Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

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

(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,
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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

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

Class : F.Y.B.Sc.
Semester : II
Course Type : Theory
Course Code : MICRO-1201
Course Title : Introduction to Microbiology
No. of Credits : 02
No. of Teaching Hours : 36

Course Objective:

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

Course Outcome:

CO1 The students will acquire a fundamental understanding of biochemistry.
CO2 The students will be aware of the basic concepts used in biochemistry field.
CO3 The students will be able to do the calculations related to preparation of molar and normal solutions.
CO4 The students will be able to distinguish the different parts of bacterial cell.
CO5 The students will be able to understand the chemical composition of various parts of bacterial cell.
CO6 Students shall earn information about major biomolecules present in the bacterial cell.
CO7 Students shall learn about the physiology of various components of bacterial cell.

Credit No	Topic	Lectures
III	**Unit1:Basic biochemistry for Microbiology** 1. Atoms, elements, ions and molecules 2. Molarity, Normality and Isotopes Avogadro's number 3. Covalent and non-covalent bonding in biomolecules 4. Biochemical reactions-Metabolism and enzymes 5. Concepts of pH, acid, base and buffers	**6**
	Unit2:Structure and functions of Biomolecules and Macromolecules 1. Carbohydrates (Monosaccharide, disaccharides and polysaccharides) 2. Lipids (Triglycerides, phospholipids, oils and sterol) 3. Proteins (Structural levels, Haemoglobin and Immunoglobulin) 4. Nucleic acids (DNA and RNA)	**12**

IV	**Unit1:Bacterial Cytology** Structure, chemical composition and functions of the following: 1. Flagella (Gram positive and Gram negative) and types of motility. 2. Fimbriae and Pili 3. Capsule (Slime layer and glycocalyx) 4. Cell wall (Gram positive and Gram negative) 5. Cell membrane 6. Endospore (sporulation cycle) 7. Ribosomes 8. Chromosomal & extra-chromosomal material 9. Cell inclusions: (Gas vesicles, carboxysomes ,PHB granules, metachromatic granules, Megnatosomes, chromosomes and glycogen bodies)	**18**

References:

1. SalleA.J.(1971)FundamentalPrinciplesofBacteriology.7thEdition.Tat aMacGraw Hill Publishing Co.
2. StanierR.Y.,Adelberg E.A. and IngrahamJ.L.(1987) General Microbiology, 5th Edition. Macmillan Press Ltd.
3. Prescott,Lancing.M.,John,P.Harley and Donald,A.Klein (2006) Microbiology 6thEdition, McGraw Hill Higher Education.
4. M.H.Gajbhiye, S.J.Sathe, S.R.Pharande and R.J.Marathe (2015) Introduction to Microbiology, 3rd Edition. Career publication.
5. Michael JPelczar, JR.E.C.S.Chan, Noel R.Krieg. (1993) Microbiology, 5thEdition, Tata MacGraw Hill Press.
6. Nelson D.L.and CoxM.M.(2002) Lehninger's Principles of Biochemistry, Mac Millan Worth Pub. Co. NewDelhi.
7. MadiganM.T., Martinko J.M.(2006). Brock's Biology of Microorganisms. 11th Edition.Pearson Education Inc.
8. Mount,D.W.(2001) Bioinformatics :Sequence and Genome analysis. Cold Spring Harbor Laboratory Press, New York.
9. Mahendra Rai and NelsonDuran(2011) Metal Nanoparticles inMicrobiology, 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	3	3		2	3	3			
CO3	3	3		3	3	3			
CO4	3								2
CO5	3								
CO6	3	2						2	
CO7	3							3	

Justification for the mapping

PO1 **Disciplinary Knowledge:**

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

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

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

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

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

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

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

PO2 **CriticalThinkingandProblemSolving:**

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

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

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

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

PO4 **Research-relatedskillsandScientifictemper:**

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

CO3:The students shall be able to prepare the solutions of different concentrations Used to performs everal biological experiments.

PO5 **Trans-disciplinary knowledge:**

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

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

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

PO6 **Personal and professional competence:**

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

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

PO8 **Environment and Sustainability:**

CO6:The knowledge of acidic and basic solutions shall help students understand the effect of chemical wastes on the environment.

CO7:Understanding the role of microbes in different environmental sectors shall Help students understand the functions of different components of a bacterial cell.

PO9 **Self-directed and Life-long learning:**

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

CO4:To maketheirfutureunderstanding ofthesubjectbetter, thestudentsshall gain Knowledge about the basic chemicals present in bacterial cell.

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

Class	**: F.Y.B.Sc.**
Semester	**: II**
Course Type	**: Practical**
Course Name	**: Basic Techniques in Microbiology**
Course Code	**: MICRO-1202**
No. of Credits	**: 02**
No. of Lectures	**:36**

Course Objectives:

1. Introduce students to the foundational principles and methodologies utilized in microbiology, emphasizing techniques for isolation, preservation, and cultivation.

2. Provide students with insights into the nutrients and nutritional classification specific to microorganisms.

3. Familiarize students with a variety of culture media and their applications in the field of microbiological research.

4. Foster students' understanding of the principles and procedures involved in isolating microbial growth.

5. Introduce students to diverse culture preservation techniques commonly employed in microbiology.

6. Convey knowledge to students regarding the processes involved in microbial growth.

7. Enhance students' comprehension of the methodologies employed in the enumeration of microorganisms.

8. Introduce students to the various factors that influence bacterial growth.

9. Enable students to grasp the concept of synchronous and diauxic growth cultures

Course Outcomes :

CO1	Develop a comprehensive understanding of the principles and practical applications of various types of media, including knowledge of their components
CO2	Attain in depth knowledge of diverse isolation techniques commonly used in microbiology.
CO3	Demonstrate a nuanced understanding of the applications and limitations associated with different preservation techniques in microbiological research.
CO4	Articulate the importance of isolation techniques in upholding aseptic conditions in the laboratory and preventing contamination

CO5 Acquire knowledge about the methodologies employed for the enumeration of bacterial cells.

CO6 Cultivate proficiency in the execution of isolation and preservation methods within the context of microbiology

CO7 Gain insight into the different phases of bacterial growth.

CO8 Apply the acquired techniques to effectively analyze and interpret experimental data in the field of microbiology

Credit No	Topic	Lectures
III	**Unit1:Cultivation of Microorganisms** **1.** Nutritional requirements and nutritional classification **2.** Design and preparation of media–Common ingredients of media and types of media **3.** Methods for cultivating photosynthetic, extremophilic and chemolithotrophic bacteria. **4.** Concept of Pure Culture, Enrichment, Isolation and Preservationtechniques.Maintenanceofbacterialand fungalcultures **5.** Culture collection centers and their role.	**18**
IV	**Unit2:Bacterial Growth** Growth curve; definition of Generation time, Growth rate and specific growth rate Methods of enumeration: 1. Microscopic methods (Direct Microscopic Count, Counting cells using Neubauer chambers) 2. Plate counts (Total Viable Count) 3. Estimation of Biomass (Dry mass, Cell volume) 4. Chemical methods (Cell Carbon and Nitrogen estimation) 5. Turbidometric methods 6. Factors affecting bacterial growth (pH, Temperature, Solute Concentration\(Salt and Sugar) and Heavy metals) 7. Diauxic growth Synchronous culture	**18**

References:

1. SalleA.J.(1971) Fundamental Principles of Bacteriology. 7thEdition. Tata Mac Graw 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 6thEdition, McGraw Hill Higher Education.
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Course outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3				2			3	3
CO2	2					3		2	2
CO3	3	3		3		2		1	2
CO4		3				2		2	1
CO5	2	2		3					3
CO6	3				1	3		3	2
CO7	3				3				
CO8		3		3	3	3			2

Justification for the mapping

PO1: Disciplinary Knowledge:

CO1. Develop an understanding of various nutrient elements, types of media, and their applications.

CO2. Attain knowledge of diverse isolation techniques employed in the field of microbiology.

CO3. Acquire knowledge related to the preservation of microbial cultures.

CO5. Gain fundamental knowledge about the enumeration of bacterial cells.

CO6. Cultivate knowledge and skills in the execution of isolation and preservation methods.

CO7. Obtain insights into the bacterial growth curve.

PO2: Critical Thinking and Problem Solving:

CO3. Demonstrate a nuanced understanding of the applications and limitations of various preservation techniques in microbiological research.

CO4. Implement isolation techniques to ensure aseptic conditions and prevent contamination.

CO5. Acquire knowledge about techniques applied for the enumeration of bacterial cells.

CO8. Apply, analyze, and interpret experimental data within the context of microbiology.

PO4: Research related Skills and Scientific Temper:

CO3. Showcase proficiency in employing various preservation techniques across diverse fields of microbiology.

CO5. Acquire knowledge about techniques used for the enumeration of bacterial cells.

CO8. Apply learned techniques to analyze and interpret experimental data in the field of microbiology.

PO5: Trans disciplinary Knowledge:

CO1. Develop an understanding of different nutrient elements, types of media, and their applications.

CO6. Cultivate knowledge and skills to perform isolation and preservation methods.

CO7. Acquire knowledge about bacterial growth.

CO8. Apply learned techniques to analyze and interpret experimental data in the broader context of microbiology.

PO6: Personal and Professional Competence:

CO2. Attain knowledge of various isolation techniques employed in microbiology.

CO3. Understand the applications and limitations of preservation techniques.

CO4. Explain the process of cultivating microorganisms.

CO6 Gain fundamental knowledge about preservation methods.

CO8. Apply learned techniques to analyze and interpret experimental data in the field of microbiology.

PO8: Environment and Sustainability:

CO1.Grasp the principles and uses of different types of media and their components.

CO2.Acquire knowledge of various isolation techniques used in microbiology.

CO3. Demonstrate an understanding of the applications and limitations of different preservation techniques in microbiological research.

CO4.Explain the significance of isolation techniques in maintaining aseptic conditions and preventing contamination.

CO6. Obtain knowledge about performing isolation and preservation methods.

PO9: Self directed and Life long Learning:

CO1. Understand the principles and uses of different types of media and their components.

CO2. Acquire knowledge of diverse isolation techniques used in microbiology.

CO3. Demonstrate an understanding of the applications and limitations of different preservation techniques in microbiology research.

CO4. Explain the importance of isolation techniques in maintaining aseptic conditions and preventing contamination.

CO5. Obtain knowledge about techniques used for the enumeration of bacterial cells.

CO6. Gain knowledge about performing isolation and preservation methods.

CO8.Apply, analyze, and interpret experimental data in the context of microbiology.

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

Class	**: F.Y.B.Sc.**
Semester	**: II**
Course Type	**: Practical**
Course Name	**: Practical based on theory**
Course Code	**: MICRO-1203**
No. of Credits	**: 02**
No. of Lectures	**:40**

Course Objectives:

1. Strengthen students' grasp and expertise in fundamental Microbiology principles.
2. Educate students on the various isolation methods and elucidate their importance in aseptic research and diagnostics.
3. Provide students with hands on, practical experience in essential microbial techniques for cultivating microorganisms.
4. Familiarize students with the techniques necessary for aseptic culture practices.
5. Introduce students to methods for identifying the structural characteristics of microorganisms.
6. Cultivate proficiency in laboratory skills among students while emphasizing a strong awareness of safety procedures.
7. Endow students with knowledge about optimizing growth requirements for microorganisms.
8. Foster the development of critical thinking and problem solving skills among students.

Course Outcomes :

CO1	Introduce students to the microbiology laboratory, acquainting them with standard practices applied in both research and diagnostic microbiology
CO2	Foster proficiency in students for the preparation of media, broth, and slants.
CO3	Develop students' ability to analyze, interpret, and describe the morphological features of microorganisms
CO4	Imbue students with an understanding of the significance of aseptic transfer techniques
CO5	Equip students with the capability to execute special staining techniques, facilitating the visualization and differentiation of structures within microorganisms
CO6	Convey knowledge regarding the importance and methods of calibration utilized in sterilization processes.
CO7	Enable students to optimize and analyze the influences of various factors on the growth of microorganisms

CO8 Cultivate expertise in students, empowering them to work directly in applied fields such as industry or institutions, eliminating the need for additional training

Expt. No.	Topic	Hours
1	Cultivation of microorganisms: 1. Preparation of simple laboratory media (solid and liquid) 2. Observation of the growth of cultures and reporting of colony and cultural characteristics (Nutrient Agar, MacConkey's agar & Potato Dextrose Agar)	**4**
2	Isolation of bacteria by streak plate technique	**4**
3-4	Enumeration of bacteria from fermented food/soil/water by: 1. Spread plate method 2. Pour plate method	**4**
5	Aseptic transfer techniques (slant to slant, broth to broth, broth to agar and agar to agar)	**4**
6	Preservation of cultures on slants, soil and on grain surfaces; revival of these Cultures.	**4**
7	Checking sterilization efficiency of autoclave using a biological indicator	**4**
8	Demonstration of checking the efficacy of chemical disinfectant: Phenol Coefficient by Rideal Walker method	**4**
9	Study of normal flora of skin: Cultivating and observing different morphoforms of bacteria from skin & Study the effect of soap and disinfectant on skin microflora	**4**
10	To study the effect of different parameters on growth of bacteria: pH, temperature & heavy metal	**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

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

Justification for the mapping

PO1: Disciplinary Knowledge:

CO1. Familiarize students with the do's and don'ts related to common practices in research and diagnostic microbiology.

CO4. Enable students to proficiently perform aseptic transfer techniques.

CO6. Provide students with knowledge about calibration methods utilized for sterilization.

PO2: Critical Thinking and Problem Solving:

CO2. Develop proficiency in students for the preparation of media, broth, and slants.

CO3. Equip students with the ability to analyze, interpret, and describe the morphological features of microorganisms.

CO4. Foster skills related to aseptic techniques.

CO5. Enable students to perform special staining techniques for visualizing and differentiating structures within microorganisms.

CO7. Empower students to optimize and analyze the impact of various factors affecting the growth of microorganisms.

CO8. Cultivate expertise in students for direct application in applied fields, such as industry or institutions.

PO4: Research related Skills and Scientific Temper:

CO3. Enable students to perform basic research related steps for the cultivation and identification of microorganisms.

CO4. Foster skills related to aseptic techniques.

CO5. Equip students to perform special staining techniques for visualizing and differentiating structures within microorganisms.

CO7. Enable students to optimize the growth of microorganisms.

CO8. Cultivate expertise for direct application in applied fields, eliminating the need for additional training.

PO5 : Trans disciplinary Knowledge:

CO1. Introduce students to the microbiology laboratory and common practices in research and diagnostic microbiology.

CO6. Develop knowledge and skills related to sterilization.

CO7. Enable students to optimize the growth of microorganisms.

PO6: Personal and Professional Competence:

CO1. Acquire skills related to common practices used in research and diagnostic microbiology.

CO2. Attain proficiency in preparing media, broth, and slants.

CO3. Enable students to analyze and interpret the classification of bacteria.

CO5. Develop skills for special staining techniques to observe structures within microorganisms.

CO6. Gain knowledge about the significance and calibration methods used for sterilization.

CO8. Cultivate expertise for direct application in applied fields, such as industry or institutions.

PO8: Environment and Sustainability:

CO1. Raise awareness about the do's and don'ts in common practices used in research and diagnostic microbiology.

CO7. Facilitate optimization and observation of the effects of different factors on microorganism growth.

PO9: Self directed and Life long Learning:

CO1. Acquire skills related to common practices used in research and diagnostic microbiology.

CO2. Develop proficiency in preparing media, broth, and slants.

CO3. Apply learned knowledge to identify microorganisms.

CO5. Gain skills in special staining techniques.

CO6. Acquire knowledge about the significance and calibration methods used for sterilization.

CO8. Cultivate expertise for direct application in applied fields, eliminating the need for additional training.