# F. Y. B. Sc. MICROBIOLOGY

| PAPER I – INTRODUCTION TO MICROBIOLOGY | | |
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| I.* | 1**. Scope and Applications of Microbiology** | |
| | 2. **Basic and applied aspects:**<br>a. Medical Microbiology<br>b. Immunology<br>c. Soil and Agricultural Microbiology<br>d. Food and Dairy Microbiology<br>e. Geomicrobiology<br>f. Microbial Genetics and Biotechnology | 10 |
| II. | 1**. History of Microbiology**<br>a. Discovery of microscope and Microbial world<br>• Early observations<br>• Micrographia of Anton von Leeuwenhoek and Robert Hooke<br>b. Controversy over Abiogenesis<br>• Aristotle's notion about spontaneous generation<br>• Redi's experiment<br>• Louis Pasteur's & Tyndall's experiment | 2<br><br><br>4 |
| | **2. Development of Microbiology in 19$^{th}$ century & Last two Decades**<br>a. Discovery of Microbial role in transformation of organic matter.<br>• Germ theory of fermentation<br>• Discovery of anaerobic life & physiological significance of fermentation<br>b. Discovery of microbial role in causation of disease<br>• Surgical antisepsis<br>• Germ theory of disease – Koch's postulates & River's postulates | 2<br><br><br>4 |
| | **3. Developments in 20$^{th}$ century in:**<br>• Vaccination<br>• Chemotherapy<br>• Modern Immunology<br>• Molecular Biology & Biotechnology | 4 |
| III. | **Diversity of Microbial World**<br>**Morphological and other characteristic features of:**<br>Bacteria<br>Rickettsia<br>Protozoa<br>Algae<br>Fungi<br>Viruses, viroids and prions | 10 |

Topics I, II and III are for the first term

This topic (I) should be used only for internal evaluation and no questions be asked in final examination on this topic.

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| IV. | **a. Morphological / physiological characters, habitat and significance / role of the following microbial groups in natural environment / human health;:**<br>• Gram positive endospore forming rods – *Bacillus*<br>• Gram positive nonspore forming rods- Lactobacillus<br>• Gram positive cocci – *Staphylococcus*<br>• Gram negative rods - *Salmonella*<br>**b. General characters and life cycle of**<br>• *Plasmodium* spp.<br>• Animal viruses - Polio virus<br>• Plant viruses - TMV<br>• *Yeasts – Saccharomyces*<br>• *Molds- Penicillium*<br>• Bacteriophage – λ phage | 4<br><br><br><br><br>6 |
| V. | Bacterial cytology | |
| | 1. Comparative account of prokaryotes and eukaryotes | 2 |
| | 2. Studies on chemical composition and structure –function relationship in bacteria;<br>Cell wall<br>Cell membrane<br>Endospore<br>Capsule<br>Flagella<br>Fimbriae and pili<br>Ribosomes<br>Chromosomal & extra-chromosomal material<br>Cell inclusions ( Gas vesicles, carboxysomes, PHB granules, metachromatic granules and glycogen bodies) | 10 |
| VI. | Molecules that make life | |
| | Chemical elements, structure of atoms, molecules and chemical bonds, chemical reactions, pH and pK, buffers | 6 |
| | Chemistry of Biomolecules<br>Carbohydrates<br>Lipids<br>Proteins<br>Nucleic acids | 8 |

The topics IV, V & VI are for second term

**References:**


1. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3nd Edition. Thomson Brooks / Cole.
2. Madigan M.T., Martinko J.M. (2006). Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
3. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology: An Introduction. 8th Edition. Pearson Education Inc
4. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology, 5th Edition. Macmillan Press Ltd.

| **PAPER II – BASIC TECHNIQUES IN MICROBIOLOGY** | | |
|---|---|---|
| I. | Safety in Microbiology laboratory, Possible laboratory hazards, Safety precautions, Disposal of laboratory waste | 2 |
| II. | Microscopy :<br>Bright field microscopy: Structure, working of and ray diagram; concepts of magnification, numerical aperture and resolving power<br>Types, ray diagram and functions of – condenser, eye-pieces and objectives<br>Aberration of lenses - spherical, chromatic, comma and astigmatism<br>Principles, construction, working and applications of:<br>Dark field microscopy,<br>Fluorescence microscopy,<br>Phase Contrast microscopy,<br>Transmission Electron Microscope and Scanning Electron Microscope | <br>3<br>2<br>1<br><br>1<br>1<br>2<br>3 |
| III. | Staining Techniques :Definitions: Stain(Basic and Acidic ), Fixative, Mordant, Decoloriser,Accentuator<br>Principles of staining techniques for following:: –<br>• Monochrome staining and Negative staining<br>• Differential staining - Gram staining and Acid fast staining<br>• Special staining techniques – Spore and Capsule | 1<br><br>1<br>3<br>2 |
| IV. | Sterilization and Disinfection | |
| | 1. Physical Agents - Heat, Radiation, Filtration | 6 |
| | 2. Chemical agents and their mode of action - Aldehydes, Halogens, Quaternary ammonium compounds, Phenol and phenolic compounds, Heavy metals, Alcohol, Dyes, and Detergents, Ethylene oxide,<br>Characteristics of an ideal disinfectant | 8 |

Topics I, II, III and IV are for first term

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| V. | Cultivation of Microorganisms | |
| | 1. Introduction to concept of pure culture and methods for pure culture | 2 |
| | 2. Nutritional requirements and nutritional classification | 4 |
| | 3. Design and preparation of media – Ingredients of media and types of media | 2 |
| | 4. Techniques of enrichment | 2 |
| | 5. Methods of cultivating protozoa, photosynthetic organisms, extremophiles, chemolithotrophs | 4 |
| | 6. Isolation and maintenance of bacterial and fungal cultures | 2 |
| | 7. Culture collections and their role | 2 |
| VI. | 1. Bacterial Growth | |
| | a. Growth Kinetics and growth curve;definitions of Generation time, Growth rate, specific growth rate | 4 |
| | b. Methods of enumeration -<br>Microscopic methods<br>Plate counts<br>Biomass<br>Chemical methods<br>Optical density | 6 |

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| | c. Continuous culture – Chemostat and Turbidostat models | 3 |
| | d. Diauxic growth | 2 |
| | e. Synchronous culture | 3 |

Topics V, VI and VII are for second term

**References:**


1. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3nd Edition. Thomson Brooks / Cole.
2. Madigan M.T., Martinko J.M. (2006). Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
3. Prescott L.M., Harley J.P., AND Klein D.A. (2005). Microbiology, 6th Edition. MacGraw Hill Companies Inc.
4. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Publishing Co.
5. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology, 5th Edition. Macmillan Press Ltd.
6. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology: An Introduction. 8th Edition. Pearson Education Inc.
7. Wilson K. and Walker J.M. (2005) Principles and Techniques of Biochemistry and Molecular Biology. 6th Edition. Cambridge University Press.

| PRACTICAL COURSE - BASED ON THEORY PAPER I & II | ( 72 ) |
|---|---|
| 1. | Introduction to laboratory instruments – incubator, oven, autoclave, colorimeter and pH meter. |
| 2 | Structure and working of light and dark field microscope, phase contrast microscope |
| 3 | Observation of microorganisms - Bacteria, Protozoa, Fungi and yeasts, Algae – from natural habitat |
| 4 | Cultivation of microorganisms- Hay infusion broth |
| 5 | Enumeration of cells by Neubaeur chamber |
| 6 | Preparation of laboratory media (Liquid & solid ) |
| 7 | Checking sterilization efficiency of – autoclave |
| 8 | Aseptic transfer techniques – types – slant to slant, broth to broth, broth to agar |
| 9 | Isolation of bacteria by spread plate, streak plate and pour plate method, Observation of cultural characters |
| 10 | Staining - Monochrome, Negative, Gram |
| 11 | Stainings: Cell wall, Capsule, Spore, and metachromatic granules |
| 12 | Observation of bacterial motility – Hanging drop, Cragie tube, Swarming growth |
| 13 | Demonstrations: Enrichment of photosynthetic organisms, chemolithotrophs, anaerobic bacteria, Bacteriophage, Demonstrations: Winogradsky column,Anaaerobic jar,Enrichment of bacteriophage and plaque formation. |
| 14 | Maintenance and revival of cultures on slants and soil |
| 15 | Personal Hygiene –<br>Study of normal flora of skin:<br>a. Cultivating and observing different morphoforms of bacteria from skin.<br>b. Effect of soap and disinfectant washing |

**References**:


1. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3nd Edition. Thomson Brooks / Cole.
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