



**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**





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Credit Requirements for obtained different degree		
Degree	Year	Total Credit
Certificate in Microbiology	1	38
Diploma in Microbiology	2	80
B.Sc (Three Years) in Microbiology	3	120
B.Sc (Hons.) in Microbiology (with research)	4	160
B.Sc (Hons.) in Microbiology (without research)	4	160

**B.Sc Microbiology**  
**Course Curriculum for All Semesters**  
**Semester VIII (With Research)**

Sl. No.	Course Code	Course Title	Contact Hrs. / Week			Credit	Page No.
			L	T	P		
<b>Theory</b>							
1.		Major: Ecology and Biodiversity	2	1		3	
2.		Major: Fungal, algal and protozoal pathogenesis	2	1		3	
3.		Major: Plant Pathology	2	1		3	
<b>Practical</b>							
4.		Major: Ecology and Biodiversity			1	1	
5.		Major: Fungal, algal and protozoal pathogenesis			1	1	
6.		Major: Plant Pathology			1	1	
7.		Dissertation/ Research work-I			4	4	
8.		Dissertation/ Research work-II			4	4	
<b>Total Credit</b>						<b>20</b>	



**Semester VIII (Without Research)**

Sl. No.	Course Code	Course Title	Contact Hrs. / Week			Credit	Page No.
			L	T	P		
<b>Theory</b>							
1.		Major: Ecology and Biodiversity	2	1	0	3	
2.		Major: Fungal, algal and protozoal pathogenesis	2	1	0	3	
3.		Major: Plant Pathology	2	1	0	3	
		Major: Advances in Microbiology	2	1	0	3	
		Major: Genetics and Genomics	2	1	0	3	
<b>Practical</b>							
4.		Major: Ecology and Biodiversity			1	1	
5.		Major: Fungal, algal and protozoal pathogenesis			1	1	
6.		Major: Plant Pathology			1	1	
7.		Major: Advances in Microbiology			1	1	
8.		Major: Genetics and Genomics			1	1	
<b>Total Credit</b>						<b>20</b>	

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## *Semester VIII*

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Course Name : Ecology and Biodiversity (Theory)

Course Code:

Course Details:

### Unit 1 The Environment

Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Population Ecology: Characteristics of a population; population growth curves; population regulation.

### Unit 2 Community Ecology

Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.

### Unit 3: Ecosystem Ecology

Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); Food Chain, Food web, Trophic level, Ecological pyramids, primary production and decomposition; structure and function of some ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; biogeographical zones of India

### Unit 4 Biodiversity



levels of biodiversity, alpha, beta and gamma diversity, hotspots of biodiversity, Threat to species diversity, Extinction vortex, Causes of extinction; RedData Book, Biodiversity conservation approaches: Local, National and International, In situ and ex situ conservation, Concept of protected area network, Selecting protected areas, criteria for measuring conservation value of areas, Sanctuary, National Park and Biosphere reserves; Design and management of protected areas; Threats to wildlife conservation and wildlife trade; Tools for wildliferesearch, Wildlife threat, Use of Radiotelemetry and Remote sensing in wildlife research, Indian case studies on conservation/management strategy (Project Tiger)

#### Unit 5 Applied Ecology

Environmental pollution; Microorganisms and environmental pollutants, Overall process of biodegradation, Environmental biomonitoring and indicator microorganisms, biodegradation of organic pollutants.

#### SUGGESTED READING

1. Odum, E.P. (1971). Fundamentals of Ecology. W.B. Saunders Natraj publication (Indian edition).
2. Sharma, P.D.(2017) Ecology and environment, 13th edition, Rastogi Publication.
3. Kormandy E. J. (1996) Concepts of ecology, Prentice Hall of India Pvt. Ltd.
4. Chapman J.L. and Reiss M.J. (2000) Ecology : Principles and applications 2 nd edition, Cambridge : University Press. Microbiology, 9 th edition, McGraw Hill Higher Education

Course Name : Ecology and Biodiversity (Tutorial)

Course Code:

Course Details:

Student will have to make a field visit to any ex-situ conservation site and submit a field report. Evaluation will be based on the viva voce and examination of field report by an external examiner.

Course Name : Fungal, Algal and Protozoal pathogenesis (Theory)

Course Code:

Course Details:

#### Unit 1 Host pathogen interaction

Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS

#### Unit 2 Viral diseases

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis, Covid.

#### Unit 3 Protozoal diseases

List of diseases of various organ systems and their causative agents. The following diseases in



detail with Symptoms, mode of transmission, prophylaxis and control Malaria, Kala-azar

#### Unit 4 Fungal diseases

Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention Cutaneous mycoses: Tinea pedis (Athlete's foot) Systemic mycoses: Histoplasmosis, opportunistic mycoses: Candidiasis

#### Unit 5 Antimicrobial agents

General characteristics and mode of action Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine. Anti Protozoal medicine: Chloroquine phosphate, Liposomal amphotericin B, Metronidazole

#### 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, 4 th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology, 9 th 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 Freeman
6. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
7. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company

Course Name : Fungal, Algal and Protozoal pathogenesis (Practical)

Course Code:

Course Details:

A dissertation paper will have to be submitted on any viral, fungal and protozoan disease. A viva voce assessment will be conducted on the dissertation paper.

Course Name : Plant Pathology (Theory)

Course Code:

Course Details:

#### Unit 1 Introduction and History of plant pathology

Concept of plant disease- definitions of disease, disease cycle & pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens, economic losses and social impact of plant diseases. Significant landmarks in the field of plant pathology- Contributions of Anton DeBary, Millardet, Burrill, E. Smith, Adolph Mayer, Ivanowski, Diener, Stakman, H.H. Flor, Van Der Plank, molecular Koch's postulates.

#### Unit 2 Stages in development of a disease



Inoculation, prepenetration, penetration, infection, invasion, colonization, dissemination, overwintering/oversummering of pathogens.

### Unit 3 Plant disease epidemiology

Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle & disease pyramid, forecasting of plant diseases and its relevance in Indian context.

### Unit 4 Host Pathogen Interaction

#### A. Microbial Pathogenicity

Virulence factors of pathogens: enzymes, toxins (host specific and non specific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane permeability, translocation of water and nutrients, plant growth and reproduction).

#### B. Genetics of Plant Diseases

Concept of resistance (R) gene and avirulence (avr) gene; gene for gene hypothesis, types of plant resistance: true resistance– horizontal & vertical, apparent resistance.

#### C. Defense Mechanisms in Plants

Concepts of constitutive defense mechanisms in plants, inducible structural defenses (histological-cork layer, abscission layer, tyloses, gums), inducible biochemical defenses [hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins, plantibodies, phenolics, quinones, oxidative bursts].

### Unit 5 Control of Plant Diseases

Principles & practices involved in the management of plant diseases by different methods, viz. regulatory - quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material cultural - host eradication, crop rotation, sanitation, polyethylene traps and mulches chemical - protectants and systemic fungicides, antibiotics, resistance of pathogens to chemicals. biological - suppressive soils, antagonistic microbes-bacteria and fungi, trap plants genetic engineering of disease resistant plants- with plant derived genes and pathogen derived genes

### Unit 6 Specific Plant diseases

Study of some important plant diseases giving emphasis on its etiological agent, symptoms, epidemiology and control

#### A. Important diseases caused by fungi

Late blight of potato - *Phytophthora infestans*, Powdery mildew of wheat - *Erysiphe graminis*  
Ergot of rye - *Claviceps purpurea*, Black stem rust of wheat - *Puccinia graminis tritici*, Loose smut of wheat - *Ustilago nuda*, Red rot of sugarcane - *Colletotrichum falcatum*, Early blight of potato - *Alternaria solani*

**B. Important diseases caused by phytopathogenic bacteria:** crown galls, bacterial cankers of citrus

**C. Important diseases caused by phytoplasmas:** Aster yellow

**D. Important diseases caused by viruses:** Rice tungro, Tobacco mosaic

### SUGGESTED READING

1. Agrios GN. (2006). Plant Pathology. 5 th edition. Academic press, San Diego,
2. Lucas JA. (1998). Plant Pathology and Plant Pathogens. 3 rd edition. Blackwell Science, Oxford.
3. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
4. Rangaswami G. (2005). Diseases of Crop Plants in India. 4th edition. Prentice Hall of



IndiaPvt. Ltd., New Delhi.  
5. Singh RS. (1998). Plant Diseases Management. 7 th edition. Oxford & IBH, New Delhi

Course Name : Plant Pathology (Practical)

Course Code:

Course Details:

1. Demonstration of Koch's postulates in fungal, bacterial and viral plant pathogens.
2. Study of important diseases of crop plants by cutting sections of infected plant material - Albugo, Puccinia, Ustilago, Fusarium, Colletotrichum.

## **For B.Sc (Hons) In Microbiology Without Research**

Course Name : Advances in Microbiology (Theory)

Course Code:

Course Details:

### Unit 1 Systematics, Taxonomy

Concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers

### Unit 2 Sequencing of nucleic acids and proteins

Nucleic acid sequencing technologies: Maxam Gilbert sequencing, Sanger's dideoxy sequencing, Pyrosequencing, Next-Generation Sequencing, Protein sequencing technologies: Edman degradation, Sanger's method, Trypsin and Cyanogen Bromide fragmentation, Dansyl and Dabsyl chloride derivatisation

### Unit 3 Evolution of Microbial Genomes

Salient features of sequenced microbial genomes, core genome pool, flexible genome pool and concept of pangenome, Horizontal gene transfer (HGT), Evolution of bacterial virulence - Genomic islands, Pathogenicity islands (PAI) and their characteristics

### Unit 4 Metagenomics

Brief history and development of metagenomics, Understanding bacterial diversity using metagenomics approach, Prospecting genes of biotechnological importance using metagenomics Basic knowledge of viral metagenome, metatranscriptomics, metaproteomics and metabolomics

### Unit 5 Molecular Basis of Host-Microbe Interactions

Epiphytic fitness and its mechanism in plant pathogens, Hypersensitive response (HR) to plant pathogens and its mechanism, Type three secretion systems (TTSS) of plant and animal pathogens, virulence and antimicrobial resistance

### SUGGESTED READING

1. Biochemistry, Donald Voet and Judith G. Voet, 4th Edition, John Wiley and Sons, 2011.



2. DNA Sequencing Protocols, 2nd edition, by Graham, Humana Press Inc.2001
3. Fraser CM, Read TD and Nelson KE. Microbial Genomes, 2004, Humana Press
4. Miller RV and Day MJ. Microbial Evolution- Gene establishment, survival and exchange, 2004, ASM Press
5. Bull AT. Microbial Diversity and Bioprospecting, 2004, ASM Press
6. Madigan MT, Martink JM, Dunlap PV and Clark DP (2014) Brook's Biology of Microorganisms, 14th edition, Pearson-Bejamin Cummings
7. Wilson BA, Salyers AA Whitt DD and Winkler ME (2011) Bacterial Pathogenesis- A molecular Approach, 3rd edition, ASM Press,
8. Bouarab K, Brisson and Daayf F (2009) Molecular Plant-Microbe interaction CAB International

Course Name : Advances in Microbiology (Practical)

Course Code:

Course Details:

1. Extraction of metagenomic DNA from soil
2. Understand the impediments in extracting metagenomic DNA from soil
3. PCR amplification of metagenomic DNA using universal 16S ribosomal gene primers
4. Reading a DNA sequence from a sequencing gel

Course Name : Genetics and Genomics (Theory)

Course Code:

Course Details:

#### Unit 1 Mendelian Principles

Mendel's Laws: Dominance, segregation, independent assortment, deviation from Mendelian inheritance, Rediscovery of Mendel's principles, Chromosome theory of inheritance: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian genetics: Allelic interactions, concept of dominance, recessiveness, incomplete dominance and co-dominance, multiple alleles, epistasis, penetrance and expressivity, epigenetic controls

#### Unit 2 Linkage and Crossing over

Linkage and recombination of genes, Cytological basis of crossing over, Crossing over at fourstrand stage, Molecular mechanism of crossing over, mappin

#### Unit 3 Extra-Chromosomal Inheritance

Rules of extra nuclear inheritance, Organelle heredity - Chloroplast mutations in Chlamydomonas, mitochondrial, mutations in Saccharomyces, Maternal effects – Shell coiling in Limnaea peregra Infectious heredity - Kappa particles in Paramecium

#### Unit 4 Characteristics of Chromosomes

Structural organization of chromosomes - centromeres, telomeres and repetitive DNA, Concept of euchromatin and heterochromatin, Normal and abnormal karyotypes of human chromosomes, Chromosome banding, Giant chromosomes: Polytene and lampbrush chromosomes, Variations in chromosome structure: Deletion, duplication, inversion and translocation, Variation in chromosomal number and structural abnormalities - Klinefelter syndrome, Turner syndrome, Down syndrome



Unit 5 Genomics

Introduction to genomics; Mapping genomes: Genetic mapping -molecular markers- RFLP, SSLP, SNPs, basis to genetic mapping; Physical mapping- : Restriction mapping and optical mapping, FISH, RH and STS Mapping, Genome sequencing, assembly and annotation; Human genome project; Brief Overview of Structural, functional and comparative genomics; Application of genome data in forensics, disease diagnosis and genetic counselling

SUGGESTED READING

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. WileyIndia
2. Snustad DP, Simmons MJ (2011). Principles of Genetics. 6th Ed. John Wiley and Sons Inc.
3. Weaver RF, Hedrick PW (1997). Genetics. 3rd Ed. McGraw-Hill Education
4. Klug WS, Cummings MR, Spencer CA, Palladino M (2012). Concepts of Genetics.10th Ed. Benjamin Cummings
5. Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. (2007). Introduction to Genetic Analysis. 9th Ed. W.H.Freeman and Co., New York
6. Hartl DL, Jones EW (2009). Genetics: Analysis of Genes and Genomes. 7th Ed, Jones and Bartlett Publishers
7. Russell PJ. (2009). i Genetics - A Molecular Approach. 3rd Ed, BenjaminCummings
8. Brown TA (2018) Genomes 4th Ed., Garland Science
9. Primrose SB and Twyman RM (2006) Principles of Gene Manipulation and Genomics, 7th Ed., Blackwell Publishing

Course Name : Genetics and Genomics (Practical)

Course Code:

Course Details:

1. Mendelian deviations in dihybrid crosses
2. Studying Barr Body with the temporary mount of human cheek cells
3. Extraction of information of any gene from available genome resources