Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

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

(2019 Pattern)

w.e.f.

June 2019

Preamble

Microbiology is a branch of science that studies “Life” taking an example of microorganisms such as bacteria, protozoa, algae, fungi, viruses, etc. These studiesintegratecytology,physiology,ecology,geneticsand molecularbiology, 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.

Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati
(Autonomous)
SYLLABUS (CBCS) FOR F. Y. B. Sc. MICROBIOLOGY
(w.e.f. June2019)

COURSE STRUCTURE FOR F. Y. B. Sc. MICROBIOLOGY (w.e.f. 2019)

Sr. No.	Class	Semester	Code	Paper	PaperTitle	Credit	Marks (I+E)
1	F.Y.BSc	I	MICRO1101	Theory	Introduction to Microbiology	2	50 +50
2	F.Y.BSc	I	MICRO1102	Theory	Basic Techniques in Microbiology	2	50 +50
3	F.Y.BSc	I	MICRO1103	Practical	Practical's based on theory	2	50 +50
4	F.Y.BSc	II	MICRO1201	Theory	Introduction to Microbiology	2	50 +50
5	F.Y.BSc	II	MICRO1202	Theory	Basic Techniques in Microbiology	2	50 +50
6	F.Y.BSc	II	MICRO1203	Practical	Practical's based on theory	2	50 +50

I: Internal Examination
E: External Examination

(w. e. from June, 2019)

Class : F.Y.B.Sc.
Semester : I
Course Type : Theory
Course Code : MICRO-1101
Course Title : Introduction to Microbiology
No. of Credits : 02
No. of Teaching Hours : 36

Course Objectives:

1. To enrich the knowledge of under graduate 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 differenthabitats.
5. Toallowstudentstounderstandthegeneralclassificationschemeoflivingthings.
6. Tounderstandthehistoricaldevelopments inthefieldofmicrobiology.
7. Toenrichstudents'knowledgeaboutrecentinventionsanddiscoveriesinmicrobiology.

Course Outcome:

CO1 The students will obtain a fundamental understanding of microbiology areas.
CO2 The freshers in microbiology subject will acquire knowledge of the importance of microbes about 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 Unit 1: Scope of Microbiology:** i. Industrial Microbiology and Biotechnology ii. Medical Microbiology iii. Immunology iv. Microbial Genetics v. Geomicrobiology vi. Food and Dairy Microbiology vii. Bioinformatics viii. Nano-Biotechnology ix. Space Microbiology	**7**

	Unit2: Few Applications of Microbiology with special reference to: I. Significance of normal flora and probiotics in human health II. Microbes as Biofertilizers (e.g. Nitrogen fixers, Phosphate solubilizers) and Biocontrol Agents (*Bacillus thuringensis* and *Tricoderma*)	**3**
	Unit3:Morphological and differentiating characters of microorganisms: Whittaker five Kingdom classification i. Structures of prokaryotic and eukaryotic cell ii. Bacteria:(Eubacteria,Archaebacteria,Rickettsia,Chlamydia, Actinomycetes and Mycoplasma) Introduction to Bergey's Manual of Determinative and Systemic Bacteriology iii. Protozoa iv. Algae v. Fungi(Molds and Yeasts) vi. Viruses,viroids and prions	**8**
II	**Unit1:History of Microbiology** i. Discovery of microscope (Micrographia of Anton van Leeuwenhoek and Robert Hooke) ii. Abiogenesisvs biogenesis a. Aristotle's notion about spontaneous generation b. Redi'sexperiment c. Louis Pasteur's & Tyndall's experiments	**6**
	Unit 2:Development of Microbiology in 19th century 2.1 Observations and role of microorganisms in transformation of organic matter. 1. Germ theory of fermentation 2. Discovery of anaerobic life & physiological significance of fermentation 2.2 Discovery of microbes as pathogens and disease prevention 1. Surgical antisepsis 2. Germ theory of disease–Koch's postulates & River's postulates 3. Vaccination: Edward Jenner and Louis Pasteur– chicken cholera and Rabies	**8**

	Unit3:Developments in 20th and 21st Centuries with respect to: 1. Chemotherapy: Paul Ehrlich, Domagk, Walkman and Alexander Fleming 2. Contributions of Nobel Laureates (Elie Metchnikoff, Burnett, George Beadle, Edward Tatum, Porter and Edelman, Kohler and Milstein) 3. Molecular Biology & Biotechnology : Watson and Crick and Hargobind Khurana	**4**

References:

1. TortoraG.J.,FunkeB.R.,Case C.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.and IngrahamJ.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. MichaelJ Pelczar,JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5thEdition, Tata MacGraw Hill Press.
7. Nelson D.L. and Cox M. M. (2002) Lehninger's Principles of Biochemistry, Mac Millan WorthPub. Co. NewDelhi.
8. MadiganM.T., MartinkoJ.M. (2006). Brock'sBiologyof Microorganisms. 11th Edition.Pearson Education Inc.
9. Mount,D.W.(2001)Bioinformatics:SequenceandGenomeanalysis.ColdSpring 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)								
Courseoutcomes (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, 2019)

Class	**: F.Y.B.Sc.**
Semester	**: I**
Course Type	**: Theory**
Course Name	**: Basic Techniques in Microbiology**
Course Code	**: MICRO-1102**
No. of Credits	**: 02**
No. of Lectures	**:36**

Course Objectives:

1. Enhancing students' understanding and expertise in fundamental Microbiology principles.
2. Instructing students on the diverse sterilization methods and their importance in upholding aseptic environments in laboratories.
3. Offering students practical exposure to microbial staining techniques for microscopic analysis.
4. Familiarizing students with the art of aseptic culture techniques.
5. Introducing students to microbial enumeration and quantification methods.
6. Cultivating proficiency among students in laboratory skills and safety protocols.
7. Nurturing critical thinking and problem-solving abilities in students.

Course Outcomes :

CO1	Introduction to the microbiology laboratory and familiarization with common microbiology laboratory instruments
CO2	Attainment of proficiency in preparing and interpreting stained microbial slides under the microscope
CO3	Ability to analyze and interpret microscopic images of microorganisms, detailing their morphological features.
CO4	Understanding the importance of proper microscope maintenance, calibration, and troubleshooting for optimal microscopy outcomes
CO5	Capability to perform staining techniques, facilitating the visualization and differentiation of microorganisms under the microscope
CO6	Acquisition of knowledge in enumerating and quantifying microorganisms through various methods.
CO7	Development of expertise enabling students to directly engage in applied fields such as industry or institutions, without the need for additional training.

Credit No	Topic	Lectures
I	**Unit 1:Units of measurement: Modern SIunits** (Length,volume,Weight) **Unit 2**: **Microscopy** 1.Bright field microscopy: Structure, working of and ray diagram of a compound light microscope; Concepts of magnification, numerical aperture and resolving power. 2. Types, ray diagram and functions of–condensers, eye-pieces and objectives 3. Aberrations in lenses-spherical, chromatic, comma and astigmatism 4. Principle, construction, working and applicationsof: i. Bright field microscopy ii. Dark field microscopy iii. Fluorescence microscopy iv. Electron Microscopy - Transmission electron microscope (TEM) - Scanning electron microscope (SEM) **Unit3 : Staining Techniques :** 1. Definitions of Stain: Types of stains (Basic and Acidic), 2. Properties and role of Fixatives, Mordants, Decolorisers and Accentuators 3. Principles of staining techniques for following: i. Monochrome staining and Negative (Relief)staining ii. Differential staining-Gram staining and Acid fast staining	**12** 06
II	**Unit1: Sterilization and Disinfection** 1. Physical Agents-Heat, Radiation, Filtration 2. Chemical agents and their mode of action - Aldehydes, Halogens, Quaternary ammonium compounds, Phenol and phenolic compounds, Heavy metals, Alcohol, Dyes, Detergents and Ethylene oxide. 3. Characteristics of an ideal disinfectant 4. Checking of Efficiency of Sterilization–Biological and Chemical Indicators 5. Checking of Efficiency of Disinfection-Phenol Coefficient	**18**

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.Pharande and R.J.Marathe (2015) Introduction to Microbiology, 3rd Edition. Career publication.
6. Michael JPelczar, 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 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.
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Mapping of course outcomes and programme outcomes:

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

Justification for the mapping

PO1: Disciplinary Knowledge:

CO1 aligns with PO1 as it introduces students to the microbiology laboratory and familiarizes them with common microbiology laboratory instruments. This lays the foundation for disciplinary knowledge in microbiology.

PO2: Critical Thinking and Problem Solving:

CO2 and CO3 contribute to critical thinking as students attain proficiency in preparing and interpreting stained microbial slides, analyze and interpret microscopic images, and detail morphological features. These activities require analytical skills and problem-solving abilities.

PO3: Social Competence:

While the provided information doesn't explicitly mention social competence, the development of expertise in applied fields (CO7) implies the potential for interaction and collaboration in social and professional settings.

PO4: Research-related Skills and Scientific Temper:

CO4 emphasizes the understanding of the importance of proper microscope maintenance, calibration, and troubleshooting, which is crucial for scientific temper and aligns with research-related skills in a laboratory setting.

PO5: Trans-disciplinary Knowledge:

CO6, which involves enumerating and quantifying microorganisms through various methods, may require knowledge from multiple disciplines such as statistics and mathematics, 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 such as industry or institutions 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 the foundational skills and knowledge needed for further exploration and application in microbiology beyond the course.

PO8: Environment and Sustainability:

While the provided information does not explicitly address environmental aspects, the skills developed in microscopy and microorganism analysis (CO2, CO3, CO4, CO5, CO6) indirectly contribute to environmental and sustainability concerns, especially in areas such as food and water safety.

PO9: Self-directed and Life-long Learning:

CO7 further reinforces the idea that students are equipped to directly engage in applied fields without additional training, emphasizing the continuous learning aspect throughout their professional life.

SYLLABUS (CBCS) FOR F.Y.B.Sc. Microbiology
(w. e. from June, 2019)

Class	**: F.Y.B.Sc.**
Semester	**: I**
Course Type	**: Practical**
Course Name	**: Practical based on theory**
Course Code	**: MICRO-1103**
No. of Credits	**: 02**
No. of Lectures	**:40**

Course Objectives

1. To enhance students' understanding and educate them in fundamental Microbiology concepts.
2. To instruct students on different sterilization methods and their importance in preserving aseptic conditions within the laboratory.
3. To offer students practical exposure to microbial staining techniques for the examination under a microscope.
4. Students will familiarize themselves with the techniques of aseptic culture.
5. To familiarize students with the methods of microbial enumeration and measurement.
6. To ensure students attain proficiency in laboratory skills and adhere to safety procedures.
7. Students will cultivate critical thinking skills and problem-solving abilities.

Course Outcomes :

CO1	Introduce students to the microbiology laboratory environment and familiarize them with commonly used microbiology laboratory instruments
CO2	Develop students' proficiency in the preparation and interpretation of stained microbial slides when examined under a microscope
CO3	Enable students to analyze and interpret microscopic images of microorganisms, describing their morphological features.
CO4	Instill in students an understanding of the importance of proper microscope maintenance, calibration, and troubleshooting for achieving optimal microscopy results.
CO5	Equip students with the ability to perform staining techniques to visualize and differentiate microorganisms under the microscope
CO6	Provide students with knowledge on enumerating and quantifying microorganisms using various methods
CO7	Imbue students with the expertise to directly engage in applied fields, be it in industry or institutions, without requiring additional training

Expt. No.	Topic	Hours
1-2	Preparation of Standard Operating Procedures (SOP) for common microbiology laboratory instruments e.g. Incubator, Hot Air Oven, Autoclave, Colorimeter, pH Meter, Distillation Unit, Chemical Balance, Laminar air flow hood, Clinical Centrifuge and Biosafety Cabinet.	**8**
3	Construction (mechanical and optical), working and care of bright field microscope	**4**
4-5	Observation of microorganisms using bright field microscope–Bacteria,Protozoa,MoldsandYeasts, Algae – from natural habitat Preparation of Winogradsky column and observation of different types of microorganisms using bright field microscope.	**4**
6-9	Observation of bacteria using staining techniques: a. Monochrome staining b. Negative/Relief staining & Capsule staining c. Gram staining of bacteria	**12**
10	Observation of motility in bacteria using: a. Hanging drop method b. Swarming growth methods	**4**
11	Enumeration of cells using Neubaeur chamber	**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 Mc Graw Hill
3. Dr.R.C.Dubey and Dr.D.K.Maheshwari- Practical Microbiology

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

Justification for the mapping

PO1: Disciplinary Knowledge:

CO1 corresponds to PO1 by introducing students to the microbiology laboratory environment and acquainting them with commonly used instruments, establishing the groundwork for disciplinary knowledge in microbiology

PO2: Critical Thinking and Problem Solving:

CO2 and CO3 contribute to the cultivation of critical thinking as students acquire proficiency in preparing and interpreting stained microbial slides, along with analyzing microscopic images, demanding analytical skills and problem-solving capabilities.

PO3: Social Competence:

The hands-on nature of microbiology labs (as suggested in CO1, CO2, CO3, CO4, CO5, CO6) may entail collaborative work, indirectly fostering social competence within a laboratory environment.

PO4: Research-related Skills and Scientific Temper:

CO4 underscores the significance of proper microscope maintenance, calibration, and troubleshooting, aligning with research-related skills and nurturing a scientific temper within the laboratory setting**.**

PO5: Trans-disciplinary Knowledge:

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

PO6: Personal and Professional Competence:

CO7 directly corresponds to PO6, aiming to cultivate expertise that empowers students to seamlessly participate in applied fields without the need for additional training, showcasing both personal and professional competence

PO7: Self-directed and Life-long Learning:

CO1, CO2, CO3, and CO6 collectively contribute to fostering self-directed learning by imparting foundational skills and knowledge, establishing the foundation for ongoing 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 considerations, particularly in areas like food and water safety.

PO9: Self-directed and Life-long Learning:

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