of Practical Microbiology, 1st edition, Ahuja Publishing House, New Delhi. (2005)

**Reference Books:**

1. Atlas, R. M. (1997). Principles of Microbiology, 2nd edition, W. M. T. Brown Publishers.
2. Cappuccino, J. & Sherman, N. (2010). Microbiology: A Laboratory Manual, 9th edition, Pearson Education Limited, New Jersey.
3. Prescott L M, J P Harley and D A Klein "Microbiology".
4. Ingraham J.L. and Ingraham C.A "Introduction to Microbiology"



**VSC-1/MBN 213 : Pathology**

Total Credits : 01

Total Contact Hours : 15 Hrs

Maximum Marks : 50

**Learning Objectives:**

The students will gain knowledge about the haematology, RBC & WBC counts, DLC etc.

**Course Outcomes (CO's)**

After successful completion of this course, students are expected to:

**CO1: Understanding Hematological Basics:** Students will develop a fundamental understanding of the components of blood, including red blood cells, white blood cells, platelets, and plasma. They will learn about the structure and function of these blood components.

**CO2: Blood Testing and Analysis:** Students will learn how to perform basic hematological tests, interpret results from tests like complete blood counts (CBC), and understand the significance of different blood parameters in diagnosing and monitoring hematological conditions.

**CO3: Clinical Applications:** Students will be introduced to the clinical applications of basic hematology in healthcare settings. They will understand the role of hematology in disease diagnosis, patient care, and treatment

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	<ul style="list-style-type: none"> <li>• Introduction of hematology               <ul style="list-style-type: none"> <li>a. Formation of Blood</li> <li>b. Erythropoiesis</li> <li>c. Leucopoiesis</li> <li>d. Thrombopoiesis</li> </ul> </li> </ul>	5 Hrs
II	<ul style="list-style-type: none"> <li>• Hematological Techniques –I               <ul style="list-style-type: none"> <li>a. Collection of Blood</li> <li>b. Anticoagulants</li> </ul> </li> </ul>	5 Hrs
III	<ul style="list-style-type: none"> <li>• RBC &amp; WBC               <ul style="list-style-type: none"> <li>a. Red cell count – Hemocytometer, Methods and Calculation</li> <li>b. WBC Count – Methods</li> <li>c. Differential Leucocytes Count (DLC)</li> <li>d. Morphology of White Cells, Normal Values, Hb.</li> </ul> </li> </ul>	5 Hrs

**Text Books:**

1. Modern Medical Laboratory Technology: Methods & Interpretation by Ramnik Sood
2. Hematology for students practitioners including practical hematology 7<sup>th</sup> Ed. by Ramnik Sood
3. Text Book of Medical Laboratory Technology by Ramnik Sood
4. Clinical Pathology, hematology and blood banking by Nanda Maheshwari
5. Blood banking and transfusion medicine-Basic principles and practice by Christopher D., Hill Yeretel, Publishers: Churchill Livingstone, Philadelphia
6. Practical Hematology by Sir John Dalie, Publisher Churevill, London
7. Textbook of Pathology by Robbins.
8. Textbook of General Pathology Part I & II by Bhende and Deodhare.
9. Textbook of Pathology by Harsh Mohan.
10. IAPM textbook of Pathology.



VSC -1/MBN 214 : Sustainable Agriculture		
Total Credits : 01		Total Contact Hours : 15 Hrs
Maximum Marks : 50		
<b>Learning Objectives:</b> The students will understand impact of conventional agriculture and will learn to develop strategies to reduce pollution, greenhouse gas emissions, minimize agriculture's environmental footprints.		
<b>Course Outcomes (CO's)</b> After successful completion of this course, students are expected to:		
<b>CO1: Understanding properties of Soil:</b> Gain knowledge on soil fertility, plant nutrition from the perspectives of Microbiology.		
<b>CO2: Biofertilizers:</b> understand the concepts of various biofertilizers used and get acquainted to various microbes involved in PGPR.		
Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Concept of biofertilizers, their types, and their role in enhancing soil fertility and plant nutrition. Various production methods for biofertilizers, including composting, vermicomposting, and the use of microbial cultures.	5 Hrs
II	Plant growth promoting bacteria, biofertilizers – symbiotic ( <i>Bradyrhizobium</i> , <i>Rhizobium</i> , <i>Frankia</i> ), Non-Symbiotic ( <i>Azospirillum</i> , <i>Azotobacter</i> , <i>Mycorrhizae</i> , MHBs, Phosphate solubilizers, algae), Novel combination of microbes as biofertilizers, PGPRs.	5 Hrs
III	General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers.	5 Hrs
<b>Text Books:</b>		
<b>Reference Books:</b> <ol style="list-style-type: none"> <li>1. Mahendra K. Rai (2005). Handbook of Microbial biofertilizers, The Haworth Press, Inc. New York.</li> <li>2. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.</li> <li>3. Aggarwal SK (2005) Advanced Environmental Biotechnology, APH publication</li> </ol>		



**VSC-2/MBN 222 : Pathology (Practicals Based on MBN213)**

Total Credits : 01

Total Contact Hours : 30 Hrs

Maximum Marks : 50

**Learning Objectives:**

The students will get acquainted with various pathological procedures like handling of instruments, staining blood samples. WBC measurements etc.

**Course Outcomes (CO's)**

After successful completion of this course, students are expected to:

**CO1:** will collect the blood.

**CO2:** They will get to know the different techniques for counting the RBC and WBC.

**CO3:** measure Hb estimation from blood samples.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	b. Collection of Blood (Demonstration only) c. Red cell count – Hemocytometer, Methods and Calculation d. WBC Count – Methods e. Differential Leucocytes Count (DLC) f. Hb estimation	30 Hrs

**Text Books:****Reference Books:**

1. Modern Medical Laboratory Technology: Methods & Interpretation by Ramnik Sood
2. Hematology for students practitioners including practical hematology 7<sup>th</sup> Edition by Ramnik Sood
3. Textbook of Medical Laboratory Technology by Ramnik Sood
4. Clinical Pathology, hematology and blood banking(For DMLT students) by Nanda Maheshwari
5. Blood banking and transfusion medicine-Basic principles and practice by Christopher D., Hill Yeretel, Publishers: Churchile Livingstone, Philadelphia
6. Practical Hematology by Sir John Dalie, Publisher Churevill , London



<b>VSC 2/MBN 223: Sustainable Agriculture (Practicals Based on MBN214)</b> Total Credits : 01 Total Contact Hours : 30 Hrs Maximum Marks : 50		
<b>Learning Objectives:</b> The students will get acquainted with various isolation procedures for rhizobacteria, handling of various instruments.		
<b>Course Outcomes (CO's)</b> After successful completion of this course, students are expected to: <b>CO1:</b> Students will now the various isolation techniques for Nitrogen fixation and phosphate solubilizing bacteria. <b>CO2:</b> They will get to know the about siderophores in plant growth promotion and biocontrol. <b>CO3:</b> students will get hands on training for production of biofertilizers and vermicomposting.		
Module No.	Topics / actual contents of the syllabus	Contact Hours
I	1. Isolation of plant growth promoting rhizobacteria a. nitrogen fixing. b. siderophore producing. c. phosphate solubilizing. 2. Lab Scale Production of biofertilizers and vermicomposting.	30 Hrs
<b>Text Books:</b>		
<b>Reference Books:</b> 1. Mahendra K. Rai (2005). Handbook of Microbial biofertilizers, The Haworth Press, Inc. New York. 2. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi. 3. Aggarwal SK (2005) Advanced Environmental Biotechnology, APH publication		



<b>This course will be available for the students from other faculty</b>		
<b>GE/ OE -2/MBN 212 : Food Fermentations</b>		
Total Credits : 02	Maximum Marks : 50	Total Contact Hours : 30 Hrs

### Learning Objectives:

The students will gain knowledge about the various fermentation concepts, different fermented foods obtained from milk, meat, grain and vegetables etc.

### Course Outcomes (CO's)

After successful completion of this course, students are expected to:

**CO1: Understanding Fermentation Principles:** Students will develop a comprehensive understanding of the science and principles of fermentation, including the role of microorganisms (bacteria, yeast, and molds) in the fermentation process and the biochemical changes that occur during fermentation.

**CO2: Fermentation Techniques and Practices:** Students will learn various fermentation techniques used for different food sources, including vegetables, grains, meat, and milk.

**CO3: Product Development and Quality Control:** They will understand how to monitor and control the quality and safety of these products throughout the fermentation process.

**CO4: Cultural and Nutritional Significance:** Students will gain insights into the cultural and nutritional significance of fermented foods.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	<ul style="list-style-type: none"> <li><b>Milk Based Fermented Foods</b> Definition, types, advantages and health benefits Curd, Yogurt, Buttermilk, Kefir and cheese: Preparation of inoculums, types of microorganisms and production process</li> <li><b>Meat based fermented food and Probiotic Food</b> Definition, types, microorganisms and health benefits</li> </ul>	10 Hrs
II	<ul style="list-style-type: none"> <li><b>Vegetable Based Fermented Foods</b> Definition, types, advantages and health benefits. Vegetable: Pickles, Sauerkraut, Kimchi, Jalapenos, olives: Microorganisms and production process</li> </ul>	10 Hrs
III	<ul style="list-style-type: none"> <li><b>Grain Based Fermented Foods</b> Definition, types, advantages and health benefits Soy sauce, Bread, Idli, Dosa Dhokla, Hussuwa, Rye Bread: Microorganisms and production process</li> </ul>	10 Hrs

### Text Books:

#### Reference Books:

1. Modern Food Microbiology: James M. Jay.
2. Food Microbiology: W. C. Frazier, D. C. West Hoff



### Basket 1: List of Major subjects in Science (DSC)

Students willing to pursue their bachelors in the **Faculty of Science and Technology** shall choose any three subjects (from the following options) as Major 1, Major 2 and Major 3 (Based on the available options in the respective college)

Semester	Sr No	BOS / Ad hoc Board proposing the course	Title of the Course
<b>1<sup>st</sup> and 2<sup>nd</sup> Semester</b> <i>(Students shall choose any three subjects (from these options) as Major 1, Major 2 and Major 3 (Based on the available options in the respective college))</i>	1	BOS in Botany	Botany
	2	BOS in Chemistry	Chemistry Analytical Chemistry Polymer Chemistry
	3	BOS in Mathematics	Mathematics
	4	BOS in Physics	Physics Non-Conventional and Conventional Energy Instrumentation Practice
	5	BOS in Zoology	Zoology
	6	BOS in Electronics	Electronics
	7	BOS in Fishery Science	Fishery Science
	8	BOS in Microbiology	Microbiology
	9	Ad Hoc Board in Statistics	Statistics
	10	Ad hoc Board in Industrial Chemistry	Industrial Chemistry
	11	Ad hoc Board in Dairy Science & Technology	Dairy Science & Technology
	12	Ad hoc Board in Biotechnology and Bioinformatics	Biotechnology Bioinformatics
	13	Ad hoc Board in Biochemistry	Biochemistry
	14	Ad hoc Board in Home Science	Home Science
	15	Ad Hoc Board in Agrochemical Fertilizers, Horticulture, Dry land Agriculture	Agrochemical Fertilizers Horticulture
	16	Ad hoc Board in Forensic Science	Forensic Science Forensic Science & Cyber Security
	17	Ad Hoc Board in Computer Science	Computer Science Computer Application Information Technology Data Science
	18	Ad Hoc Board in Networking and Multimedia	Networking and Multimedia
	19	Ad Hoc Board in Environmental Science	Environmental Science
	20	BOS in Fishery Science	Fishery Science
	21	Ad hoc Board in Automobile Technology / Workshop Technology / Refrigerator and Air Conditioning	Automobile Technology Workshop Technology Refrigerator and Air



			Conditioning
	22	Ad hoc Board in Geology	Geology

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