

**F.Y.B.Sc SYLLABUS UNDER AUTONOMY
MICROBIOLOGY 2013- 2014**

MICROBIAL CELL STRUCTURE & FUNCTION 45 LECTURES S.MIC.1.01

LEARNING OBJECTIVES:

- Learn the fundamental aspects of Prokaryotic and Eukaryotic Cell structure and function, and the differences between these cells
 - Learn and understand the principles of working of the light microscope and other modified microscopes and to know the differences between them. To be able to apply this knowledge in the laboratory.
 - Develop analytical skills
 - Think in a critical & creative manner
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**UNIT 1: PROCARYOTIC CELL STRUCTURE, FUNCTION AND STAINING
15 LECTURES**

1. Members of the Microbial World 3L

- The universal Phylogenetic tree
- Discovery of Micro-organisms
- Overview of Prokaryotic Cell Structure: Size, Shape, Arrangement, Micrometry
- Diagram of Prokaryotic cell organization

2. Cell Wall Structure and Gram Stain 3L

3. Cell Membrane: Bacterial and Archaeal 2L

4. Cytoplasmic Matrix 3L

- Cytoskeleton, Nucleoid, Plasmids, Ribosome
- Inclusion granules: Composition, Function and Staining

5. Components External to Cell Wall 3L

- Capsule, Slime, S-layer, Demonstration
- Pili, Fimbriae
- Flagella: Structure, Motility, Chemotaxis, Staining

6. Bacterial Endospores 1L

- Examples of spore forming organisms, habitats, function, staining
- Formation and Germination

ACTIVITY: Draw Table to include: names, morphology, arrangement, Gram nature with diagrams and kind of motility for each of 15 common microbes

UNIT 2: EUKARYOTIC CELL STRUCTURE AND FUNCTION 15 LECTURES

1. Overview of eukaryotic cell structure: General structure and types of cells 1L

2. External Cell coverings and Cell Membrane: Structure and Function 2L

3. Cytoplasmic Matrix 9L

- Cytoskeleton: Structure and Function
- Single Membrane Organelles - Endoplasmic reticulum, Golgi complex, Lysosomes, Vesicles, and Ribosomes: Structure and Function and the Endocytic, Biosynthetic and Secretory pathways involved
- Double Membrane Organelles – Nucleus, Mitochondrion and Chloroplast: Structure and Function
- Peroxisomes : Structure and Function

4. Organelles of motility – Structure and movement of flagella and cilia 2L

5. Comparison of Prokaryotic and Eukaryotic cells - Structure & Function 1L

UNIT 3: MICROSCOPY 15 LECTURES

1. History of the Microscope 1L

2. Lenses and bending of Light 1L

3. Light Microscopy 5L

- Bright field Microscopy: Objectives, Eyepiece, Condenser
- Characteristics of lenses: Resolution, Magnification, Numerical Aperture, Focal Length, Working distance, Depth of Focus.
- Specimen Preparation and Principles of Bacterial cell staining.

4. Dark Field Microscopy 1L

5. Phase Contrast and Differential Interference Contrast Microscopy 1L

6. Fluorescence Microscopy 1L

7. Electron Microscopy: TEM & SEM and Specimen preparation 3L

8. Newer Techniques in Microscopy 2L

- Confocal Microscope.
- Scanning Probe Microscope

Student activity: History of the microscope, different types of light microscopes other than those mentioned above – draw or stick images of microbes using all of the above microscopes

CIA: Quiz

References

1. Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, , 7th International, edition 2008, McGraw Hill.
2. Foundations in Microbiology, K. P. Talaro, 7th International edition 2009, McGraw Hill.
3. Medical Microbiology, R.Cruickshank, P.Duguid, B.P.Marmion, R.H.A.Swain, 12th ed Vol II., Churchill Livingstone
4. Mackie and McCartney's Practical Medical Microbiology, Eds J. G. Collee, J. P. Duguid, A. G. Fraser & B. P. Marmion, 13th edition, Vol II; Churchill Livingstone
5. A Textbook of Microbiology, R. C. Dubey and D. K. Maheshwari, 1st edition, 1999, S. Chand & Company Ltd.
6. Brock Biology of Microorganisms, M.T.Madigan, J.M.Martinko, P. V. Dunlap, D. P. Clark- 12th edition, Pearson International edition 2009, Pearson Benjamin Cummings.
7. Microbiology – An Introduction, G. J.Tortora, B. R.Funke, C. L. Case, 10th ed. 2008,Pearson Education.

ELEMENTS OF MICROBIAL NUTRITION, GROWTH & CONTROL
45 LECTURES **S.MIC.1.02**

LEARNING OBJECTIVES:

- Understand the basic concepts of microbial nutrition, growth and control
 - Gain knowledge of the principles and basic methods involved in the study and control of microbes
 - Develop analytical and problem solving skills
 - Think in a critical & analytical manner
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UNIT 1: MICROBIAL NUTRITION, CULTIVATION, ISOLATION AND PRESERVATION **15 LECTURES**

1. **Scope and Relevance of Microbiology** 2L
2. **Nutritional requirements- Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulphur and Growth factors** 1L
3. **Nutritional types of microorganisms** 2L
4. **Nutrient uptake mechanisms** 2L
5. **Types of culture media with examples** 3L
6. **Isolation of microorganisms and pure culture techniques** 3L
7. **Preservation of microorganisms** 2L

UNIT 2: MICROBIAL GROWTH **15 LECTURES**

1. **Definition of growth, Mathematical expression, Growth curve** 3L
2. **Measurement of Growth** 7L
 - Direct Microscopic count- Breeds, Petroff-Hausser counting chamber, Haemocytometer
 - Viable count- Spread plate and Pour plate technique, Membrane filtration
 - Electronic Counting
 - Measurement of cell mass
 - Turbidity measurements- Nephelometer and spectrophotometer techniques
 - Measurements of cell constituents.

- 3. Synchronous growth, Continuous growth (chemostat and turbidostat), Diauxic growth, Growth Yield (definition of terms) 1L**
- 4. Influence of environmental factors on growth 3 L**
- 5. Microbial growth in natural environments, viable non-culturable organisms, Quorum sensing 1L**

UNIT 3: CONTROL OF MICROORGANISMS

15 LECTURES

- 1. Definitions of frequently used terms 1L**
- 2. Pattern/Rate of Microbial Death 1L**
- 3. Conditions influencing the effectiveness of Antimicrobial agents 1L**
- 4. Physical Methods of Microbial Control 5L**
 - Heat: Moist and Dry
 - Low temperature
 - Filtration
 - High pressure
 - Desiccation
 - Osmotic pressure
 - Radiations
- 5. Chemical methods of Microbial Control 5L**
 - Phenolics
 - Biguanides - chlorhexidine
 - Alcohols
 - Halogens
 - Heavy Metals
 - Quaternary ammonium compounds
 - Surface active agents
 - Aldehydes
 - Sterilizing gases
 - Peroxygens
 - Chemotherapeutic agents
- 6. Evaluation of effectiveness of Antimicrobial agent 2L**

C.I.A – Quiz /Problem solving

References

1. Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, , 7th International, edition 2008, McGraw Hill.
2. Foundations in Microbiology, K. P. Talaro, 7th International edition 2009, McGraw Hill.
- 3 Brock Biology of Microorganisms, M.T.Madigan, J.M.Martinko, P. V. Dunlap, D. P. Clark- 12th edition, Pearson International edition 2009, Pearson Benjamin Cummings.
4. General Microbiology, Stanier, Ingraham et al, 4th and 5th edition 1987, Macmillan education limited.
5. Microbiology- Concepts and Applications, Pelczar Jr,Chan, Krieg, International ed, McGraw Hill

PRACTICALS

SEMESTER I

COURSE: S.MIC.1.PR

LEARNING OBJECTIVES:

- To learn, understand and practice Safety rules when in the Microbiology Laboratory and become proficient in Aseptic techniques
 - To gain proficiency in the use of Micropipettes
 - To learn principles of Microscopy, to gain proficiency in the use and care of the Compound Microscope and to successfully stain bacteria
 - To gain proficiency in the techniques of cultivation, isolation and preservation of bacteria
 - To use physical and chemical methods to control the growth of micro-organisms.
 - To learn the techniques of enumeration of micro-organisms.
 - To learn to critically observe and record the observation of all experimentation.
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PRACTICAL 1

1. Biosafety in the Microbiology Laboratory- practices and rules involved with a short experimental study
2. Assignments –
 - a) Contributions of one Scientist of the Golden Era
 - b) Experiments that refuted the belief in Spontaneous Generation
3. The Light Microscope –
 - a) Diagram of Path of Light through Compound Microscope
 - b) Working Rules
4. Monochrome staining of bacteria
5. Negative staining and Micrometry
6. Gram staining of bacteria
7. Staining of Cell components – Cell wall, Capsule, Metachromatic & Lipid granules, Endospores
8. Staining of Flagella and Spirochaetes
9. Motility by Hanging drop technique
10. Staining of Yeasts
11. Wet mount of Hay Infusion and Pond water for observing bacterial, algal and protozoan forms.

C.I.A – Quiz/Staining technique

PRACTICAL 2

1. Preparation of culture medium:

- a) Liquid medium (Nutrient broth)
- b) Solid media (Nutrient agar, Sabouraud agar)
- c) Preparation of slants, butts and plates

2. Inoculation Techniques:

- a) Aseptic Transfer techniques using glass and micro pipettes
- b) Liquid medium
- c) Solid media (slants, butts and plates)

3. Cultivation of bacteria:

- a) Study of Colony Characteristics on Nutrient agar
- b) Study of Motility using Motility agar
- c) Use of differential, selective and enriched media
 - (i) MacConkey's agar
 - (ii) Superimposed blood agar

4. Determination of optimum growth conditions (Temperature, pH, aeration)

5. Measurement of Microbial growth

- a) Microscopic cell count (Haemocytometer, Breed's Count)
- b) Brown's opacity tubes
- c) Viable count (Pour plate and surface spread)
- d) Growth curve of *E.coli* and determination of generation time (Group Experiment)

6. Physical methods of control of microorganisms:

- a) Heat: Autoclaving, Fractional sterilization, Dry heat.
- b) Bacteria proof filtration (Demonstration of Membrane filtration)
- c) Effect of U-V rays
- d) Effect of desiccation.
- e) Effect of high osmotic pressure

7. Chemical Methods of Control of microorganisms:

- a) Effect of phenolics (Disc Method) and other disinfectants used at home
- b) Oligodynamic action of Copper foil and Mercurochrome
- c) Effect of Cetrimide
- d) Effect of Dyes (Disc Method)
- e) Effect of Chemotherapeutic agents

CIA- Isolation and Motility Techniques