



**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 IV**

Sl. No.	Course Code	Course Title	Contact Hrs. / Week			Credit	Page No.
			L	T	P		
<b>Theory</b>							
1.		Major: Molecular Biology	2	1		3	
2.		Major: Cell Biology	2	1		3	
3.		Major: Microbial Genetics	2	1		3	
4.		Major: Virology	2	1		3	
5.		Minor:	2	1		3	
6.		AEC:	2			2	
<b>Practical</b>							
7.		Major: Molecular Biology			1	1	
8.		Major: Cell Biology			1	1	
9.		Major: Microbial Genetics			1	1	
10.		Major: Virology			1	1	
11.		Minor:			1	1	
<b>Total Credit</b>						<b>22</b>	



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## Semester IV

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### Core Subject:

Course Name : Molecular Biology

Course Code:

Course Details:

#### Unit 1 Genetic Material and its Features

Types of Genetic material: DNA and RNA (mRNA, tRNA, rRNA, miRNA, snRNA etc.). Denaturation and Renaturation of DNA: Hyperchromic effect,  $T_m$ , Cot curves. DNA topology and topoisomerase enzyme- linking number, twist number, writhing number. Organization of DNA in Prokaryotes (nucleoid), Eukaryotes (nucleosome-10 nm model, 30 nm model, scaffold arrangement). Organelle DNA - mitochondrial and chloroplast DNA. The Central Dogma.

#### Unit 2 Replication of prokaryotic DNA

DNA replication - Meselson-Stahl experiment as evidence of semi-conservative replication, Bidirectional and unidirectional replication, Semi- discontinuous replication. Mechanism of DNA replication: Enzymes and proteins involved in DNA replication, differences with eukaryotic replication –DNA polymerases, DNA ligase, primase, telomerase – for replication of linear ends. Various models of DNA replication including  $\Theta$  (theta), rolling circle mode of replication and other accessory proteins, fidelity of DNA replication.

#### Unit 3 Transcription in Prokaryotes and Eukaryotes

Transcription: Definition, difference from replication, promoter - concept and strength of Promoter, RNA Polymerase and the transcription unit. Mechanism of transcription (initiation, elongation and termination). Transcription in Eukaryotes: major difference with prokaryotic system, important modifications of eukaryotic RNA: concept of introns and exons, RNA splicing, concept of alternative splicing, Polyadenylation and capping, Processing of rRNA and tRNA.

#### Unit 4: Translation (Prokaryotes and Eukaryotes)

Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, genetic code and its features, mechanism of initiation, elongation and termination of translation in both prokaryotes and eukaryotes, Fidelity of translation, Inhibitors of protein synthesis in prokaryotes and eukaryote.

#### Unit 5: Regulation of gene Expression in Prokaryotes and Eukaryotes



Principles of transcriptional regulation, regulation at initiation with examples from *lac* and *trp* operons, Yeast mating type switching, changes in chromatin structure: DNA methylation and Histone acetylation mechanisms

#### SUGGESTED READING

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
3. Burton E. Tropp Molecular Biology Genes to Proteins, 3rd Edition, Jones and Bartlett Publishers
4. Robert F. Weaver, Molecular Biology, Fourth Edition, McGraw-Hill International Publishers.
5. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
6. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
7. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
8. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
9. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India

Course Name :Molecular biology (Practical)

Course Code:

Course Details:

1. Isolation of genomic DNA from *E. coli* and visualization of gDNA in Agarose gel electrophoresis
2. Estimation of salmon sperm / calf thymus DNA using UV spectrophotometer (A260 measurement)
3. Estimation of RNA using UV spectrophotometer (A260 measurement)

Course Name : CELL BIOLOGY

Course Code:

Course Details:

#### Unit 1: Structure and organization of Cell

Cell Organization – Prokaryotic and Eukaryotic (Plant and animal cells) Plasma membrane: Structure and transport of small molecules Cell Wall: Eukaryotic cell wall, extracellular matrix and cell matrix interactions, Cell-Cell Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata (only structural aspects) Mitochondria, chloroplasts and



peroxisomes Cytoskeleton: Structure and organization of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules

Unit 2: Nucleus

Nuclear envelope, nuclear pore complex, nucleoporins and nuclear lamina, nuclear transport Nucleolus-composition and functions

Unit 3 Protein Sorting and Transport and Targeting

Ribosomes, Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids Golgi Apparatus – Organization, protein glycosylation, protein sorting and export from Golgi Apparatus Protein targeting to Lysosomes

Unit 4 Cell Signaling

Signaling molecules and their receptors Function of cell surface receptors Pathways of intracellular receptors – Cyclic AMP pathway, cyclic GMP and MAP kinase pathway

Unit 5 Cell Cycle, Cell Death and Cell Renewal

Eukaryotic cell cycle and its regulation, Mitosis and Meiosis, Development of cancer, causes and types, Programmed cell death, Stem cells: Embryonic stem cell, induced pluripotent stem cells

SUGGESTED READING

1. Alberts, B. et al. (2008) Molecular Biology of the cell. 5th edition. Garland Science
2. Hardin J, Bertoni G and Kleinsmith LJ. (2010). Becker's World of the Cell. 8th edition. Pearson.
3. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
4. De Robertis, EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition, Lipincott Williams and Wilkins, Philadelphia.
5. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition, ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
6. Watson JD. et al. (2008) Molecular Biology of the Gene. 6th edition, Cold Spring Harbor Laboratory Press

Course Name : CELL BIOLOGY (Practical)

Course Code:

Course Details:

1. Cytochemical staining of DNA – Feulgen
2. Study of polyploidy in Onion root tip by colchicine treatment
3. Study of different stages of Mitosis
4. Study of different stages of Meiosis

**Core Subject:**

Course Name : MICROBIAL GENETICS

Course Code:



Course Details:

Unit I: Nucleic acid as genetic material
Experimental evidence for DNA and RNA as genetic material: experiments of Griffith, Avery MacLeod and McCarthy, Hershey and Chase, Fraenkel and Conrat.
Unit 2: Mechanisms of Genetic Exchange
Transformation - Discovery, mechanism of natural competence Conjugation - Discovery, mechanism, Hfr and F' strains, Interrupted mating technique and time of entry mapping Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates, Mapping by recombination and co-transduction of markers
Unit 3: Mutations, Repair and Recombination
Mutations and mutagenesis: Definition and types of Mutations (tautomeric shift, base analog, alkylating agent, UV radiation and thymine dimers, replicational error). Mutagenic agents: Physical and chemical mutagens Molecular basis of mutations, Functional mutants (loss and gain of function mutants), Uses of mutations. Repair of DNA: Mismatch and nucleotide excision repair, photoreactivation, SOS repair, error prone repair Reversion and suppression: True revertant; Intra- and inter-genic suppression; Ames test; Mutator genes Recombination: Homologous recombination (Holiday structure-RecBCD system).
Unit 4: Plasmids
Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids. Yeast plasmids- 2 $\mu$ plasmid, Plasmid replication and partitioning, Host range, plasmid-incompatibility, Regulation of plasmid copy number, curing of plasmids
Unit 5: Transposable elements
Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon Eukaryotic transposable elements - Maize (Ac/Ds), LTR and Non-LTR transposons, LINES and SINES. Uses of transposons and transposition
SUGGESTED READING
1. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings 2. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning 3. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning 4. Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed., Benjamin Cummings 5. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc. 6. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India 7. Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings 8. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press. 9. Maloy SR, Cronan JE and Friefelder D (2004) Microbial Genetics 2nd Ed., Jones and Barlett



Publishers

Course Name : MICROBIAL GENETICS (Practical)

Course Code:

Course Details:

1. Effect of UV on bacteria and plotting of survival curve
2. Demonstration of Master and Replica plate preparation
3. Isolation of Plasmid DNA from E. coli and study of different conformations of plasmid DNA through Agarose gel electrophoresis
4. Bacterial Conjugation

**Core Subject:**

Course Name : Virology

Course Code:

Course Details:

**Unit 1 Nature and Properties of Viruses**

Introduction: Discovery of viruses, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite viruses and Prions. Theories of viral origin Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses Isolation, purification and cultivation of viruses Viral taxonomy: Classification and nomenclature of different groups of viruses

**Unit 2 Bacteriophages**

Diversity, classification, one step multiplication curve, lytic and lysogenic phages (lambda phage) concept of early and late proteins, regulation of transcription in lambda phage, genetic basis of lytic vs lysogenic switch of lambda phage

**Unit 3 Viral Transmission, Salient features of viral nucleic acids and Replication**

Modes of viral transmission: Persistent, non-persistent, vertical and horizontal Salient features of viral Nucleic acid : Unusual bases (TMV, T4 phage), overlapping genes ( $\phi$ X174, Hepatitis B virus), alternate splicing (HIV), terminal redundancy (T4 phage), terminal cohesive ends (lambda phage), partial double stranded genomes (Hepatitis B), long terminal repeats (retrovirus), segmented (Influenza virus), and non-segmented genomes (picornavirus), capping and tailing (TMV) Viral multiplication and replication strategies: Interaction of viruses with cellular receptors and entry of viruses. Replication strategies of viruses as per Baltimore classification (phi X 174, Retroviridae, Vaccinia, Picorna) , Assembly, maturation and release of virions

**Unit 4 Viruses and Cancer**





Introduction to oncogenic viruses, types of oncogenic DNA and RNA viruses: Concepts of oncogenes and proto-oncogenes

#### SUGGESTED READING

1. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
2. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons.
3. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition. ASM press Washington DC.
4. Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey.
5. Wagner EK, Hewlett MJ. (2004). Basic Virology. 2nd edition. Blackwell Publishing.
6. Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.
7. Nayudu MV. (2008). Plant Viruses. Tata McGraw Hill, India.
8. Bos L. (1999) Plant viruses-A text book of plant virology by. Backhuys Publishers.
9. Versteeg J. (1985). A Color Atlas of Virology. Wolfe Medical Publication

Course Name : Virology (Practical)

Course Code:

Course Details:

1. Study of the structure of important animal viruses (rhabdo, influenza, paramyxo hepatitis B and retroviruses) using electron micrographs
2. Study of the structure of important plant viruses (caulimo, Gemini, tobacco ringspot, cucumber mosaic and alpha-alpha mosaic viruses) using electron micrographs
3. Study of the structure of important bacterial viruses ( $\phi$ X 174, T4,  $\lambda$ ) using electron micrograph
4. Isolation of bacteriophages from water/sewage sample using double agar layer technique
5. Phage Titration
6. Isolation of Nucleic Acid from Phage