



**TECHNO INDIA UNIVERSITY**  
WESTBENGAL

# **Proposed Syllabus for 4-year B.Sc (Honours with or without research) (NEP)**

**2023**

## **MICROBIOLOGY**



**Department of Microbiology**

**Techno India University, West Bengal  
EM-4, EM Block, Sector V, Bidhannagar,  
Kolkata, West Bengal 700091**







## Semester VI

**Core Subject:**

Course Name : IMMUNOLOGY

Course Code:

Course Details:

Unit 1: Introduction
Concept of Innate and Adaptive immunity; Contributions of following scientists to the development of the field of immunology - Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne, Rodney Porter and Susumu Tonegawa
Unit 2: Immune Cells and Organs
Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT
Unit 3 Antigens
Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants
Unit 4 Antibodies
Structure, Types, Functions and Properties of antibodies; Antigenic Determinants on antibodies (Isotypic, allotypic, idiotypic); VDJ rearrangements; Monoclonal and Chimeric antibodies
Unit 5 Major Histocompatibility Complex
Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways)
Unit 6 Complement System
Components of the Complement system; Activation pathways (Classical, Alternative, and Lectin pathways); Biological consequences of complement Activation
Unit 7 Generation of Immune Response
Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance
Unit 8 Immunological Disorders and Tumor Immunity
Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD; Types of tumors, tumor Antigens, causes and therapy for



cancers.

#### Unit 9 Immunological Techniques

Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluorescence, Flow cytometry, Immunoelectron microscopy.

#### SUGGESTED READING

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 5th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinburgh.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication

Course Name : IMMUNOLOGY (Practical)

Course Code:

Course Details:

1. Identification of human blood groups.
2. Perform Total Leukocyte Count of the given blood sample.
3. Perform immunodiffusion by Ouchterlony method.
4. Perform DOT ELISA.
5. Perform immunoelectrophoresis.

#### **Core Subject:**

Course Name : Environmental Microbiology

Course Code:

Course Details:

#### Unit 1 Microorganisms and their Habitats

Structure and function of ecosystems, Terrestrial Environment: Soil profile and soil microflora, Aquatic Environment: Microflora of fresh water and marine habitats Atmosphere: Aero microflora and dispersal of microbes Animal Environment: Microbes in/on human body (Microbiome) & animal (ruminants) body, Extreme Habitats: Extremophiles-microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Microbial succession in decomposition of plant organic matter

#### Unit 2 Microbial Interactions



Microbe-microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation  
Microbe-Plant interaction: Symbiotic and non-symbiotic interactions  
Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria

### Unit 3 Biogeochemical Cycling

Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin  
Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction  
Phosphorus cycle: Phosphate immobilization and solubilization  
Sulphur cycle: Microbes involved in Sulphur cycle  
Other elemental cycles: Iron and manganese

### Unit 4 Waste Management

Solid Waste management: Sources and types of solid waste, methods of solid waste disposal (composting and sanitary landfill)  
Liquid waste management: Composition and strength of sewage (BOD and COD), primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment

### Unit 5 Microbial Bioremediation

Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants

### SUGGESTED READING

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition, Benjamin/Cummings Science Publishing, USA
2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition, Pearson/ Benjamin Cummings
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology, 2nd edition, Academic Press
4. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York
5. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Heidelberg
6. Barton LL & Northup DE (2011). Microbial Ecology, 1st edition, Wiley Blackwell, USA
7. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.

Course Name : Environmental Microbiology(Practical)

Course Code:

Course Details:



1. Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action.
2. Isolation of microbes (bacteria & fungi) from soil (28oC & 45oC).
3. Isolation of microbes (bacteria & fungi) from rhizosphere.
4. Study the presence of microbial activity by detecting (qualitatively) enzymes (amylase, urease) in soil.
5. Report on Field Trip of any non hazardous, solid waste landfill site (garbage dump, rubbish dump or municipal landfills receiving household waste)/ wastewater treatment plant

Course Name : BACTERIAL PATHOGENESIS

Course Code:

Course Details:

#### Unit 1: Introduction to Bacterial Pathogenesis

Basic concepts of infection and host-pathogen interactions, bacterial virulence factors, toxins (types, mechanisms of action, and their effects on the host).

#### Unit 2: Mechanisms of Bacterial Pathogenesis

Adhesion factors involved in bacterial attachment, invasion strategies, host colonization, inflammatory response of host, tissue damage and disease progression, biofilm formation and quorum sensing

#### Unit 3 Bacterial Diseases

Following diseases to be studied with reference to the causative agents, symptoms, mode of transmission, pathogenesis, treatment and control  
Respiratory disease: tuberculosis (*Mycobacterium tuberculosis*), pneumonia (*Streptococcus pneumoniae*)  
Gastrointestinal disease: Salmonellosis (*Salmonella typhi*), cholera (*Vibrio cholerae*)  
Sexually transmitted infections: Gonorrhoea (*Neisseria gonorrhoeae*), syphilis (*Treponema pallidum*)  
Others: Urinary tract infections (*Escherichia coli*), Skin and soft tissue infection (*Staphylococcus aureus*), tetanus (*Clostridium tetani*)

#### Unit 4 Laboratory Techniques for Culture and Identification of Bacterial Pathogens

Sample collection, transport and culturing of clinical samples. Principles of different diagnostic tests (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes).

#### Unit 5 Antibiotics

Definition, classification of antibiotics based on their mechanism of action, side effects, drug interaction and allergic reactions. Mechanisms of action of antibiotics: Cell wall inhibitors (beta-lactams), Protein synthesis inhibitors (tetracyclines, macrolides), DNA synthesis inhibitors (quinolones), RNA synthesis inhibitors (rifamycins)  
Antibiotic Resistance: Overview of antibiotic resistance mechanisms, factors contributing to the emergence and spread of antibiotic resistance, strategies to combat antibiotic resistance (e.g., stewardship, combination therapy)

#### SUGGESTED READING



1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition, McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology, 4th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition, Pearson International Edition.
6. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
7. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
8. SubbaRao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.
9. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

Course Name : BACTERIAL PATHOGENESIS (Practical)

Course Code:

Course Details:

1. Identify laboratory strains of E. coli, Salmonella, Pseudomonas, Staphylococcus, Bacillus (any three) on the basis of cultural, morphological and biochemical characteristics through IMViC test, growth on TSI and nitrate reduction, urease production and catalase tests (any two).
2. Study of composition and use of important differential media for identification of bacteria: EMB agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS
3. Study of bacterial flora of skin by swab method
4. Perform antibacterial sensitivity by Kirby-Bauer method
5. Determination of minimal inhibitory concentration (MIC) of an antibiotic.