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

Preamble:

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.

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

Sr. No.	Class	Semester	Code	Paper	Paper Title	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

Class : **F.Y.B.Sc. (Semester- I)**

Paper Code: **USMB111**

Paper : **I** Paper Title: **Introduction to Microbiology I**

Credit : **2 Credits (Each credit=16 lectures)**

A. Learning Objectives:

1. To cater the needs of students for building up knowledge in the basics of Microbiology.
2. To understand the scope and applications of microbes in different industrial sectors.
3. To understand the historical developments in the microbiology field.

B. Learning outcome:

1. The major outcome is the understanding of different fields and sectors of microbiology and their importance in relation to the environment.
2. Understanding of role of microbes in environment.
3. Students shall earn the knowledge of designing of simple experiments through historical background.

Credit No	Topic	Lectures
I	**Scope And Application of Microbiology** **Unit 1: Scope of Microbiology:** a) Industrial Microbiology and Biotechnology b) Medical Microbiology c) Immunology d) Microbial Genetics e) Geomicrobiology f) Food and Dairy Microbiology g) Nano-Biotechnology	**4**
	Unit 2 : Applications of Microbiology with special reference to: a) Significance of normal flora and probiotics in human health b) Microbes as Biofertilizers (e.g. Nitrogen fixers, Phosphate solubilizers) and Biocontrol Agents (*Bacillus thuriengensis*) c) Use of bacteriophages as biocontrol agents in agriculture	**4**

	Unit 3 : Morphological and differentiating characters 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	**Unit 1 : History of Microbiology** a) Invention of microscope (Micrographia of Antony van Leeuwenhoek and Robert Hooke) b) Abiogenesis v/s biogenesis i. Aristotle's notion about spontaneous generation; Needham's experiment ii. Redi's experiment iii. Louis Pasteur's & Tyndall's experiments	**5**
	Unit 2 : Development of Microbiology in 19th century a) Observations and role of microorganisms in transformationof 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**

Class : **F.Y.B.Sc. (Semester-I)**

Paper Code : **USMB112**

Paper : **II** Paper Title: **Basic Techniques in Microbiology I**

Credit : **2 Credits (Each credit=16 lectures)**

A. Learning Objectives:

1. To develop the expertise in handling of microscope and related tools.
2. To understand the basic techniques of coloring the microbes.
3. To enrich students' knowledge in relation to sterilization methods.

B. Learning outcome:

1. Theoretical understanding of basic techniques of microscopy and staining of bacteria.
2. Understanding of the various methods used for the sterilization of objects and medium.

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)	**2**
	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) 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	**6**

	b) Radiation c) Filtration **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 **Unit 3 :** Characteristics of an ideal Disinfectant Checking of Efficiency of Disinfectant – Phenol Coefficient	**7** **3**

Class: **F.Y.B.Sc. (Semester-I)**

Paper Code: **USMB113**

Paper : **Practical** Paper Title: **Practical Course I**

Credit : **2 Credits**

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**

Class : **F.Y.B.Sc. (Semester-II)**

Paper Code : **USMB121**

Paper : **I** Paper Title: **Introduction to Microbiology II**

Credit : **2 Credits (Each credit=16 lectures)**

A. Learning Objectives:

1. To understand the basic concepts in chemistry.
2. To understand the structural components of a bacterial cell.

B. Learning outcome:

1. The major outcome is the understanding of essential biochemistry required for microbiology.
2. Students shall earn the knowledge about various structural components of bacterial cell.

Credit No	Topic	Lectures
I	**Unit 1 : Basic biochemistry for Microbiology** a) Atoms, elements, ions and molecules b) Mole, Molarity, Normality, Isotopes, Avogadro's number c) Covalent and non-covalent (ionic, hydrogen, van der Waals, hydrophobic, hydrophilic) bonding in biomolecules d) Biochemical reactions - Metabolism and enzymes e) Concepts of pH, acid, base and buffers	**6**
	Unit 2 : Structure and functions of Biomolecules a) Carbohydrates (Monosaccharide-Aldoses & Ketoses, disaccharides, Oligosaccharides and polysaccharides b) Lipids (Triglycerides, phospholipids, oils and sterol) c) Proteins (Structural levels, Haemoglobin and Immunoglobulin) d) Nucleic acids (DNA and RNA) e) Conjugated biomolecules	**10**

II	**Unit 1 : Bacterial Cytology** Structure, chemical composition and functions of the following: a) Flagella (Gram-positive and Gram-negative) and types of motility (spirochetal and gliding) b) Fimbriae and Pili c) Capsule (Slime layer and glycocalyx) d) Cell wall (Gram-positive and Gram-negative) e) Cell membrane f) Endospore (sporulation cycle) g) Ribosomes (23S, 5S, 16S, 30S, 50S) h) Chromosomal & extra-chromosomal material i) Cell inclusions: (Gas vesicles, carboxysomes, PHB granules, metachromatic granules, Megnatosomes, starch granules, sulfur granules and glycogen bodies)	**2** **1** **1** **2** **1** **1** **2** **2** **4**

Class : **F.Y.B.Sc. (Semester-II)**
Paper Code : **USMB122**
Paper : **II** Paper Title: **Basic Techniques in Microbiology II**
Credit : **2 Credits (Each credit=16 lectures)**

A. Learning Objectives:

1. To develop the expertise in understanding of the methods of cultivation of various types of microorganisms.
2. To understand the bacterial growth techniques.

B. Learning outcome:

1. Theoretical understanding of basic techniques of microbial cultivation.
2. Students will be able to understand the various methods of bacterial growth measurement and their isolation.

Credit No	Topic	Lectures
I	**Cultivation of Microorganisms** **Unit 1:** Nutritional requirements: a) Nutritional classification of microorganisms b) Common ingredients of media c) Types of media **Unit 2:** Methods of Cultivation of : a) Photosynthetic Bacteria b) Chemoautotrophic Bacteria c) Extremophiles **Unit 3 :** Isolation and Preservation a) Isolation of bacteria by - i. Streak Plate Method ii. Spread Plate Method iii. Pour Plate Method b) Preservation techniques - i. Agar Slant Method ii. Soil & Grain Culture Method iii. Saline Suspension Method iv. Freezing Method v. Lyophilization c) Culture collection centers and their role	**4** **4** **4** **4**
II	**Bacterial Growth** **Unit 1 : Phases of bacterial Growth curve** a) Definition of : i. Generation ii. Generation time iii. Growth rate and	**4**

	iv. Specific growth rate **Unit 2 : Methods for the Enumeration of Bacteria:** a) Microscopic Methods i. Direct Microscopic Count ii. Counting cells by Neubauer chamber b) Plate counts c) Estimation of Biomass d) Turbidimetric methods **Unit 3:** a) Factors affecting bacterial growth: i. pH ii. Temperature iii. Solute Concentration iv. Heavy metals b) Diauxic growth, Synchronous culture c) Continuous cultivation-Chemostat and Turbidostat	**7** **5**

Class : **F.Y.B.Sc. (Semester-II)**

Paper Code: **USMB123**

Paper : **Practical** Paper Title: **Practical Course II**

Credit : **2 Credits**

Credit No	Expt. No.	Topic	Hours
I	**1**	Cultivation of microorganisms: a) Preparation of simple laboratory media (solid and liquid) (Nutrient Broth & Agar, MacConkey's Broth & Agar & Potato Dextrose Broth & Agar)	**4**
	2	Isolation of bacteria by Streak plate technique & Observation of the growth of cultures and reporting of colony characteristics	**4**
	3-4	Enumeration of bacteria from fermented food / soil / water by: a) Spread plate method b) Pour plate method	**8**
	5	Aseptic transfer techniques (slant to slant, broth to broth, broth to agar and Agar to Agar)	**4**
II	**6**	Oligodynamic effect of heavy metals	**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 the effect of soap and disinfectant on skin microflora	**4**
	10	To study the effect of different parameters on growth of bacteria: pH, temperature &Salt concentration	**4**

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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, 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.
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9. Mount, D. W. (2001) Bioinformatics: Sequence and Genome analysis. Cold Spring Harbor Laboratory Press, NewYork.
10. Mahendra Rai and Nelson Duran (2011) Metal Nanoparticles in Microbiology, Springer Verlag Berlin Heidelberg.

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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.