TECHNO INDIA UNIVERSITY
WESTBENGAL

Syllabusfor3-yearB.Sc(Honours)inMicrobiology 2018

ChoiceBasedCreditSystem(CBCS)

Department of Microbiology

TechnoIndiaUniversity,WestBengal

EM-4,EMBlock,SectorV,Bidhannagar, Kolkata, West Bengal 700091

TECHNO INDIA UNIVERSITY
WESTBENGAL

B.Sc Microbiology (CBCS)

CourseCurriculumforAllSemester

SemesterIII

Sl. No.	Course Code	CourseTitle	ContactHrs./ Week			Credit	Page No.
			L	T	P		
Theory							
1	TIU-HMB-T201	Virology	03	01	00	04	
2	TIU-HMB-T203	Microbialphysiologyandmetabolism	03	01	00	04	
3	TIU-HMB-T205	Molecular Biology	03	01	00	04	
4	TIU-SEE-T201	BiofertilizersandBiopesticides	01	01	00	02	
5	TIU-SEE-T203	MicrobialQualityControlinFoodand Pharmaceutical Industries	01	01	00	02	
6	TIU-UCS-T201	Computer	03	01	00	04	
Practical							
1	TIU-HMB-L201	Virology	00	00	02	02	
2	TIU-HMB-L203	Microbialphysiologyandmetabolism	00	00	02	02	
3	TIU-HMB-T205	Molecular Biology	00	00	02	02	
4	TIU-UCS-L201	Computer	00	00	02		
TotalCredit						26	

CORECOURSES

SEMESTER –3

TIU-HMB-T201:VIROLOGY(THEORY)

TOTAL HOURS: 60 CREDITS: 4

Course Outcome:

Aftersuccessfulcompletion,thiscourseenables students:

- Tounderstandaboutnatureandpropertiesofviruses.
- Toknowaboutdiversity,classificationofBacteriophagesonestepmultiplication curve, lytic and lysogenic phages (lambda phage),
- Tounderstandaboutviraltransmission,Salientfeaturesofviralnucleicacidsand Replication.
- Tounderstandtheconceptsofoncogenes,proto-oncogenesandtumorsuppressor genes.
- Togainbetterunderstandingofantiviralcompoundsandtheirmodeofaction, Interferon and their mode of action, General principles of viral vaccination.

Contents:

Unit 1 Nature and Properties of Viruses No. of Hours: 12Introduction: Discovery of viruses, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite virusesandPrions.TheoriesofviraloriginStructureofViruses:Capsidsymmetry,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: 10Diversity, 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 Salientfeatures of viral Nucleic acid : Unusual bases (TMV,T4 phage), overlapping genes (ϕX174, 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: Interactionofviruseswithcellularreceptorsandentryofviruses.Replicationstrategiesof

virusesasperBaltimoreclassification(phiX174,Retroviridae,Vaccinia,Picorna), Assembly, maturation and release of virions

Unit4VirusesandCancerNo.ofHours:6IntroductiontooncogenicvirusesTypesof oncogenic DNA and RNAviruses: Concepts of oncogenes and proto-oncogenes

Unit5Prevention&controlofviraldiseasesNo. ofHours: 8

Antiviralcompoundsandtheir mode of actionInterferonandtheir mode of actionGeneral principles of viral vaccination

Unit6ApplicationsofVirologyNo.ofHours:4Useofviralvectorsincloningand expression, Gene therapy and Phage display

TIU-HMB-L201:VIROLOGY(PRACTICAL) TOTAL

HOURS: 60 CREDITS: 2

1. Studyofthestructureofimportantanimalviruses(rhabdo,influenza,paramyxohepatitisB 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 (ϕX 174, T4, λ) 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.Performlocallesiontechniquefor assayingplantviruses.

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. BosL.(1999)Plantviruses-Atextbookofplantvirologyby.BackhuysPublishers.9. Versteeg J. (1985).AColorAtlas of Virology.Wolfe Medical Publication.

TIU-HMB-T203:Microbialphysiologyandmetabolism(THEORY)

TOTALHOURS:60CREDITS:4

Course Outcome:

Aftersuccessfulcompletion,thiscourseenables students:

- Tounderstandaboutnatureandpropertiesofviruses.
- Toknowaboutdiversity,classificationofBacteriophagesonestepmultiplication curve, lytic and lysogenic phages (lambda phage),
- Tounderstandaboutviraltransmission,Salientfeaturesofviralnucleicacidsand Replication.
- Beabletounderstandtheconceptsofoncogenes,proto-oncogenesandtumor suppressor genes.
- Togainbetterunderstandingofantiviralcompoundsandtheirmodeofaction, Interferon and their mode of action, General principles of viral vaccination.

Contents:

Unit1MicrobialGrowthandEffectofEnvironmentonMicrobialGrowth 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 responsetonutritionandenergy–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

Unit5ChemolithotrophicandPhototrophic Metabolism No.ofHours: 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

Unit6NitrogenMetabolism -anoverviewNo.of Hours:6

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

TIU-HMB-L203:Microbialphysiologyandmetabolism(PRACTICAL) TOTAL

HOURS: 60CREDITS: 2

1. StudyandplotthegrowthcurveofE.colibyturbidometricandstandardplatecount methods.

2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data

3. EffectoftemperatureongrowthofE.coli4.EffectofpHon growthof E.coli

5. Effect of carbon and nitrogen sources on growth of E.coli 6. Effect of salt on growth of E. coli

7.Demonstrationofalcoholic fermentation

8.Demonstrationofthe thermaldeathtimeanddecimalreduction timeofE. coli.

SUGGESTED READINGS

1. MadiganMT,andMartinkoJM(2014).BrockBiologyofMicroorganisms.14th edition.Prentice Hall International Inc.

2. MoatAG and Foster JW. (2002). Microbial Physiology.4th edition. John Wiley & Sons 3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India

4. GottschalkG.(1986). BacterialMetabolism.2ndedition.SpringerVerlag

5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5thedition, McMillan Press.

6. WilleyJM,SherwoodLM,andWoolvertonCJ.(2013).Prescott'sMicrobiology.9th edition.McGraw Hill Higher Education.

TIU-HMB-T205:MOLECULARBIOLOGY(THEORY) TOTAL

HOURS: 60 CREDITS: 4

Course Outcome:

Aftersuccessfulcompletionofthiscourse, students:

- Be able to understand various processes of replication involving mechanism of DNA replication in prokaryote and eukaryotes.
- Beabletounderstandtheroleandprocessoftranscriptioninprokaryotesand Eukaryotes.
- Beabletoknow aboutregulationof geneexpressioninprokaryotesand Eukaryotes.

Contents:

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 ofdouble 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), Θ (theta) mode of replicationand other accessory protein, Mismatch and excision repair

Unit3TranscriptioninProkaryotesandEukaryotesNo.ofHours:8Transcription: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, aminoacyltRNAsynthetases, 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 oftranscriptional regulation, regulationat initiation with examples from lacand trp

operons,SporulationinBacillus,Yeastmatingtypeswitching,ChangesinChromatin Structure - DNA methylation and Histone Acetylation mechanisms.

TIU-HMB-L205:MOLECULARBIOLOGY(PRACTICAL)

TOTAL HOURS: 60 CREDITS: 2

1. StudyofdifferenttypesofDNAandRNAusingmicrographsandmodel/schematic representations

2. Studyofsemi-conservativereplicationofDNAthroughmicrographs/schematic representations 3. Isolation of genomic DNAfrom E. coli

4. Estimation of salmonsperm / calf thymus DNAusingcolorimeter (diphenylamine reagent) or UV spectrophotometer (A260 measurement)

5. Estimationof RNA using colorimeter (orcinolreagent) or UV spectrophotometer (A260measurement) 6. Resolution and visualization of DNAbyAgarose Gel Electrophoresis.

7.ResolutionandvisualizationofproteinsbyPolyacrylamideGelElectrophoresis(SDS- PAGE).

SUGGESTED READINGS

1. WatsonJD,BakerTA,BellSP,GannA,LevineMandLosickR(2008)MolecularBiology 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, 7thedition, 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. SambrookJandRussellDW.(2001).MolecularCloning:ALaboratoryManual.4th Edition, Cold Spring Harbour Laboratory press.

6. KrebsJ,GoldsteinE,KilpatrickS(2013).Lewin'sEssentialGenes,3rdEd.,Jonesand Bartlett Learning

7. GardnerEJ,SimmonsMJ,SnustadDP(2008).PrinciplesofGenetics.8thEd.Wiley-India

SEMESTER 3

TIU-SEE-T201: Biofertilizers and Biopesticides (THEORY)
TOTAL HOURS: 30 CREDITS: 2

Course Outcome:
After successful completion of this course students:

- Be able to understand various aspects of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers
- Be able to interpret about the type of Non - Symbiotic Nitrogen Fixers.
- Be able to know about various concepts related to Phosphate solubilizing microbes.
- Be able to understand the role of mycorrhizae and associated plants

- Be able to know about microbes used as bioinsecticides and their advantages over synthetic pesticides.

Contents:
Unit 1 BiofertilizersNo of Hours: 10 General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers. Symbiotic N2 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 MycorrhizalBiofertilizersNo of Hours: 5 Importance of mycorrizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.
Unit 5 BioinsecticidesNo 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-SEE-T203: Microbial Quality Control in Food and Pharmaceutical Industries (THEORY)
TOTAL HOURS: 30 CREDITS: 2

Course Outcome:
After successful completion of this course students:
- Be able to understand various aspects of Good laboratory practices, Good microbiological practices.
- Be able to interpret about culture and microscopic methods including standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods.
- Be able to diagnose microbial pathogens through microscopic study and differential culturing including enrichment culture technique.
- Be able to understand the quality test for milk.
- Be able to know about - principles, flow diagrams, limitations of Hazard analysis of critical control point (HACCP).

Contents:
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, Saboraud 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.