

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

VIROLOGY AND IMMUNOLOGY

45 LECTURES

S.MIC.4.01

OVERALL LEARNING OBJECTIVES

- Understand viral structure, replication, cultivation, purification & enumeration
 - Understand important functional properties of antigens and antibodies
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UNIT 1: ANTIGENS AND ANTIBODIES 15 LECTURES

LEARNING OBJECTIVES

- Understanding the terms-antigen, epitope, immunogenicity, antigenicity, antibody, monoclonal antibodies
 - Understand important functional properties of antigens
 - Describe basic structure and valence of human antibodies, classes of antibodies, functions of antibodies
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1. Immunogenicity versus antigenicity, haptens 1L

2. Properties of the immunogen contributing to immunogenicity 2L

Foreignness, molecular size, chemical composition and heterogeneity, susceptibility to antigen processing and presentation

3. Other factors contributing to immunogenicity 2L

- Properties of biological system that contribute to immunogenicity- genotype, immunogen dosage, route of administration
- Adjuvants

4. Epitopes- Tcell epitopes and B cell epitopes 2L

5. Antibodies 8L

- Basic structure of antibodies
- Antibody binding site
- Antibody mediated effector functions
- Antibody classes and biological activities
- Antigenic determinants on immunoglobulins
- Immunoglobulin superfamily

- Monoclonal antibodies-an introduction

UNIT 2: VIRAL ARCHITECTURE, REPLICATION & CLASSIFICATION 15 LECTURES

LEARNING OBJECTIVE

- Knowledge of viral morphology, classification and replication
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1. Viral Architecture 4L

- Morphology of viruses
- Structure of TMV, Influenza virus, HIV

2. Viral classification 1L

- Baltimore classification
- International Committee on Taxonomy of Viruses

3. Viral replication cycle 10L

- Attachment, penetration, uncoating, replication, assembly, maturation and release
- Life cycle of TMV, Influenza virus, HIV & T4 phage
- Prions and viroids

UNIT 3 : VIRAL CULTIVATION, PURIFICATION & ENUMERATION 15 LECTURES

LEARNING OBJECTIVE

- Understand principles underlying methods used for cultivation, purification and enumeration of viruses
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1. Cultivation of viruses- 6L

- Laboratory animals, embryonated egg, cell culture techniques

2. Purification of viruses 2L

- Methods used with their principles

3. Visualization and enumeration of virus particles 7L

- Measurement of infectious units
 - i. Plaque assay, Pock assay
 - ii. Fluorescent focus assay
 - iii. Infectious center assay
 - iv. Transformation assay
 - v. Endpoint dilution assay

- Measurement of virus particles and their components
 - i. Electron microscopy
 - ii. Atomic force microscopy
 - iii. Haemagglutination
 - iv. Measurement of viral enzyme activity

- Fate of the cells following virus infection

CIA: Quiz

References: -

1. Understanding Viruses, Teri Shors, 2009, Jones and Bartlett Publishers
2. Basic Virology, Edward Wagner and Martinez Hewlett, 2nd edition, Blackwell Publishing
3. Principles of Virology, Flint, Enquist, Racanillo and Skalka, 2nd edition. ASM press
4. Prescott, Harley, Klein's Microbiology, 7th edition, Wiley, Sherwood, Woolverton, Mc Graw Hill
5. Kuby Immunology, Thomas Kindt, Richard Goldsby, Barbara Osborne, 6th edition, W.H. Freeman & Co

ENVIRONMENTAL MICROBIOLOGY
45 LECTURES

S.MIC.4.02

OVERALL LEARNING OBJECTIVES

- Understand behavior & activities of microorganisms in their natural environments
 - Gain awareness of the microbial processes that occur in different environments
 - Learn important tools & techniques in Microbial Ecology
 - Understand Microbial Diversity
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UNIT 1: MICROBIAL BIODIVERSITY AND TAXONOMY **15 LECTURES**

LEARNING OBJECTIVES

- Understand the principles involved in Microbial Taxonomy
 - Gain knowledge of the principles & methods involved in studying microbial ecology
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1. Microbial Taxonomy and Diversity 5L

- Introduction to Microbial Taxonomy and Classification -
- Taxonomic Ranks
- Bergey's Manual of Systematic Bacteriology, The Prokaryotes, Systematic Bacteriology
- Survey of Prokaryotic Phylogeny and Diversity

2. Methods of study - microbial taxonomy and phylogeny 10L

- Techniques for Determining Microbial Taxonomy and Phylogeny based on classical & molecular characteristics

UNIT 2: WATER MICROBIOLOGY 15 LECTURES

LEARNING OBJECTIVES

- Describe aquatic habitats of microorganisms & microbial diversity therein
 - Describe water purification processes & bacteriological analysis of water
 - Gain knowledge of the significance of waste water treatment and the processes involved
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1. Aquatic Environments 2L

- Microbial Habitats in the Aquatic Environments- Planktonic, Benthic, Microbial Mats, Biofilms
- Aquatic Environments – Freshwater Environments, Brackish Water, Marine Water, Subterranean Water
- Micro-organisms in Marine Environments
- Micro-organisms in Fresh Water Environments

2. Microbiology of Potable Water – Sanitary Analysis and Water Purification 8 L

- Definition of potable water
- Standards for potability
- Microorganisms as bio-indicators of fecal pollution
- Routine analysis of water
- Municipal water purification process
- Domestic water purification processes

3. Microbiology of Waste Water 5 L

- Types of waste water and Characteristics
- Measuring Waste Water Quality
- Waste Water Treatment Processes-domestic and industrial
- Home Treatment Systems
- Impact on environment

UNIT 3: AEROMICROBIOLOGY AND TERRESTRIAL MICROBIOLOGY 15 LECTURES

LEARNING OBJECTIVES

- Describe microorganisms in air & terrestrial environments & their significance
- Understand principles involved in sampling microorganisms from air & terrestrial environments
- Gain knowledge of significant environment management processes

1. Aeromicrobiology 5 L

- Distribution of microorganisms in air
- Aeromicrobiological Pathway- launching, transport and deposition of aerosols
- Survival of microorganisms in air

- Significance of microorganisms in air (extramural and intramural)- agriculture, waste disposal, germ warfare, buildings, spaceflight, public health, hospital and laboratories.
- Methods to study airborne microorganisms -Sampling, qualitative and quantitative methods
- Bioaerosol control (ventilation, filtration, biocidal control -uv, gaseous, quarantine)
- Biosafety in the laboratory

2. Microorganisms in Terrestrial Environments 6L

- Soil as an Environment for Microorganisms
- Soils, Plants and Nutrients
- Microorganisms in the soil environment and Significance
- Microorganisms & Formation of Soil
- Microorganisms and Vascular Plants
- Soil Microorganisms and the Atmosphere, Subsurface Biosphere
- Soil Microorganisms and Human Health
- Methods in study of microbial ecology - Culture dependent & independent analyses of microbial communities, measuring microbial activities in nature

3. Environment Management 4L

- Bioremediation
- Solid waste management : Landfills, Composting, Production of Biomass, Production of Fuels

CIA: Quiz

References: -

1. Brock Biology of Microorganisms Michael.T.Madigan, John.M.Martinko, Paul V. Dunlap, David P. Clark, 12th edition, Pearson International edition 2009
2. Prescott, Harley, Klein's Microbiology, 7th edition, Wiley, Sherwood, Woolverton, Mc Graw Hill
3. Fundamental principles of Bacteriology 7th edition, Salle A. J. ,Tata McGraw Hill
4. Bergey's Manual of Systematic Bacteriology. 2nd edition
5. Microbial Ecology-Fundamentals and Application, Atlas and Bartha Pearson Education
6. Environmental Microbiology, Maier, Pepper, Gerba, 2nd edition, Academic Press
7. Foundations in Microbiology 7th edition, Kathleen Talaro, McGraw Hill
8. The Prokaryotes, Falkow S, Rosenberg E, Schleifer, K.H, Stackebrandt E, 3rd edition, Volumes 1 – 7, Springer Publication

FOOD MICROBIOLOGY & BIOPROCESS TECHNOLOGY

45 LECTURES

COURSE: S.MIC. 4.03

OVERALL LEARNING OBJECTIVES

- Understand the principles of Food Microbiology & Microbial Biotechnology
 - Develop critical thinking & presentation skills
 - Independent study & planning of projects
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UNIT 1: FOOD & DAIRY MICROBIOLOGY 15 LECTURES

LEARNING OBJECTIVES

- Understand the principles & methods involved in food & dairy fermentation
 - Understand preservation as an important field for a microbiologist
 - Knowledge of recent trends in Food & Dairy Microbiology
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1. Introduction – Scope of food microbiology & role of a microbiologist 1L

2. Food Spoilage 1L

- Microbial flora of food & milk – normal – self study
- Food/milk as substrate for microbes (spoilage) – self study
- Other causes of spoilage – environmental, mechanical, pests
- Types of spoilage – fermentation, putrefaction, rancidity
- Spoilage by molds

3. Preservation of foods & dairy products 6L

- Asepsis, removal of microbes – filtration & centrifugation
- Hindrance to microbial growth – Use of low temperatures, drying, food additives, anaerobiosis – canning
- Food additives other than preservatives – antioxidants, sweeteners, coloring agents, nutraceuticals, fortified foods
- Killing of microbes – Use of heat, radiations, gaseous sterilants
- Mechanical destruction – grinding, use of high pressure
- Combination of methods: examples of foods preserved

4. Beneficial microbes & food fermentation processes 7L

- Cheese fermentation
- Butter making
- Yogurt fermentation
- Bread fermentation
- Wine fermentation
- Mushroom fermentation
- Probiotics & Nutraceuticals

UNIT 2: FOOD SAFETY & METHODS IN FOOD MICROBIOLOGY 15 LECTURES

LEARNING OBJECTIVES

- Gain knowledge of Food Safety & its scope in Quality Control of Foods
 - Understand basic techniques involved in ensuring food quality
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1. Contamination of foods & milk – Sources & prevention - self study 1L

2. Food & milk borne diseases 1L

- Food borne infections – bacterial & viral pathogens
- Food intoxications – bacterial & fungal toxins

3. Methods in Food Microbiology 10L

- Physical methods – Impedance, microcalorimetry, flow cytometry
- Chemical methods – Detection of thermostable nuclease, endotoxins, ATP, radiometry, chromogenic substrates
- Molecular methods - phage typing, PCR, PAGE, DNA probes, RFLP
- Immunological methods – serotyping, FAT, RIA, ELISA
- Bioassay methods – suckling mouse, ligated loop technique, cell cultures (HeLa and human fetal cells)

4. Food sanitation & control of food safety 3L

- Microbiological standards of foods – criteria, purpose & difficulties & Sanitary quality of foods – indicator microbes & total microbial load
- HACCP/ISO – definitions, principles of HACCP, guidelines for application of HACCP system

UNIT 3: UPSTREAM BIOPROCESS TECHNOLOGY 15 LECTURES

LEARNING OBJECTIVES

- Gain knowledge of Fermenter design & basic concepts of microbial biotechnology
 - Understand basic application of fermentation technology
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1. Introduction 7L

- Historical Aspects
- Scope, concept & range of Fermentation technology
- Design of a typical aerobic fermentor
- Parameters to be considered in designing a typical fermentor

2. Overview of a fermentation process 8L

- Development of Industrial Process Upstream Processing of typical aerobic, submerged batch fermentation – requirements & scale –up
- Fermentation media
- Screening of industrially useful microbes – ideal characteristics, primary & secondary screening
- Stock cultures – primary & working stock cultures, preservation & inoculum preparation & scale-up of culture for a fermentation process

CIA: Assignment

References: -

1. Food Microbiology, Frazier & Westhoff, 4th edition, Tata McGraw Hill Publications
2. Modern Food Microbiology, James Jay, 7th edition, Springer Publications
3. Food Microbiology by Adams & Moss, 3rd edition, The Royal Society of Chemistry
4. Advances in Biotechnology, S. N. Jogdand, Himalaya Publishing House
5. Milk & Milk Products, C. Eckles, 4th edition, Tata McGraw Hill Publications
6. Brock Biology of Microorganisms Michael.T.Madigan, John.M.Martinko, Paul V. Dunlap, David P. Clark, 12th edition, Pearson International edition 2009
7. Industrial Microbiology” 2009 Reprint, Casida L. E., New Age International (P) Ltd, Publishers, New Delhi
8. Principles of Fermentation Technology Stanbury P. F., Whitaker A. & Hall--S. J., 1997, 2nd Edition, Aditya Books Pvt. Ltd, New Delhi.
9. A Textbook of Industrial Microbiology Crueger W. and Crueger A. 2000 Biotechnology, 2nd Edition, Panima Publishing Corporation, New Delhi.
10. Industrial Microbiology 1982, Prescott and Dunn's, 4th Edition, McMillan Publishers

11. Industrial Microbiology, A. H. Patel, Macmillan Publishers India Limited
12. Fermentation Technology, H. A. Modi, 2009, Vols 1 & 2, Pointer Publications, India
13. Microbial Technology, Pepler, H. J. and Perlman, D. (1979), Vol 1 & 2, Academic Press

SEMESTER 4

COURSE: S.MIC.4.PR

VIROLOGY AND IMMUNOLOGY

1. Agarose gel and polyacrylamide gel electrophoresis of serum
2. Lymphocyte separation, staining, checking viability
3. Phage assay

CIA: Phage Assay

ENVIRONMENTAL MICROBIOLOGY

1. Study of air flora: Qualitative and quantitative, Liquid impingement and Gravity sedimentation methods
2. Study of aquatic flora: Qualitative and quantitative, isolation of agar digesters, isolation of haloduric and halophilic bacteria
4. Study of soil flora isolation - qualitative & quantitative (bacteria, fungi and actinomycetes), enrichment/ isolation of – cellulose degraders, starch hydrolysers, ureolytic, saccharolytic organisms, nitrosifiers, nitrifiers and sulphate reducers, Cultivation of anaerobes.
3. Isolation of *Azotobacter* and *Rhizobium*
4. Analysis of potable water: SPC Presumptive, confirmed and completed test, detection of fecal enterococci and *Clostridium* species, determination of coliform count in water by MPN, Membrane filtration technique
5. Waste water analysis: Physical (TDS), Chemical (COD), Biological (BOD), Microbiological study of raw and treated sewage
6. Isolation and identification of a bacterial isolate

CIA: Project in Environmental Microbiology

FOOD MICROBIOLOGY AND UPSTREAM BIOPROCESS TECHNOLOGY

1. Study of food spoilage organisms
2. Study of organisms causing food borne infections
3. TDP and TDT determination
4. Food preservation - MIC & tolerance of sugar and salt
5. Microbiological analysis of milk - DMC, SPC, coliform, psychrophilic & thermophilic counts, RRT, MBRT, phosphatase test
6. Isolation of an antibiotic producer
7. Study of antibacterial spectrum of antibiotic producers
8. Isolation of amino acid producers

CIA: MIC of an antimicrobial agent

VISITS: Educational visits relevant to Environmental Microbiology