



**TECHNO INDIA UNIVERSITY**  
WESTBENGAL

**3yr B.Sc (HONOURS)**

**In**

**MICROBIOLOGY**

**SYLLABUS**

**Choice Based Credit System (CBCS)**

**2019**



Semester Wise Microbiology Honours Courses						
	1	2	3	4	5	6
<b>Core Courses</b>	TIU-HMB-T1C1 TIU-HMB-P1C1 TIU-HMB-T1C3 TIU-HMB-P1C3 2T+2P (2X4+2X2=12 Credits)	TIU-HMB-T1C2 TIU-HMB-P1C2 TIU-HMB-T1C4 TIU-HMB-P1C4 2T+2P (2X4+2X2=12 Credits)	TIU-HMB-T2C5 TIU-HMB-P2C5 TIU-HMB-T2C7 TIU-HMB-P2C7 TIU-HMB-T2C9 TIU-HMB-P2C9 3T+3P (3X4+3X2=18 Credits)	TIU-HMB-T2C6 TIU-HMB-P2C6 TIU-HMB-T2C8 TIU-HMB-P2C8 TIU-HMB-T2C10 TIU-HMB-P2C10 3T+3P (3X4+3X2=18 Credits)	TIU-HMB-T3C11 TIU-HMB-P3C11 TIU-HMB-T3C13 TIU-HMB-P3C13 2T+2P (2X4+2X2=12 Credits)	TIU-HMB-T3C12 TIU-HMB-P3C12 TIU-HMB-T3C14 TIU-HMB-P3C14 2T+2P (2X4+2X2=12 Credits)
<b>Generic Elective Courses</b>	TIU-UCH-T1G1 TIU-UCH-P1G1 1T+1P (1X4+1X2=6 Credits)	TIU-UCH-T1G2 TIU-UCH-P1G2 1T+1P(1X4+1X2=6 Credits)	TIU-UCS-T2G1 TIU-UCS-P2G1 1T+1P (1X4+1X2=6 Credits)	TIU-UCS-T2G2 TIU-UCS-P2G2 1T+1P (1X4+1X2=6 Credits)		
<b>Discipline Specific Elective Courses</b>					TIU-HMB-T3D1 TIU-HMB-P3D1 TIU-HMB-T3D3 TIU-HMB-P3D3 TIU-HMB-T3D5 TIU-HMB-P3D5 2T+2P Any two: (2X4+2X2=12 Credits)	TIU-HMB-T3D2 TIU-HMB-P3D2 TIU-HMB-T3D4 TIU-HMB-P3D4 TIU-HMB-T3D6 TIU-HMB-P3D6 2T+2P Any two: (2X4+2X2=12 Credits)
<b>Skill Enhancement Elective Courses</b>			TIU-HMB-T2S1 TIU-HMB-P2S1 TIU-HMB-T2S3 TIU-HMB-P2S3 1T+0P (1X2=2 Credits)Any one	TIU-HMB-T2S2 TIU-HMB-P2S2 TIU-HMB-T2S4 TIU-HMB-P2S4 1T+0P(1X2=2 Credits)Any one		
<b>CASD</b>	TIU-UCE-T105 1T+0P (2 Credits) (language)	TIU-UES-T106 1T+0P (2 Credits) (Environmental Science)				
<b>Total = 140 Credits</b>	20 Credits	20 Credits	26 Credits	26 Credits	24 Credits	24 Credits





Core Courses		
Semester	Core Courses (Code)	Subject
1	TIU-HMB-T1C1 TIU-HMB-P1C1	Introduction to microbiology and microbial diversity
	TIU-HMB-T1C3 TIU-HMB-P1C3	Bacteriology
2	TIU-HMB-T1C2 TIU-HMB-P1C2	Biochemistry
	TIU-HMB-T1C4 TIU-HMB-P1C4	Cell Biology
3	TIU-HMB-T2C5 TIU-HMB-P2C5	Virology
	TIU-HMB-T2C7 TIU-HMB-P2C7	Microbial physiology and metabolism
	TIU-HMB-T2C9 TIU-HMB-P2C9	Molecular Biology
4	TIU-HMB-T2C6 TIU-HMB-P2C6	Microbial Genetics
	TIU-HMB-T2C8 TIU-HMB-P2C8	Environmental Microbiology
	TIU-HMB-T2C10 TIU-HMB-P2C10	Recombinant DNA Technology
5	TIU-HMB-T3C11 TIU-HMB-P3C11	Food and Dairy Microbiology
	TIU-HMB-T3C13 TIU-HMB-P3C13	Industrial Microbiology
6	TIU-HMB-T3C12 TIU-HMB-P3C13	Immunology
	TIU-HMB-T3C14 TIU-HMB-P3C14	Medical Microbiology





<b>Skill Enhancement Elective Courses</b>		
<b>Semester</b>	<b>Core Courses (Code)</b>	<b>Subject</b>
<b>3</b>	TIU-HMB-T2S1 TIU-HMB-P2S1	Bio fertilizer
	TIU-HMB-T2S3 TIU-HMB-P2S3	Microbial quality control in food and pharmaceutical industry
<b>4</b>	TIU-HMB-T2S2 TIU-HMB-P2S2	Food Fermentation Technique
	TIU-HMB-T2S4 TIU-HMB-P2S4	Microbiological analysis of air and water

<b>Discipline Specific Elective Courses</b>		
<b>Semester</b>	<b>Core Courses (Code)</b>	<b>Subject</b>
<b>5</b>	TIU-HMB-T3D1 TIU-HMB-P3D1	Biostatistics
	TIU-HMB-T3D3 TIU-HMB-P3D3	Medical & Diagnostics Microbiology
	TIU-HMB-T3D5 TIU-HMB-P3D5	Advance Method in Microbiology
<b>6</b>	TIU-HMB-T3D2 TIU-HMB-P3D2	Inheritance Biology
	TIU-HMB-T3D4 TIU-HMB-P3D4	Bioinformatics
	TIU-HMB-T3D6 TIU-HMB-P3D6	Project Work





## **CORE COURSES**

### **SEMESTER –3**

#### **TIU-HMB-T2C5: VIROLOGY (THEORY)**

**TOTAL HOURS: 60 CREDITS: 4** **Unit 1 Nature and Properties of Viruses No. of**

**Hours: 12** 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 No. of Hours: 10** Diversity, classification, one step multiplication curve, lytic and lysogenic phages (lambda phage) concept of early and late proteins, regulation of transcription in lambda phage

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

**No. of Hours: 20**

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 No. of Hours: 6** Introduction to oncogenic viruses Types of oncogenic DNA and RNA viruses: Concepts of oncogenes and proto-oncogenes

**Unit 5 Prevention & control of viral diseases No. of Hours: 8**

Antiviral compounds and their mode of action Interferon and their mode of action General principles of viral vaccination

**Unit 6 Applications of Virology No. of Hours: 4** Use of viral vectors in cloning and expression, Gene therapy and Phage display

#### **TIU-HMB-P2C5: VIROLOGY (PRACTICAL)**





- TOTAL HOURS: 60 CREDITS: 21.** 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 ring spot, 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 and enumeration of bacteriophages (PFU) from water/sewage sample using double agar layer technique
  5. Studying isolation and propagation of animal viruses by chick embryo technique
  6. Study of cytopathic effects of viruses using photographs
  7. Perform local lesion technique for assaying plant viruses.

### 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.

## TIU-HMB-T2C7: Microbial physiology and metabolism (THEORY)

### **TOTAL HOURS: 60 CREDITS: 4 Unit 1 Microbial Growth and Effect of Environment on Microbial Growth**

#### **No. of Hours: 12**

Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxic growth curve Microbial growth in response to environment -Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe), barophilic. Microbial growth in response to nutrition and energy – Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph.





**Unit 2 Nutrient uptake and Transport No. of Hours: 10** Passive and facilitated diffusion  
Primary and secondary active transport, concept of uniport, symport and antiport Group translocation  
Iron uptake

**Unit 3 Chemoheterotrophic Metabolism - Aerobic Respiration No. of Hours: 16** Concept  
of aerobic respiration, anaerobic respiration and fermentation Sugar degradation pathways i.e. EMP,  
ED, Pentose phosphate pathway TCA cycle Electron transport chain: components of respiratory  
chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers  
and inhibitors

**Unit 4 Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation  
No. of Hours: 6**

Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate  
/nitrite and nitrate/ammonia respiration; fermentative nitrate reduction) Fermentation - Alcohol  
fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative  
pathways), concept of linear and branched fermentation pathways

**Unit 5 Chemolithotrophic and Phototrophic Metabolism No. of Hours: 10**

Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation  
(definition and reaction) and methanogenesis (definition and reaction) Introduction to phototrophic  
metabolism - groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with  
reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria

**Unit 6 Nitrogen Metabolism - an overview No. of Hours: 6**

Introduction to biological nitrogen fixation Ammonia assimilation Assimilatory nitrate reduction,  
dissimilatory nitrate reduction, denitrification

### **TIU-HMB-P2C7: Microbial physiology and metabolism (PRACTICAL)**

- TOTAL HOURS: 60 CREDITS: 2**
1. Study and plot the growth curve of *E. coli* by turbidometric and standard plate count methods.
  2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data
  3. Effect of temperature on growth of *E. coli*
  4. Effect of pH on growth of *E. coli*
  5. Effect of carbon and nitrogen sources on growth of *E. coli*
  6. Effect of salt on growth of *E. coli*
  7. Demonstration of alcoholic fermentation
  8. Demonstration of the thermal death time and decimal reduction time of *E. coli*.

#### **SUGGESTED READINGS**





1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India
4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
5. Stanier RY, Ingraham JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

## **TIU-HMB-T2C9: MOLECULAR BIOLOGY (THEORY)**

**TOTAL HOURS: 60 CREDITS: 4**

**Unit 1 Structures of DNA and RNA / Genetic Material No. of Hours: 12** DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves. DNA topology - linking number, topoisomerases; Organization of DNA Prokaryotes, Viruses, Eukaryotes. RNA Structure, Organelle DNA -- mitochondria and chloroplast DNA.

**Unit 2 Replication of DNA (Prokaryotes and Eukaryotes) No. of Hours: 10** Bidirectional and unidirectional replication, semi- conservative, semi- discontinuous replication Mechanism of DNA replication: Enzymes and proteins involved in DNA replication –DNA polymerases, DNA ligase, primase, telomerase – for replication of linear ends Various models of DNA replication including rolling circle, D- loop (mitochondrial),  $\Theta$  (theta) mode of replication and other accessory protein, Mismatch and excision repair

**Unit 3 Transcription in Prokaryotes and Eukaryotes No. of Hours: 8** Transcription: Definition, difference from replication, promoter - concept and strength of promoter RNA Polymerase and the transcription unit Transcription in Eukaryotes: RNA polymerases, general Transcription factors

**Unit 4 Post-Transcriptional Processing No. of Hours: 8** Split genes, concept of introns and exons, RNA splicing, spliceosome machinery, concept of alternative splicing, Polyadenylation and capping, Processing of rRNA, RNA interference: si RNA, miRNA and its significance







**Unit 5 Translation (Prokaryotes and Eukaryotes) No. of Hours: 10** Translational machinery, Charging of tRNA, aminoacyl-tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides in both prokaryotes and eukaryotes, Fidelity of translation, Inhibitors of protein synthesis in prokaryotes and eukaryote

**Unit 6 Regulation of gene Expression in Prokaryotes and Eukaryotes No. of Hours: 12** Principles of transcriptional regulation, regulation at initiation with examples from lac and trp operons, Sporulation in Bacillus, Yeast mating type switching, Changes in Chromatin Structure - DNA methylation and Histone Acetylation mechanisms.

### **TIU-HMB-P2C9: MOLECULAR BIOLOGY (PRACTICAL)**

- TOTAL HOURS: 60 CREDITS: 21.** Study of different types of DNA and RNA using micrographs and model / schematic representations
2. Study of semi-conservative replication of DNA through micrographs / schematic representations
  3. Isolation of genomic DNA from E. coli
  4. Estimation of salmon sperm / calf thymus DNA using colorimeter (diphenylamine reagent) or UV spectrophotometer (A260 measurement)
  5. Estimation of RNA using colorimeter (orcinol reagent) or UV spectrophotometer (A260 measurement)
  6. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
  7. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).

#### **SUGGESTED READINGS**

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. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
6. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
7. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India





## **Skill Enhancement Elective Courses**

### **SEMESTER 3**

#### **TIU-HMB-T2S1: Biofertilizers and Biopesticides (THEORY)**

**TOTAL HOURS: 30 CREDITS: 2** **Unit 1 Biofertilizers No of Hours: 10** General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers.

Symbiotic N<sub>2</sub> fixers: Rhizobium - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants Frankia - Isolation, characteristics, Alder, Casurina plants, non-leguminous crop symbiosis.

Cyanobacteria, Azolla - Isolation, characterization, mass multiplication, Role in rice cultivation, Crop response, field application.

**Unit 2 Non - Symbiotic Nitrogen Fixers No of Hours: 4** Free living Azospirillum, Azotobacter - free isolation, characteristics, mass inoculums, production and field application.

**Unit 3 Phosphate Solubilizers No of Hours: 4** Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, field application

**Unit 4 Mycorrhizal Biofertilizers No of Hours: 5** Importance of mycorrhizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.

**Unit 5 Bioinsecticides No of Hours: 7** General account of microbes used as bioinsecticides and their advantages over synthetic pesticides, Bacillus thuringiensis, production, Field applications, Viruses – cultivation and field applications.

#### **Suggested Readings**

1. Kannaiyan, S. (2003). Bioetchnology of Biofertilizers, CHIPS, Texas.
2. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
3. Reddy, S.M. et. al. (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.
4. SubbaRao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt. Ltd. NewDelhi.
5. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG
6. Aggarwal SK (2005) Advanced Environmental Biotechnology, APH publication.





## **TIU-HMB-T2S3: Microbial Quality Control in Food and Pharmaceutical Industries (THEORY)**

**TOTAL HOURS: 30 CREDITS: 2 Unit 1 Microbiological Laboratory and Safe Practices No. of Hours: 8** Good laboratory practices - Good laboratory practices, Good microbiological practices Biosafety cabinets –Working of biosafety cabinets, using protective clothing, specification for BSL-1, BSL-2, BSL-3. Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration

**Unit 2 Determining Microbes in Food / Pharmaceutical Samples No. of Hours: 10** Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

**Unit 3 Pathogenic Microorganisms of Importance in Food & Water No. of Hours: 8** Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Sabouraud Agar Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay)

**Unit 4 HACCP for Food Safety and Microbial Standards No. of Hours: 4** Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water

### **SUGGESTED READING**

1. Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press
2. Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
3. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer
4. Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.

