GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Food Engineering & Technology
Subject Code : BE03051011
Subject Name : Basic Microbiology

w. e. f. Academic Year:	2024-25
Semester:	3
Category of the Course:	PCC

Prerequisite:	Basic knowledge of general microbiology.
Rationale:	Basic microbiology studies microorganisms in food, including those that cause spoilage and beneficial ones like probiotics. It plays a key role in fermented food production. Food safety is another critical aspect, involving microbial testing to ensure safe consumption and prevent foodborne illnesses.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Explain the fundamental concepts of microbiology, including microbial classification and structure.	U
02	Analyze the role of microorganisms in food fermentation and their applications in food industries.	N
03	Identify food spoilage microorganisms and assess their impact on food quality and safety.	A
04	Evaluate the causes, transmission, and control measures of foodborne diseases.	E
05	Perform microbial analysis of food to determine contamination levels and safety standards.	A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	TH		ESE (E)	PA (M)	PA/ (I)	PBL (I)	ESE (V)	
45	0	30	45	120	04	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment

*** Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.**

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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction to Microbiology** • History and scope of microbiology • Importance of microorganisms in food, industry, and environment • Classification and types of microorganisms	4	7
2.	**Microbial Cell Structure and Function** • Types of microorganisms associated with food • Structure of bacteria, fungi, yeasts, and viruses • Significance of spores in food microbiology	4	10
3.	**Microbial Growth and Control** • Microbial growth and reproduction, Growth curve of bacteria (lag, log, stationary, death phase) • Factors affecting microbial growth (temperature, pH, water activity) • Physical and chemical methods for microbial control	7	15
4.	**Microbiology of Food and Fermentation** • Common foodborne pathogens and spoilage microorganisms • Fermentation and role of microbes in food production • Beneficial microbes in dairy, beverages, and probiotics	7	15
5.	**Food Spoilage and Preservation** • Microbial spoilage of different food products (meat, dairy, fruits, vegetables etc.) • Principles of food preservation (thermal, chemical, biological methods etc.) • Role of preservatives and hurdle technology	5	12

6	**Foodborne Diseases and Safety** • Common foodborne pathogens (Salmonella, E. coli, Listeria, etc.) • Food intoxications vs. food infections • HACCP (Hazard Analysis Critical Control Point) and food safety regulations	5	12
7	**Microbial Analysis of Food** • Sampling and microbiological examination of food • Standard plate count, coliform test, and other microbial assays • Rapid detection methods for foodborne pathogens	5	10
8	**Industrial and Environmental Microbiology** • Role of microorganisms in biotechnology and waste treatment • Microbial enzymes in food processing • Bioremediation and probiotics	4	12
9	**Emerging Trends in Food Microbiology** • Genetically modified microorganisms (GMOs) in food • Application of metagenomics in food safety • Role of AI and automation in food microbiology	4	7
	Total	**46**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**30**	**20**	**15**	**15**	**0**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. General Microbiology by Roger Y. Stanier, John L. Ingram, Mark L. WheelsandPage R. Painter.

(Macmillan Press Ltd.)

2. Microbiology by M. J. Pelczar Jr., E.C.S Chan and Noel R Krieg. Tata McGraw-Hill
3. Food Microbiology, W C Frazier and D C Westhoff, McGraw Hill Book Company,NY

(b) Open source software and website:

1. International Journal of Food Microbiology (Elsevier)
2. Journal of Applied Microbiology (Wiley)
3. Food Microbiology (Elsevier)
4. World Health Organization (WHO) – Food Safety Reports
5. FDA & EFSA (European Food Safety Authority) Guidelines

Suggested Course Practical List:

1. Introduction to microbiology lab safety and aseptic techniques
2. Preparation of growth media for microorganism
3. Simple staining for visualization of bacteria
4. Differential staining for visualization of bacteria (Gram Staining)
5. Staining for visualization of fungi.
6. To study the effect of various factors on microbial growth.
7. To perform viable plate count in given sample by pour plate method.
8. To perform viable plate count in given sample by spread plate method.
9. Identification of enteric bacteria using biochemical tests (IMViC).
10. To study microbial growth curve.

(Minimum 8 experiments to be performed)

List of Laboratory/Learning Resources Required:

1. Laminar air flow cabinet
2. Autoclave
3. Microscope
4. Rotatory Shaker
5. Biological /BOD incubator
6. Refrigerator

- **List of suggested activities for Problem Based Learning:**

Sr. No.	Activity Name	Suggested Topics/Focus Area	Hours	Evaluation Criteria
1	Industry/Research Laboratory Visit	Visit to food processing unit, R&D center, food testing lab (e.g., dairy, bakery, oil mill, FSSAI lab)	10 h (Visit + Report)	Report with observations, flow diagram, critical control points
2	Technical Video-Based Learning	Unit operations (drying, milling), food safety (HACCP, ISO 22000), thermal processing	10 h	Report/Presentation based on learning outcomes
3	Assignment Writing (Numericals)	Mass/energy balance, drying rate, thermal conductivity, food refrigeration load	10 h	Based on assignment depth and accuracy
4	Problem Solving / Coding	Shelf life prediction models, food drying simulation (using Python/Excel), curve fitting for kinetics	10 h	Based on correctness and code output
5	Online Course (MOOCs)	NPTEL/SWAYAM course on Food Processing, Food Microbiology, Packaging Technology	10 h	Based on completion certificate and assessment
6	Complex Problem Solving	Case: Spoilage in packaged milk; identify root cause and solution	10 h	Based on root cause analysis and justification
7	Industrial Safety Videos	Food plant safety, hygiene and sanitation, machinery safety	10 h	Based on quiz or summary report
8	Discussion on Research Papers	Food fortification, novel food packaging, extrusion, nanotechnology in food	20 h (5 papers × 4 h)	Evaluation of scientific depth, summary of findings
9	Poster/Chart/PowerPoint Presentation	Food adulteration detection, cold chain, pasteurization process, millet-based products	6 h	Presentation clarity and content relevance

10	Model Development (Working/Non-working)	Mini spray dryer, solar dryer, shell & tube heat exchanger, agitator mixer	8–12 h	Internal/external demonstration and explanation
11	Industrial Exposure (2–3 Days)	Observe processes in dairy/fruit processing/bakery/oil refinery, identify inefficiencies	20 h	Critical evaluation report with suggested solutions
12	Group Discussion (Technical Trends)	Food sustainability, functional foods, AI in food industry, alternative proteins	1 h per GD	Technical input and communication skill
13	Case Study-Based Learning	Real case: Maggi ban (regulatory aspect), Patanjali contamination issue, FSSAI recall cases	10 h	Report with fact analysis and regulatory links
14	Application / Software Development	Nutrition calculator app, food label generator, moisture loss calculator	10 h	Based on functionality and usability

- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.

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