

Anekant Education Society's  
**Tuljaram Chaturchand College,**  
Of Arts, Science & Commerce  
Baramati  
(Autonomous Institute)

**Syllabus (CBCS) for F. Y. B. Sc. Microbiology**

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 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.

**A. Learning Objectives:**

1. To cater the needs of students for building up their careers in industry and research.
2. The syllabus orientation at local and global level.
3. To enrich student's knowledge and train them in core Microbiology.
4. To inculcate sense of scientific responsibilities and social and environment awareness
5. To help students build-up a progressive and successful career.

**B. Learning outcome:**

1. The major outcome is the understanding of basic principles and applied aspects of Microbiology and basic techniques of handling of Microbiology.
2. Theory supplemented with extensive laboratory expertise will help to work directly in applied fields (industry or institutions), without any additional training.
3. The trained and skilled man-power.

**COURSE STRUCTURE FOR F. Y. B. SC. MICROBIOLOGY (w.e.f. June2019)**

<b>Sr. No.</b>	<b>Class</b>	<b>Semester</b>	<b>Code</b>	<b>Paper</b>	<b>Paper Title</b>	<b>Credit</b>	<b>Marks (I + E)</b>
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	Practicals 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	Practicals based on theory	2	50 + 50

**I** : Internal Examination

**E** : External Examination

**SYLLABUS (CBCS) FOR F. Y. B. SC. MICROBIOLOGY (w.e.f. June2019)**

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

Paper Code : **MICRO-1101**

Paper : **I**

Paper Title: **Introduction to Microbiology**

Credit : **2 Credits**

Credit No	Topic	Lectures
<b>I</b>	<p><b>Scope And Application of Microbiology</b></p> <p><b>Unit 1: Scope of Microbiology:</b></p> <ul style="list-style-type: none"> <li>i. Industrial Microbiology and Biotechnology</li> <li>ii. Medical Microbiology</li> <li>iii. Immunology</li> <li>iv. Microbial Genetics</li> <li>v. Geomicrobiology</li> <li>vi. Food and Dairy Microbiology</li> <li>vii. Bioinformatics</li> <li>viii. Nano-Biotechnology</li> <li>ix. Space Microbiology</li> </ul>	<b>7</b>
	<p><b>Unit 2 : Few Applications of Microbiology with special reference to:</b></p> <ul style="list-style-type: none"> <li>I. Significance of normal flora and probiotics in human health</li> <li>II. Microbes as Biofertilizers (e.g. Nitrogen fixers, Phosphate solubilizers ) and Biocontrol Agents (<i>Bacillus thuringensis</i> and <i>Tricoderma</i>)</li> </ul>	<b>3</b>
	<p><b>Unit 3 : Morphological and differentiating characters of microorganisms:</b></p> <p>Whittaker five Kingdom classification</p> <ul style="list-style-type: none"> <li>i. Structures of prokaryotic and eukaryotic cell</li> <li>ii. Bacteria: (Eubacteria, Archaeobacteria, Rickettsia, Chlamydia, Actinomycetes and Mycoplasma) Introduction to Bergey's Manual of Determinative and Systemic Bacteriology</li> <li>iii. Protozoa</li> <li>iv. Algae</li> <li>v. Fungi (Molds and Yeasts)</li> <li>vi. Viruses, viroids and prions</li> </ul>	<b>8</b>
<b>II</b>	<p><b>Unit 1 : History of Microbiology</b></p> <ul style="list-style-type: none"> <li>i. Discovery of microscope ( Micrographia of Anton von Leeuwenhoek and Robert Hooke)</li> <li>ii. Abiogenesis v/s biogenesis <ul style="list-style-type: none"> <li>a. Aristotle's notion about spontaneous generation</li> <li>b. Redi's experiment</li> <li>c. Louis Pasteur's &amp; Tyndall's experiments</li> </ul> </li> </ul>	<b>6</b>

	<p><b>Unit 2 : Development of Microbiology in 19th century</b>  <b>2.1. Observations and role of microorganisms in transformation of organic matter.</b></p> <ol style="list-style-type: none"> <li>1. Germ theory of fermentation</li> <li>2. Discovery of anaerobic life &amp; physiological significance of fermentation</li> </ol> <p><b>2.2 Discovery of microbes as pathogens and disease prevention</b></p> <ol style="list-style-type: none"> <li>1. Surgical antisepsis</li> <li>2. Germ theory of disease – Koch’s postulates &amp; River’s postulates</li> <li>3. Vaccination: Edward Jenner and Louis Pasteur – chicken cholera and Rabies</li> </ol>	<b>8</b>
	<p><b>Unit 3 : Developments in 20<sup>th</sup> and 21<sup>st</sup> Centuries with respect to:</b></p> <ol style="list-style-type: none"> <li>1. Chemotherapy : Paul Ehrlich, Domagk, Walkman and Alexander Fleming</li> <li>2. Contributions of Nobel Laureates (Elie Metchnikoff, Burnett, Gerorge Beadle, Edward Tatum, Porter and Edelman, Kohler and Milstein )</li> <li>3. Molecular Biology &amp; Biotechnology: Watson and Crick and Hargobind Khurana</li> </ol>	<b>4</b>

Class : **F.Y.B.Sc. (Semester-II)**  
Paper Code : **MICRO-1201**  
Paper : **I** Paper Title: **Introduction to Microbiology**  
Credit : **2 Credits**

<b>Credit No</b>	<b>Topic</b>	<b>Lectures</b>
<b>III</b>	<p><b>Unit 1 : Basic biochemistry for Microbiology</b></p> <ol style="list-style-type: none"> <li>1. Atoms , elements, ions and molecules</li> <li>2. Molarity , Normality and Isotopes Avogadro’s number</li> <li>3. Covalent and non-covalent bonding in biomolecules</li> <li>4. Biochemical reactions - Metabolism and enzymes</li> <li>5. Concepts of pH, acid, base and buffers</li> </ol>	<b>6</b>
	<p><b>Unit 2 : Structure and functions of Biomolecules and Macromolecules</b></p> <ol style="list-style-type: none"> <li>1. Carbohydrates (Monosaccharide, disaccharides and polysaccharides)</li> <li>2. Lipids (Triglycerides, phospholipids, oils and sterol)</li> <li>3. Proteins (Structural levels, Haemoglobin and Immunoglobulin)</li> <li>4. Nucleic acids ( DNA and RNA)</li> </ol>	<b>12</b>

<b>IV</b>	<b>Unit 1 : Bacterial Cytology</b> Structure, chemical composition and functions of the following: <ol style="list-style-type: none"><li>1. Flagella (Gram positive and Gram negative ) and types of motility.</li><li>2. Fimbriae and Pili</li><li>3. Capsule (Slime layer and glycocalyx )</li><li>4. Cell wall (Gram positive and Gram negative )</li><li>5. Cell membrane</li><li>6. Endospore (sporulation cycle )</li><li>7. Ribosomes</li><li>8. Chromosomal &amp; extra-chromosomal material</li><li>9. Cell inclusions: ( Gas vesicles, carboxysomes, PHB granules, metachromatic granules, Megnatosomes, chromosomes and glycogen bodies)</li></ol>	<b>18</b>
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Class : **F.Y.B.Sc. (Semester- I)**

Paper Code : **MICRO-1102**

Paper : **II**

Paper Title: **Basic Techniques In Microbiology**

Credit : **2 Credits**

<b>Credit No</b>	<b>Topic</b>	<b>Lectures</b>
<b>I</b>	<p><b>Unit 1: Units of measurement. Modern SI units</b> (Length, volume, Weight)</p> <p><b>Unit 2 : Microscopy</b></p> <ol style="list-style-type: none"><li>1. Bright field microscopy: Structure, working of and ray diagram of a compound light microscope; Concepts of magnification, numerical aperture and resolving power.</li><li>2. Types, ray diagram and functions of – condensers, eye-pieces and objectives</li><li>3. objectives</li><li>4. Aberrations in lenses - spherical, chromatic, comma and astigmatism</li><li>5. Principle, construction, working and applications of:<ol style="list-style-type: none"><li>i. Fold scope</li><li>ii. Dark field microscopy</li><li>iii. Fluorescence microscopy</li><li>iv. Electron Microscopy</li></ol></li><li>6. Transmission electron microscope (TEM)</li><li>7. Scanning electron microscope (SEM)</li></ol> <p><b>Unit 3 : Staining Techniques :</b></p> <ol style="list-style-type: none"><li>1. Definitions of Stain; Types of stains (Basic and Acidic),</li><li>2. Properties and role of Fixatives, Mordants, Decolorisers and Accentuators</li><li>3. Principles of staining techniques for following:<ol style="list-style-type: none"><li>i. Monochrome staining and Negative (Relief) staining</li><li>ii. Differential staining - Gram staining and Acid fast staining</li></ol></li></ol>	<p><b>12</b></p> <p><b>06</b></p>
<b>II</b>	<p><b>Unit 1 : Sterilization and Disinfection</b></p> <ol style="list-style-type: none"><li>1. Physical Agents - Heat, Radiation, Filtration</li><li>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.</li><li>3. Characteristics of an ideal disinfectant</li><li>4. Checking of Efficiency of Sterilization – Biological and Chemical Indicators</li><li>5. Checking of Efficiency of Disinfection - Phenol Coefficient</li></ol>	<p><b>18</b></p>

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

Paper Code : **MICRO-1202**

Paper : **II**

Paper Title: **Basic Techniques in Microbiology**

Credit : **2 Credits**

<b>Credit No</b>	<b>Topic</b>	<b>Lectures</b>
<b>III</b>	<b>Unit 1 : Cultivation of Microorganisms</b>  <ol style="list-style-type: none"><li>1. Nutritional requirements and nutritional classification</li><li>2. Design and preparation of media – Common ingredients of media and types of media</li><li>3. Methods for cultivating photosynthetic, extremophilic and chemolithotrophic bacteria.</li><li>4. Concept of Pure Culture, Enrichment, Isolation and Preservation techniques. Maintenance of bacterial and fungal cultures</li><li>5. Culture collection centers and their role.</li></ol>	<b>18</b>
<b>IV</b>	<b>Unit 2 : Bacterial Growth</b>  Growth curve; definition of Generation time, Growth rate and specific growth rate Methods of enumeration: <ol style="list-style-type: none"><li>1. Microscopic methods (Direct Microscopic Count, Counting cells using Neubauer chambers)</li><li>2. Plate counts (Total Viable Count)</li><li>3. Estimation of Biomass (Dry mass, Cell volume)</li><li>4. Chemical methods (Cell Carbon and Nitrogen estimation)</li><li>5. Turbidometric methods</li><li>6. Factors affecting bacterial growth ( pH, Temperature, Solute Concentration\ (Salt and Sugar) and Heavy metals)</li><li>7. Diauxic growth Synchronous culture</li></ol>	<b>18</b>

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

Paper Code : **MICRO-1103**

Paper : Practical Course

Paper Title: **Practicals based on theory**

Credit: **2 Credits**

<b>Expt. No.</b>	<b>Topic</b>	<b>Hours</b>
<b>1-2</b>	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.	<b>8</b>
<b>3</b>	Construction (mechanical and optical), working and care of bright field microscope	<b>4</b>
<b>4-5</b>	Observation of microorganisms using bright field microscope – Bacteria, Protozoa, Molds and Yeasts, Algae – from natural habitat Preparation of Winogradsky column and observation of different types of microorganisms using bright field microscope.	<b>4</b>
<b>6-9</b>	Observation of bacteria using staining techniques: a. Monochrome staining and b. Negative /Relief staining & Capsule staining c. Gram staining of bacteria	<b>12</b>
<b>10</b>	Observation of motility in bacteria using: a. Hanging drop method b. Swarming growth methods	<b>4</b>
<b>11</b>	Enumeration of cells using Neubauer chamber	<b>4</b>

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

Paper Code : **MICRO-1203**

Paper : Practical Course

Paper Title: **Practical based on theory**

Credit: **2 Credits**

<b>Expt. No.</b>	<b>Topic</b>	<b>Hours</b>
<b>1</b>	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)	<b>4</b>
<b>2</b>	Isolation of bacteria by streak plate technique	<b>4</b>
<b>3-4</b>	Enumeration of bacteria from fermented food / soil / water by:  1. Spread plate method  2. Pour plate method	<b>4</b>
<b>5</b>	Aseptic transfer techniques (slant to slant, broth to broth, broth to agar and Agar to Agar)	<b>4</b>
<b>6</b>	Preservation of cultures on slants, soil and on grain surfaces; revival of these Cultures.	<b>4</b>
<b>7</b>	Checking sterilization efficiency of autoclave using a biological indicator	<b>4</b>
<b>8</b>	Demonstration of checking the efficacy of chemical disinfectant: Phenol Coefficient by Rideal Walker method	<b>4</b>
<b>9</b>	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	<b>4</b>
<b>10</b>	To study the effect of different parameters on growth of bacteria: pH, temperature & heavy metal	<b>4</b>

### References for theory papers:

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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, 6<sup>th</sup> Edition, McGraw Hill Higher Education.
5. M. H. Gajbhiye , S. J. Sathe, S.R. Pharande and R.J. Marathe(2015) Introduction to Microbiology, 3<sup>rd</sup> Edition. Career publication.
6. Michael J Pelczar, 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 Millan 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.

### References for Practical Papers

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..