



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
Core Courses	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)
Generic Elective Courses	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)		
Discipline Specific Elective Courses					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)
Skill Enhancement Elective Courses			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		
CASD	TIU-UCE-T105 1T+0P (2 Credits) (language)	TIU-UES-T106 1T+0P (2 Credits) (Environmental Science)				
Total = 140 Credits	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





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

Discipline Specific Elective Courses		
Semester	Core Courses (Code)	Subject
5	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
6	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 –4

TIU-HMB-T2C6: Microbial Genetics (THEORY)

TOTAL HOURS: 60 CREDITS: 4 **Unit 1 Genome Organization and Mutations** **No. of Hours: 18**

Genome organization: E. coli, Saccharomyces, Tetrahymena Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens; Molecular basis of mutations; Functional mutants (loss and gain of function mutants); Uses of mutations Reversion and suppression: True revertants; Intra- and inter-genic suppression; Ames test; Mutator genes

Unit 2 Plasmids No. of Hours: 10 Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast- 2 μ plasmid, Plasmid replication and partitioning, Host range, plasmid-incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids

Unit 3 Mechanisms of Genetic Exchange No. of Hours: 12

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 4 Phage Genetics No. of Hours: 8 Features of T4 genetics , Genetic basis of lytic versus lysogenic switch of phage lambda

Unit 5 Transposable elements No. of Hours: 12 Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon Eukaryotic transposable elements - Yeast (Ty retrotransposon), Drosophila (P elements), Maize (Ac/Ds)

Uses of transposons and transposition

TIU-HMB-P2C6: Microbial Genetics (PRACTICAL)

TOTAL HOURS: 60 CREDITS: 21. Preparation of Master and Replica Plates
2. Study the effect of chemical (HNO₂) and physical (UV) mutagens on bacterial cells
3. Study survival curve of bacteria after exposure to ultraviolet (UV) light
4. Isolation of Plasmid DNA from E.coli





5. Study different conformations of plasmid DNA through Agarose gel electrophoresis.
6. Demonstration of Bacterial Conjugation
7. Demonstration of bacterial transformation and transduction
8. Demonstration of AMES test

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. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
6. Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings
7. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
8. Maloy SR, Cronan JE and FriefelderD(2004) Microbial Genetics 2nd EDITION., Jones and Barlett Publishers

TIU-HMB-T2C8: ENVIRONMENTAL MICROBIOLOGY (THEORY)

TOTAL HOURS: 60 CREDITS: 4

Unit 1 Microorganisms and their Habitats No. of Hours: 14

Structure and function of ecosystems

Terrestrial Environment: Soil profile and soil microflora

Aquatic Environment: Microflora of fresh water and marine habitats Atmosphere: Aeromicroflora and dispersal of microbes

Animal Environment: Microbes in/on human body (Microbiomics) & 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 No. of Hours: 12 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 No. of Hours: 12 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 solubilisation

Sulphur cycle: Microbes involved in sulphur cycle

Other elemental cycles: Iron and manganese

Unit 4 Waste Management No. of Hours: 12 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 No. of Hours: 5 Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants

Unit 6 Water Potability No. of Hours: 5 Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

TIU-HMB-P2C8: ENVIRONMENTAL MICROBIOLOGY (PRACTICAL)

TOTAL HOURS: 60 CREDITS: 21. Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action.

2. Isolation of microbes (bacteria & fungi) from soil (28°C & 45°C).
3. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.
4. Assessment of microbiological quality of water.
5. Determination of BOD of waste water sample.
6. Study the presence of microbial activity by detecting (qualitatively) enzymes (dehydrogenase, amylase, urease) in soil.
7. Isolation of Rhizobium from root nodules.

SUGGESTED READINGS

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 Hedeilberg
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
7. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning
8. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
9. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
10. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
11. SubbaRao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.
12. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

TIU-HMB-T2C10: RECOMBINANT DNA TECHNOLOGY (THEORY)

TOTAL HOURS: 60 CREDITS: 4 Unit 1 Introduction to Genetic Engineering No. of Hours: 2 Milestones in genetic engineering and biotechnology

Unit 2 Molecular Cloning- Tools and Strategies No. of Hours: 20 Cloning Tools; Restriction modification systems: Types I, II and III. Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyltransferase, kinases and phosphatases, and DNA ligases Cloning Vectors: Definition and Properties Plasmid vectors: pBR and pUC series Bacteriophage lambda and M13 based vectors Cosmids, BACs, YACs Use of linkers and adaptors Expression vectors: E.coli lac and T7 promoter-based vectors, yeast YIp, YEp and YCp vectors, Baculovirus based vectors, mammalian SV40-based expression vectors

Unit 3 Methods in Molecular Cloning No. of Hours: 16

Transformation of DNA: Chemical method, Electroporation, Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viral-mediated delivery, Agrobacterium - mediated delivery DNA, RNA and Protein analysis: Agarose gel electrophoresis, Southern - and Northern - blotting techniques, dot blot, DNA microarray analysis, SDS-PAGE and Western blotting.

Unit 4 DNA Amplification and DNA sequencing No. of Hours: 10

PCR: Basics of PCR, RT-PCR, Real-Time PCR Sanger's method of DNA Sequencing: traditional and automated sequencing Primer walking and shotgun sequencing





Unit 5 Construction and Screening of Genomic and cDNA libraries No. of Hours: 6

Genomic and cDNA libraries: Preparation and uses, Screening of libraries: Colony hybridization and colony PCR, Chromosome walking and chromosome jumping

Unit 6 Applications of Recombinant DNA Technology No. of Hours: 6

Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH, antisense molecules. Bt transgenic - cotton, brinjal, Gene therapy, recombinant vaccines, protein engineering and site directed mutagenesis

**TIU-HMB-P2C10:RECOMBINANT DNA TECHNOLOGY
(PRACTICAL)**

TOTAL HOURS: 60 CREDITS: 21. Preparation of competent cells for transformation

2. Demonstration of Bacterial Transformation and calculation of transformation efficiency.
3. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis
4. Ligation of DNA fragments
5. Cloning of DNA insert and Blue white screening of recombinants.
6. Interpretation of sequencing gel electropherograms
7. Designing of primers for DNA amplification
8. Amplification of DNA by PCR
9. Demonstration of Southern blotting

SUGGESTED READING

1. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA
3. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
4. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press
5. Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education
6. Brown TA. (2007). Genomes-3. Garland Science Publishers
7. Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.





Skill Enhancement Elective Courses

SEMESTER 4

TIU-HMB-T2S2: Food Fermentation Techniques (THEORY)

TOTAL HOURS: 30 CREDITS: 2 Unit 1 Fermented Foods No of Hours: 4 Definition, types, advantages and health benefits

Unit 2 Milk Based Fermented Foods No of Hours: 8 Dahi, Yogurt, Buttermilk (Chach) and cheese: Preparation of inoculums, types of microorganisms and production process

Unit 3 Grain Based Fermented Foods No of Hours: 6 Soy sauce, Bread, Idli and Dosa: Microorganisms and production process

Unit 4 Vegetable Based Fermented Foods No of Hours: 4 Pickels, Saeurkraut: Microorganisms and production process

Unit 5 Fermented Meat and Fish No of Hours: 4 Types, microorganisms involved, fermentation process

Unit 6 Probiotic Foods No of Hours: 4 Definition, types, microorganisms and health benefits

Suggested Readings

1. Hui YH, Meunier-Goddik L, Josephsen J, Nip WK, Stanfield PS (2004) Handbook of food and fermentation technology, CRC Press
2. Holzapfel W (2014) Advances in Fermented Foods and Beverages, Woodhead Publishing.
3. Yadav JS, Grover, S and Batish VK (1993) A comprehensive dairy microbiology, Metropolitan
4. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer

TIU-HMB-T2S4: Microbiological Analysis of Air and Water (THEORY)

TOTAL HOURS: 30 CREDITS: 2 Unit 1 Aeromicrobiology No of Hours: 4 Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens

Unit 2 Air Sample Collection and Analysis No of Hours: 7

Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics





Unit 3 Control Measures No of Hours: 4

Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration

Unit 4 Water Microbiology No of Hours: 4

Water borne pathogens, water borne diseases

Unit 5 Microbiological Analysis of Water No of Hours: 7 Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

Unit 6 Control Measures No of Hours: 4

Precipitation, chemical disinfection, filtration, high temperature, UV light

Suggested Reading

1. da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and Water A Laboratory Manual, CRC Press
2. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4 th edition. Benjamin/Cummings Science Publishing, USA
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
4. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3rd edition, ASM press

