Semester: V	Course No.: 354	Course Code: -- MIE-354 (T) Course Title: Food and Dairy Microbiology
Credits: 4		Course Category: -Minor

Course Outcomes: On successful completion of the course the learner will be able to:

CO#	COGNITIVE ABILITIES	COURSE OUTCOMES
CO354.1	REMEMBERING	Recall the types of microbial flora present in various foods (e.g., fruits, vegetables, milk, and meat). List common microorganisms involved in foodborne infections and poisoning
CO354.2	UNDERSTANDING	Explain how intrinsic and extrinsic factors influence microbial growth in food. Describe the principles and methods of food preservation. Understand the role of microbes in fermented foods, probiotics, and single-cell protein production.
CO354.3	APPLYING	Perform microbiological analyses of food and milk (e.g., MPN, CFU, phosphatase test, and staining methods). Apply preservation techniques such as pasteurization, refrigeration, dehydration, and the use of preservatives.
CO354.4	ANALYZING	Examine microbial spoilage patterns in food and milk products. Analyze microbiological criteria for food safety using standards set by FSSAI and other certifications
CO354.5	EVALUATING	Assess foodborne infections and spoilage to recommend appropriate control strategies. Evaluate the effectiveness of preservation methods and microbial safety standards.

Unit No.	Unit Contents	Sessions Allotted
1	**Microbial Spoilage of Food** 1. Food as a substrate for microorganisms 2. Contamination of food from soil, water, air and during handling and processing 3. Microbial flora of food: Meats, Eggs, Fruits & Vegetables, Milk (biochemical, temperature and pathogenic types of microorganisms) 4. Factors affecting microbial growth in food: Intrinsic and Extrinsic 5. Microbial spoilage of food:	15

	A. Biochemical changes: Putrefaction, Fermentation, Rancidity B. Spoilage of fresh foods, fresh milk, canned foods	
2	**Food Infection and Poisoning** 1. Food infections: 2. Microorganism involved, source of infection, incubation period and characteristics inbrief: A. Bacterial infections: *Salmonella sp., Shigella sp, Vibrio sp., Campylobacter jejuni, Listeria monocytogenes* B. Viral infections: Rotavirus, Hepatitis A, Poliovirus C. Protozoal infections: Entamoeba 3. Food poisoning: A. Bacteria as poisoning agent: *Staphylococcus aureus, Clostridium botulinum* B. Molds as poisoning agents: *Claviceps purpurea, Aspergillus flavus*, *Fusarium moniliformis.* 4. Microbiological examination of foods A. Generalized scheme for microbiological examination of foods B. Microscopic techniques C. Culture Techniques	**15**
3	**Food Preservation** 1. General principles 2. Methods of food preservation A. Aseptic handling B. High temperature: Canning, Pasteurization of milk – confirmation by phosphatase test, Sterilization C. Low temperature: Refrigeration and freezing D. Dehydration E. Osmotic pressure F. Chemicals G. Radiations H. Microbial product-based inhibition	**15**
4	**Fermented Food and Food Standards** 1. Fermented dairy products A. Starter culture B. Fermented milks: Cultured buttermilk, Acidophilus milk, Yogurt, Kefir C. Cheese: Types, curdling, processing, ripening 2. Other fermented foods: Bread, Sauerkraut, Pickles 3. Traditional Indian fermented foods: Dahi, Idli, Dosa, Dhokla 4. Fermented beverage: Wine 5. Microbes as food: Yeast, Spirulina (SCP), Mushroom, Probiotics (including Prebiotics and Synbiotics) 6. Microbiological criteria of food safety: A. Introduction to Food Safety and Standards Act, 2006, India	**15**

	B. Microbiological standards (criteria) for foods 7. Food certification marks in India: ISI, BIS, Agmark, FPO, India Organic, FSSAI and HACCP	

Suggested Text Books:

1. Pelczar Jr, M J, Chan E C S, Krieg N R, (1986), Microbiology: An Application Based Approach, 5th edn. McGraw-Hill Book Company, NY
2. Frazier W C and Westhoff D C (1988), Food Microbiology, 4th edn. McGraw-Hill Book Company, NY
3. Prescott L, Harley J P, and Klein D A, (2008), Microbiology, 7th edn. Wm C. Brown - McGraw Hill, Dubuque, IA.
4. Indian Standards: Food Hygiene-Microbiological Criteria-Principles for Establishment and Application
5. FSSAI: Manual of methods of analysis of foods- food safety and standards authority of India, Ministry of health and family welfare, Government of India, New Delhi, 2015

MIE- 355(P): MICROBIOLOGY PRACTICALS
Paper Name: Microbiology Practicals

Credits: 04 (08 hours/week)

- On completion of this course the student will be able to:

CO#	COGNITIVE ABILITIES	COURSE OUTCOMES
CO355.1	REMEMBERING	Recall laboratory procedures for various microbiological tests (e.g., SPC, MPN, enzyme detection). Recall characteristics of microorganisms like yeasts, and coliforms.
CO355.2	UNDERSTANDING	Understand the importance of microbiological tests in assessing food, water, and milk quality.
CO355.3	APPLYING	Perform microbiological tests (e.g., SPC, MPN, acid-fast staining) on milk, and food samples. Cultivate and isolate various microorganisms for laboratory analysis
CO355.4	ANALYZING	Analyze test results (e.g., microbial load, presence of coliforms) to evaluate sample quality.
CO355.5	EVALUATING	Assess the effectiveness of various detection methods (e.g., MBRT, RRT) for determining microbial contamination.
CO355.6	CREATING	Design microbiological experiments to detect contamination or evaluate microbial quality in various samples

[A] Microbiological analysis of milk
1. Standard plate count of milk
2. Determination of microbial load by use of MBRT of raw, boiled and pasteurized milk
3. Determination of microbial load by use of RRT of raw, boiled and pasteurized milk
4. Detection of faecal coliforms
5. Detection of Acid-fast bacteria in raw milk
6. Adulteration of milk: Starch and Urea

[B] Microbiological analysis of food
7. Standard plate count of food
8. Detection of microbial enzymes: Amylase, Protease and Lipase
9. Preparation of Curd
10. Isolation and characterization of bacteria from fermented batter
11. Isolation and cultivation of yeast
12. Study of permanent slides: Amoeba, Euglena, Paramecium, Fusarium

Semester: VI Course No.: 364
Course Code: -- MIE-364 (T+P)
Course Title: Immunology and Clinical Microbiology
Credits: 4
Course Category: -Minor

CO No.	Course Outcome	Cognitive Ability (Bloom's Level)
CO364.1	Recall and describe the fundamental concepts of antigen–antibody interactions, immune disorders, and diagnostic microbiology.	**Knowledge / Remembering**
CO364.2	Explain the principles and applications of immunological and microbiological diagnostic techniques, including modern tools.	**Comprehension / Understanding**
CO364.3	Apply laboratory methods (microscopy, biochemical tests, ELISA, AST, PCR, POCT) for analysis of clinical samples.	**Application**
CO364.4	Analyze clinical data and correlate immunological and microbiological findings with pathological conditions.	**Analysis**
CO364.5	Evaluate the role of vaccines, biosensors, molecular tools, quality control and biosafety in disease diagnosis and prevention.	**Evaluation**
CO364.6	Propose diagnostic strategies or preventive measures by integrating classical and modern approaches in immunology and clinical microbiology.	**Synthesis / Creating**

Unit No.	Unit Contents	Sessions Allotted
1	**Antigen-antibody reactions and Immune disorders** 1. **Antigen–Antibody Reactions** a. Mechanism: zone phenomenon and lattice formation b. Principles, types and applications of in vitro antigen–antibody reactions: ▪ Precipitation reaction ▪ Agglutination reaction ▪ Immunofluorescence 2. **Advanced Immunological Techniques** a. Enzyme Linked Immunosorbent Assay (ELISA) b. Radio Immunoassay (RIA) c. Western Blot d. Monoclonal antibodies – production and applications 3. **Effector Mechanisms** a. Complement system: classical, alternative and lectin pathways 4. **Immune Disorders** a. Hypersensitivity and its types b. Autoimmunity and autoimmune disorders c. Immunodeficiency (congenital and acquired) d. Tumour immunology – concept of immune surveillance 5. **Applied Immunology** a. Introduction to vaccines: conventional and modern (recombinant, DNA, mRNA)	**15**
2	**Clinical Microbiology** 1. **Clinical Specimens** • Types of specimens • Methods of collection, storage and transportation 2. **Classical Diagnostic Approaches** • Microscopy: light, fluorescence, electron microscopy (intro) • Growth and biochemical characteristics of pathogens • Clinical immunology in diagnosis • Pathological changes in blood, body fluids and tissues 3. **Antimicrobial Susceptibility Testing (AST)** • Disk diffusion method (Kirby–Bauer) • Minimum inhibitory concentration (MIC) 4. **Molecular and Rapid Diagnostic Tools** • PCR and Real-time PCR • Nucleic acid probes / sequencing approaches (intro) • Point-of-care testing (POCT): rapid kits for malaria, HIV, pregnancy, COVID-19 • Biosensors in clinical diagnosis	**15**

	5. **Modern Laboratory Practices** • Role of computers in diagnostic microbiology • Quality control and biosafety in clinical laboratories • Emerging diagnostics: nanotechnology and lab-on-chip (overview)	

MIE 364 (P)
Credit: 2
4 hours/week
Total 60 hours

Course Outcomes:

CO No.	Cognitive Level (Bloom's)	Course Outcome
CO364.1	REMEMBERING	Recall principles, procedures, and applications of biochemical, microbiological, and immunological techniques.
CO364.2	UNDERSTANDING	Explain the scientific basis, clinical relevance, and interpretation of results obtained from laboratory experiments.
CO364.3	APPLYING	Perform standard laboratory techniques with accuracy and precision for analysis of biological samples.
CO364.4	ANALYSING	Interpret experimental data to identify microorganisms, detect antigens/antibodies, and evaluate biochemical/haematological parameters.
CO364.5	EVALUATING	Assess reliability and validity of experimental results and troubleshoot errors in laboratory procedures.
CO364.6	CREATING	Integrate laboratory findings to propose diagnostic or research applications in microbiology, biochemistry, and immunology.

Practicals:

1) Use of enzyme as analytical tool: Glucose estimation by GOD-POD method
2) Isolation, cultivation and identification of Gram-negative bacteria - *Escherichia coli, Enterobacter aerogenes*, *Proteus vulgaris*, *Pseudomonas aeruginosa*.
3) Study of antibiogram (using multidisc)
4) Physical and chemical analysis of urine.
5) Estimation of blood urea by diacetyl monoxime method (DAM).
6) Study of agglutination reaction: Widal test by slide agglutination and double dilution method.
7) Detection of HBsAg using ELISA test.
8) Estimation of haemoglobin by Sahli's acid hematin method.
9) Total count of erythrocytes and leucocytes.
10) Differential count of leucocytes by Field's method.