

Progressive Education Society's
Modern College of Arts, Science and Commerce,
Shivajinagar, Pune 5
(An Autonomous College Affiliated to Savitribai Phule Pune University)

Detailed Syllabus

For B.Sc. Microbiology

(2019-20 Course)

(with effect from 2019-20)

Semester 1 (First Year)

Course Type	Course Code	Course / Paper Title	Hours / Week	Credit	CIA	End Sem Exam	Total
CCT-1	19ScMicU101	Introduction to Microbiology	03	02	40	60	100
CCT-2	19ScMicU102	Techniques in Microbiology	03	02	40	60	100
CCP-1	19ScMicU103	Practical course based on Theory Papers I and II	03	02	40	60	100
Total Credits			-	06			

Semester 2 (First Year)

Course Type	Course Code	Course / Paper Title	Hours / Week	Credit	CIA	End Sem Exam	Total
CCT-9	19ScMicU201	Biochemistry and cell organization	03	02	40	60	100
CCT-10	19ScMicU202	Bacterial growth and cultivation	03	02	40	60	100
CCP-5	19ScMicU203	Practical course based on Theory Papers I and II	03	02	40	60	100
Total Credits			-	06			

Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
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First Year of B.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMicU101
Course Name: Introduction to Microbiology - I

Teaching Scheme: TH: 3 Hours/Week

Credit: 02

Examination Scheme: CIA: 40 Marks

End-Sem: 60 Marks

Prerequisite Courses: 12th pass science stream

Course Objectives:

- To introduce the students to the history of Microbiology
- To enrich students with the knowledge of Microbiology
- To introduce the concepts of applications in Microbiology
- To help the students to build up a successful career

Course Outcomes:

- Students will be aware of the history of microbiology
- Students will be perceptive about the basic structure and function of microbial cells
- Students will be cognizant about the applications of microbiology

Course Contents:

Unit 1	Introduction to the microbial world	No of lectures
	<p>A. History of Microbiology</p> <ul style="list-style-type: none">• Developments in Microbiology <p>Discovery of the microscope, Micrographia of Antonvan Leeuwenhoek and Robert Hooke, Abiogenesis v/s biogenesis, Aristotle's notion about spontaneous generation, Redi's experiment, Louis Pasteur's & Tyndall's experiments</p> <ul style="list-style-type: none">• Golden Era of Microbiology <p>Contributions of-Louis Pasteur (Fermentation, Rabies, and Pasteurization) Robert Koch (Germtheory of disease, Tuberculosis, and Cholera) Ferdinand Cohn (Endospore discovery)</p>	18

	<p>Contribution of Joseph Lister (antisepticsurgery), Paul Ehrlich (Chemotherapy), Elie Metchnikoff (Phagocytosis), Edward Jenner (Vaccination) and Alexander Fleming (Penicillin) in the establishment of fields of Medical Microbiology and Immunology, Contribution of Martinus W. Beijerinck (Enrichment culture technique, <i>Rhizobium</i>), Sergei N. Winogradsky (Nitrogen fixation and Chemolithotrophy) in the development of the field of Soil Microbiology</p> <p>B. Scope of Microbiology</p> <ul style="list-style-type: none"> • Microbiology in human health and diseases • Microbiology in industry and waste treatment • Microbiology in food and dairy • Microbiology in agriculture • Microbiology in the marine environment 	
Unit 2	Diversity of Microbial world	No of lectures
	<p>A. Systems of Classification</p> <ul style="list-style-type: none"> • Binomial Nomenclature • Whittaker's five kingdoms and Carl Woese's three domain classification systems and their utility. <p>B. Difference between prokaryotic and eukaryotic microorganisms</p> <ul style="list-style-type: none"> • Types of microorganisms and their differentiating characters: • General characteristics including details of the morphology of different groups: Acellular microorganisms (Viruses, Viroids, and Prions) and cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance. <p>C. Principles of classification</p> <ul style="list-style-type: none"> • Introduction to 9th edition Bergey's Manual of Determinative and Systemic Bacteriology viruses • Introduction to different groups of viruses 	17
Unit 3	Experiential learning / field visit/ internship	01

References:

- Ingraham, J.L. , & Ingraham, C.A. (2013). Introduction to Microbiology. Wadsworth Publishing Company.
- Madigan, M.T., & Martinko, J.M. (2019). Microorganisms and Microbiology. Brock biology of microorganisms. 15th edition. New York: Pearson
- Tortora, G. J. , Funke, B. R., Case, C. L. , & Johnson, T. R. (2016). Microbiology : an introduction. 12th edition, Pearson Education
- Michael, J. P. (2009). Microbiology : An Application-Based Approach. Tata McGraw Hill Education Private Limited.
- Willey, J. M., Sherwood, L., & Woolverton, C. J. (2013). Prescott, Harley, and Klein's microbiology. 8th edition, McGraw-Hill Higher Education.
- Salle, A. J. (1971). Fundamental Principles of Bacteriology. 7th edition. Tata McGraw Hill Publishing Co.
- Stanier, R. Y., Ingraham, J. L., Wheelis, M. L., & Painter, P. R. (1987). General Microbiology., 5th edition. Macmillan Press Ltd.
- Nelson, D. L., & Cox, M. M. (2008). Leininger principles of Biochemistry. 7th edition. McMillan.
- Brown, J. H. (1939). Bergey's manual of determinative bacteriology.
- Holt, J. G., & Krieg, N. R. (1984). Bergey's manual of systematic bacteriology, vol.1. The Williams and Wilkins Co., Baltimore, 1-1388.

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First Year of B.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMicU102
Course Name: Techniques in Microbiology

Teaching Scheme: TH: 3 Hours/Week

Credit: 02

Examination Scheme: CIA: 40 Marks

End-Sem: 60 Marks

Course Objectives:

- To enrich the students with knowledge in microbial sciences
- To acquaint the students with different microscopic and staining techniques
- To develop awareness in the students about the various techniques in microbial laboratories
- To inculcate a sense of environmental awareness

Course Outcomes:

- Students will be familiar with the different techniques routinely used in microbiology laboratories
- Students will be cognizant about the various aspects associated with the microbial growth
- Students will have knowledge about the cultivation techniques used for microorganisms

Course Contents:

Unit 1	Microscopy	Nooflectures
	<p>A. Fundamental Principles</p> <ul style="list-style-type: none"> • SI units of measurements, Molar and Normal solutions • Problems on measurements <p>B. Microscopy</p> <ul style="list-style-type: none"> • Properties of light, Spectrum, Wavelength, Frequency, Amplitude • History of microscopy • Concepts in microscopy- Magnification, Refractive index, Numerical aperture, Resolving power • Aberrations in lenses - spherical, chromatic, comma and astigmatism, • Principle, working, ray diagram and applications of <ul style="list-style-type: none"> ○ Bright field microscopy ○ Dark field microscopy ○ Phase contrast microscopy ○ Fluorescence microscopy ○ Electron microscopy– SEM, TEM and AFM 	18

Unit 2	Staining and Sterilization	Nooflectures
	<p>A. Basic staining techniques:</p> <ul style="list-style-type: none"> • Definitions of Stain, Types of stains (Basic and Acidic), Properties and role of Fixatives, Mordants, Decolorizers, and Accentuators. • Monochrome staining and Negative (Relief) staining; Differential staining-Gram staining and Acid-fast staining; Special staining-Capsule, Cellwall, Spore, Flagella, Lipidgranules, Metachromatic granules <p>B. Sterilization and Disinfection Mode of action and application of</p> <ul style="list-style-type: none"> ○ Physical agents: <ul style="list-style-type: none"> ○ Heat ○ Radiation ○ Filtration • Chemical agents : <ul style="list-style-type: none"> ○ Mode of action and application of: Aldehydes, Halogens, Quaternary ammonium compounds, Phenol, and Phenolic compounds, Heavy metals, Alcohols, Dyes, Detergents, and Ethyleneoxide • Characteristics of an ideal disinfectant • Checking of efficiency of sterilization Biological and Chemical indicators • Checking the efficiency of disinfectant –Phenolco efficient-Rideal Walker coefficient 	17
Unit 3	Experiential learning / field visit/ internship	01

References:

- Ingraham, J. L., & Ingraham, C.A. (2013). Introduction to Microbiology. Wadsworth Publishing Company.
- Madigan, M.T., & Martinko, J. M. (2019). Microorganisms and microbiology. Brock biology of Microorganism, 15th edition, New York (NY) :Pearson
- Tortora, G. J., Funke, B. R., Case, C. L., & Johnson, T. R. (2016). Microbiology : an introduction. 12th edition, Pearson Education
- Michael, J. P. (2009). Microbiology : An Application Based Approach. Tata McGraw Hill Education Private Limited
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First Year of B.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMicU103

Course Name: Laboratory on Microbiology

Teaching Scheme: TH: 3 Hours/Week

Credit: 02

Examination Scheme: CIA: 40 Marks

End-Sem: 60 Marks

Prerequisite Courses: 12th Science Stream

Course Objectives:

- To enrich students' knowledge about microorganisms
- To introduce the concepts related to cultivation, maintenance, and control of microorganisms
- To inculcate a sense of scientific responsibilities and social and environmental awareness

Course Outcomes:

On completion of the course, the student will be able to:

- Perform microbiological manipulations independently and confidently.
- Buildup a progressive and successful career.

Course Contents:

Practical 1	Bio safety and chemical safety in Microbiology laboratory	2
Practical 2	Preparation of Standard Operating Procedures (SOPs) for common microbiology laboratory instruments	2
Practical 3	Construction and working of bright field microscope and dark-field microscope	2
Practical 4	Observations of microorganisms from soil and water fungi, bacteria, yeast, protozoa and algae and Field visit	2
Practical 5	Observations of morpho forms on the human skin, effect of soap and disinfectant on hand washing	2
Practical 6	Observation of bacterial motility by hanging drop technique and swarming growth	2
Practical 7	Enumeration of yeast cells by Neubauer's chamber counting technique	2
Practical 8	Simple staining techniques: a. Monochrome staining b. Negative/Relief staining (Capsule staining)	2
Practical 9	Differential staining techniques a. Gram staining of bacteria b. Endospore staining	2

References:

- Aneja K. R., (2003). Experiments in Microbiology, Plant Pathology, and Biotechnology 4th edition. New Age International (P) Ltd.
- Fleming, D. O., & Hunt, D. L. (2006). Biological safety: principles and practices, 4th edition. ASM Press.
- Prescott, H. (2002). Laboratory exercises in microbiology 5th edition. McGraw-Hill.
- Richmond, J. Y., & McKinney, R. W. (1993). Biosafety in microbiological and biomedical laboratories. U. S. Government Printing Office, Washington
- Salle, A. J. (1954). Fundamental principles of bacteriology. McGraw-Hill.
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First Year of B.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMicU201

Course Name: Biochemistry and Cell Organization

Teaching Scheme: TH: 3 Hours/Week

Credit: 02

Examination Scheme: CIA: 40 Marks

End-Sem: 60 Marks

Course Contents:

Unit 1	Chemistry of Biomolecules: Structure, organization, and functions	Noofle ctures
	<p>A. Proteins:</p> <ul style="list-style-type: none"> • Structure of amino acids, peptide bond, Types of amino acids based on R group • Structural levels of proteins: primary, secondary, tertiary and quaternary, Examples (Hemoglobin, flagellin) • Functions of proteins <p>B. Carbohydrates:</p> <ul style="list-style-type: none"> • Families of mono saccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses. • Stereoisomerism of monosaccharides, epimers, mutarotation, and anomers of glucose. Furanose and pyranose forms of glucose and fructose, Haworth projection formulae for glucose; chair and boat forms of glucose • Sugar derivatives: glucose amine, galactos amine, muramic acid, N-acetylneuraminic acid • Disaccharides: the concept of reducing and non-reducing sugars, occurrence and Haworth projections of maltose, lactose, and sucrose • Polysaccharides: storage polysaccharides, starch, and glycogen. Structural Polysaccharides, cellulose, peptidoglycan and chitin <p>C. Lipids:</p> <ul style="list-style-type: none"> • Definition and major classes of storage and structural lipids. Storage lipids. Fatty acids structure and functions. Essential fatty acids. Triacylglycerols structure, functions, and properties. Saponification, Structural lipids. • Phosphoglycerides: Building blocks, General structure, functions, and properties. • Structure of phosphatidylethanolamine and phosphatidylcholine, Sphingolipids: building blocks, the structure of sphingosine, ceramide. • Lipid functions: cell signals, cofactors, prostaglandins, Introduction of lipid micelles, monolayers, bilayers <p>D. Nucleic Acids:</p> <ul style="list-style-type: none"> • Structure and composition DNA 	18

Unit 2	Cell organization in prokaryotes	No of lectures
	<ul style="list-style-type: none"> • Cell size, shape and arrangement Glycocalyx, capsule, flagella, endoflagella, fimbriae and pili. • Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaeobacterial cell wall, Gram and acid-fast staining mechanisms, lipopolysaccharide (LPS), spheroplasts, protoplasts, and L-forms. • Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. • Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome, and plasmids. • Endospore: Structure, formation, stages of sporulation. 	17
Unit 3	Experiential learning /field visit/ internship	01

References:

- Ingraham, J. L., & Ingraham, C.A. (2013). Introduction to Microbiology. Wadsworth Publishing Company.
- Madigan, M. T., & Martinko, J. M. (2019). Microorganisms and Microbiology. Brock biology of microorganisms. 15th edition. New York: Pearson
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First Year of B.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMicU202

Course Name: Microbial Growth and Cultivation

Teaching Scheme: TH: 3 Hours/Week

Credit: 02

Examination Scheme: CIA: 40 Marks

End-Sem: 60 Marks

Unit 1	Bacterial growth and measurement	No of lectures
	<p>A. Bacterial growth</p> <ul style="list-style-type: none"> • Growth curve and Generation time • Diauxic growth <p>B. Measurement of bacterial growth</p> <ul style="list-style-type: none"> • Microscopic methods (Direct Microscope (Count, counting cells using Neubauer, Petroff and Hausser's chambers) • Plate counts (Total Viable Count), Turbidi metric methods, Estimation of Biomass (Drymass, Cell volume) Chemical Methods (Cell carbon and nitrogen estimation) <p>C. Factors affecting bacterial growth {pH, temperature, solute concentration (salt and sugar)} and heavy metals</p> <p>D. Synchronous and continuous culture (Turbidostat and Chemostat)</p>	18
Unit 2	Cultivation of Microorganisms:	No of lectures
	<p>A. Nutritional requirements and their classification</p> <p>B. Design and preparation of media –Commoning redients of media and functional types of media.</p> <p>C. Methods for cultivating photosynthetic, extremophilic, chemolithotrophic aerobic and anaerobic bacteria, action mycetes, algae, fungi, and protozoa</p> <p>D. Concept of pure culture, enrichment, and isolation</p> <p>E. Maintenance of bacterial and fungal cultures by using various techniques</p> <p>F. Culture collection centers and theirrole</p> <p>G. Requirements and guidelines of National Biodiversity Authority for culture collection centers</p>	17
Unit 3	Experiential learning/ field visit/ internship	01

References:

- Aneja K. R., (2003). Experiments in Microbiology, Plant Pathology, and Biotechnology 4th edition. New Age International (P) Ltd.
- Atlas, R. M. (2005). Media for environmental microbiology. Hand book 2nd edition, CRC Press.
- Ingraham, J. L., & Ingraham, C.A. (2013). Introduction to Microbiology. Wadsworth Publishing Company.
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- Nelson, D. L., & Cox, M. M. (2008). Lehninger principles of Biochemistry. 7th edition. Mc-Millan.
- Power, D. A., & Johnson, J. A. (2009). Difco™ and BBL™ manual: manual of microbiological culture media 2nd edition. BD Diagnostics – Diagnostic Systems.
- Salle, A. J. (1971). Fundamental Principles of Bacteriology. 7th edition. Tata McGraw Hill Publishing Co.
- Stanier, R. Y., Ingraham, J. L., Wheelis, M. L., & Painter, P. R. (1987). General Microbiology., 5th edition. MacO-Millan Press Ltd.
- Tortora, G. J., Funke, B. R., Case, C. L., & Johnson, T. R. (2016). Microbiology: an introduction. 12th edition, Pearson Education
- Willey, J. M., Sherwood, L., & Woolverton, C. J. (2013). Prescott, Harley, and Klein's microbiology. 8th edition, McGraw-Hill Higher Education.

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First Year of B.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMicU203

Course Name: Laboratory on Microbiology

Teaching Scheme: TH: 3 Hours/Week

Credit: 02

Examination Scheme: CIA: 40 Marks

End-Sem: 60 Marks

(The practical course has practical of four hours, two hours on each consecutive days)

Practical 1	Preparation of liquid and solid media	2
Practical 2	Demonstration practical-Cultivation of microorganisms using a. Winogradusky's column b. Fungi using potato dextrose agar c. Protozoans using hey infusion d. Algae using BG11 medium	2
Practical 3	Aseptic transfer techniques: slant to the broth, broth to broth, broth to agar, Agar to Agar.	2
Practical 4	Cultivation of bacteria on the growth media by streak plate technique and recording colony and cultural characteristics	2
Practical 5	Enumeration of bacteria from food/soil/water by spread and pour plate technique	2
Practical 6	Preservation of microbial cultures (on slants, grains, inglycerol, liquid nitrogen, and by lyophilization) and revival of cultures	2
Practical 7	Checking sterilization efficiency of autoclave and hot air sterilizer	2
Practical 8	Study the effect of different parameters on the growth of <i>E.coli</i> : pH, temperature, sodium chloride concentration	2
Practical 9	Study of Oligo dynamic action of heavy metal	2

References:

- Atlas, R. M. (2005). Media for environmental microbiology. Handbook 2nd edition. CRC Press.
- Bensons, H. J. (2002). Microbiological applications: a laboratory manual in general microbiology, 8th edition. McGraw-Hill.
- Jay, J. M., Loessner, M. J., & Golden, D. A. (2005). Modern food Microbiology 7th edition. Springer.
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- Willey, J. M., Sherwood, L., & Woolverton, C. J. (2008). Prescott, Harley, and Klein's microbiology 7th edition. McGraw-Hill HigherEducation.