Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

Syllabus (CBCS) for F.Y.B.Sc. Microbiology
Semester I
(2022 Pattern)

w.e.f.

June 2022

Preamble:

Microbiology is a branch of science that studies “Life” taking an example ofmicroorganisms such asbacteria, protozoa, algae,fungi,viruses, etc. Thesestudies 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 tothe 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 otherdisciplines 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, Geo microbiology); and the technological aspects of these areas. Knowledge of different aspects of Microbiology has become crucial and indispensable to everyone in the society. Study ofmicrobes has become anintegral partofeducation 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 formicrobiologists in the work force – education, industry and research. Careeropportunities for the graduate students are available in manufacturing industryand researchinstitutesattechnicallevel.

Eligibility:
First Year B.Sc.:

A. Higher Secondary School Certificate (10+2) or its equivalent Examinationwith 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.

Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati
(Autonomous)
SYLLABUS (CBCS) FOR F. Y. B. Sc. MICROBIOLOGY
(w.e.f. June 2022)

COURSE STRUCTURE FOR F.Y. B.Sc. MICROBIOLOGY (w.e.f. June 2022)

Sr. No.	Class	Semester	Code	Paper	PaperTitle	Credit
1	F.Y.B.Sc	I	USMB111	Theory	Introduction to Microbiology I	2
2	F.Y.B.Sc.	I	USMB112	Theory	Basic Techniques In Microbiology I	2
3	F.Y.B.Sc.	I	USMB113	Practical	Practical Course I	2
4	F.Y.B.Sc.	II	USMB121	Theory	Introduction to Microbiology II	2
5	F.Y.B.Sc.	II	USMB122	Theory	Basic Techniques in Microbiology II	2
6	F.Y.B.Sc.	II	USMB123	Practical	Practical Course II	2

SYLLABUS (CBCS) FOR F.Y.B.Sc. Microbiology
(w. e. from June, 2022)

Class : F.Y.B.Sc.
Semester : I
Course Type : Theory
Course Code : USMB111
Course Title : Introduction to Microbiology I
No. of Credits : 02
No. of Teaching Hours : 32

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 Outcome:

CO1 The students will obtain the fundamental understanding of microbiology areas.
CO2 The freshers in microbiology subject will acquire knowledge of the importance of microbes in relation to their beneficial and harmful effects.
CO3 The students will be able to distinguish the different categories of microorganisms.
CO4 The students will be able to gain the knowledge about diversity of microorganisms.
CO5 Understanding historical developments in microbiology shall help students to develop an idea about setting up of experiments.
CO6 The students shall learn about the theory of the origin of living things.
CO7 The students shall learn about the significant developments microbiology in recent years.

Credit No	Topic	Lectures
I	**Scope And Application of Microbiology Unit1: Scope of Microbiology:** a) Industrial Microbiology and Biotechnology b) Medical Microbiology c) Immunology d) Microbial Genetics e) Geo microbiology 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	**4**

	(*Bacillus thuriengensis*) c) Use of bacteriophages as biocontrol agents in agriculture	
	Unit 3 : Morphological and differentiating characters of microorganisms: Whittaker five Kingdom classification system a) Structures of prokaryotic and eukaryotic cell b) Bacteria: (Eubacteria, Archaebacteria, Rickettsia, Chlamydia, Actinomycetes, Mycoplasma and bacterivorous bacteria); Introduction to Bergey's Manual of Determinative and Systemic Bacteriology c) Protozoa d) Algae e) Fungi (Molds and Yeasts) f) Viruses (Animal & plant viruses, Bacteriophages) g) Viroids and prions	**8**
II	**Unit1:HistoryofMicrobiology** 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	**5**
	Unit 2:Development of Microbiology in 19thcentury 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	**8**

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

References:

1. TortoraG.J.,FunkeB.R.,CaseC.L.(2006).Microbiology:An Introduction. 8th Edition.Pearson Education Inc
2. SalleA.J.(1971)FundamentalPrinciplesofBacteriology.7thEdition.TataMacGraw Hill Publishing Co.
3. StanierR.Y.,AdelbergE.A.andIngrahamJ.L.(1987) General Microbiology, 5th Edition. Macmillan Press Ltd.
4. Prescott,Lancing.M.,John,P.HarleyandDonald,A.Klein(2006) Microbiology 6thEdition, McGraw Hill Higher Education.
5. M.H.Gajbhiye,S.J.Sathe,S.R.PharandeandR.J.Marathe(2015)Introductionto Microbiology, 3rd Edition. Career publication.
6. Michael J Pelczar, J R .E.C.S. Chan, Noel R.Krieg.(1993) Microbiology, 5th Edition, Tata Mac Graw Hill Press.
7. Nelson D.L.and CoxM.M.(2002)Lehninger'sPrinciples of Biochemistry, Mac MillanWorthPub. Co. NewDelhi.
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
CO1	3					2		3	3
CO2	2							3	3
CO3	2								3
CO4	3					2			3
CO5		2				2			3
CO6				3					
CO7	3	2		3				3	

PO1 **DisciplinaryKnowledge:**

CO1:The basics of different fields of microbiology shall belearnedby thestudents.

CO2: The students shall learn about the importance of microbes in life.

CO3: The students shall be able to differentiate among the categories of microbes.

CO4: Students shall learn about the different categories of microorganisms.

CO7: The students shall gain knowledge about the recent developments in microbiology.

PO2 **CriticalThinkingandProblemSolving:**

CO5: The students shall be aware of the basic knowledge required for setting up experiments.

CO7:The students shall know about the important experiments performed by different researchers.

PO4 **Research-relatedskillsandScientifictemper:**

CO6:The students will be able to learn basic experimental techniques.

CO7: Understanding modern microbiological developments shall help students to develop scientific temper.

PO6 **Personal and professional competence**

CO1: The students will be able to learn different areas and linkages of microbiology subject.

CO4: Students shall understand different categories of microbes and its relatedness with other sciences.

CO5: Students shall inculcate the ideas about the experimental setups.

PO8 **Environment and sustainability**

CO1: Students shall understand the environmental microbiology area of microbiology.

CO2: Students will acquire knowledge about the role of microbes in environment.

CO7: Understanding modern developments shall help students to know advanced microbiological technology for sustainable development.

PO9 **Self directed and life long learning**

CO1: Students shall gain knowledge about the areas of microbiology that shall benefit students for a long period in learning process.

CO2: The students will understand the roles of microbes in real life workings.

CO3: This knowledge shall benefit students till completion of undergraduate and post graduate studies.

CO4: Understanding microbial diversity shall help students to distinguish microbes.
CO5: Students shall learn the techniques for setting up of experiments.

SYLLABUS (CBCS) FOR F.Y.B.Sc. Microbiology
(w. e. from June, 2022)

Class	**: F.Y.B.Sc.**
Semester	**: I**
Course Type	**: Theory**
Course Name	**: Basic Techniques in Microbiology-I**
Course Code	**: USMB112**
No. of Credits	**: 02**
No. of Lectures	**:32**

Course Objectives

1. Strengthening students' comprehension and proficiency in essential Microbiology principles.
2. Teaching students the various sterilization methods and their significance in maintaining aseptic conditions within laboratory settings.
3. Providing students with hands-on experience in microbial staining techniques for microscopic examinations.
4. acquainting students with the techniques of aseptic culture and honing associated skills.
5. Introducing students to methods for microbial enumeration and quantification.
6. Developing students' competence in laboratory skills and emphasizing safety procedures.
7. Fostering the growth of critical thinking and problem-solving skills among students

Course Outcomes :

CO1	Introduction to the microbiology laboratory, including familiarization with commonly used instruments.
CO2	Mastery in the preparation and interpretation of stained microbial slides using a microscope
CO3	Proficiency in analyzing and interpreting microscopic images of microorganisms, elucidating their morphological features
CO4	Recognition of the significance of proper microscope maintenance, calibration, and troubleshooting for achieving optimal microscopy results.
CO5	Ability to execute staining techniques, enhancing the visualization and differentiation of microorganisms under the microscope.
CO6	Acquisition of knowledge pertaining to the enumeration and quantification of microorganisms using diverse methods.
CO7	Development of expertise empowering students to directly participate in applied fields, such as industry or institutions, without the necessity for additional training

Credit No	Topic	Lectures
I	**Microscopy and Staining Techniques** **Unit 1: Units of measurement. Modern SI units** (Length, Volume, Weight)	**1**
	Unit 2 : **Microscopy** a) Structure, working and ray diagram of : i. Bright Field Microscopy ii. Dark Field Microscopy	**3**
	b) Concepts of Magnification, Numerical Aperture and Resolving Power	**1**
	c) Types, ray diagram and functions of : i. Condensers ii. Eye-pieces iii. Objectives	**2**
	d) Aberrations in lenses : (Spherical, Chromatic, Comma and Astigmatism)	
	e) Principle and Applications of: i. Fluorescence Microscopy ii. Electron Microscopy	**2**
	Unit 3 : Staining Techniques: a) Definitions of Stain; Types of stains (Basic and Acidic)	**2**
	b) Properties and role of Fixatives, Mordants, Decolorisers and Accentuators	
	c) Principles of staining techniques of the following: i. Monochrome staining and ii. Negative (Relief) staining iii. Differential staining – (Gram staining and Acid-Fast staining)	**1** **1** **3**
II	**Sterilization and Disinfection** **Unit 1: Physical methods** – a) Heat b) Radiation c) Filtration	**6**
	Unit 2 : 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 h) Ethylene oxide	**7**
	Unit 3 : Characteristics of an ideal Disinfectant	**3**

	Checking of Efficiency of Disinfectant – Phenol Coefficient	

References:

1. TortoraG.J.,FunkeB.R.,CaseC.L.(2006).Microbiology:An Introduction. 8th Edition.Pearson Education Inc
2. SalleA.J.(1971)FundamentalPrinciplesofBacteriology.7thEdition.TataMacGraw Hill Publishing Co.
3. StanierR.Y.,Adelberg E.A.and IngrahamJ.L.(1987) General Microbiology, 5th Edition. Macmillan Press Ltd.
4. Prescott,Lancing.M.,John,P.Harley and Donald,A.Klein (2006) Microbiology 6thEdition, 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. MichaelJPelczar,JR.E.C.S.Chan,NoelR.Krieg.(1993)Microbiology,5thEdition, Tata MacGraw Hill Press.
7. Nelson D.L.and CoxM.M.(2002) Lehninger's Principles of Biochemistry, Mac MillanWorthPub. Co. NewDelhi.
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Course outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3				2			3	3
CO2						3		2	2
CO3		3		3		2		2	2
CO4		3				1		1	1
CO5		2		3					3
CO6					1	3		3	2
CO7					3				
CO8		3		3	2	3			2

Justification for the mapping

PO1 :Disciplinary Knowledge

CO1 aligns with PO1 as it introduces students to the microbiology laboratory, laying the foundation for disciplinary knowledge by familiarizing them with fundamental concepts and instruments in microbiology.

PO2 :Critical Thinking and Problem Solving

CO2 aligns with PO2 as mastery in slide preparation and interpretation requires critical thinking and problem-solving skills for accurate observations and analysis, contributing to the development of these competencies.

PO4 :Research-related skills and Scientific Temper:

CO3 aligns with PO4 by focusing on the development of research-related skills, as students analyze microscopic images, fostering a scientific temper and research-oriented mindset in understanding microbial morphology.

PO5 :Trans-disciplinary Knowledge

CO5 aligns with PO5 as staining techniques are trans-disciplinary, applicable across various biological disciplines, demonstrating the integration of knowledge beyond the microbiology domain.

PO6 :Personal and Professional Competence

CO4 aligns with PO6 as recognizing the significance of microscope maintenance contributes to personal and professional competence, emphasizing the importance of professional responsibility in laboratory practices.

PO8 :Environment and Sustainability

CO7 aligns with PO8 as developing expertise for direct participation in applied fields, such as industry or institutions, implies contributing to practices aligned with environmental sustainability, showcasing awareness of environmental implications.

PO9: Self-directed and Life-long Learning

CO6 aligns with PO9 as acquiring knowledge in various methods of enumerating and quantifying microorganisms supports self-directed and life-long learning, demonstrating adaptability and continuous learning.

SYLLABUS (CBCS) FOR F.Y.B.Sc. Microbiology
(w. e. from June, 2022)

Class	**: F.Y.B.Sc.**
Semester	**: I**
Course Type	**: Practical**
Course Name	**: Practical Course-I**
Course Code	**: USMB113**
No. of Credits	**: 02**
No. of Lectures	**: 40**

Course Objectives

1. Strengthening students' comprehension and equipping them with essential skills in the realm of Microbiology.

2. Providing instruction to students on diverse sterilization methods and their significance in maintaining sterile conditions within the laboratory.

3. Granting students hands-on experience in employing microbial staining techniques for microscopic analysis.

4. acquainting students with the intricacies of aseptic culture techniques, ensuring mastery in the associated skills.

5. Introducing students to techniques for the enumeration and quantification of microorganisms.

6. Nurturing proficiency among students in both laboratory skills and safety procedures.

7. Cultivating the growth of critical thinking and problem-solving skills in students

Course Outcomes :

CO1	Introduce students to the microbiology laboratory setting, acquainting them with commonly utilized instruments in microbiological laboratories
CO2	Enhance students' skills in preparing and interpreting stained microbial slides observed under a microscope.
CO3	Enable students to analyze and interpret microscopic images of microorganisms, articulating their morphological features
CO4	Cultivate in students an appreciation for the importance of proper microscope maintenance, calibration, and troubleshooting to achieve optimal microscopy results.
CO5	Empower students with the capability to execute staining techniques for visualizing and distinguishing microorganisms under the microscope
CO6	Impart knowledge to students on the enumeration and quantification of microorganisms using a variety of methods.
CO7	Immerse students with the expertise to seamlessly transition into applied fields, whether in industry or institutions, without the need for additional training

Credit no.	Expt. No.	Topic	Hours
I	**1-2**	Principle & Standard Operating Procedures (SOP) for common microbiology laboratory instruments e.g. Incubator, Hot Air Oven, Autoclave, Colorimeter, pH Meter, Laminar air flow hood, Centrifuge	**8**
	3	Construction (mechanical and optical),working and care of Bright Field Microscope	**4**
	4	Observation of Microorganisms using bright field microscope – Bacteria, Protozoa, Molds and Yeasts, Algae – from natural habitat	**4**
	5	Preparation of Winogradsky column and observation of different types of microorganisms using bright field microscope.	**4**
II	**6-9**	Observation of bacteria using staining techniques: a. Monochrome staining b. Negative /Relief staining c. Capsule staining (Maneval's method) d. Gram staining	 **4** **4** **4** **4**
	10	Observation of motility in bacteria using:Hanging Drop 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-Practical Microbiology

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CO1	3				2		2		
CO2		3					3	2	2
CO3		3					2	2	2
CO4				2				1	1
CO5								2	3
CO6					2		3	1	2
CO7									
CO8						3			2

Justification for the mapping

PO1: Disciplinary Knowledge:

CO1 aligns with PO1 as it introduces students to the microbiology laboratory, which is foundational for disciplinary knowledge in microbiology.

PO2: Critical Thinking and Problem Solving:

CO2 and CO3 contribute to critical thinking as students enhance their skills in preparing and interpreting stained microbial slides, and analyze and interpret microscopic images, which require critical thinking and problem-solving abilities.

PO4: Research-related Skills and Scientific Temper:

CO4 emphasizes the importance of proper microscope maintenance, calibration, and troubleshooting, aligning with research-related skills and fostering a scientific temper within the laboratory setting.

PO5: Trans-disciplinary Knowledge:

CO6 introduces students to the enumeration and quantification of microorganisms using various methods, requiring knowledge from multiple disciplines and contributing to trans-disciplinary knowledge.

PO6: Personal and Professional Competence:

CO7 directly aligns with PO6, as it aims to develop expertise enabling students to engage in applied fields without additional training, showcasing personal and professional competence.

PO7: Self-directed and Life-long Learning:

CO1, CO2, CO3, and CO6 collectively contribute to self-directed learning by providing students with foundational skills and knowledge, laying the groundwork for continuous learning in microbiology beyond the course.

PO8: Environment and Sustainability:

the skills developed in microscopy and microorganism analysis (CO2, CO3, CO4, CO5, CO6) may indirectly contribute to environmental and sustainability concerns, especially in areas such as food and water safety.

PO9: Self-directed and Life-long Learning:

After completing the course, are equipped to directly engage in applied fields without additional training, highlighting the concept of life-long learning throughout their professional journey