

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

**MICROBIAL DIVERSITY, TAXONOMY AND SIGNIFICANCE**

**45 LECTURES**

**S.MIC.2.01**

**LEARNING OBJECTIVES:**

- Learn about the different Taxonomic Groups of organisms and identify their differences
  - Appreciate the diversity amongst organisms
  - Learn ecological principles and concepts
  - Associate the organisms fundamental cell function with various applied aspects of microbiology and biotechnology
  - Think in a critical & creative manner
  - Study on a comparative basis the various groups
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**UNIT 1: TAXONOMY & PROKARYOTIC DIVERSITY**

**15 LECTURES**

**1. Microbial Evolution and Origins of life 3L**

- Endosymbiotic Theory
- An Introduction to Microbial Classification and Taxonomy
- Taxonomic Ranks.
- List of Techniques used for determination of Microbial Taxonomy & Phylogeny
- Systems of Procaryotic and Eucaryotic Phylogeny.

**2. Classification systems in Prokaryotes 1L**

An Overview - Taxonomy based on

- Bergey's Manual of Systematic Bacteriology
- The Prokaryotes
- Systematic Bacteriology.

**3. Prokaryotic groups with unusual characteristics 3L**

- Photosynthetic Bacteria: Cyanobacteria, Green and Purple sulphur bacteria
- Gliding bacteria
- Rickettsia and Chlamydia
- Actinomycetes

**4. Archaea 2L**

- Classification
- Significance

## **5. Viruses 6L**

- Definitions of Virus , Viroids and Prions
- General Structure of viruses
- Structure of Bacteriophage T<sub>4</sub>
- Reproduction with T<sub>4</sub> bacteriophage as an example
- Lytic and lysogenic cycle concepts only
- Basic Concepts of Virus cultivation
- Classification-criteria involved

**Self Study: Comparison between Bacteria, Archaea and Viruses  
Commercial applications of Archaea.**

## **UNIT 2: EUKARYOTIC DIVERSITY 15 LECTURES**

### **1. Overview of eukaryotic cell diversity 5L**

- Three Domains of Life
- Endosymbiotic theories
- Eukaryotic cell cycle and Cell division – Mitosis and Meiosis

### **2. Types of Eukaryotic cells, Morphological characteristics, Classification, Reproduction and Significance 10L**

- Fungi: Molds and Yeasts
- Algal protists
- Protozoan protists

## **UNIT 3: INTRODUCTION TO MICROBIAL ECOLOGY AND MICROBIAL BIOTECHNOLOGY 15 LECTURES**

### **1. Principles of microbial ecology 12 L**

- Ecological concepts 3L
  - i. Species diversity in habitats
  - ii. Microbial ecosystems and biogeochemical cycling-microorganisms as the beginning and end of every energy pyramid.
  - iii. Biofilms and microbial mats
- Microorganisms on land and in water & extreme environments 2L
- Types of Microbial interactions - 2 L

- i. Mutualism, Cooperation, Commensalism, Predation, Amensalism, Competition
- ii. Mycorrhizae, Rumen symbiosis, legume-*Rhizobium* association

- Microbe-human interactions - Normal flora of humans - 3 L

## **2. Microbial biotechnology 3 L**

- Introduction to applied microbiology and biotechnology
- Microorganisms in food-beneficial effects and detrimental effects.
- Industrial microbiology-products from microorganisms-metabolites, enzymes, pharmaceuticals, fuels, biopolymers - a list
- Microorganisms and agriculture- biopesticides & biofertilizers
- Bioremediation- oil spills and waste water treatment
- Impact of Biotechnology and ethics

## **C.I.A – 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. A Textbook of Microbiology, R. C. Dubey and D. K. Maheshwari, 1st edition, 1999, S. Chand & Company Ltd.
4. 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.
5. Microbiology – An Introduction, G. J.Tortora, B. R.Funke, C. L. Case, 10th ed. 2008,Pearson Education.

**BASICS OF METABOLISM & GENETICS      45 LECTURES    S.MIC.2.02**

**LEARNING OBJECTIVES:**

- Learn structure and function of the various chemical cellular molecules
  - Understand the basic concepts of metabolism, genetics and bioinformatics
  - Think in a critical and analytical manner
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**UNIT 1: CHEMISTRY OF CELLULAR COMPONENTS 15 LECTURES**

**1. Atoms, Bonds & Molecules 2L**

- Types of atoms - Elements & their properties
- Bonds & Molecules

**2. Water 3L**

**3. Non- informational macromolecules**

- Carbohydrates – sugars & polysaccharides **5L**
- Lipids – Fats, Phospholipids & Waxes **3L**
- Amino acids & Peptide bonds **2L**

**UNIT 2: INFORMATIONAL MACROMOLECULES & INTRODUCTION TO METABOLISM 15 LECTURES**

**1. The Nucleic acids 5L**

- RNA& types, DNA – Features & forms

**2. Proteins 3L**

- Primary & secondary structures & higher order structures

**3. Biocatalysts 4L**

- i) Definition of enzymes, & ribozymes
- ii) Effect of pH, temperature, enzyme concentration, substrate concentration, and inhibitor
- iii) Cofactors & allosteric enzymes

#### **4. Introduction to metabolism 3L**

- Linking of catabolism & anabolism
- Role of ATP & reducing power
- Mechanism of fermentation, respiration & photosynthesis
- Substrate level, Oxidative and Photophosphorylation

### **UNIT 3: INTRODUCTION TO GENETICS & BIOINFORMATICS 15 LECTURES**

#### **1. Structure of genetic material - Structural characteristics of prokaryotic & eukaryotic chromosomes 10L**

- Experiments involved, Watson & Crick's model of DNA, circularity, supercoiling, topoisomerases
- Gene and its function-Central Dogma of life
- Genetic elements: The chromosome, non-chromosomal genetic elements, viruses and plasmids, transposable elements
- Chromatin structure, euchromatin, heterochromatin, Role of histones and non-histone proteins, Structure of condensed chromatin, nucleosomes, centromere, kinetochores, telomeres
- Differences in the chromosomal structure of prokaryotes, eukaryotes and viruses

#### **2. Replication of DNA 1L**

#### **3. Genetic code, Central dogma of molecular biology 3L**

#### **4. Introduction to bioinformatics 1L**

- Definitions of bioinformatics, genomics, proteomics, metabolomics

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#### **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. Principles of Biochemistry, Lehninger, 4th edition. D. Nelson & M. Cox. W.H.Freeman & Co. New York 2005
4. Outlines of Biochemistry, E. Conn, P. Stumpf, G.Bruening & R. Doi, 5th edition. John Wiley & Sons. New York. 1999

5. Introduction to bioinformatics, Attwood T.K., Parry- Smith D.J., Phukan Samiron, Pearson Education 2007
6. iGenetics – A Molecular Approach, Peter Russell, 3<sup>rd</sup> ed, Pearson Publications
7. 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.

## **PRACTICAL**

### **SEMESTER II**

**COURSE: S.MIC.2.PR**

### **LEARNING OBJECTIVES:**

- To practice Safety rules when in the Microbiology Laboratory
- To examine living prokaryotic and eukaryotic organisms using different techniques like differential staining, wet mounts and other procedures.
- To cultivate eukaryotic cells.
- To study of organisms from various habitats.
- To apply learnt techniques for the laboratory scale production of biotechnological products.
- To study microbial enzyme producers.
- To use qualitative chemical tests to identify biomolecules.
- To isolate genomic DNA and perform Agarose gel electrophoresis
- To learn to critically observe and record the observation of all experimentation.

### **PRACTICAL 1**

1. Gram stain and isolation of Actinomycetes – *Nocardia* and *Streptomyces*
2. Permanent slides of Cyanobacteria
3. Wet Mount of *Aspergillus*, *Penicillium*, *Mucor* & *Rhizopus*
4. Permanent slides of *Spirogyra*, *Spirulina*, *Euglena*, *Diatoms*
5. Observations of Plaques on a lawn of host cells - Demonstration.
6. Setting up Winogradsky's column- study of different types of microorganisms
7. Study of microorganisms in soil and water
8. Study of extremophiles- isolation of halophiles from sea water/ dried fish
9. Study of *Rhizobium* –legume symbiosis, isolation of *Rhizobium* from nodules of methi plants
10. Study of normal flora from skin, URT and GIT
11. Study of microorganisms in fermented food by Gram Stain (curd and idli batter)
12. Wine production
13. Bread making
14. Mushroom cultivation – demonstration

### **Assignment on Diversity of Micro-organisms**

Students will record in the pages of the journal a list of all microbes studied in Theory and Practicals. These organisms will be grouped according to classification

studied in theory. The record will include a representative well labeled color diagram and the function of each of the chosen organisms in ecology.

### **TABLE ACTIVITY: Small exhibition on FERMENTED FOODS**

#### **CIA- Wet Mount of Fungi**

### **PRACTICAL 2**

1. Qualitative tests for Proteins, Amino Acids Carbohydrates, Nucleic Acids & Lipids
2. Study of Bacterial Enzymes -  
Study of Amylase, Casease, Urease, Catalase & Lipase Producers
3. To isolate genomic DNA from onion or cauliflower and perform Agarose gel electrophoresis.

#### **CIA- Isolation technique / Viable count by the pour plate technique**

#### **References:**

1. Practical Microbiology, R.Vasanthakumari, BI Publications 2009.
2. Microbiology, A Laboratory Manual, 7th ed, Cappucino and Sherman, Pearson Education
3. An Introduction to Practical Biochemistry, 3rd edition, David Plummer, Tata McGraw Hill
4. Microbiological Applications, A Laboratory Manual in General Microbiology, 5th edition, Harold Benson.