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 -I

To be implemented from Academic Year 2023-2024

(Eligibility : 12th Science)

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.

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 Commerce, Baramati

(Autonomous)

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 Human Welfare (2 credits) (Theory)	MIB-121-VSC Agricultural Microbiology (2 credits) (Theory)	ENG-131-AEC Functional English-I(2 credits) (Theory)	CC (2 credits)	22	UG Certificate 44 credits
		MIB-102-MJM Basic Techniques in Microbiology (2 credits) (Theory)			MIB-117-OE Food, Agricultural and Pharmaceutical Microbiology(2 credits) (Practical)	MIB-126-SEC Microbiology Laboratory Techniques (2 credits) (Practical)	MIB-135-VEC Environmental Science-I (2 credits) (Theory)			
							MIB-137-IKS Ethno-Microbiology(2 credits) (Theory)			
		MIB-103-MJM Laboratory Procedures in Microbiology (2 Credits) (Practical)								
	II	MIB-151-MJM Bacterial cytology (2 credits) (Theory)		MIB-161-MN Microbial diseases (2 credits)	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)	CC (2 credits)	22	

		MIB-152-MJM Fundamental Microbiology (2 credits) (Theory)		**(Theory)**	**MIB-167-OE Biofertilizer Production (2 credits) (Practical)**	**MIB-176-SEC Clinical pathology(2 credits) (Practical)**	**MIB-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**	

*** 1 credit = 15 Hr.**

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

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

Name of the Programme : B.Sc. Microbiology

Program Code : USMIB

Class : F.Y.B.Sc.

Semester I

Course Type : Major Mandatory (Theory)

Course Code : MIB-101-MJM

Course Title : Introduction to Microbiology

No. of Credits 02

No. of Teaching Hours 30

Course Objectives:

1. To enrich the knowledge of undergraduate science faculty students about the different areas of microbiology.
2. To allow students to understand the mysterious world of microorganisms.
3. To explain the various categories of microorganisms and their general characteristics.
4. To make students understand the role of beneficial microorganisms present in different habitats.
5. To allow students to understand the general classification scheme of living things.
6. To understand the historical developments in the field of microbiology.
7. To enrich students' knowledge about recent inventions and discoveries in microbiology.

Course Outcomes:

CO1 The students will acquire the basic knowledge of microbiology fields by the freshers in microbiology.

CO2 The students will be aware of the importance of microorganisms concerning beneficial and harmful impacts on society.

CO3 The students shall be aware of modern microbial technology for future developments.

CO4 The students will be able to distinguish the different categories of microorganisms.

CO5 The students will be able to identify the various processes happening in the surrounding domestic environment in which microbes are involved.

CO6 Understanding the historical developments in microbiology, students shall earn knowledge about setting up basic experiments.

CO7 Students shall learn about the theory of the origin of life and the experimental setups leading to different conclusions.

CO8 Students shall learn about how different experimental setups led to different conclusions.

CO9 Understanding the significant developments in recent times shall direct the students in the selection of microbiology fields for the future.

	Topic & Learning Points	Teaching Hours
Unit 1	**Scope and Application of Microbiology** a. Industrial Microbiology and Biotechnology b. Medical Microbiology c. Immunology d. Microbial Genetics e. Geomicrobiology f. Food and Dairy Microbiology g. Nano-Biotechnology	**4**
Unit 2	**Applications of Microbiology with special reference to:** a. Significance of normal flora and probiotics in human health b. Microbes as Biofertilizers (e.g. Nitrogen fixers, Phosphate solubilizers) and Biocontrol Agents (*Bacillus thuriengensis*) c. Use of bacteriophages as biocontrol agents in agriculture	**4**
Unit 3	**Morphological and differentiating characters ofmicroorganisms:** a. Whittaker five Kingdom classification system b. Structures of prokaryotic and eukaryotic cell c. Bacteria: (Eubacteria, Archaebacteria, Rickettsia, Chlamydia,Actinomycetes, Mycoplasma and bacterivorous bacteria); Introduction to Bergey's Manual of Determinative and Systemic Bacteriology d. Protozoa e. Algae f. Fungi (Molds and Yeasts) g. Viruses (Animal & plant viruses, Bacteriophages) h. Viroids and prions	**8**
Unit 4	**History of Microbiology** a. Invention of microscope (Micrographia of Antony van Leeuwenhoek and Robert Hooke) b. Abiogenesis v/s biogenesis i. Aristotle's notion about spontaneous generation; Needham's experiment ii. Redi's experiment iii. Louis Pasteur's & Tyndall's experiments	**4**
Unit 5	**Development of Microbiology in 19th century** a. Observations and role of microorganisms in transformation of organic matter. i. Germ theory of fermentation ii. Discovery of anaerobic life & physiological significance offermentation b. Discovery of microbes as pathogens and disease prevention	**7**

i. Surgical antisepsis (Joseph Lister-Father of modern surgery)
ii. Germ theory of disease – Robert Koch's experiment, Koch's & River's postulates
iii. Vaccination: Edward Jenner and Louis Pasteur – chicken choleraand Rabies

Unit 6 Developments in 20th and 21st Centuries with respect to: 3

a. Chemotherapy : Paul Ehrlich, Domagk, Walkman and Alexander Fleming
b. Contributions of Nobel Laureates (Elie Metchnikoff, Burnett, George Beadle, Edward Tatum, Porter and Edelman, Kohler andMilstein)
c. Molecular Biology & Biotechnology: Watson and Crick and Hargobind Khurana

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, NewYork.
10. Mahendra Rai and Nelson Duran (2011). Metal Nanoparticles in Microbiology, Springer, Verlag Berlin Heidelberg.

CBCS Syllabus as per NEP 2020 for F. Y. B. Sc. Microbiology

(2023 Pattern)

Name of the Programme	**: B.Sc. Microbiology**
Program Code	**: USMIB**
Class	**: F.Y.B.Sc.**
Semester	**I**
Course Type	**: Major Mandatory (Theory)**
Course Code	**: MIB-102-MJM**
Course Title	**: Basic Techniques in Microbiology**
No. of Credits	**02**
No. of Teaching Hours	**30**

Course Objectives:

1. To introduce students to the fundamental principles and techniques used in microbiology, focusing on microscopy, staining, and sterilization methods.
2. To familiarize students with the different types of microscopes, their components, and their applications in microbiological research.
3. To provide students with an understanding of the principles and procedures involved in staining techniques for microbial visualization and differentiation.
4. To introduce students to the principles and applications of different types of microscopy, such as bright-field, fluorescence and electron microscopy
5. To develop students' theoretical knowledge of microscope maintenance, calibration, and troubleshooting.
6. To enable students to comprehend the significance of proper staining techniques in microbial identification and classification.
7. To enhance students' understanding of the importance of aseptic techniques and sterilization in preventing contamination and ensuring accurate experimental results.

Course Outcomes:

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

CO2. Students will acquire knowledge of the different staining techniques used in microbiology, including simple staining, differential staining

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

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

CO5. Students will gain knowledge about performing sterilization and disinfection methods

CO6. Students will recognize the importance of aseptic techniques and sterile handling in microbiological experiments, ensuring accurate results.

CO7. Students will applying the learned techniques to analyze and interpret experimental data in the context of microbiology.

Topic & Learning Points	Teaching Hours

UNIT1: Microscopy **10**

• Structure, working and ray diagram of Bright Field Microscopy

• Concepts of Magnification, Numerical Aperture and Resolving Power

• Types and functions of :

a) Condensers

b) Eye-pieces

c) Objectives

• Aberrations in lenses :(Spherical, Chromatic, Comma and Astigmatism)

• Principle and Applications of:

a) Fluorescence Microscopy

b) Electron Microscopy

UNIT2: Staining Techniques **10**

• Definitions of Stain; Types of stains (Basic and Acidic)

• Properties and role of Fixatives, Mordants, Decolorisers and Accentuators

• Principles of staining techniques of the following:

a) Monochrome staining

b) Negative (Relief) staining

c) Differential staining -(Gram staining and Acid-Fast staining)

UNIT3: Sterilization and Disinfection **10**

- Definition and concept of sterilization and disinfection

- Physical methods –
    a) Heat
    b) Radiation
    c) Filtration
- Chemical agents and their mode of action –
    a) Aldehydes
    b) Halogens
    c) Quaternary ammonium compounds
    d) Phenol and phenolic compounds
    e) Heavy metals
    f) Alcohol
    g) Detergents
- Characteristics of an ideal Disinfectant
- Concept of Phenol Coefficient

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. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata MacGraw Hill Press.

6. McDonnell G. E. (2020). Antisepsis, Disinfection, and Sterilization: Types, Action, and Resistance. United States: Wiley.

7. Murphy D. B. and Davidson M. W. (2012). Fundamentals of Light Microscopy and Electronic Imaging. Germany: Wiley.

CBCS Syllabus as per NEP 2020 for F. Y. B. Sc. Microbiology

(2023 Pattern)

Name of the Programme	**: B.Sc. Microbiology**
Program Code	**: USMIB**
Class	**: F.Y.B.Sc.**
Semester	**I**
Course Type	**: Major Mandatory Practicals**
Course Code	**: MIB-103-MJM**
Course Title	**: Laboratory Procedures in Microbiology**
No. of Credits	**02**
No. of Teaching Hours	**60**

Course Objectives:

1. To enrich students' knowledge and train them in core Microbiology
2. To teach students the various methods of sterilization and their significance in maintaining aseptic conditions in the laboratory.
3. To provide students with hands-on experience in microbial staining techniques for microscopic examination.
4. Students will get acquainted with skills of aseptic culture technique
5. To introduce students to the techniques of microbial enumeration and quantification
6. To make students proficient at laboratory skills and safety procedures.
7. Students will develop critical thinking and problem-solving

Course Outcomes:

CO1. Students will be Introduced to microbiology laboratory and common microbiology laboratory instruments.

CO2. Students will gain proficiency in preparing and interpreting stained microbial slides under the microscope.

CO3. Students will be able to analyze and interpret microscopic images of microorganisms and describe their morphological features.

CO4. Students will understand the significance of proper microscope maintenance, calibration, and troubleshooting for optimal microscopy results.

CO5. Students will be able to perform staining techniques to visualize and differentiate microorganisms under the microscope.

CO6. Students will gain knowledge Students will be able to enumerate and quantify microorganisms using different methods

CO7. Students will get expertise to work directly in applied fields (industry or institutions), without any additional training.

No of Experiments	Topic	Teaching Hours
1	Introduction to microbiology laboratory instruments: Incubator, Hot Air Oven, Autoclave	4
2	Introduction to microbiology laboratory instruments: Colorimeter, pH Meter, Laminar air flow hood, Centrifuge	4
3	Construction (mechanical and optical), working and care of Bright Field Microscope	4
4	Observation of Microorganisms (Bacteria, Protozoa, Molds and Yeasts, Algae) using bright field microscope from pond water	4
5	Observation of Microorganisms (Bacteria, Protozoa, Molds and Yeasts, Algae) using bright field microscope wastewater	4
6	Preparation of Winogradsky column and observation of different types of microorganisms using bright field microscope	4
7-10	Observation of bacteria using staining techniques: a. Monochrome staining	4
	b. Negative /Relief staining	4
	c. Capsule staining (Maneval's method)	4
	d. Gram staining	4
11	Observation of motility in bacteria using: Hanging Drop Method	4
12	Enumeration of cells using Neubauer chamber	4
13	Preparation of molar solutions	4
14	Preparation of normal solutions	4
15	Determination of pH of different natural samples viz., coconut water, fruit juices, milk, soil, pond water, wastewater	4

References:

1. James G. Cappuccino and Natalie Sherman (2014) Microbiology: A Laboratory Manual, 10th Edition Pearson.

2. David T. Plummer (2010) An introduction to practical biochemistry: By McGraw-Hill

3. Dr. R.C. Dubey and Dr. D.K. Maheshwari (2010) - Practical Microbiology

4. Burton E.Pierce and Michael J.Leboffe(2012) Microbiology laboratory theory and application 3rd edition

5. Harley J. P. and Prescott L. (2020). Laboratory Exercises in Microbiology. Independently Published.

6. Karwa A.S., Rai M.K. and Singh H.B. (2012). Handbook of Techniques in Microbiology: A Laboratory Guide to Microbes. Scientific Publishers, Jodhpur, Rajasthan, India

7.Kumar V. (2012). Laboratory Manual of Microbiology. Scientific Publishers, Jodhpur, Rajasthan, India

8. Sastry A. S. and Bhat S. K. (2017). Essentials of Practical Microbiology. Jaypee Brothers, Medical Publishers Private Limited, Pune, Maharashtra, India

CBCS Syllabus as per NEP 2020 for F. Y. B. Sc. Microbiology

(2023 Pattern)

Name of the Programme	**: B.Sc. Microbiology**
Program Code	**: USMIB**
Class	**: F.Y.B.Sc.**
Semester	**I**
Course Type	**: Open Elective (Theory)**
Course Code	**: MIB-116-OE**
Course Title	**: Microorganisms for Human Welfare**
No. of Credits	**02**
No. of Teaching Hours	**30**

Course Objectives:

1. To enrich the knowledge of undergraduate science faculty students about the different areas of microbiology.
2. To allow students to understand the role of microorganisms in food fermentation.
3. To explain the various categories of microorganisms involved in agriculture.
4. To make students understand the role of beneficial microorganisms present in rhizosphere.
5. To allow students to understand the general characters of drugs produced in pharmaceutical industry.
6. To understand the use of different antibiotics in chemotherapy.
7. To enrich students' knowledge about developments in vaccine technology.

Course Outcomes:

CO1. The students will acquire the basic knowledge of microbiology fields by the freshers in microbiology.

CO2. The students will be aware of the importance of microorganisms concerning beneficial role in foods.

CO3. The students shall be aware of modern microbial technology for agricultural developments.

CO4. The students will be able to distinguish the role of microorganisms in different fields of microbiology.

CO5. The students will be able to identify the various processes happening in the surrounding domestic environment in which microbes are involved.

CO6. Students shall earn knowledge about setting up basic experiments.

CO7. Students shall learn about the differences among drugs, antibiotics and vaccines.

CO8. Students shall learn about how different experimental setups led to different conclusions.

CO9. Understanding the significant developments in recent times in the development of vaccines.

	Topic & Learning Points	Teaching Hours
Unit 1	**Fermented food & it's products**	**10**
	Fermented Foods – Types, nutritional values and health benefits. Probiotics, prebiotics, synbiotics and nutraceuticals. Fermented Products – Alcoholic and non-alcoholic beverages, dairy products.	
Unit 2	**Agricultural Microbiology**	**10**
	Introduction to agricultural microbiology.	
	Bio-fertilizers and bio-pesticides - types and applications, beneficial microorganisms in agriculture, arbuscular mycorrhiza fungi, mushroom cultivation, biogas production	
Unit 3	**Pharmaceutical Microbiology**	**10**
	Introduction to pharmaceutical microbiology.	
	Drugs – types, development and applications. Antibiot functions and antibiotic therapy. Vaccines – types, pro functions and schedules.	

References:

Ananthnarayanan, R and Jeyaram Panicker, C. K. 2010.Textbooks of Microbiology, Orient Longman.

2. Dubey, R.C. and Maheshwari, D.K. 2013. A Textbook of Microbiology –2 nd edition (S chand & Co. N. Delhi).

3. Michael, J. Pelczar, Jr. E.C.S., Chan, Noel R. 1998. Krieg Microbiology Tata McGraw-Hill Publisher.

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5. Prescott, L.M., Harley, J.P. and Klein, D.A., 2007. Microbiology –7 th edition (Wm. C. Brown Publishers, USA) Elementary Microbiology – Modi, HA (vol. I), 1st edition (Ekta Pakashan, Nadiad).

6. Prescott, M.J., Harly, J.P. and Klein 2002. Microbiology 5ft Edition, WCB McGraw Hill, New York.

7. Sateesh, M.K. 2010. Bioethics and Biosafety. IK International Pvt Ltd. 2. Dubey, RC A Textbook of Biotechnology. S Chand Publications.

8. Singh, B.D. 2013. Expanding Horizons in Biotechnology. Kalyani Publication.

9. Sree Krishna, V. 2007. Bioethics and Biosafety in Biotechnology, New age international publishers

10. Willey, J.M., Sherwood L.M and Woolverton C.J., Prescott, Harley and Klein's. 2013. Microbiology. McGraw Hill Higher education. 9th Edition.

CBCS Syllabus as per NEP 2020 for F. Y. B. Sc. Microbiology

(2023 Pattern)

Name of the Programme : B.Sc. Microbiology

Program Code : USMIB

Class : F.Y.B.Sc.

Semester I

Course Type : Open Elective (Practical)

Course Code : MIB-117-OE

Course Title : Food, Agricultural and Pharmaceutical Microbiology

No. of Credits 02

No. of Teaching Hours 60

Course Objectives:

1. To enrich students' knowledge and train them in basic fermentation technology
2. To teach students the various methods of production of alcoholic beverages 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 Outcomes:

CO1. Students will be able to perform the production of alcoholic beverage in laboratory.

CO2. Students will understand the different types of raw materials that can be used in the production of alcoholic beverages.

CO3. Students will be able to analyze 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.

No of Experiments	Topic	Teaching Hours
1-4	Production of ethanol: a. using grape juice as raw material b. using jaggery medium as raw material c. assembly, decontamination, inoculation, incubation d. harvesting of broth	16
5	Production of curd	4
6-8	Production of mushrooms: a. Pretreatment of paddy straw b. Inoculation c. Production & harvesting	12
9-12	Production of biofertilizer: a. Isolation of *Azotobacter* sp. b. Biomass production c. Preparation of biofertilizer d. Application	16
13	Isolation of antibiotic producing microorganisms by crowded plate technique	4
14	Antibacterial activity assay	4
15	Antifungal activity assay	4

References:

1. James G. Cappuccino and Natalie Sherman (2014) Microbiology: A Laboratory Manual, 10th Edition Pearson.

2. David T. Plummer (2010) An introduction to practical biochemistry: By McGraw-Hill

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CBCS Syllabus as per NEP 2020 for F. Y. B. Sc. Microbiology

(2023 Pattern)

Name of the Programme	**: B.Sc. Microbiology**
Program Code	**: USMIB**
Class	**: F.Y.B.Sc.**
Semester	**I**
Course Type	**: Vocational Skill Course (Theory)**
Course Code	**: MIB-121-VSC**
Course Title	**: Agricultural Microbiology**
No. of Credits	**02**
No. of Teaching Hours	**30**

Course Objectives:

1. To enrich the students knowledge about agricultural microbiology for building a pathway for sustainable agriculture.
2. To gain knowledge on several beneficial and harmful micro-organisms.
3. To know the complex interaction between agriculture system and micro-organism.
4. To make the students knowledgeable with respect to biofertilizer and biocontrol agents as a sense of social and environmental awareness.
5. To expose the students to various emerging areas of agricultural microbiology.
6. To develop their ability to apply the knowledge of agricultural microbiology in day to day life
7. To help students to buildup successful career.

Course Outcomes:

Students will be able to :

CO1. Understand the importance of microbiology in agriculture and its role in sustainable farming practices.
CO2. Learn about the beneficial and harmful roles of microorganisms in crop production.
CO3. Learn the interactions between microorganisms, plants, and the soil ecosystem.
CO4. Understand the roles of microorganisms in soil fertility and in plant growth promotion.
CO5. Gain knowledge of the principles and applications of microbial biofertilizers and biocontrol agents.
CO6. Stay updated with emerging trends and advancements in agriculture microbiology. Apply theoretical knowledge to practical situations for human welfare.

Topic & Learning Points	Teaching Hours

Unit 1: Soil microbiology **10**

- Types of soil
- Microbial community in soil
- Microflora in Rhizosphere and Phyllosphere
- Role of microbes in soil fertility and crop production
- Biological nitrogen fixation (symbiotic, asymbiotic and associative).

Unit 2: Agricultural microbiology **10**

- Introduction to agricultural microbiology.
- Scope and importance of agricultural microbiology.
- Role of microorganisms in soil and plant ecosystems.
- Beneficial and harmful microorganisms in agriculture.

Unit 3: Microbiology for sustainable agriculture **10**

- Microbial biofertilizers: definition, types of biofertilizers.
- Biocontrol agents for plant diseases.
- Recent emerging trends in agricultural microbiology.

References:

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CBCS Syllabus as per NEP 2020 for F. Y. B. Sc. Microbiology

(2023 Pattern)

Name of the Programme	**: B.Sc. Microbiology**
Program Code	**: USMIB**
Class	**: F.Y.B.Sc.**
Semester	**I**
Course Type	**: Skill Enhancement Course (Practical)**
Course Code	**: MIB-126-SEC**
Course Title	**: Microbiology Laboratory Techniques**
No. of Credits	**02**
No. of Teaching Hours	**60**

Course Objectives:

1. To introduce students to the fundamental concepts and principles of microbiology and its practical applications.
2. To familiarize students with the basic laboratory techniques used in microbiology research and diagnostics.
3. To develop students' skills in aseptic technique and safe handling of microorganisms.
4. To enable students to understand and perform various methods of microbial cultivation
5. To teach students the principles and procedures involved in handling of instruments
6. To make student knowledgeable about microbiological techniques and the impact of microbes on our daily lives
7. To enhance students' understanding of laboratory safety practices and waste disposal methods in microbiology.

Course Outcomes:

CO1. To cater the needs of students for building up their careers in industry & research

CO2. To enrich student’s knowledge and train them in core Microbiology.

CO3. To inculcate sense of scientific responsibilities, social and environment awareness

CO4. To help students build-up a progressive and successful career.

CO5. Students will be able to demonstrate proficiency in aseptic technique and proper handling of microorganisms.

CO6. Students will acquire the skills to cultivate different types of microorganisms using various media and techniques.

CO7. Students will demonstrate an understanding of laboratory safety guidelines & procedures to ensure the safe handling & disposal of microorganisms and laboratory waste.

CO8. Students will get expertise to work directly in applied fields (industry or institutions), without any additional training.

No of Experiments	Topic	Teaching Hours
1-8	Handling of the following instruments with respect to SOP:	
	a. Laminar air flow	4
	b. Incubator	4
	c. Water bath	4
	d. Colorimeter	4
	e. Micropipette	4
	f. pH meter	4
	g. Distillation	4
	h. Refrigerator	4
9	Cleaning of glassware	4
10	Wrapping of glassware	4
11	Preparation of media and slants	4
12	Sterilization of media and glassware	4
13	Preparation of stains and reagents	4
14	Fumigation techniques	4
15	Disposal of laboratory waste	4

References:

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CBCS Syllabus as per NEP 2020 for F. Y. B. Sc. Microbiology

(2023 Pattern)

Name of the Programme	**:B.Sc. Microbiology**
Program Code	**: USMIB**
Class	**: F.Y.B.Sc.**
Semester	**I**
Course Type	**: IKS (Theory)**
Course Code	**: MIB-137-IKS**
Course Title	**: Ethno-Microbiology**
No. of Credits	**02**
No. of Teaching Hours	**30**

Bhārata has a very rich and versatile knowledge system and cultural heritage. The Bhāratīya knowledge system was developed during the Vedic period, the Saraswatī-Sindhu Civilization, the Middle ages and practiced till the conditions of modern times. Inthis course, a special attention is given to the reasons of ideas occurrence in the ancientsociety, and connection with the concept of material world, and religious, social, andcultural beliefs. On the closer examination religion, culture and science have appearedepistemological very rigidly connected in the Bhāratīya knowledge system. As such, thisland has provided invaluable knowledge stuff to the society and the world in all thespheres of life; e.g. aeronautics, science, astronomy, mathematics, life science, medicalscience, architecture, art, music, dance, literature, and drama.Over the period, most of the works were either lost or confined to the libraries orpersonal possessions. However, some of the activities are still in practice of the massesunknowing the scientific and practical values. Given the nature of course and diversityof the learners' fields, the course is designed to provide a broad-spectrum of theBhāratīya knowledge system. The main objectives of this course are as follows:

1.Creating awareness amongst the youths about the true history and rich culture of thecountry;
2. Understanding the scientific value of the tradition and culture of the Bhārata;
3.Promoting the youths to do research in the various fields of Bhāratīya knowledgetradition;
4. Converting the Bhāratīya wisdom into the applied aspect of the modern scientificparadigm;
5. Adding career, professional and business opportunities to the youths.

Course Objectives:

1. To enrich students' knowledge about the traditional Indian fermented foods.
2. To allow students to understand about various benefits of Indian fermented foods.
3. To help students to understand fermentation process.
4. To allow students to understand microbiology behind the fermentation of food.
5. To allow students to understand fermentation of food, translate concepts to real-life situations and apply acquired competencies in new/unfamiliar contexts
6. To allow students to preserve and pass on the knowledge of ethnic fermented food.
7. To enrich students' knowledge about usage of fermentation in food preparation.

Course Outcomes:

CO1. The student should be able to apply the knowledge fermentation in food preparation.
CO2. Graduates should be able to demonstrate the acquisition of capacity to extrapolate from what has been learned about fermentation, translate concepts to real-life situations and apply acquired competencies in new/unfamiliar contexts, rather than merely replicate curriculum content knowledge, to generate solutions to specific problems.
CO3. Graduates should be able to demonstrate the acquisition of comprehensive knowledge and coherent understanding of ethnic fermented food.
CO4. Graduates should be able to demonstrate the acquisition of comprehensive knowledge and coherent understanding of fermentation process.
CO5. Graduates should be able to demonstrate the acquisition of comprehensive knowledge and coherent understanding of microorganism's role in fermentation.
CO6. Graduates should be able to demonstrate the acquisition of comprehensive knowledge and coherent understanding of benefits of ethnic fermented food.
CO7. Graduates should be able to preserve and pass on the knowledge of ethnic fermented food.
CO8. Awareness amongst the youths about the true history and rich culture of the country.
CO9. The youth will be an individual with a great sense of patriotism and nation-pride.
CO10. The youths will be self-motivated to do research in the various fields of Bhāratīya knowledge tradition.
CO11. The students would be able to convert Bhāratīya wisdom into the applied aspect of the modern scientific paradigm.

Topic & Learning Points **Teaching Hours**

UNIT 1: Ancient Bhartiya Contribution towards Science & Mathematics (4L)

Concept of Matter, Life and Universe, Gravity, Sage Agastya's Model of Battery,Velocity of Light, Vimāna: Aeronautics, Vedic Cosmology and Modern Concepts,BhāratīyaKāla-gaṇanā, Kerala School for Mathematics and Astronomy, History andCulture of Astronomy, Sun, Earth, Moon, and Eclipses, Earth is Spherical andRotation of Earth, Archaeostronomy; Concepts of Zero and Pi, Number System,Pythagoras Theorem, and Vedic Mathematics

UNIT 2: Ancient Bhartiya Contribution in Environment & Health (4L)

Ethnic Studies, Life Science in Plants, Anatomy, Physiology, Agriculture, Ecology andEnvironment, Āyurveda, Integrated Approach to Healthcare, Medicine,Microbiology, Medicine, Surgery, and Yoga, etc.

UNIT 3: Introduction to Ethno-microbiology (4L)

- Definition of Ethno-microbiology
- Definition of Fermentation
- Historic and cultural heritage of Indian fermented foods
- Types of ethnic fermented foods
- Benefits of fermented food

UNIT 4: Curd Fermentation (6L)

- Procedure of curd setting
- Microorganisms present in curd
- Role of microbes in setting curd
- Benefits of consuming curd

UNIT 5: Idli Fermentation (6L)

- Preparation of idli batter and idli
- Microorganisms present in idli batter
- Role of microbes in fermenting idli batter
- Benefits of consuming idli

UNIT 6: Jilebi Fermentation (6L)

- Preparation of Jilebi batter and Jilebi
- Microorganisms present in Jilebi batter
- Role of microbes in fermenting Jilebi batter
- Benefits of consuming Jilebi

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11. Pride of India- A Glimpse of India's Scientific Heritage edited by PradeepKohle et al.SamskritBharati (2006)

Examination Pattern / Evaluation Pattern

Teaching and Evaluation (for Major, Minor, AEC, VEC, IKS courses)

Course Credits	No. of Hours per Semester Theory/Practical	No. of Hours per Week Theory/Practical	Maximum Marks	CE 40 %	ESE 60%
1	15 / 30	1 / 2	25	10	15
2	30 / 60	2 / 4	50	20	30
3	45 / 90	4 / 6	75	30	45
4	60 / 120	4 / 8	100	40	60

Teaching and Evaluation (for VSC, SEC & CC courses)

- Evaluation to be done by Internal & External Experts
- No descriptive end semester written examination
- Evaluation to be done at Department level preferably prior to commencement of Theory /Practical Examinations

Evaluation to be done on the Skills gained by student