



**TECHNO INDIA UNIVERSITY**  
WESTBENGAL

**Syllabus for 3-year B.Sc (Honours)in Microbiology  
2018**

**Choice Based Credit System (CBCS)**

**Department of Microbiology**

**Techno India University, West Bengal  
EM-4, EM Block, Sector V, Bidhannagar,  
Kolkata, West Bengal 700091**



**B.Sc Microbiology (CBCS)**

**Course Curriculum for All Semester**

Semester V

Sl. No.	Course Code	Course Title	Contact Hrs. / Week			Credit	Page No.
			L	T	P		
<b>Theory</b>							
1	TIU-HMB-T301	Food and Dairy Microbiology	03	01	00	04	
2	TIU-HMB-T303	INDUSTRIAL MICROBIOLOGY	03	01	00	04	
3	TIU-DSE-T301	BIOMATHEMATICS ANDBIOSTATISTICS	02	02	00	04	
4	TIU-DSE-T303	MEDICAL & DIAGNOSTIC MICROBIOLOGY	02	02	00	04	
5	TIU-DSE-T305	ADVANCES IN MICROBIOLOGY	02	02	00	04	
<b>Practical</b>							
1	TIU-HMB-L301	Food and Dairy Microbiology	00	00	02	02	
2	TIU-HMB-L303	INDUSTRIAL MICROBIOLOGY	00	00	02	02	
3	TIU-DSE-L301	BIOMATHEMATICS ANDBIOSTATISTICS	00	00	02	02	
4	TIU-DSE-L303	MEDICAL & DIAGNOSTIC MICROBIOLOGY	00	00	02	02	
5	TIU-DSE-L305	ADVANCES IN MICROBIOLOGY	00	00	02	02	
<b>Total Credit</b>						24	



## CORE COURSES

### SEMESTER –5

#### **TIU-HMB-T301: Food and Dairy Microbiology (THEORY)**

**TOTAL HOURS: 60 CREDITS: 4**

Course Outcome:

After successful completion, this course enables students:

- To understand the concept of fermentation and its industrial applications.
- To understand the preservation and maintenance methods of important strains of microbes in dairy microbiology.
- To understand the parameters that affect microbial growth in food, and to learn about food infection and intoxications.
- To understand the principles and methods of food preservation and food sanitation

Contents:

Unit 1 Foods as a substrate for microorganisms No. of Hours: Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general.

Unit 2 Microbial spoilage of various foods No. of Hours: 10 Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods

Unit 3 Principles and methods of food preservation No. of Hours: 12 Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO<sub>2</sub>, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins

Unit 4 Fermented foods No. of Hours: 10 Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

Unit 5 Food borne diseases (causative agents, foods involved, symptoms and preventive measures) No. of Hours: 10

Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins; Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni

Unit 6 Food sanitation and control No. of Hours: 5

HACCP, Indices of food sanitary quality and sanitizers



Unit 7 Cultural and rapid detection methods of food borne pathogens in foods and introduction to predictive microbiology. No. of Hours: 5

**TIU-HMB-L301: Food and Dairy Microbiology (PRACTICAL)**

**TOTAL HOURS: 60 CREDITS: 2**

1. MBRT of milk samples and their standard plate count.
2. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
3. Isolation of any food borne bacteria from food products.
4. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
5. Isolation of spoilage microorganisms from bread.
6. Preparation of Yogurt/Dahi.

**SUGGESTED READINGS**

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
2. Banwart JM. (1987). Basic Food Microbiology.1st edition.CBS Publishers and Distributors, Delhi, India.
3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.
4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.
5. Frazier WC and Westhoff DC. (1992). Food Microbiology.3rd edition.Tata McGrawHill Publishing Company Ltd, New Delhi, India.
6. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London. 7. Jay JM, Loessner MJ and Golden DA.(2005). Modern Food Microbiology.7th edition, CBS Publishers and Distributors, Delhi, India.
8. Lund BM, Baird Parker AC, and Gould GW. (2000). The Microbiological Safety and Quality of Foods. Vol. 1-2, ASPEN Publication, Gaithersberg, MD.
9. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition.Pearson Education.

**TIU-HMB-T303:INDUSTRIAL MICROBIOLOGY (THEORY)**

**TOTAL HOURS: 60 CREDITS: 4**



**Course Outcome:**

After successful completion, this course enables students:

- To understand the concept of fermentation and its industrial applications.
- To understand the preservation and maintenance methods of industrially important strains of microbes in microbiology.
- To understand the different downstream processing and production of industrially important enzymes.

**Contents:**

Unit 1 Introduction to industrial microbiology No. of Hours: 2

Brief history and developments in industrial microbiology

Unit 2 Isolation of industrially important microbial strains and fermentation media No. of Hours: 10

Sources of industrially important microbes and methods for their isolation, preservation and maintenance of industrial strains, strain improvement, Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates

Unit 3 Types of fermentation processes, bio-reactors and measurement of fermentation parameters No. of Hours: 12

Types of fermentation processes - Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch (eg. baker's yeast) and continuous fermentations Components of a typical bio-reactor, Types of bioreactors-Laboratory, pilot- scale and production fermenters, constantly stirred tank and air-lift fermenters, Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration

Unit 4 Down-stream processing No. of Hours: 6 Cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying

Unit 5 Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and uses) No. of Hours: 18

Citric acid, ethanol, penicillin, glutamic acid, Vitamin B12 Enzymes (amylase, protease, lipase) Wine, beer

Unit 6 Enzyme immobilization No. of Hours: 4 Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase)

**TIU-HMB-L303:INDUSTRIAL MICROBIOLOGY (PRACTICAL)**

**TOTAL HOURS: 60 CREDITS: 2**

1. Study different parts of fermenter

2. Microbial fermentations for the production and estimation (qualitative and quantitative) of:  
(a) Enzymes: Amylase and Protease (b) Amino acid: Glutamic acid (c) Organic acid: Citric acid (d) Alcohol: Ethanol



3. A visit to any educational institute/industry to see an industrial fermenter, and other downstream processing operations.

#### SUGGESTED READINGS

1. Patel A.H. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited
2. Okafor N. (2007). Modern Industrial Microbiology and Biotechnology.1st edition.Bios Scientific Publishers Limited. USA
3. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. (2001). Industrial Microbiology: An Introduction. 1st edition. Wiley – Blackwell
4. Glaze A.N. and Nikaido H. (1995). Microbial Biotechnology: Fundamentals of Applied Microbiology. 1st edition. W.H. Freeman and Company
5. Casida LE. (1991). Industrial Microbiology.1st edition.Wiley Eastern Limited.
6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition.Panima Publishing Co. New Delhi.
7. Stanbury PF, Whitaker A and Hall SJ.(2006). Principles of Fermentation Technology.2nd edition, Elsevier Science Ltd.

## **Discipline Specific Elective Courses**

### **SEMESTER 5**

#### **TIU-DSE-T301: Instrumentation, Biotechniques and Biostatistics (Theory)**

Course Outcome:

After successful completion, this course enables students:

- To understand the importance, principle and types of microscopy techniques.
- To understand the importance, principle and types of chromatography, spectrophotometric, centrifugation & electrophoretic techniques and their role in the study of biological system.
- Basic understanding of Moments, Skewness, central tendency kurtosis by moments.
- Well versed in the concepts Probability and Probability Distribution along with its application
- Understand the Statistical Quality Control, Correlation and regression analysis.
- Good understanding and analytical knowledge in applying & testing of Hypothesis and Analysis of variance.



- Basic understanding of Moments, Skewness, central tendency kurtosis by moments.

Contents:

Unit 1: Microscopy- Brightfield and darkfield microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy) and Micrometry.

Unit 2: Chromatography- Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection. Gel filtration chromatography, ion exchange chromatography and affinity chromatography, GLC, HPLC.

Unit 3: Electrophoresis- Principle and applications of native polyacrylamide gel electrophoresis, SDS polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, and Agarose gel electrophoresis.

Unit 4: Spectrophotometry- Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV and visible range. Colorimetry and turbidometry. Fluorescence Spectroscopy.

Unit 5: Centrifugation- Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, principle and application of differential centrifugation, density gradient centrifugation and ultracentrifugation.

Unit 6: Biostatistics: Sample and population: Sampling methods, construction of histogram, interpretation of histogram, sample mean, sample standard deviation, the normal distribution, the mean mode, median and standard deviation of the normal distribution, uncertainties in estimation of a mean. Laws of probability, theorem of total probability.

Testing of hypothesis, comparison of population means and variances- F-test, notion of confidence limit. Chi-square test, goodness of fit and the test of independence of two attributes; count data, examples of count data – bacterial cell count, radioactivity count, colony and plaque counts, statistical treatment to count data.

Poisson distribution, standard error, confidence limits of counts; test of significance, difference of means in large samples, t-test (small samples), paired and unpaired data with computation of critical difference; Binomial, Gaussian distribution fitting on observed data. Analysis of variance of one-way and two-way classified data, Simple linear regression.

### **TIU-DSE-L301: Instrumentation, Biotechniques and Biostatistics (PRACTICAL)**

**TOTAL HOURS: 60 CREDITS: 2**

1. Mean, Median, Mode from grouped and ungrouped Data set 2. Standard Deviation and Coefficient of Variation
3. Curve fitting
4. Correlation and Regression
5. Testing of Hypothesis- t-test, chi-square test



6. Fluorescent microscopy, Electron microscopy, Phase contrast microscopy (Demo)
7. Determination of  $\lambda_{\max}$  for an unknown sample and calculation of extinction coefficient.
8. Separation of components of a given mixture using a laboratory scale centrifuge.
9. Separation of mixtures by paper chromatography.

#### SUGGESTED READINGS

1. H. S. Bear: Understanding Calculus, John Wiley and Sons (Second Edition); 2003.
2. E. Batschelet : Introduction to Mathematics for Life Scientists, SpringerVerlag, International Student Edition, Narosa Publishing House, New Delhi (1971, 1975)
3. A. Edmondson and D. Druce : Advanced Biology Statistics, Oxford University Press; 1996.
4. W. Danial : Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004.

#### **TIU-DSE-T303: MEDICAL & DIAGNOSTIC MICROBIOLOGY**

Course Outcome:

After successful completion, this course enables students:

- To understand the normal microflora of different parts of the human body.
- To have knowledge on different cell culture media and their preparation methods.
- To gain knowledge on various bacterial and viral diseases .
- To understand the different protozoan and fungal diseases and their causative agents.
- To get an insight into the various antimicrobial, antifungal agents and their mode of action.

Contents:

##### Unit - I

Collection and transportation of specimens for Microbiological investigations such as Blood, Urine, Throat swab, Rectal swab, Stool, Pus, OT specimens. Processing of samples, inoculation and interpretation. Preservation of bacteria.

##### Unit - II

Hospital infections

Quality control in microbiology

Laboratory control of antimicrobial therapy

Collection of specimens for bacteriological investigations

##### Unit - III



Methods of culture, techniques and organisms encountered in: CSF, blood culture, sputum, pus, urine, stool, UTI, endocarditis, Bone and joint infections

#### Unit - IV

Bacteriological investigation in:

- PUO
- Tuberculosis
- Leprosy
- Meningitis
- Eye infections

#### Unit - V

Causative agents and investigations in cases of:

- Food poisoning, gastroenteritis, diarrhea
- Respiratory tract infections
- Sexually transmitted diseases
- Dental infections

#### Unit – VI

- Blood transfusion and associated infections
- Immunoprophylaxis against diseases
- Rapid diagnostic methods in microbiology

#### **TIU-DSE-L303: MEDICAL & DIAGNOSTIC MICROBIOLOGY (Practicals )**

1. Preparation and pouring of media – Nutrient agar, Blood agar, Mac Conkey agar, Kligler iron agar, Robertson's cooked meat.
2. Collection and preservation of serum.
3. PCR
4. Determination of the blood group of an individual
5. Performance of common serological tests.i) Flocculation Test ii) Neutralization Test
6. Agglutination tests
7. Preparation of antigens

#### **TIU-DSE-T305:ADVANCES IN MICROBIOLOGY (THEORY)**

**TOTAL HOURS: 60 CREDITS: 4**

Course Outcome:



After successful completion, this course enables students:

- To understand the evolution of Microbial Genomes.
- To understand the brief history and development of metagenomics.
- To understand the molecular Basis of Plant-Microbe Interactions.
- To understand the Secretion system of animal Pathogens and role and formation of biofilms.
- To understand the networking in biological systems, quorum sensing in bacteria, future implications of synthetic biology with respect to bacteria and viruses.

Contents:

Unit 1 Evolution of Microbial Genomes No. of Hours: 15 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 2 Metagenomics No. of Hours: 15 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 3 Molecular Basis of Host-Microbe Interactions No. of Hours: 15 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, Biofilms: types of microorganisms, molecular aspects and significance in environment, health care, virulence and antimicrobial resistance

Unit 4 Systems and Synthetic Biology No. of Hours: 15 Networking in biological systems, Quorum sensing in bacteria, Co-ordinated regulation of bacterial virulence factors, Basics of synthesis of poliovirus in laboratory, Future implications of synthetic biology with respect to bacteria and viruses

### **TIU-DSE-L305 :ADVANCES IN MICROBIOLOGY (PRACTICAL)**

**TOTAL HOURS: 60 CREDITS: 2**

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. Case study to understand how the poliovirus genome was synthesized in the laboratory
5. Case study to understand how networking of metabolic pathways in bacteria takes place

### **SUGGESTED READING**

1. Fraser CM, Read TD and Nelson KE. Microbial Genomes, 2004, Humana Press



2. Miller RV and Day MJ. Microbial Evolution- Gene establishment, survival and exchange, 2004, ASM Press
3. Bull AT. Microbial Diversity and Bioprospecting, 2004, ASM Press
4. Sangdun C. Introduction to Systems Biology, 2007, Humana Press
5. Klipp E, Liebermeister W. Systems Biology – A Textbook, 2009, Wiley –VCH Verlag
6. Caetano-Anolles G. Evolutionary Genomics and Systems Biology, 2010, John Wiley and Sons
7. Madigan MT, Martink JM, Dunlap PV and Clark DP (2014) Brook's Biology of Microorganisms, 14th edition, Pearson-Benjamin Cummings
8. Wilson BA, Salyers AA Whitt DD and Winkler ME (2011) Bacterial Pathogenesis- A molecular Approach, 3rd edition, ASM Press,
9. Bouarab K, Brisson and Daayf F (2009) Molecular Plant-Microbe interaction CAB International 10. Voit EO (2012) A First Course in Systems Biology, 1st edition, Garland Science