



Anekant Education Society's

**Tuljaram Chaturchand College of Arts, Science and
Commerce, Baramati**

(Autonomous)

Four Year B. Sc. Degree Program in Microbiology

(Faculty of Science and Technology)

Choice-Based Credit System Syllabus

(2023 Pattern) (As Per NEP 2020)

F. Y. B. Sc. Microbiology

Semester II

To be implemented from Academic Year 2023-2024

Title of the Programme: F.Y.B.Sc. (Microbiology)**Preamble**

Anekant Education Society's Tuljaram Chaturchand College has decided to change the syllabus of various faculties from June, 2023 by taking into consideration the guidelines and provisions given in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcomes for the development of the students. The credit structure and the courses framework provided in the NEP are nationally accepted and internationally comparable.

The rapid changes in science and technology and new approaches in different areas of Microbiology and related subjects, Board of Studies in Microbiology of Tuljaram Chaturchand College, Baramati, Dist.- Pune has prepared the syllabus of F. Y. B. Sc. Microbiology Semester - I as per Choice Based Credit System (CBCS) by following the guidelines of NEP 2020, NCrF, NHEQF, Prof. R.D. Kulkarni's Report, GR of Gov. of Maharashtra dated 20th April and 16th May 2023 and Circular of SPPU, Pune dated 31st May 2023.

Microbiology is a branch of science that studies "Life" taking an example of microorganisms such as bacteria, protozoa, algae, fungi, viruses, etc. These studies integrate cytology, physiology, ecology, genetics and molecular biology, evolution, taxonomy and systematics with a focus on microorganisms; in particular bacteria. The relevance and applications of these microorganisms to the surrounding environment including human life and Mother Nature becomes part of this branch. Since inception of this branch of science, Microbiology has remained a field of actively research and ever expanding in all possible directions; broadly categorized as pure and applied science. Different branches of Pure Microbiology based on taxonomy are Bacteriology, Mycology, Protozoology and Parasitology, Phycology and Virology; with considerable overlap between these specific branches over each other and also with other disciplines of life sciences, like Biochemistry, Botany, Zoology, Cell Biology, Biotechnology, Nanotechnology, Bioinformatics, etc. Areas in the applied Microbial Sciences can be identified as: Medical, Pharmaceutical, Industrial

(Fermentation, Pollution Control), Air, Water, Food and Dairy, Agriculture (Plant Pathology and Soil Microbiology), Veterinary, Environmental (Ecology, Geomicrobiology); and the technological aspects of these areas. Knowledge of different aspects of Microbiology has become crucial and indispensable to everyone in the society. Study of microbes has become an integral part of education and human progress. Building a foundation and a sound knowledge- base of Microbiological principles among the future citizens of the country will lead to an educated, intellectual and scientifically advanced society. Microbiological tools have been extensively used to study different life processes and are cutting edge technologies. There is a continual demand for microbiologists in the work force – education, industry and research. Career opportunities for the graduate students are available in manufacturing industry and research institutes at technical level.

Eligibility:

First Year B.Sc.:

- A. Higher Secondary School Certificate (10+2) or its equivalent Examination with English and Biology; and two of the science subjects such as Physics, Chemistry, Mathematics, Geography, Geology, etc.

OR

- B. Diploma in Pharmacy Course of Board of Technical Education conducted by Government of Maharashtra or its equivalent.

Programme Specific Outcomes (PSOs)

- PSO1** **Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.
- PSO2** **Critical Thinking and Problem solving:** Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
- PSO3** **Social competence:** Display the understanding, behavioural skills needed for successful social adaptation, work in groups, exhibit thoughts and ideas effectively in writing and orally
- PSO4** **Research-related skills and Scientific temper:** Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
- PSO5** **Trans-disciplinary knowledge:** Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem
- PSO6** **Personal and professional competence:** Performing dependently and also collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self motivation and adaptability skills and commit to professional ethics.
- PSO7** **Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
- PSO8** **Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
- PSO9** **Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and
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Board of Studies (BoS) in Microbiology

From 2022-23 to 2024-25

Sr. No.	Name	Designation
1.	Prof. Dr. S. T. Pawar	Chairman
2.	Prof. Dr. M. H. Gajbhiye	Member
3.	Prof. Dr. Y. R. Mulay	Member
4.	Mr. D. V. Doshi	Member
5.	Mrs. K. R. Jagtap	Member
6.	Miss P. C. Bhosale	Member
7.	Prof. Dr. Snehal Kulkarni	Expert from SPPU, Pune
8.	Prof. Dr. T. A. Kadam	Expert from other University
9.	Prof. Dr. A. V. Pethkar	Expert from other University
10.	Mr. Pradip Lonkar	Industry Expert
11.	Miss Kiran Sonawane	Meritorious Alumni
12.	Miss Pooja Jamdade	Student Representative

Credit Distribution Structure for F.Y.B.Sc. 2023-2024 (Microbiology) (2023 Pattern)

Level	Semester	Major		Minor	OE	VSC, SEC, (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr/ Sem	Degree/ Cum.Cr.
		Mandatory	Electives							
4.5	I	MIB-101-MJM Introduction to Microbiology(2 credits) (Theory)	-	—	MIB-116-OE Microorganisms for HumanWelfare (2 credits) (Theory)	MIB-121-VSC Agricultural Microbiology (2 credits) (Theory)	ENG-131-AEC Functional English-I (2 credits) (Theory)	CC (2 credits) (YOG/ PES/ CUL/NSS/ NCC)	22	UG Certificate 44 credits
		MIB-102-MJM Basic Techniques inMicrobiology (2 credits) (Theory)				MIB-135-VEC Environmental Science-I (2 credits) (Theory)				
		MIB-103-MJM Laboratory Procedures in Microbiology(2 Credits) (Practical)			MIB-117-OE Food, Agricultural and Pharmaceutical Microbiology (2 credits) (Practical)	MIB-126-SEC Microbiology Laboratory Techniques (2 credits) (Practical)	MIB-137-IKS Ethno-Microbiology (2 credits) (Theory)			
	II	MIB-151-MJM Basic Biochemistry & Bacterial cytology (2credits) (Theory)		MIB-161-MN Basic Medical Microbiology (2 credits) (Theory)	MIB-166-OE Food Microbiology (2 credits) (Theory)	MIB-171-VSC Agriculture Microbiology (2 credits) (Practical)	ENG-181-AEC Functional English-II (2 credits) (Theory)	YOG/ PES/ CUL/NSS/ NCC-189-CC (2 credits)	22	
		MIB-152-MJM Fundamental Microbiology(2 credits) (Theory)			MIB-167-OE Biofertilizer Production (2 credits)(Practical)	MIB-176-SEC Clinical pathology(2 credits) (Practical)	COS-185-VEC Digital and Technological Solutions (2 credits) (Theory)			
	MIB-153-MJM Techniques in Microbiology (2 credits) (Practical)									
	Cum Cr.	12		2	8	8	10	4	44	

**Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati
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Course Structure for F. Y. B. Sc. Microbiology (2023 Pattern)

Semester	Course Type	Course Code	Course Name	Theory/ Practical	Credits	Marks (I + E)
I	Major Mandatory	MIB-101-MJM	Introduction to Microbiology	Theory	02	20+30
	Major Mandatory	MIB-102-MJM	Basic Techniques in Microbiology	Theory	02	20+30
	Major Mandatory	MIB-103-MJM	Laboratory Procedures in Microbiology	Practical	02	25+25
	Open Elective (OE)	MIB-116-OE	Microorganisms for Human Welfare	Theory	02	20+30
	Open Elective (OE)	MIB-117-OE	Food, Agricultural and Pharmaceutical Microbiology	Practical	02	25+25
	Vocational Skill Course (VSC)	MIB-121-VSC	Agricultural Microbiology	Theory	02	20+30
	Skill Enhancement Course (SEC)	MIB-126-SEC	Microbiology Laboratory Techniques	Practical	02	25+25
	Ability Enhancement Course (AEC)	ENG-131-AEC	Functional English-I	Theory	02	20+30
	Value Education Course (VEC)	MIB-135-VEC	Environmental Science-I	Theory	02	20+30
	Indian Knowledge System (IKS)	MIB-137-IKS	Ethno-Microbiology	Theory	02	20+30
	Co-curricular Course (CC)		NSS/NCC/Yoga/Cultural activities/Sports	Theory	02	20+30
	Total Credits Semester-I					22
II	Major Mandatory	MIB-151-MJM	Basic Biochemistry & Bacterial cytology	Theory	02	20+30
	Major Mandatory	MIB-152-MJM	Fundamental Microbiology	Theory	02	20+30
	Major Mandatory	MIB-153-MJM	Techniques in Microbiology	Practical	02	25+25
	Minor	MIB-161-MN	Basic Medical Microbiology	Theory	02	20+30
	Open Elective (OE)	MIB-166-OE	Food Microbiology	Theory	02	20+30
	Open Elective (OE)	MIB-167-OE	Biofertilizer Production	Practical	02	20+30
	Vocational Skill Course (VSC)	MIB-171-VSC	Agriculture Microbiology	Practical	02	25+25
	Skill Enhancement Course (SEC)	MIB-176-SEC	Clinical pathology	Practical	02	25+25
	Ability Enhancement Course (AEC)	ENG-181-AEC	Functional English-II	Theory	02	20+30
	Value Education Course (VEC)	COS-185-VEC	Digital and Technological Solutions	Theory	02	20+30
	Co-curricular Course (CC)	YOG/ PES/ CUL/NSS/ NCC-189- CC	NSS/NCC/Yoga/Cultural activities/Sports	Theory	02	20+30
	Total Credits Semester-II					22
Cumulative Credits Semester I + Semester II					44	

**CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Microbiology
(2023 Pattern)****SYLLABUS (CBCS as per NEP 2020) FOR F.Y.B.Sc. Microbiology
(w. e. from June, 2023)**

Name of the Programme	: B.Sc. Microbiology
Program Code	: USMI
Class	: F.Y.B.Sc.
Semester	: II
Course Type	: Major Mandatory (Theory)
Course Code	: MIB-151-MJM
Course Title	: Basic Biochemistry & Bacterial Cytology
No. of Credits	: 02
No. of Teaching Hours	: 30

Course Objective:

1. To enrich the knowledge of undergraduate science faculty students about the basic terms used in biochemistry.
2. To allow students to understand the biochemical reactions going on in microorganisms.
3. To explain the various categories of macromolecules present in microorganisms.
4. To make students understand the chemical composition of different parts of bacterial cell.
5. To allow students to understand the general structure of bacterial cell.
6. To understand the functions of different parts of bacterial cell.
7. To enrich students' knowledge about bacterial cell inclusions and their functions.

Course Outcome:

CO1	The students will acquire the basic knowledge of biochemistry.
CO2	The students will be aware of the importance of understanding the basic concepts of biochemistry.
CO3	The students shall be aware of preparation of molar and normal solutions.
CO4	The students will be able to distinguish the different parts of bacterial cell.
CO5	The students will be able to understand the chemical composition of various parts of bacterial cell.
CO6	Students shall earn knowledge about macromolecules present in the bacterial cell.
CO7	Students shall learn about the functions of various components of bacterial cell

TOPICS and Learning Points		Teaching Hours
Unit 1	Basic biochemistry for Microbiology a. Atoms, elements, ions and molecules b. Mole, Molarity, Normality, Isotopes, Avogadro's number c. Covalent and non-covalent (ionic, hydrogen, van der Waals, hydrophobic, hydrophilic) bonding in biomolecules d. Biochemical reactions-Metabolism and enzymes e. Concepts of pH, acid, base and buffers	6
Unit 2	Structure and functions of Biomolecules a. Carbohydrates (Monosaccharide-Aldoses & Ketoses, disaccharides, oligosaccharides and polysaccharides) b. Lipids (Triglycerides, phospholipids, oils and sterol) c. Proteins (Structural levels, Haemoglobin and Immunoglobulin) d. Nucleic acids (DNA and RNA) e. Conjugated biomolecules	10
Unit 3	Bacterial Cytology Structure, chemical composition and functions of the following: a. Flagella (Gram-positive and Gram-negative) and types of motility (spirochetal and gliding) b. Fimbriae and Pili c. Capsule (Slime layer and glycocalyx) d. Cell wall (Gram-positive and Gram-negative) e. Cell membrane f. Endospore (sporulation cycle) g. Ribosomes (23S, 5S, 16S, 30S, 50S) h. Chromosomal & extra-chromosomal material i. Cell inclusions:(Gas vesicles, carboxysomes, PHB granules, metachromatic granules, Megnatosomes, starch granules, sulfur granules and glycogen bodies)	14

References:

1. Tortora G. J., Funke B. R., Case C. L. (2006). Microbiology: An Introduction. 8th Edition. Pearson Education Inc.
2. Salle A. J. (1971). Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Hill Publishing Co.
3. Stanier R. Y., Adelberg E. A. and Ingraham J. L. (1987). General Microbiology, 5th Edition. Macmillan Press Ltd.
4. Prescott, Lancing, M., John, P. Harley and Donald, A. Klein (2006). Microbiology, 6th Edition, McGraw Hill Higher Education.
5. M. H. Gajbhiye, S. J. Sathe, S.R. Pharande and R.J. Marathe (2015). Introduction to Microbiology, 3rd Edition. Career publication.
6. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata MacGraw Hill Press.

7. Nelson D.L. and Cox M.M. (2002) Lehninger's Principles of Biochemistry, Mac Millan Worth Pub. Co. New Delhi.
8. Madigan M. T., Martinko J. M. (2006). Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
9. Mount, D. W. (2001). Bioinformatics: Sequence and Genome analysis. Cold Spring Harbor Laboratory Press, New York.
10. Mahendra Rai and Nelson Duran (2011). Metal Nanoparticles in Microbiology, Springer, Verlag Berlin Heidelberg.

Mapping of course outcomes and programme outcomes:

Class: FYBSc (Sem II)

Subject: Microbiology

Course: Basic Biochemistry & Bacterial Cytology

Course code: MIB-151-MJM

Weightage: 1= weak or low relation, 2= Moderate or partial relation, 3= Strong or direct relation

Course Outcomes (COs)	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2			3				3
CO2	3	3		2	3	3			
CO3	3	3		3	3	3			
CO4	3								2
CO5	3								
CO6	3	2						2	
CO7	3							3	

Justification for the mapping

PO1 Disciplinary Knowledge:

CO1: The fundamentals of biochemistry shall be learned by the students.

CO2: The students shall learn about the basic concepts used in the biochemistry area.

CO3: The students shall gain knowledge about the molarity and normality of the solutions.

CO4: Students shall learn about the different components of a typical bacterial cell.

CO5: The students shall learn knowledge about the different chemicals present in different components of a bacterial cell.

CO6: The students shall learn information about the macromolecules present in a biological cell.

CO7: The students shall gain knowledge about the functions of different components of bacterial cells.

PO2 Critical Thinking and Problem Solving:

CO1: The students shall be aware of the basic terms and units used in chemistry.

CO2: The students will be able to do the basic calculations used in the analysis.

CO3: The students will be able to understand the preparation of solutions with different concentrations.

CO6: The students shall know about the quantitative relationships of different macromolecules present in bacterial cells.

PO4 Research-related skills and Scientific temper:

CO2: The students will be able to do the calculations and perform relevant experiments.

CO3: The students shall be able to prepare the solutions of different concentrations used to perform several biological experiments.

PO5 Trans-disciplinary knowledge:

CO1: The students shall learn basic concepts in chemistry subject.

CO2: The students shall learn about the subject of biochemistry.

CO3: The students shall get the knowledge of inorganic chemistry.

PO6 Personal and professional competence:

CO2: The students will be able to learn the skills needed to work in laboratories of industrial sectors.

CO3: This knowledge shall grant confidence in students while working in groups.

PO8 Environment and Sustainability:

CO1: The knowledge of acidic and basic solutions shall help students understand the effect of chemical wastes on the environment.

CO6: Understanding the role of microbes in different environmental sectors shall help students understand the functions of different components of a bacterial cell.

PO9 Self-directed and Life-long learning:

CO1: For the better understanding of the biochemistry subject in the future, understanding the basic concepts of chemistry is needed for the students.

CO4: To make their future understanding of the subject better, the students shall gain knowledge about the basic chemicals present in bacterial cell.

SYLLABUS (CBCS as per NEP 2020) FOR F. Y. B. Sc. Microbiology
(w. e. from Nov, 2023)

Name of the Programme	: B.Sc. Microbiology
Program Code	: USMI
Class	: F.Y.B.Sc.
Semester	: II
Course Type	: Major mandatory theory
Course Name	: Fundamental Microbiology
Course Code	: MIB-152-MJM
No. of Lectures	: 30
No. of Credits	: 02

Course Objectives:

1. To introduce students to the fundamental principles and techniques used in microbiology, focusing on isolation, preservation and cultivation methods.
2. Students will gain knowledge about the nutrients and nutritional classification of microorganisms
3. To familiarize students with the Different culture media and their applications in microbiological research
4. To enable students to comprehend the principles and procedures involved in isolation of microbial growth
5. To familiarize students with the different different types of culture preservation techniques
6. Students will gain knowledge about the microbial growth
7. To enhance students' understanding for microbial enumeration methods
8. To familiarize students with influence of factors affecting bacterial growth
9. Students will be able to understand the concept of synchronous and diauxic growth culture

Course Outcomes:

- CO1. Students will be able to understand the principle and uses of different types of media and their components.
- CO2. Students will acquire knowledge of the different isolation techniques used in microbiology
- CO3. Students will demonstrate an understanding of the applications and limitations of different preservation techniques in microbiology research
- CO4. Students will be able to explain the importance of isolation techniques in maintaining aseptic conditions in the laboratory and preventing contamination.
- CO5. Students shall earn knowledge about techniques used for the enumeration of bacterial cell
- CO6. Students will gain knowledge about performing isolation and preservation methods
- CO7. Students shall earn knowledge about phases of bacterial growth
- CO8. Students will applying the learned techniques to analyze and interpret experimental data in the context of microbiology.

Topic & Learning Points	Teaching Hours
<p style="text-align: center;">UNIT-1: Cultivation of Microorganisms</p> <ul style="list-style-type: none"> ● Nutritional requirements ● Nutritional classification of microorganisms ● Common ingredients of media ● Types of media ● Methods of Cultivation for: <ul style="list-style-type: none"> a)Photosynthetic Bacteria b)Chemoautotrophic Bacteria. ● Extremophiles 	10
<p style="text-align: center;">UNIT-2: Isolation and preservation</p> <ul style="list-style-type: none"> ● Isolation of bacteria by - <ul style="list-style-type: none"> a)Streak Plate Method b)Spread Plate Method c)Pour Plate Method ● Preservation techniques - <ul style="list-style-type: none"> a)Agar Slant Method b)Soil/Grain Culture Method c) Saline Suspension Method d)Freezing Method e) Lyophilization ● Culture collection centers and their role. 	10
<p style="text-align: center;">UNIT-3: Bacterial Growth</p> <ul style="list-style-type: none"> ● Definitions of Growth , Generation time, Growth rate and specific growth rate ● Growth curve ● Methods of enumeration: <ul style="list-style-type: none"> a) Microscopic methods (Direct Microscopic Count, Counting cells using Neubauer chambers) b) Plate counts (Total Viable Count) c) Turbidometric methods ● Factors affecting bacterial growth (pH, Temperature, Salt Concentrationand Heavy metals) ● Diauxic growth ● Synchronous culture 	10
<p>References:</p> <ol style="list-style-type: none"> 1. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology:An Introduction. 8th Edition. Pearson Education Inc 2. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Hill Publishing Co. 3. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987)General Microbiology, 5th Edition. Macmillan Press Ltd. 4. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition, McGraw Hill Higher Education 5. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata MacGraw Hill Press. 	

Mapping of course outcomes and programme outcomes:

Class: FYBSc (Sem II)

Subject: Microbiology

Course: Fundamental Microbiology

Course code: MIB-152-MJM

Weightage: 1=weak or low relation, 2= Moderate or partial relation, 3= Strong or direct relation

Course outcomes (COs)	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3				2			3	3
CO2	3					3		2	2
CO3	3	3		3		3		3	1
CO4		3				2		2	2
CO5	3	2		3					3
CO6	3				2	3		3	2
CO7	3				3				
CO8		3		3	3	3			2

Justification for the mapping**PO1 Disciplinary Knowledge:**

CO1. Students will get knowledge about different elements of nutrient, different types of media and their applications

CO2. Students will acquire knowledge of the different isolation techniques used in microbiology

CO3. Students acquire knowledge regarding preservation of microbial cultures

CO5. Students get basic knowledge about enumeration of bacterial cell

CO6. Students will gain knowledge about performing isolation and preservation methods

CO7. Students get knowledge of bacterial growth curve

PO2 Critical Thinking and Problem Solving:

CO3. Students will understanding of the applications and limitations of different preservation techniques in microbiology research

CO4. Students will be able to do isolation techniques in maintaining aseptic conditions in the laboratory.

CO5. Students shall earn knowledge about enumeration of bacterial cell

CO8. Students will able to apply, analyze and interpret experimental data in the context of microbiology.

PO4 Research-related skills and Scientific temper:

CO3. Students will demonstrate different preservation techniques in the different fields of microbiology

CO5. Students earn knowledge about techniques used for the enumeration of bacterial cell

CO8. Students will applying the learned techniques to analyze and interpret

experimental data in the context of microbiology.

PO5 Trans-disciplinary knowledge:

CO1. Students will get knowledge about different elements of nutrient, different types of media and their applications

CO6. Students gain knowledge to perform isolation and preservation methods

CO7. Students get knowledge about bacterial growth

CO8. Students able to apply the learned techniques to analyze and interpret experimental data in the field of microbiology.

PO6 Personal and professional competence:

CO2. Students will acquire knowledge of the different isolation techniques used in microbiology

CO3. Students will understand the applications and limitations of preservation techniques

CO4. Students will be able to explain how to cultivate microorganisms

CO6. Students will gain basic knowledge about preservation methods

CO8. Students will applying the learned techniques to analyze and interpret experimental data in the context of microbiology.

PO8 Environment and Sustainability:

CO1. Students will be able to understand the principle and uses of different types of media and their components.

CO2. Students will acquire knowledge of the different isolation techniques used in microbiology

CO3. Students will demonstrate an understanding of the applications and limitations of different preservation techniques in microbiology research

CO4. Students will be able to explain the importance of isolation techniques in maintaining aseptic conditions in the laboratory and preventing contamination.

CO6. Students will gain knowledge about performing isolation and preservation methods

PO9 Self-directed and Life-long learning:

CO1. Students will be able to understand the principle and uses of different types of media and their components.

CO2. Students will acquire knowledge of the different isolation techniques used in microbiology

CO3. Students will demonstrate an understanding of the applications and limitations of different preservation techniques in microbiology research

CO4. Students will be able to explain the importance of isolation techniques in maintaining aseptic conditions in the laboratory and preventing contamination.

CO5. Students shall earn knowledge about techniques used for the enumeration of bacterial cell

CO6. Students will gain knowledge about performing isolation and preservation methods

CO8. Students will able to apply, analyze and interpret experimental data in the context of microbiology

**SYLLABUS (CBCS as per NEP 2020) FOR F. Y. B. Sc. Microbiology
(w. e. from Nov, 2023)**

Name of the Programme	: B.Sc. Microbiology
Program Code	: USMI
Class	: F.Y.B.Sc.
Semester	: II
Course Type	: Major mandatory practical
Course Name	: Techniques in Microbiology
Course Code	: MIB-153-MJM
No. of Lectures	: 60
No. of Credits	: 02 (02 x 02=04)

Course Objectives:

1. To enrich students' knowledge and train them in core Microbiology
2. To teach students the various methods of isolation and their significance in aseptic research and diagnostics
3. To provide students with hands-on experience in microbial techniques for cultivating microorganisms.
4. Students will get acquainted with skills of aseptic culture technique
5. To introduce students to the techniques of microbial structural identification
6. To make students proficient at laboratory skills and safety procedures.
7. Students gain knowledge about optimization of growth requirements
8. Students will develop critical thinking and problem-solving

Course Outcomes:

- CO1. Students will be Introduced to microbiology laboratory and common practices used in research and diagnostic microbiology.
- CO2. Students will gain proficiency in preparing media, broth and slants
- CO3. Students will be able to analyze, interpret and describe their morphological features.
- CO4. Students will understand the significance of aseptic transfer techniques
- CO5. Students will be able to perform special staining techniques to visualize and differentiate structures present within the microorganisms.
- CO6. Students will gain knowledge about the significance and calibration methods used for sterilization
- CO7. Students will be able to optimize and analyze the effect of different factors affecting growth of microorganisms
- CO8. Students will get expertise to work directly in applied fields (industry or institutions), without any additional training.

**SYLLABUS (CBCS as per NEP 2020) FOR F.Y.B.Sc. Microbiology
(w. e. from June, 2023)**

Name of the Programme	: B.Sc. Microbiology
Program Code.	: USMI
Class	: F.Y.B.Sc.
Semester	: II
Course Type	: Minor Mandatory (Theory)
Course Name	: Basic Medical Microbiology
Course Code	: MIB-161-MN
No. of Credits	: 02
No. of Lectures	:30

Course Objective :

1. Develop a comprehensive understanding of microbial pathogens, including bacteria, viruses, fungi, and parasites, and their roles in causing diseases in humans.
2. Classify microbial diseases based on the type of pathogen and mode of transmission.
3. Examine the principles of disease transmission and epidemiology, including modes of transmission, reservoirs, and factors influencing disease spread.
4. Evaluate the principles of disease treatment, including the use of antimicrobial agents, vaccines, and strategies for disease prevention and control.
5. Analyze the global impact of microbial diseases.
6. Consider the ethical, social, and cultural dimensions of microbial diseases.
7. Promote interdisciplinary learning by integrating concepts from microbiology, immunology, epidemiology, and public health to better understand and address microbial diseases.

Course Outcomes :

CO1	Able to understand different microbial pathogens, including bacteria, viruses, fungi, and parasites, and their roles in causing diseases in humans
CO2	Students can classify microbial diseases based on the type of pathogen, mode of transmission and acquire knowledge disease epidemiology
CO3	Exploration of the cellular interactions between microbes and the human immune system
CO4	Can evaluate the use of antimicrobial agents, vaccines, and strategies for disease prevention and control.
CO5	Students will acquire understanding of normal microflora of human body
CO6	Know common diseases caused by bacteria, viruses and other microbes.
CO7	Aware about handling of microorganisms in the laboratory.

TOPICS and Learning Points	Teaching Hours
UNIT 1 Disease and Immunity	15

- Definition of disease and types of causative agents
- Sources of infection: human, animal, insects, soil, water and food
- Routes of entry of pathogens
- Modes of transmission of diseases: direct contact, air-borne, water-borne, food-borne, insect-borne
- Mechanisms of production of disease: pathogenesis, pathogenicity factors
- Defensive mechanisms of the human body
- Normal microflora of the human body and its importance

UNIT 2 Microbial Diseases: Treatment, prevention, diagnosis, outbreaks	15
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- Methods of disease treatment
- Disease prevention practices
- Techniques of diagnosis of microbial diseases
- Types of disease outbreaks – Sporadic, Endemic, Hyperendemic, Epidemic, Index case, Pandemic

Reference Books

1. Ananthanarayan R and Paniker CKJ. Textbook of Microbiology. 7th Edition. University Press Publication. (2005).
2. Brooks GF, Carroll KC Blue S and M SA Jawetz, Melnick and Adelberg's Medical Microbiology. 24 123 of 139 Publication. (2007).
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5. Roitt I. Essential Immunology. 10" Ed. Blackwell Science.
6. Kuby. Immunology, 4 edition. W. H. Freeman & company.
7. Ellen Strauss, James Strauss. Viruses and Human Disease 2nd Edition. Academic Press
8. Christopher Burrell Colin Howard Frederick Murphy Fenner and White's Medical Virology 5th Edition. Academic Press
9. Patrick R. Murray PhD. Ken S. Rosenthal PhD. Michael A. Pfaller MD Medical microbiology Elsevier
10. Jawetz. Medical microbiology. Me. Graw Hill
11. Kenneth, J. Ryan Medical microbiology, Sherri's an introduction to infectious diseases Me. Graw Hill

Mapping of Program Outcomes with Course Outcomes**Class:** F.Y.B.Sc (Sem II)**Subject:** Microbiology**Course:** Basic Medical Microbiology**Course Code:** MIB-161-MN**Weightage:**1=weak or low relation,2=moderate or partial relation,3=strong or direct relation

Course Outcomes	Programme outcomes(POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3				2	3			
CO2	3	2			2	2			
CO3	3	2	3	2	2				
CO4	2	2	3	2	3	3			2
CO5	2								1
CO6	2								1
CO7	2					2			2

Justification for the mapping**PO1: Disciplinary Knowledge**

All the outcomes CO1 to CO7 provides essential insights into the understand different microbial pathogens, including bacteria, viruses, fungi, and parasites, and their roles in causing diseases in humans, microbial diseases based on the type of pathogen, mode of transmission and acquire knowledge disease epidemiology, the human immune system, the human immune system.

PO2: Critical Thinking and Problem Solving

CO2, CO3, encourages critical thinking by requiring students to classify microbial diseases based on the type of pathogen, mode of transmission and acquire knowledge disease epidemiology.

CO4 explores the cellular interactions between microbes and the human immune system and Can evaluate the use of antimicrobial agents, vaccines, and strategies for disease prevention.

PO3: Social competence

All the course outcomesCO2 to CO5 fosters social competence by emphasizing data of microbial diseases based on the type of pathogen, mode of transmission and acquire knowledge disease epidemiology, and discussions, promoting effective teamwork and communication skills crucial for scientific research and community engagement

PO4: Research related skills and scientific temper

The CO3,CO4 cultivates research-related skills by immersing students in the scientific process, where they learn to evaluate the use of antimicrobial agents, vaccines, and strategies for disease prevention and control. This experience fosters a scientific temper by encouraging curiosity, evidence-based thinking, and a commitment to the pursuit of knowledge. Additionally, it promotes an understanding of cellular interactions between microbes and the human immune system.

PO5: Trans-disciplinary knowledge

Medical microbiology plays a crucial role in various disciplines, such as microbiology, biotechnology, and medicine. CO1, CO2 ,CO3, CO4 imparts research-related skills by guiding students through exploration of the cellular interactions between microbes and the human immune system. Evaluation of antimicrobial agents, vaccines, and strategies for disease prevention and control instills a scientific temper by encouraging curiosity, critical thinking, and a commitment to evidence-based inquiry, which are essential attributes for a research-oriented mindset.

PO6: Personal and professional competence

CO1, CO2 ,CO4, CO7 enhances personal and professional competence by developing critical thinking and problem-solving skills, enabling students to excel in research and industry roles.

PO9: Self –directed and life –long learning

TheCO4, CO5, CO6, CO7, promotes self-directed and lifelong learning by encouraging students to engage in independent research and stay updated on rapidly evolving technologies.

SYLLABUS (CBCS as per NEP 2020) For F.Y.B.Sc Microbiology**(w. e. from June, 2023)**

Name of the Programme	: B.Sc Microbiology
Program Code	: USMIB
Class	: F.Y.B.Sc
Semester	: II
Course Type	: OE
Course Title	: Food Microbiology
Course Code	: MIB-166-OE
No. of Lectures	: 30
No. of Credits	: 02

Course Objective :

1. To enrich knowledge of students about important microorganisms associated with food and their characteristics.
2. To enrich students about common causes of food spoilage.
3. To enrich students with fermented food and its significance
4. To aware students about pathogenic, non-pathogenic and useful microorganisms in the food.
5. To acquaint the students with food sanitation and its regulation.
6. Comprehend knowledge regarding fermented food products.
7. To help student to build up successful career in food industry.

Course Outcomes:

After completion of course , learners would be able to :

CO1.Understand the important developments in food microbiology and its scope.

CO2.Understand the significance and activities of microorganisms in food.

CO3. Understand the principles in traditional food preservation techniques

CO4.Gain Knowledge and comparevarious physical and chemical methods used in the control of microorganisms.

CO5. The learners will be able to gain knowledge about the role of different microorganisms in food spoilage.

CO6. The learners will be able to differentiate foodborne infection and food intoxication

CO7.This course will help learners to understand the current trends and concepts related to food Microbiology.

	Topic & Learning Points	Teaching Hours
Unit 1	Introduction to Food microbiology 1. Definition and classification of foods 2. Food as a substrate for microorganism 3. Importance of microorganisms in foods 4. Fermented food its type and significance	10
Unit 2	Microbial spoilage of food and methods of food preservation 1. Sources of food spoilage micro-organisms 2. Microbial spoilage of food a. Fruits b. Vegetables c. Meat d. Sea Foods 3. Physical and Chemical methods of food preservation	10
Unit 3	Foodborne infections and Food sanitation 1. Food intoxications – <i>Clostridium botulinum</i> and mycotoxins 2. Food infections – <i>Campylobacter jejuni</i> and <i>Yersinia enterocolitica</i> 3. Indices of food sanitary quality and regulation	10

References :

- Banwart, G. J., (1987), Basic Food Microbiology, CBS Publ., New Delhi.
- Bilgrami, K. S, Dube, H. G., (1994), Textbook of Modern Plant pathology, Vikas Publ., New Delhi
- Franklin, T. J. and Snow, G. A. 2012. Biochemistry of Antimicrobial Action. Springer Science & Business Media 6. Dey, N. C. and Dey, T. K. 1988. Medical Bacteriology, Allied Agency, Calcutta, 17th edition.
- Chakraborty, P., 2003. A textbook of Microbiology, 2nd Edition New Central Book Agency, India.
- James M. Jay, Martin J. Loessner, David A. (2012), Modern Food Microbiology, 7th Edition (Food Science Texts Series)
- Medical Microbiology edited by Samuel Baron. Fourth edition. (University of Texas, Medical Branch of Galvesion) 3. Sherris, John C., Medical Microbiology: An Introduction to infectious diseases. Elsevier Publication, 2 nd edition.
- Sherris, John C., Medical Microbiology: An Introduction to infectious diseases. Elsevier Publication, 2 nd edition.

Mapping of Program Outcomes with Course Outcomes**Class:** FYBSc (Sem II)**Subject:** Microbiology**Course:** Food Microbiology**Course Code:** MIB-166-OE**Weightage:** 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)								
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3								3
CO 2	3	3						3	
CO 3	3					2			
CO 4	3	2		3	2	2			3
CO 5	3	2							
CO 6	3	2						2	
CO 7	3			2					3

Justification for the mapping**PO1: Disciplinary Knowledge**

CO1: The students shall learn important developments in food microbiology and its scope.

CO2: Students shall learn different activities of microorganisms in food.

CO3: Students will understand principle of traditional food preservation techniques like sun drying, addition of salts or oil for preservation purpose etc.

CO4: Students will gain knowledge and compare various physical and chemical methods to control microorganism causing spoilage

CO5: Students shall learn role of different microorganism in spoilage on different types of food.

CO6: The students shall learn difference between foodborne infection and food intoxication

CO7: Most importantly from this course students will gain current trends and concepts related to food microbiology.

PO2: Critical Thinking and Problem Solving

CO2: Students will be able to study the activities of microorganism in food, and inhibit the growth of microorganism by knowing the important parameters to control their growth.

CO4: The students will be able to control growth of spoilage causing microorganism by using various physical and chemical techniques.

CO5: Students will learn different roles of microorganism causing spoilage to different types of food.

CO6: Students will gain knowledge of foodborne infection and food intoxication, use preventive measures to control it.

PO4: Research-related skills and Scientific temper:

CO4: Students shall use the knowledge of various physical and chemical methods to control microorganisms and shall perform different experiments at industrial sector of Research and development.

CO 7: Students can apply knowledge of emerging trends and concepts in food microbiology in research and use them to perform experiments too.

PO5: Trans-disciplinary Knowledge

CO4: Students shall learn chemistry subject by studying different physical and chemical methods used to control growth of microorganism such as organic, inorganic their chemical nature which play important role in preservation.

PO6: Personal and Professional Competence

CO4: Students will be able to learn skills related various physical and chemical methods to control growth of microorganism in laboratory experiment.

CO3: Students can compare tradition and current knowledge to preserve food and can also apply it in their day to day life.

PO8: Environment and sustainability

CO2: Different activities of microorganism in food can make students aware about quality of food to which microbes attack fast, and deteriorate food.

CO6: Students will learn foodborne infection and food intoxication mechanism and make awareness in society avoid such infection by eating nutritious and quality food.

PO9: Self-directed and Life-long Learning

CO1: Students will demonstrate the ability to apply food microbiology concepts. This ability will enable them to continue learning and developing their skills throughout their careers.

CO4: Students will apply food microbiology physical and chemical methods into practical contexts, can be entrepreneur.

CO7: The current knowledge of food microbiology can help students in their build up successful career in food industry

**CBCS Syllabus as per NEP 2020 for F. Y. B. Sc. Microbiology
(2023 Pattern)**

Name of the Programme	: B.Sc. Microbiology
Program Code	: USMI
Class	: F.Y.B.Sc. Semester II
Course Type	: Open Elective (Practical)
Course Code	: MIB-167-OE
Course Title	: Bio-fertilizer Production
No. of Credits	: 02
No. of Teaching Hours	: 60

• **Course Objective :-**

1. To enrich students' knowledge and train them in basic Bio-fertilizers
2. To teach students the various methods of production of Bio-fertilizer under laboratory conditions.
3. To provide students with hands-on experience in microbial production techniques.
4. Students will get acquainted with skills of aseptic culture techniques
5. To introduce students to the techniques of microbial production and quantification
6. To make students proficient at laboratory skills.
7. Students will develop critical knowledge about the domestic microbial processes

• **Course Outcome :-**

- CO1. Students will be able to perform the production of Bio-fertilizer in laboratory.
- CO2. Students will understand the different types of raw materials that can be used in the production of Bio-fertilizer.
- CO3. Students will be able to analyse and interpret the results of use of different raw materials used.
- CO4. Students will understand the significance of selection of microorganisms in different production processes.
- CO5. Students will be able to learn about the troubleshooting of the problems associated with the production processes.
- CO6. Students will gain knowledge about different start-ups in microbiology.
- CO7. Students will get the expertise to work directly in industrial sectors, without any additional training.

Practical No.	Title	Teaching Hours
1-2	i. SOPs of laboratory equipment. a) Autoclave b) Incubator c) Centrifuge d) PH meter e) Laminar air flow f) Spectrometer g) Colorimeter h) Hot air oven	8
3-4	ii. Handling of laboratory equipment with respect to SOPs	
	Sterilization of glassware, culture media.	8
5	Preparation of media	4

	i. Nutrient Agar	
	ii. Nutrient Broth	
6-8	Isolation of Nitrogen fixing bacteria.	12
	i. <i>Rhizobium</i>	
	ii. <i>Azotobacter</i>	
	iii. <i>Azospirillum</i>	
9	Mass production of <i>Rhizobium</i> and <i>Azotobacter</i> using liquid media.	8
11	Isolation of phosphate solubilising bacteria	4
1	Wet mounting of Nitrogen fixing cyanobacteria.	4
	i. <i>Nostoc</i>	
	ii. <i>Anabaena</i>	
4	Application of prepared biofertilizer to seeds	4
15	Preparation of compost by using domestic and agricultural waste.	4

• **Suggested readings :-**

1. Dubey, R.C. (2005). A Textbook of Biotechnology. S. Chand & Co, New Delhi.
2. Kumaresan, V. (2005). Biotechnology. Saras Publications, New Delhi.
3. John Jothi Prakash, E. (2004). Outlines of Plant Biotechnology. Emkay Publications, New Delhi.
4. Sathe, T.V. (2004). Vermiculture and Organic Farming. Daya Publications.
5. Subha Rao, N.S. (2000). Soil Microbiology. Oxford& IBH publishers, New Delhi.
6. Somani, L.L. (2004). Handbook of Biofertilizers. Agrotech Publishing Academy, Udaipur 313002
7. Sharma, A. K. (2005). A Hand Book of organic farming. Agrobios, Jodhpur, India, Rajasthan
8. Vayas, S.C., Vayas, S. and Modi, H.A. (1998). Biofertilizers and Organic Farming. Akta Prakashan Nadiad.
9. Trueman's Biofertilizers. (2018). Trueman Book Company, Jalandhar

Mapping of Program Outcomes with Course Outcomes

Class: FYBSc (Sem II)

Subject: Microbiology

Course: Open Elective Practical II

Course Code: MIB-167-OE

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)								
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	2							
CO 2	3	2							
CO 3	3	2							
CO 4	3	2		2					
CO 5				2	2				
CO 6			3	2		2			3

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: Students will apply the knowledge and train them in basic Bio-fertilizers and able to perform the production of Bio-fertilizer in laboratory

CO2: Students will develop a deep understanding of various methods of production of Bio-fertilizer under

laboratory conditions.

CO3: Students will master the with skills of aseptic culture techniques.

CO4: Students will develop competence in the techniques of microbial production and quantification.

PO2: Critical Thinking and Problem Solving

CO1: Students will apply their knowledge of the techniques of microbial production and quantification in biofertilizer production.

CO2: Students will use their understanding of using different types of raw materials that can be used in the production of Bio-fertilizer.

CO3: Students will apply their knowledge of hands-on experience in microbial production techniques.

CO4: Students will use their understanding of the significance of selection of microorganisms in different production processes.

PO3: Social competence

CO6. Students will gain knowledge about different start-ups in microbiology including proficient at laboratory skills.

PO4: Research related skills and scientific temper

CO5. Students will be able to learn about the troubleshooting of the problems associated with the production processes.

CO6. Students will gain knowledge about different start-ups in microbiology.

CO7. Students will get the expertise to work directly in industrial sectors, without any additional training.

PO5: Trans-disciplinary Knowledge

CO5: Students will apply learn about the troubleshooting of the problems associated with the production processes.

PO6: Personal and Professional Competence

CO6: Students will demonstrate the ability to apply mathematical concepts and techniques, such as finding orthogonal trajectories, in practical contexts across various disciplines. This ability is essential for success in many different careers.

PO9: Self-directed and Life-long Learning

CO6: Students will demonstrate the ability to apply mathematical concepts and techniques in practical contexts. This ability will enable them to continue learning and developing their skills throughout their careers.

SYLLABUS (CBCS as per NEP 2020) For F.Y.B.Sc Microbiology**(w. e. from June, 2023)**

Name of the Programme : B.Sc. Microbiology
Program Code : USMI
Class : F.Y.B.Sc
Semester : II
Course Type : Vocational Skill Course
Course Title : Agriculture Microbiology
Course Code : MIB-171-VSC
No. of Credits : 02
No. of Teaching Hours : 60

Course Objective :

1. To enrich knowledge of students about important microorganisms associated with agricultural microbiology.
2. To develop students skills on isolation of microbial population from agriculture soil.
3. To teach students fungi staining for microscopic observation.
4. To teach students procedures involved in physical analysis of agricultural soil.
5. To acquaint the students with skills of slide culture and wet mount technique.
6. To make students proficient at macronutrient and micronutrient analysis of agriculture soil
7. To help student to build up successful career in agricultural microbiology.

Course Outcomes:

- CO1. To cater the needs of students for building up careers in agriculture microbiology.
 CO2. Students will gain proficiency in preparing slide culture and wet mount technique.
 CO3. Students will be able to perform staining techniques to visualize fungi.
 CO4. Gain Knowledge on physical analysis of agriculture soil.
 CO5. Students will cater knowledge to analyse macronutrient and micronutrient essential in agriculture.
 CO6. Students will acquire skills to isolate and cultivate different types of microorganisms from agricultural.
 CO7. Students will get the expertise to work directly in field without any additional training.

No of Experiment	Topic & Learning Points	Teaching Hours
1	Physical analysis of agricultural soil – pH, moisture content, texture, colour	4
2	Macronutrient analysis of agricultural soil a. Organic Carbon b. Phosphorous c. Potassium d. Ammonical –Nitrogen e. Nitrate- Nitrogen	4
3	Micronutrient analysis of agricultural soil a. Copper (Cu)	4

	b. Zinc (Zn)	
	c. Molybdenum (Mo)	
	d. Manganese (Mn)	
	e. Iron (Fe)	
	f. Boron (B)	
4-5	Enumeration of rhizospheric and non-rhizospheric bacteria by Standard Plate Count method	8
6-7	Isolation of following microbes from soil	8
	a. Actinomycetes	
	b. Fungi	
8	Slide culture technique to study morphology of fungi	4
9	Microscopic observation of fungi by staining technique	4
10	Wet mounting of cyanobacteria	4
11	Isolation of VAM (VesicularArbuscular Mycorrhizal) spores from soil by floatation method	4
12	Isolation of phylloplane microflora by Leaf –impression method	4
13	Isolation of <i>Rhizobium</i> sp. from root nodules	4
14	Isolation of <i>Azotobacter</i> sp. from garden soil	4
15	Isolation of <i>Azospirillum</i> sp. from roots /soil	4

References:

- Dubey, R. C., & Maheshwari, D. K. (2023). *A textbook of microbiology*. S. Chand Publishing.
- Baldani, J. I., Reis, V. M., Videira, S. S., Boddey, L. H., & Baldani, V. L. D. (2014). The art of isolating nitrogen-fixing bacteria from non-leguminous plants using N-free semi-solid media: a practical guide for microbiologists. *Plant and soil*, 384, 413-431.
- Beattie, G. A., & Handelsman, J. (1989). A rapid method for the isolation and identification of *Rhizobium* from root nodules. *Journal of microbiological methods*, 9(1), 29-33.
- Hamza, T. A., & Alebejo, A. L. (2017). Isolation and characterization of rhizobia from rhizosphere and root nodule of cowpea, elephant and lab lab plants. *Int. J. Nov. Res. Interdiscip. Stud*, 4, 1-7.
- Ilyas, N., & Bano, A. (2010). *Azospirillum* strains isolated from roots and rhizosphere soil of wheat (*Triticum aestivum* L.) grown under different soil moisture conditions. *Biology and Fertility of Soils*, 46, 393-406.
- Tejera, N. L. C. M. M. G. J., Lluch, C., Martinez-Toledo, M. V., & Gonzalez-Lopez, J. (2005). Isolation and characterization of *Azotobacter* and *Azospirillum* strains from the sugarcane rhizosphere. *Plant and soil*, 270, 223-232.
- Upadhyay, S., Kumar, N., Singh, V. K., & Singh, A. (2015). Isolation, characterization and morphological study of *Azotobacter* isolates. *Journal of Applied and Natural Science*, 7(2), 984-990.

Mapping of Program Outcomes with Course Outcomes

Class: FYBSc (Sem II)

Subject: Microbiology

Course: Agriculture Microbiology

Course Code: MIB-171-VSC

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)								
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1									3
CO 2	3			2					
CO 3				2					
CO 4	3			3	2	2		2	3
CO 5	3	2		2					
CO 6	3	2							
CO 7	3								3

Justification for the mapping

PO1: Disciplinary Knowledge

CO2: Students shall learn basic techniques such as to prepare slide culture and wet mounting.

CO4: Students will gain knowledge on physical analysis of agriculture soil such as pH, texture, moisture etc.

CO5: Students shall learn analysis of essential macronutrients and micronutrients such as nitrogen, potassium, Molybdenum, Manganese, Iron, Boron which are essential for the growth of plants etc.

CO6: Students shall learn skills to isolate and cultivate different types of microorganisms from agriculture which can be beneficial or pathogenic.

CO7: All basic knowledge is being gained by students from this course which can help to build up their career.

PO2: Critical Thinking and Problem Solving

CO5: The students will be able to analyse physical properties of soil and solve problems by observing the result of analysis.

CO6: Students will exhibit the skills of isolation and cultivation and solve problems of agricultural soil by studying various microorganisms from it.

PO4: Research-related skills and Scientific temper:

CO2: Students shall be able to use techniques of slide culture and wet mount in laboratory to perform experiment and also in research.

CO3: Staining techniques can be used by students to perform different experiments.

CO4: Physical analysis of soil shall grant confidence in students to perform experiments independently.

CO6: The students shall be able to learn skills of isolation and cultivation of microorganisms which can be used to perform experiments in research and laboratory.

PO5: Trans-disciplinary Knowledge

CO4: Students shall learn chemistry subject by analysing physical parameters for soil.

PO6: Personal and Professional Competence

CO4: The students will be able to learn the skills of staining techniques needed to work in laboratories of industrial sectors.

PO8: Environment and sustainability

CO5: Knowledge of analysis of macronutrient and micronutrient will help to maintain sustainable agriculture development

PO9: Self-directed and Life-long Learning

CO1: Students will demonstrate the ability to apply agriculture microbiology concepts. This ability will enable them to continue learning and developing their skills throughout their careers.

CO2: Students will apply agriculture microbiology physical technique, can be entrepreneur.

CO7: The knowledge of agriculture microbiology can help students in to build up successful career in agriculture.

**SYLLABUS (CBCS as per NEP 2020) FOR F.Y.B.Sc. Microbiology
(w. e. from June, 2023)**

Name of the Programme	: B.Sc. Microbiology
Program Code	: USMI
Class	: F.Y.B.Sc.
Semester	: II
Course Type	: Skill Enhancement Course (SEC) (Practical)
Course Name	: Clinical Pathology
Course Code	: MIB-176-SEC
No. of Lectures	: 60
No. of Credits	: 02

Course Objective:

Students will be able to

1. Estimate hemoglobin from human blood
2. Count various blood cells
3. Determine blood parameters like ESR, PCV
4. Learn use of colorimeter for standard graph preparation
5. Perform routine urine analysis
6. Analyze the observations, interpret and conclude the result and predict the diagnosis.

Course Outcome:

- CO1. Students have understood to estimate hemoglobin from human blood
 CO2. Students have understood how to count various blood cells
 CO3. Students have understood how to determine blood parameters like ESR, PCV
 CO4. Students have understood to use of colorimeter for standard graph preparation
 CO5. Students have understood how to perform routine urine analysis
 CO6. Students have understood how to analyze the observations, interpret and conclude the result and predict the diagnosis.

No of Experiments	Topic	Teaching Hours
1-3	Perform routine urine analysis	12
	a. Physical	
	b. Chemical	
	c. Microscopic	
4	Determine blood group	4
5-6	Estimation of hemoglobin by Sahli's and cynmet method	8
7	Determine differential WBC count	4
8	Determine total WBC count	4
9	Determination of bleeding time	4
10	Determination of clotting time	4
11	Determination of ESR	4
12	Determination of PCV	4
13	Standard graph preparation using colorimeter (CuSO ₄)	4
14	Observation of permanent slide of <i>Plasmodium</i>	4
15	Preparation of plasma and serum	4

References:

1. Todd and Stanford's Clinical Diagnosis and Lab Management.
2. Atlas and Text of Haematology by Tejinder Singh.
3. Text Book on Thyroid Pathology by Geetha Jayaram
4. Robbins Pathology
5. Text Book of Microbiology by C.P. Baveja
6. Harper's Text book of Biochemistry

Mapping of Program Outcomes with Course Outcomes**Class:** F.Y.B.Sc. (Sem II)**Subject:** Microbiology**Course:** Clinical Pathology**Course Code:** MIB-176-SEC**Weightage:** 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)								
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3								
CO 2	3								
CO 3	3								
CO 4	3	2							
CO 5	3								
CO 6	3	2		3					

Justification for the mapping**1. Disciplinary Knowledge:**

CO1: Students who have understood how to estimate haemoglobin from human blood will have gained valuable knowledge about a fundamental aspect of clinical medicine and diagnostics, which is crucial for healthcare professionals in their practice.

CO2: Understanding how to count various blood cells is a fundamental skill for healthcare professionals, including haematologists, clinical laboratory scientists, and medical technologists.

CO3: Understanding how to determine these blood parameters is critical for healthcare professionals, including clinical laboratory scientists, medical technologists, and physicians. ESR is a valuable tool for identifying underlying inflammatory or infectious conditions, while PCV is crucial for assessing red blood cell concentration and diagnosing conditions related to blood volume and composition.

CO4: Understanding how to use a colorimeter for standard graph preparation is a valuable skill for students pursuing careers in analytical chemistry, research, or quality control, as it allows for the precise and quantitative analysis of substances in a wide range of applications.

CO5: Understanding how to perform routine urine analysis is a critical skill for medical laboratory technicians, clinical laboratory scientists, nurses, and other healthcare professionals. It aids in the diagnosis and monitoring of various medical conditions and helps ensure the well-being of patients.

CO6: The ability to analyze data, interpret findings, draw conclusions, make accurate diagnoses, and predict outcomes is crucial in fields such as science, medicine, research, and various other domains. It requires a

combination of knowledge, critical thinking, problem-solving skills, and effective communication. This skill set is essential for making informed decisions, advancing knowledge, and providing quality healthcare.

2. Critical Thinking and Problem solving:

CO4: Understanding how to use a colorimeter for standard graph preparation showcases students' ability to think critically, plan experiments, troubleshoot problems, and interpret data accurately. These skills are valuable in various scientific fields, including chemistry, biochemistry, and analytical chemistry, and contribute to the advancement of knowledge and the accuracy of scientific measurements and predictions.

CO6: Developing strong critical thinking and problem-solving skills in the context of analyzing observations and predicting diagnoses is invaluable for students pursuing careers in healthcare, research, or any field that requires sound judgment and decision-making. These skills enable them to make well-informed, evidence-based decisions and contribute to advancing knowledge and patient care.

3. Research-related skills and Scientific temper:

CO6: Cultivating research-related skills and a scientific temper empowers students to think critically, conduct rigorous research, and contribute to the advancement of knowledge. These skills are applicable across a wide range of scientific and healthcare disciplines and are vital for making informed decisions, improving healthcare, and addressing complex research questions.