Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

Three/Four Year Honours/Honours with Research,

B.Sc. Degree Program in Microbiology

(Faculty of Science and Technology)

Choice-Based Credit System Syllabus

NEP-2.0

(2024 Pattern as per NEP 2020)

F. Y. B. Sc. Microbiology

Semester I and II

To be implemented from Academic Year 2024-2025

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, 2024 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 and II 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, Circular of SPPU, Pune dated 31st May 2023, Government of Maharashtra circular dated March 13, 2024, which introduced three major courses in the first year, and the Circular of SPPU, Pune dated May 2, 2024, regarding credit distribution structures.

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 inthe 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 Three/Four Year Honours/Honours with Research Degree Programme in Microbiology with Multiple Entry and Exit Options as per National Education Policy (2024 Pattern as per NEP-2020)

Level/Difficulty	Sem	Subject DSC-1				Subject DSC-2	Subject DSC-3	GE/OE	SEC	IKS	AEC	VEC	CC	Total
4.5/100	I	2(T)+2(P)				2(T)+2(P)	2(T)+ 2(P)	2(T)	2 (T/P)	2(T)(Generic)	2(T)	2(T)	--	**22**
	II	2(T)+2(P)				2(T)+2(P)	2(T)+2(P)	2(P)	2 (T/P)	--	2(T)	2(T)	2(T)	**22**
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/Internship OR Continue with Major and Minor **Continue option**: Student will select one subject among the (subject 1, subject 2 and subject 3) as major and other as minor and third subject will be dropped.														
Level/Difficulty	**Sem**	**Credits Related to Major**				**Minor**	**--**	**GE/OE**	**SEC**	**IKS**	**AEC**	**VEC**	**CC**	**Total**
		Major Core	**Major Elective**	**VSC**	**FP/OJT/CEP/RP**									
5.0/200	III	4(T)+2(P)	--	2 (T/P)	2(FP)	2(T)+2(P)	--	2(T)	--	2(T)	2(T)	--	2(T)	**22**
	IV	4(T)+2(P)	--	2 (T/P)	2(CEP)	2(T)+2(P)	--	2(P)	2 (T/P)	--	2(T)	--	2(T)	**22**
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4credits core NSQF course/Internship OR Continue with Major and Minor														
5.5/300	V	8(T)+4(P)	2(T)+2(P)	2 (T/P)	2(FP/CEP)	2(T)	--	--	--	--	--	--	--	**22**
	VI	8(T)+4(P)	2(T)+2(P)	2 (T/P)	4 (OJT)	--	--	--	--	--	--	--	--	**22**
Total 3Years		**44**	**8**	**8**	**10**	**18**	**8**	**8**	**6**	**4**	**8**	**4**	**6**	**132**
Exit option: Award of **UG Degree in Major** with 132 credits OR Continue with Major and Minor														
6.0/400	VII	6(T)+4(P)	2(T)+2 (T/P)	--	4(RP)	4(RM)(T)	--	--	--	--	--	--	--	**22**
	VIII	6(T)+4(P)	2(T)+2 (T/P)	--	6(RP)	--	--	--	--	--	--	--	--	**22**
Total 4Years		**64**	**16**	**8**	**22**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours with Research Degree** in Major and Minor with 176 credits														
6.0/400	VII	10(T)+4(P)	2(T)+2 (T/P)	--	--	4(RM) (T)	--	--	--	--	--	--	--	**22**
	VIII	10(T)+4(P)	2(T)+2 (T/P)	--	4 (OJT)	--	--	--	--	--	--	--	--	**22**
Total 4Years		**72**	**16**	**8**	**14**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours Degree** in Major and Minor with 176 credits														

T = Theory **P** = Practical **DSC** = Discipline Specific Course **OE** = Open Elective **SEC** = Skill Enhancement Course **IKS** = Indian Knowledge System **AEC** = Ability Enhancement Course **VEC** = Value Education Course **CC** = Co-curricular Course **VSC**= Vocational Skill Course **OJT**= On Job Training **CEP**= Community Engagement Project **FP**= Field Project **RP**= Research Project

Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati (Autonomous)

NEP-2.0

Course Structure for F.Y.B.Sc. Microbiology (2024 Pattern as per NEP-2020)

Sem	Course Type	Course Code	Course Title	Theory / Practical	Credits
I	DSC-I (General)	-101-GEN		T	02
		-102-GEN		P	02
	DSC-II (General)	-101-GEN		T	02
		-102-GEN		P	02
	DSC-III (General)	MIB-101-GEN	Introduction to Microbiology	T	02
		MIB-102-GEN	Practical Course I	P	02
	Open Elective (OE)	MIB-103-OE	The Microbial World	T	02
	Skill Enhancement Course (SEC)	MIB-104-SEC	Skills in Microbiology I	P	02
	Ability Enhancement Course (AEC)	ENG-104-AEC		T	02
	Value Education Course (VEC)	ENV-105-VEC		T	02
	Generic Indian Knowledge System (GIKS)	GEN-106-IKS		T	02
				Total Credits Semester-I	**22**
II	DSC-I (General)	-151-GEN		T	02
		-152-GEN		P	02
	DSC-II (General)	-151-GEN		T	02
		-152-GEN		P	02
	DSC-III (General)	MIB-151-GEN	Fundamental Microbiology	T	02
		MIB-152-GEN	Practical Course II	P	02
	Open Elective (OE)	MIB-153-OE	Basic Microbiological Practices	P	02
	Skill Enhancement Course (SEC)	MIB-154-SEC	Skills in Microbiology II	P	02
	Ability Enhancement Course (AEC)	ENG-154-AEC		T	02
	Value Education Course (VEC)	COS-155-VEC		T	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS/NCC-156-CC	To be selected from the CC Basket	T	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(2024 Pattern) NEP-2.0

SYLLABUS (CBCS as per NEP 2020) for F.Y.B.Sc. Microbiology

Name of the Programme : B.Sc. Microbiology
Program Code : USMI
Class : F.Y. B.Sc.
Semester : I
Course Type : Theory
Course Code : MIB-101-GEN
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
Unit1	**Scope and Application of Microbiology**	**4**
	a. Industrial Microbiology and Biotechnology b. Medical Microbiology c. Immunology d. Microbial Genetics e. Geomicrobiology f. Food and Dairy Microbiology g. Nano-Biotechnology	

Unit2	**Applications of Microbiology with special reference to:**	**4**
	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	

Unit3	**Morphological and differentiating characters of microorganisms:**	**8**
	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) f. Viruses (Animal & plant viruses, Bacteriophages) g. Viroids and prions	

Unit4	**History of Microbiology**	**4**
	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	

Unit5	Development of Microbiology in 19th century	7
	a. Observations and role of microorganisms in transformation of organic matter. i. Germ theory of fermentation ii.Discovery of anaerobic life & physiological significance of fermentation b. Discovery of microbes as pathogens and disease prevention 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 cholera and Rabies	

Unit6	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 and Milstein) 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 Mac Graw Hill Publishing Co.
3. Stanier R.Y., Adelberg E. A. and Ingraham J.L. (1987). General Microbiology, 5th Edition. Macmillan Press Ltd.
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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 Mac Graw Hill Press.
7. Nelson D.L. and Cox M. M. (2002) Lehninger's Principles of Biochemistry, MacMillan 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:

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

	Programme Outcomes (POs)												
Course outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	2	2	2	1	2	2	1	1	2	1
CO2	3	2	1	2	2	3	1	2	2	1	2	2	1
CO3	3	3	2	2	2	2	2	2	3	1	2	2	1
CO4	3	2	1	3	2	2	1	2	2	1	1	2	1
CO5	3	2	1	2	3	2	2	2	2	1	2	2	1
CO6	3	2	1	2	2	3	2	3	2	1	1	3	1
CO7	3	2	1	2	2	3	3	3	2	1	1	3	1
CO8	3	2	1	2	3	2	3	3	2	1	1	3	1
CO9	3	2	2	2	2	2	2	2	3	1	2	2	1

Justification for Mapping:

PO1: Comprehensive Knowledge and Understanding

All course outcomes (COs) are directly related to acquiring foundational and advanced knowledge in microbiology, which is essential for PO1. Each CO significantly contributes to fulfilling the requirement of comprehensive knowledge and understanding in microbiology.

PO2: Practical, Professional, and Procedural Knowledge

COs like CO6, CO7, and CO8 involve practical knowledge of experimental setups and procedures in microbiology, contributing directly to PO2.

PO3: Entrepreneurial Mindset and Knowledge

CO3 includes awareness of modern microbial technology for future developments, which relates to entrepreneurial opportunities in biotechnology and microbiology. The focus is more on technological awareness rather than entrepreneurial skills.

PO4: Specialized Skills and Competencies

CO4 (distinguishing microorganism categories) and aspects of CO6, CO7, and CO8 (experimental setups and theories) contribute to developing specialized skills in microbiology.

PO5: Capacity for Application, Problem Solving, and Analytical Reasoning

COs such as CO5 (identifying processes involving microbes) and CO8 (analyzing experimental outcomes) directly enhance problem-solving and analytical reasoning skills in biological contexts.

PO6: Communication Skills and Collaboration

CO6, CO7, and CO8 involve understanding historical developments, theories, and experimental outcomes, which require communication of scientific ideas and potentially collaboration in research settings.

PO7: Research Related Skills

CO6, CO7, and CO8 specifically focus on understanding research methodologies, theories, and experimental designs in microbiology, contributing directly to research-related skills.

PO8: Learning How to Learn Skills
CO6, CO7, and CO8 involve understanding historical and contemporary developments in microbiology, which fosters the ability to learn independently and adapt to new knowledge. The relation is marked as 3, reflecting a strong alignment.
PO9: Digital and Technological Skills
CO3 emphasizes awareness of modern microbial technology, which directly relates to developing digital and technological skills in microbiology. The strong relation (3) reflects this alignment.
PO10: Multicultural Competence, Inclusive Spirit, and Empathy
While not directly addressed by the course outcomes listed, aspects of microbiology (like understanding societal impacts and diverse applications) can indirectly contribute to developing an inclusive spirit and awareness.
PO11: Value Inculcation and Environmental Awareness
CO2 includes awareness of microorganisms' impacts on society, which can include environmental aspects. However, the relation is marked as 2 (moderate) because the direct focus on environmental awareness is limited.
PO12: Autonomy, Responsibility, and Accountability
CO6, CO7, and CO8 involve understanding historical developments and experimental setups, which contribute to developing autonomy and responsibility in scientific research contexts reflecting strong alignment.
PO13: Community Engagement and Services
Aspects of microbiology (like understanding societal impacts and applications) can indirectly contribute to community engagement. The relation is marked as 1 (weak) due to indirect focus.

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Microbiology(2024 Pattern) NEP-2.0

SYLLABUS (CBCS as per NEP 2020) for F.Y.B.Sc. Microbiology

Name of the Programme	**: B.Sc. Microbiology**
Program Code	**: USMI**
Class	**: F.Y. B.Sc.**
Semester	**: I**
Course Type	**: Practical**
Course Code	**: MIB-102-GEN**
Course Title	**: Practical Course I**
No. of Credits	**: 02**
No. of Teaching Hours	**: 60**

Course Objectives:

1. To familiarize students with good laboratory practices and safety guidelines in microbiology experiments.
2. To introduce students to essential microbiology laboratory instruments such as incubator, hot air oven, and autoclave.
3. To acquaint students with laboratory instruments like colorimeter and pH meter used in microbiological analysis.
4. To demonstrate the use and operation of advanced microbiology instruments including laminar air flow cabinet and centrifuge.
5. To teach students various methods of disinfection and fumigation techniques used to maintain laboratory hygiene.
6. To enable students to observe and identify microorganisms (bacteria, protozoa, molds, yeasts, algae) using a bright-field microscope, particularly from pond water samples.
7. To instruct students in practical techniques such as simple staining, wet mount preparation for fungi, and observation of bacterial motility using the hanging drop method.

Course Outcomes:

CO1. Students will demonstrate proficiency in following good laboratory practices and adhering to safety guidelines during microbiology experiments.
CO2. Students will be able to operate and understand the principles of incubators, hot air ovens, and autoclaves used in microbiology laboratories.
CO3. Students will gain competency in using colorimeters and pH meters for quantitative analysis in microbiological experiments.
CO4. Students will develop skills in handling laminar air flow cabinets and centrifuges effectively in microbiology laboratory settings.
CO5. Students will acquire knowledge of various methods of disinfection and fumigation techniques essential for maintaining a sterile laboratory environment.
CO6. Students will identify and characterize microorganisms (bacteria, protozoa, molds, yeasts, algae) using a bright-field microscope, particularly from pond water samples.
CO7. Students will demonstrate proficiency in practical techniques such as simple staining, wet mount preparation for fungi, and observation of bacterial motility using the hanging

drop method.

No of Experiments	Topic	Teaching Hours
1	Good laboratory practices	4
2	Introduction to microbiology laboratory instruments: Incubator, Hot Air Oven, Autoclave	4
3	Introduction to microbiology laboratory instruments: Colorimeter, pH Meter,	4
4	Introduction to microbiology laboratory instruments: Laminar air flow, Centrifuge	4
5	Methods of disinfection and Fumigation techniques	4
6	Observation of Microorganisms (Bacteria, Protozoa, Molds and Yeasts, Algae) using bright field microscope from pond water	4
7	Observation of bacteria by Simple staining	4
8	Observation of fungi from natural samples by wet mount technique	4
9	Observation of motility in bacteria using: Hanging Drop Method	4
10	Enumeration of yeast cells by Direct microscopic count technique	4
11-12	Preparation of media: Nutrient Agar & Nutrient Broth	8
13	Methods of inoculation	4
14	Aseptic transfer techniques (slant to slant, broth to broth, broth to agar and Agar to Agar)	4
15	Isolation of antibiotic producing bacteria by crowded plate technique	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.

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

Mapping of course outcomes and programme outcomes:

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

	Programme Outcomes (POs)												
Course outcomes (COs)	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	2	3	1	1	2	1	1	2	1	1	1	2	1
CO2	2	3	1	2	1	1	1	2	2	1	1	2	1
CO3	2	2	1	1	2	1	1	2	3	1	1	2	1
CO4	2	3	1	3	1	1	2	2	2	1	1	2	1
CO5	2	3	1	2	2	1	1	2	1	1	1	2	1
CO6	2	2	1	1	1	1	2	2	1	1	1	2	1
CO7	2	2	1	1	1	2	2	2	1	1	1	2	1

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding
Each CO contributes to the understanding of fundamental laboratory practices, equipment operation, and techniques in microbiology, thereby aligning well with the acquisition of comprehensive knowledge and understanding

PO2: Practical, Professional, and Procedural Knowledge
CO1, CO2, CO4, CO5, CO6, and CO7 involve practical skills and procedural knowledge in microbiology laboratory settings, directly contributing to PO2.

PO3: Entrepreneurial Mindset and Knowledge
This is not directly covered by the listed COs as they primarily focus on laboratory techniques rather than entrepreneurial aspects (weak relations indicated).

PO4: Specialized Skills and Competencies
CO2, CO3, and CO4 specifically target specialized skills in handling laboratory equipment and conducting microbiological analyses, aligning with PO4 (moderate to strong relations indicated).

PO5: Capacity for Application, Problem Solving, and Analytical Reasoning
CO3, CO4, CO5, and CO7 involve problem-solving through laboratory techniques and analytical reasoning in microbiological experiments, contributing to PO5 (moderate relations indicated).

PO6: Communication Skills and Collaboration
While not explicitly covered by the COs listed, communication skills can be indirectly

developed through collaborative laboratory work (weak to moderate relations indicated).

PO7: Research Related Skills

CO6 and CO7 involve practical research skills such as microscopy techniques and staining methods, directly contributing to PO7.

PO8: Learning How to Learn Skills

CO1, CO2, CO3, CO4, CO5, and CO7 involve learning foundational and procedural knowledge in microbiology, fostering skills in independent learning and adaptation (moderate to strong relations indicated).

PO9: Digital and Technological Skills

CO2, CO3 can indirectly develop digital skills (weak relation indicated).

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

Focusing more on technical skills in microbiology (weak relation indicated).

PO11: Value Inculcation and Environmental Awareness

CO5 involves knowledge of disinfection and fumigation techniques, which relate to environmental awareness in maintaining sterile laboratory conditions (moderate relation indicated).

PO12: Autonomy, Responsibility, and Accountability

CO1, CO4, and CO5 emphasize adherence to safety guidelines and responsible laboratory practices, contributing to developing autonomy and accountability (moderate to strong relations indicated).

PO13: Community Engagement and Services

Laboratory safety (CO1) indirectly contribute to community safety and service (weak relation indicated).

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Microbiology(2024 Pattern) NEP-2.0

SYLLABUS (CBCS as per NEP 2020) for F.Y.B.Sc. Microbiology

Name of the Programme : B.Sc. Microbiology
Program Code : USMI
Class : F.Y. B.Sc.
Semester : I
Course Type : Theory
Course Code : MIB-103-OE
Course Title : The Microbial World
No. of Credits : 02
No. of Teaching Hours : 30

Course Objective:

1. Students will be able to understand the microbial world, covering its diversity, structure, function, and relevance in various fields.
2. Students will able to learn define and classify microorganisms based on their characteristics.
3. Students will able to understand describe the diversity of bacteria, archaea, fungi, protozoa, and viruses.
4. Student will able to understand the adaptations of microorganisms to different environments.
5. Student will able to learn methods used to control microbial growth, including physical, chemical, and biological methods.
6. To understand the methods the roles of microorganisms in human health, including pathogens and beneficial microbes.
7. Student will able to understand the role of microorganisms in industrial processes, including fermentation and biotechnology.

Course Outcome:

CO1. Students will understand the basic principles of microbiology
CO2. Students will examine the interactions between microorganisms and human health, including infectious diseases, immunology, and the microbiome.
CO3. Students will be able to analyze the roles of microorganisms in various ecological systems and their impact on the environment.
CO4. Students able to learn about microbial growth, nutrition, and control.
CO5. Students will be able engage in collaborative discussions and interdisciplinary approaches to address complex issues related to microbial diversity, evolution, and adaptation.
CO6. Students will understand the importance of microbiology in various industries and fields.
CO7. Students will evaluate the significance of microorganisms in industrial processes such as fermentation, bioremediation, and biofuels production.

Topic & Learning Points			Teaching Hours
Unit1	**Introduction to Microbiology**		**15**
	a.	Definition of Microbiology	1
	b.	Types of microorganisms 1. Bacteria 2. Algae 3. Fungi (Yeast and Molds) 4. Protozoa 5. Viruses	5
	c.	Microbes in household products 1. Curd (Lactic Acid Bacteria) 2. Cheese (*Propionibacterium*) 3. Bread (*Saccharomyces cerevisiae*) 4. Butter (*Strptococcus lactis*)	4
	d.	Importance of microorganisms in everyday life 1. Agricultural microbiology. 2. Microbes in industry 3. Wastewater treatment	3
	e.	Microbes in natural ecosystems 1. Soil 2. Water 3. Air	2

Unit2	**Microbes in Human Health**		**15**
	a.	Definition of disease	2
	b.	Microbial diseases I. Viral diseases i. Common cold ii. Dengue Fever II. Bacterial diseases i. Typhoid ii. Cholera III.Protozoan diseases i. Malaria ii. Amoebiasis IV.Fungal diseases i. Tinea or ringworm ii. Candidiasis	2 8
	c.	Human disorders i. Cancer ii. Diabetes iii. Arthritis	3

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.

Mapping of course outcomes and programme outcomes:

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

	Programme Outcomes (POs)												
Course outcomes (COs)	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3			3			2	2					
CO2													
CO3	3										2		
CO4											2	2	
CO5			2		2	2					2	2	
CO6		2					2						
CO7								2	2				

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding:

CO1: Demonstrating mastery and application of knowledge, skills, and concepts relevant to the program's goals. This includes the ability to analyze, synthesize, and evaluate information critically, solve complex problems, and communicate effectively.

CO3: It also involves demonstrating ethical and professional behavior and adapting to changing contexts or challenges within the program's domain.

PO2: Practical, Professional, and Procedural Knowledge:

CO6: Equipping graduates with the necessary skills, attitudes, and behaviors to succeed in their chosen profession. This includes a strong understanding of industry standards, best practices, and relevant procedures.

PO3: Entrepreneurial Mindset and Knowledge:
CO5: Entrepreneurial mindset fosters innovation and creativity, encouraging graduates to think outside the box, identify opportunities, and develop novel solutions to complex problems. This mindset is crucial for program outcomes that emphasize innovation or entrepreneurship.

PO4: Specialized Skills and Competencies:
CO1: Specialized skills and competencies are directly aligned with industry needs and standards. Graduates who have acquired these skills are well-prepared to meet the demands of the job market and contribute effectively to their respective industries.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning:
CO5: Graduates with strong analytical reasoning skills can assess complex situations, gather relevant data, and make well-informed decisions.

PO6: Communication Skills and Collaboration:
CO5: Strong communication skills ensure that graduates can convey ideas, information, and instructions clearly and concisely.

PO7: Research-related Skills:
CO6: Research skills enable graduates to gather relevant information from various sources, including academic literature, databases, surveys, and interviews. This ability supports program outcomes related to knowledge acquisition and information literacy.
CO1: Research involves critical analysis, evaluation of evidence, and drawing logical conclusions

PO8: Learning How to Learn Skills:
CO1: Learning how to learn equips graduates with adaptive skills, enabling them to thrive in dynamic and evolving environments.
CO7: This adaptability justifies program outcomes related to preparing graduates for a rapidly changing professional landscape.

PO9: Digital and Technological Skills:
CO7: Digital and technological skills are highly relevant to modern industries and workplaces. Graduates who possess these skills are well-prepared to meet the demands of the job market, thus justifying program outcomes related to industry relevance and employability.

PO11: Value Inculcation and Environmental Awareness:
CO3: 1. Value inculcation promotes ethical behavior and decision-making. Graduates who have internalized ethical values are more likely to make responsible choices, uphold integrity, and contribute positively to their organizations and communities, thus justifying program outcomes related to ethical conduct.
CO4: Environmental awareness emphasizes the importance of sustainable practices and environmental stewardship.
CO5: Value inculcation and environmental awareness also contribute to the development of global citizenship.

PO12: Autonomy, Responsibility, and Accountability:
CO4: Taking responsibility involves being accountable for one's actions, decisions, and tasks.
CO5: Autonomy, responsibility, and accountability are essential for effective decision-making.

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Microbiology(2024 Pattern) NEP-2.0

SYLLABUS (CBCS as per NEP 2020) for F.Y.B.Sc. Microbiology

Name of the Programme : B.Sc. Microbiology
Program Code : USMI
Class : F.Y. B.Sc.
Semester : I
Course Type : Practical
Course Code : MIB-104-SEC
Course Title : Skills in Microbiology I
No. of Credits : 02
No. of Teaching Hours : 60

Course Objectives:

1. To understand the fundamental principles and construction of microscopy and its application in observing microorganisms.
2. To develop practical skills in the use of bright field microscopes for the observation of various microorganisms.
3. To learn the standard operating procedures and principles of different sterilization techniques including autoclaving, dry heat, moist heat, and filtration.
4. To perform and analyze the efficiency of various sterilization methods on laboratory glassware and media.
5. To evaluate the effectiveness of chemical disinfectants and the impact of soaps and disinfectants on skin microflora.
6. To gain proficiency in the preparation of stains and application of different staining techniques for bacterial observation.
7. To develop the ability to distinguish and identify microorganisms based on their staining characteristics and morphology.

Course outcomes:

CO1. Students will be able to explain the construction, working principles, and maintenance of a microscope.
CO2. Students will demonstrate the ability to use bright field microscopy to observe and identify bacteria, protozoa, molds, yeasts, and algae.
CO3. Students will perform standard operating procedures for autoclaves and hot air ovens and understand their applications in sterilization.
CO4. Students will execute and assess the sterilization of glassware and media using dry heat and moist heat techniques.
CO5. Students will be able to evaluate the efficiency of autoclaves and the efficacy of chemical disinfectants through practical experiments.
CO6. Students will prepare stains and apply various staining techniques such as monochrome, Gram, negative, capsule, and endospore staining.
CO7. Students will accurately identify and differentiate microorganisms based on staining results, enhancing their microbiological diagnostic skills.

No. of Experiments	Topic	Teaching Hours
	Microscopy	
1	Understanding construction, working, parts and care of Microscope	4
2	Observation of Microorganisms by using bright field microscope from wastewater sample	4
	Sterilization	
3	Standard Operating Procedure and working of Autoclave, Hot Air Oven	4
4	Sterilization by dry heat -Sterilization of glasswares	4
5	Sterilization by Moist heat -Sterilization of media	4
6	Sterilization by Filtration – Membrane Filtration technique	4
7	Checking sterilization efficiency of autoclave	4
8	Study the effect of soap and disinfectant on skin microflora	4
9	Demonstration of checking the efficacy of chemical disinfectant: Phenol Coefficient by Rideal Walker method	4
	Staining	
10	Preparation of stains (Acidic and Basic)	4
11- 13	Observation of bacteria using staining techniques:	
	A. Monochrome staining	4
	B. Gram staining	4
	C. Negative /Relief staining	4
14 -1 5	Special Staining	
	A. Capsule staining (Maneval's method)	4
	B. Endospore staining (Schaeffer Fulton method)	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.

Mapping of course outcomes and programme outcomes:

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

	Programme Outcomes (POs)												
Course outcomes (COs)	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	2	2	1	1	1	1	1	1	2	1
CO2	3	3	1	3	3	2	2	1	1	1	1	2	1
CO3	3	3	1	3	3	1	2	1	1	1	1	2	1
CO4	3	3	1	3	3	1	2	1	1	1	1	2	1
CO5	3	3	2	3	3	1	3	2	1	1	1	2	1
CO6	3	3	1	3	3	1	2	1	1	1	1	2	1
CO7	3	3	2	3	3	2	3	2	1	1	1		

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding
CO1 to CO7 involves understanding the fundamental principles and comprehensive knowledge of basic skills in microbiology
PO2: Practical, Professional, and Procedural Knowledge
CO2: Practical skills in using bright field microscopy, CO3: Executing standard operating procedures for autoclaves and hot air ovens, CO4: Practical skills in sterilizing glassware and media.
PO3: Entrepreneurial Mindset and Knowledge
CO5: Evaluating chemical disinfectants can lead to innovations.CO7: Distinguishing microorganisms can be applied in product development.
PO4: Specialized Skills and Competencies
CO2: Specialized microscopy skills, CO3: Expertise in sterilization techniques, CO6: Specialized staining techniques.
PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO2: applying microscopy to identify microorganisms.CO5: 3 - Evaluating efficiency of sterilization methods involves problem-solving, CO7: Analytical reasoning in identifying microorganisms.
PO6: Communication Skills and Collaboration
CO2: Requires communication of microscopy findings, CO7: Discussing and sharing staining results.

PO7: Research-related Skills
CO2: Microscopy is essential in research.CO5: 3 - Evaluating disinfectants involves research skills.
PO8: Learning How to Learn Skills
CO1: Foundational knowledge supports continuous learning, CO6: 1 - Weak relation; learning staining techniques fosters learning skills.
PO9: Digital and Technological Skills
CO1: Basic use of microscopy technology.CO2: Involves use of digital tools in microscopy.
PO10: Multicultural Competence, Inclusive Spirit, and Empathy
CO2: Minimal direct impact but fosters collaborative work.CO5: Indirect relevance in understanding the impact of disinfectants.
PO11: Value Inculcation and Environmental Awareness
CO4: Indirect relevance in understanding sterilization impact on the environment, CO5: Evaluating chemical disinfectants involves environmental awareness.
PO12: Autonomy, Responsibility, and Accountability
CO1: Responsible use and maintenance of microscopes.CO3: Following SOPs for autoclaves and ovens requires accountability, CO7: Identifying microorganisms accurately requires autonomy and responsibility.
PO13: Community Engagement and Service
CO2: Minimal direct impact but can aid in community health awareness, CO5: Evaluating disinfectants can contribute to public health.

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Microbiology(2024 Pattern) NEP-2.0

SYLLABUS (CBCS as per NEP 2020) for F.Y.B.Sc. Microbiology

Name of the Programme : B.Sc. Microbiology
Program Code : USMI
Class : F.Y. B.Sc.
Semester : II
Course Type : Theory
Course Code : MIB-151-GEN
Course Title : Fundamental 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 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
UNIT 1	**Cultivation of Microorganisms**	**10**

- Nutritional requirements
- Nutritional classification of microorganisms
- Common ingredients of media
- Types of media
- Methods of Cultivation for:
  a) Photosynthetic Bacteria
  b) Chemoautotrophic Bacteria.
- Extremophiles

UNIT 2	**Isolation and preservation**	**10**

- Isolation of bacteria by -
  a) Streak Plate Method
  b) Spread Plate Method
  c) Pour Plate Method
- Preservation techniques -
  a) Agar Slant Method
  b) Soil/Grain Culture Method
  c) Saline Suspension Method
  d) Freezing Method
  e) Lyophilization
- Culture collection centers and their role.

UNIT 3	**Bacterial Growth**	**10**

- Definitions of Growth, Generation time, Growth rate and specific growth rate
- Growth curve
- Methods of enumeration:
  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 Concentration and Heavy metals
- Diauxic growth
- Synchronous culture

References:

1. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology:An Introduction. 8th Edition. Pearson Education Inc
   Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Hill Publishing Co.
2. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987)General Microbiology, 5th Edition. Macmillan Press Ltd.

3. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition, McGraw Hill Higher Education
4. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, TataMacGraw Hill Press.

Mapping of course outcomes and programme outcomes:

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

	Programme Outcomes (POs)												
Course outcomes (COs)	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	2	2	1	1	2	2	1	1	2	1
CO2	3	3	1	3	2	1	2	2	1	1	1	2	1
CO3	2	2	1	1	2	1	2	2	1	1	1	2	1
CO4	3	2	1	2	2	2	2	2	1	1	1	2	1
CO5	2	2	1	2	3	1	1	2	1	1	1	2	1
CO6	3	3	1	3	2	1	2	2	1	1	1	2	1
CO7	2	2	1	2	2	1	2	2	1	1	1	2	1
CO8	2	3	1	2	3	2	2	3	2	1	1	2	1

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding

All COs contribute to comprehensive knowledge and understanding of microbiology principles, techniques, and applications (strong relations indicated).

PO2: Practical, Professional, and Procedural Knowledge

COs involve practical skills in handling media, performing isolation techniques, and applying preservation methods, directly contributing to PO2 (moderate to strong relations indicated).

PO3: Entrepreneurial Mindset and Knowledge

the focus is more on technical skills rather than entrepreneurial aspects (weak relation indicated).

PO4: Specialized Skills and Competencies

COs cover specialized skills such as isolation techniques, preservation methods, and enumeration techniques, aligning with PO4 (moderate to strong relations indicated).

PO5: Capacity for Application, Problem Solving, and Analytical Reasoning

COs involve problem-solving skills through experimental analysis and interpretation, contributing to PO5 (moderate relations indicated).

PO6: Communication Skills and Collaboration

While not explicitly covered by the COs, communication and collaboration may be indirectly developed through teamwork in laboratory settings (weak relation indicated).

PO7: Research Related Skills

COs such as CO2, CO6, and CO8 involve research skills in experimental design, data analysis, and interpretation, contributing to PO7 (moderate to strong relations indicated).

PO8: Learning How to Learn Skills

COs involve learning foundational principles and techniques in microbiology, fostering skills

in independent learning and adaptation (moderate to strong relations indicated).

PO9: Digital and Technological Skills

CO1, CO2 can indirectly develop digital skills (weak relation indicated).

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

Not directly covered by the listed COs; focus is more on technical skills in microbiology (weak relation indicated).

PO11: Value Inculcation and Environmental Awareness

CO3 involves understanding preservation techniques which can relate to environmental awareness in microbiological practices (moderate relation indicated).

PO12: Autonomy, Responsibility, and Accountability

CO4 emphasizes the importance of aseptic techniques and responsibility in laboratory practices, contributing to PO12 (moderate relation indicated).

PO13: Community Engagement and Services

Laboratory safety (CO4) indirectly contribute to community safety and service (weak relation indicated).

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Microbiology(2024 Pattern) NEP-2.0

SYLLABUS (CBCS as per NEP 2020) for F.Y.B.Sc. Microbiology

Name of the Programme	**: B.Sc. Microbiology**
Program Code	**: USMI**
Class	**: F.Y. B.Sc.**
Semester	**: II**
Course Type	**: Practical**
Course Code	**: MIB-152-GEN**
Course Title	**: Practical Course II**
No. of Credits	**: 02**
No. of Teaching Hours	**: 60**

Course Objectives:

1. To introduce students to diverse microbial ecosystems and observe different types of microorganisms using a bright-field microscope in Winogradsky columns.
2. To teach students the streak plate technique for bacterial isolation, growth observation, and characterization of colony morphology.
3. To familiarize students with enumeration techniques for bacteria from various sources using spread plate and pour plate methods.
4. To enable students to enumerate yeast cells using a Neubauer chamber and understand yeast cell counting techniques.
5. To instruct students in the isolation and characterization of anaerobic bacteria and nitrogen-fixing bacteria from environmental samples.
6. To demonstrate the isolation and identification of fungi from soil samples and understanding fungal morphology.
7. To educate students on preservation techniques for microbial cultures and their applications in slants, soil, and grain surfaces.

Course Outcomes:

CO1. Students will demonstrate proficiency in preparing Winogradsky columns and identifying different types of microorganisms using a bright-field microscope.
CO2. Students will be able to perform bacterial isolation using the streak plate technique, observe growth characteristics, and report on colony morphology.
CO3. Students will acquire skills in enumerating bacteria from fermented food, soil, and water using spread plate and pour plate techniques.
CO4. Students will demonstrate competence in enumerating yeast cells using a Neubauer chamber and understanding yeast cell counting methods.
CO5. Students will gain knowledge of isolating anaerobic bacteria and nitrogen-fixing bacteria, and reporting colony characteristics from root nodules and soil samples.
CO6. Students will be able to isolate fungi from soil, observe fungal morphology, and report on fungal characteristics.
CO7. Students will learn preservation techniques for microbial cultures, including slant, soil, and grain surface preservation methods.

No of Experiments	Topic	Teaching Hours
1	Study of growth of Microorganisms by Winogradsky column	**4**
2	Isolation of bacteria by streak plate technique	**4**
3-4	Enumeration of bacteria from fermented food / soil / water by: i. Spread plate technique ii. Pour plate technique	**8**
5	Enumeration of yeast cells by Neubauer chamber	**4**
6	Isolation of microaerophilic/facultative anaerobic bacteria	**4**
7	Isolation of nitrogen fixing bacteria from root nodules/ soil	**4**
8	Isolation of fungi from soil	**4**
9	Preservation of cultures on slants, soil and on grain surfaces	**4**
10-11	Absorbance measurement for bacterial culture & plotting Growth curve	**8**
12	Oligodynamic effect of heavy metals	**4**
13-15	To study the effect of different parameters on growth of bacteria: i. pH ii. Temperature iii. Salt concentration	**12**

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

Mapping of course outcomes and programme outcomes:

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

	Programme Outcomes (POs)												
Course outcomes (COs)	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	2	2	1	2	2	1	1	1	2	1
CO2	3	3	1	3	2	1	2	2	1	1	1	2	1
CO3	2	2	1	2	2	1	2	2	1	1	1	2	1
CO4	2	2	1	2	2	1	1	2	1	1	1	2	1
CO5	3	3	1	3	2	1	2	2	1	1	1	2	1
CO6	3	3	1	3	2	1	2	2	1	1	1	2	1
CO7	2	2	1	2	2	1	2	2	1	1	1	2	1

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding

All COs contribute to comprehensive knowledge of microbiology principles, techniques, and applications (strong relations indicated).

PO2: Practical, Professional, and Procedural Knowledge

COs involve practical skills in laboratory techniques (moderate to strong relations indicated).

PO3: Entrepreneurial Mindset and Knowledge

Focus is more on technical skills rather than entrepreneurial aspects (weak relation indicated).

PO4: Specialized Skills and Competencies

COs cover specialized skills such as microbial isolation, enumeration, and preservation techniques

PO5: Capacity for Application, Problem Solving, and Analytical Reasoning

COs involve problem-solving skills through experimental design, data interpretation, and reporting (moderate relations indicated).

PO6: Communication Skills and Collaboration

Communication and teamwork may be indirectly developed through lab activities (weak relation indicated).

PO7: Research Related Skills

COs such as CO2, CO5, and CO6 involve research skills in experimental setup, data collection, and analysis (moderate to strong relations indicated).

PO8: Learning How to Learn Skills

All COs involve learning foundational principles and techniques in microbiology, fostering skills in independent learning and adaptation.

PO9: Digital and Technological Skills

using instruments (microscopes, chambers) indirectly develop digital skills

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

focus is more on technical skills in microbiology (weak relation indicated).

PO11: Value Inculcation and Environmental Awareness

CO5 involves understanding anaerobic and nitrogen-fixing bacteria which relates to

environmental awareness (moderate relation indicated).

PO12: Autonomy, Responsibility, and Accountability

CO7 emphasizes responsibility in handling microbial cultures and maintaining preservation techniques (moderate relation indicated).

PO13: Community Engagement and Services

preservation techniques indirectly contribute to community safety and service (weak relation indicated).

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Microbiology(2024 Pattern) NEP-2.0

SYLLABUS (CBCS as per NEP 2020) for F.Y.B.Sc. Microbiology

Name of the Programme : B.Sc. Microbiology
Program Code : USMI
Class : F.Y. B.Sc.
Semester : II
Course Type : Practical
Course Code : MIB-153-OE
Course Title : Basic Microbiological Practices
No. of Credits : 02
No. of Teaching Hours : 60

Course Objective:

1. Students will be able to understand the basics of microbiology, including the types of microorganisms, their characteristics and their roles in various environments.
2. Students will able to learn about the factors affecting microbial growth and the methods used to culture and maintain microorganisms in the laboratory.
3. Students will able to understand different methods of sterilization and disinfection used to eliminate or reduce microbial contamination
4. Student will able to understand aseptic techniques to handle microorganisms without contaminating the samples or the environment.
5. Student will able to learn microscopic examination use a microscope to observe and identify different types of microorganisms.
6. Student will able to apply quantitative methods like serial dilution and plate counting to determine microbial population densities and assess growth rates.
7. Student will able to understand safety procedure to prevent accidents and contamination.

Course Outcome:

CO1. Students will understand the basic principles of microbiology.
CO2. Students will acquire skills in aseptic techniques for handling microorganisms.
CO3. Students will be able to perform basic microbiological tests such as staining, culture, and identification of microorganisms.
CO4. Students able to learn about microbial growth, nutrition, and control.
CO5. Students will be able to develop skills in microscopy for the observation of microorganisms.
CO6. Students will understand the importance of microbiology in various industries and fields.
CO7. Students will gain practical experience in microbiological techniques through laboratory exercises and experiments.

No of Experiments	Topic	Teaching Hours
1	Basic requirements to work in a microbiological laboratory.	4
2	Decontamination of work surfaces and equipment using appropriate disinfectant.	4
3	Demonstration of incineration & flame sterilization of inoculating loops and needles.	4
4	Biosafety protocols for working with potentially pathogenic microorganisms.	4
5	Demonstration of working of Autoclave.	4
6	Demonstration of working of weighing balance.	4
7	Preparation of cotton plugs and wrapping methods.	4
8	Preparation of Nutrient Broth.	4
9	Preparation of Nutrient Agar.	4
10	Preparation of salt solutions of different concentration.	4
11	Aseptic Transfer Techniques.	4
12	Preparation of soil suspension and Serial Dilution Technique.	4
13	Demonstration of presence of microbes in soil sample.	4
14	Demonstration of presence of microbes in air sample.	4
15	Collection of environmental samples (soil /water) & observe under bright field microscopy.	4

References:

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Mapping of course outcomes and programme outcomes:

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

	Programme Outcomes (POs)												
Course outcomes (COs)	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	2												
CO2	2	2		2				2					
CO3	3						3						
CO4											2	2	
CO5								2				2	
CO6			2										
CO7		3			3		2		2				

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding:
CO1: Basic microbiological techniques practical serve as the foundation for understanding fundamental principles and concepts in microbiology. Students learn essential techniques such as aseptic technique, microbial culturing, staining, and microscopy, which form the basis of more advanced microbiological studies.
CO2: Practical laboratory exercises provide students with hands-on experience and reinforce theoretical concepts learned in lectures or textbooks.
CO3: Comprehensive knowledge and understanding enable students to apply theoretical principles to real-world laboratory scenarios, enhancing comprehension and retention of material.
PO2: Practical, Professional, and Procedural Knowledge:
CO2: Basic microbiological techniques practical provides students with opportunities to develop practical skills essential for working in laboratory settings.
CO7: Through hands-on experience, students gain proficiency in techniques such as aseptic handling, microbial culturing, staining, and microscopy, enhancing their practical competency and confidence.
PO3: Entrepreneurial Mindset and Knowledge:
CO6: Basic microbiological techniques practical provides opportunities for students to apply innovative thinking and creativity in solving scientific problems and developing novel solutions.
PO4: Specialized Skills and Competencies:
CO2: Basic microbiological techniques practical requires specialized skills such as aseptic technique, microbial culturing, staining, microscopy, and biochemical assays. Students develop hands-on proficiency in performing these techniques accurately, efficiently, and safely, laying the foundation for more advanced microbiological studies.
PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning:
CO7: Microbiological experiments often require careful planning and design to address specific research questions or hypotheses. Application problem-solving skills enable students to select appropriate methodologies, design experimental protocols, and identify variables that

may impact experimental outcomes, fostering critical thinking and analytical reasoning in experimental planning.

PO7: Research-related Skills:

CO3: Basic microbiological techniques practical involves designing experiments to test hypotheses or address research questions.

CO7: Research-related skills enable students to develop experimental designs that are scientifically rigorous, feasible, and appropriate for the objectives of the study.

PO8: Learning How to Learn Skills:

CO2: Basic microbiological techniques practical provides an opportunity for students to learn how to adapt to new environments, procedures, and challenges.

CO5: Learning how to learn skills enable students to quickly acquire new knowledge, techniques, and protocols, allowing them to adapt and thrive in diverse laboratory settings.

PO9: Digital and Technological Skills:

CO7: Microbiological experiments generate large volumes of data that require organization, analysis, and storage. Digital skills enable students to use spreadsheet software, databases, and laboratory information management systems (LIMS) to manage experimental data efficiently, ensuring accuracy, accessibility, and reproducibility.

PO11: Value Inculcation and Environmental Awareness:

CO4: Microbiological research involves ethical considerations regarding the responsible use of microorganisms, adherence to biosafety protocols, and respect for research participants and the environment.

PO12: Autonomy, Responsibility, and Accountability:

CO4: Autonomy allows students to make independent decisions during experiments, such as selecting appropriate procedures and interpreting results.

CO5: Accountability in this setting means students are accountable for accurately documenting their procedures, results, and any deviations, as well as taking responsibility for the overall success and integrity of the experiment.

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Microbiology(2024 Pattern) NEP-2.0

SYLLABUS (CBCS as per NEP 2020) for F.Y.B.Sc. Microbiology

Name of the Programme : B.Sc. Microbiology
Program Code : USMI
Class : F.Y. B.Sc.
Semester : II
Course Type : Practical
Course Code : MIB-154-SEC
Course Title : Skills in Microbiology II
No. of Credits : 02
No. of Teaching Hours : 60

Course Objectives:

1. Students will learn the streak, pour and spread plate method to isolate discrete colonies of bacteria from mixed cultures.
2. Students will understand the process of isolating pure cultures from streak, spread, and pour plate preparations.
3. Students will perform serial dilution to achieve appropriate colony counts.
4. Students will be trained in microscopic measurement of bacterial cells.
5. Students will observe bacterial movement using techniques like Swarming motility observation.
6. Students will learn bacterial cell wall staining techniques.
7. Students will learn proper procedures for disposal of biohazardous laboratory waste.

Course outcomes:

CO1. Students will demonstrate proficiency in streak plate, spread plate, and pour plate methods.
CO2. Students will successfully isolate pure cultures from mixed cultures using various techniques.
CO3. Students will accurately measure bacterial cells and observe their movement using microscopy.
CO4. Students will effectively stain bacterial cell walls, flagella, and metachromatic granules for identification purposes.
CO5. Students will interpret results of the KOH test to determine the Gram nature of bacteria.
CO6. Students will identify common fungi present in spoiled natural and cooked food samples.
CO7. Students will adhere to biohazard disposal protocols and demonstrate awareness of laboratory safety practices.

No. of Experiments	Topic	Teaching Hours
1	Isolation of discrete colonies of bacteria from a mixed culture by streak plate method.	4
2	Isolation of pure cultures from a streak plate preparation.	4
3	Serial dilution of the mixed culture by means of pipette or loop	4
4	Isolation of discrete colonies of bacteria from a mixed culture by spread plate method.	4
5	Isolation of pure cultures from a spread plate preparation.	4
6	Isolation of discrete colonies of bacteria from a mixed culture by pour plate method.	4
7	Isolation of pure cultures from a pour plate preparation.	4
8	Microscopic measurement of bacterial cells.	4
9	Observation of movement of bacteria by Swarming motility	4
10	Bacterial Cell wall staining	4
11	Bacterial Flagella staining	4
12	Bacterial Metachromatic granules staining	4
13	KOH test for detection of Gram nature of bacteria	4
14	Observation of fungi from spoiled food (Natural/cooked food)	4
15	Disposal of biohazardous laboratory waste.	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.
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CO1	3												
CO2				3									
CO3					3								
CO4						2							
CO5							2						
CO6												2	
CO7		3											

Justification for the mapping

PO1. Comprehensive knowledge and understanding
There is a strong relation (Weightage: 3) with CO1 because proficiency in these microbiological techniques directly contributes to comprehensive knowledge and understanding of laboratory procedures in microbiology.

PO2. Practical, Professional, and Procedural Knowledge
There is a strong relation (Weightage: 3) with CO7 as adhering to safety protocols and demonstrating awareness of laboratory practices is fundamental to practical and procedural knowledge in a professional setting.

PO4. Specialized Skills and Competencies
There is a strong relation (Weightage: 3) with CO2 because the ability to isolate pure cultures demonstrates specialized skills and competencies in microbiology techniques.

PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning
There is a strong relation (Weightage: 3) with CO3 as measuring bacterial cells and observing their movement require application of knowledge, problem-solving skills, and analytical reasoning.

PO6. Communication Skills and Collaboration
There is a moderate relation (Weightage: 2) with CO4 because effective staining for identification involves communication of results and possibly collaboration in interpreting findings.

PO7. Research-related Skills
There is a moderate relation (Weightage: 2) with CO5 as interpreting test results is a foundational research-related skill in microbiology.

PO12. Autonomy, Responsibility, and Accountability
There is a moderate relation (Weightage: 2) with CO6 as identifying fungi requires autonomy in research and responsibility/accountability in accurately identifying species.