TAMIL NADU PUBLIC SERVICE COMMISSION

SYLLABUS

Microbiology

(PG standard)

CODE: 459

Unit I:
Microbial Morphology

Cell ultra-structure - prokaryotes and eukaryotes; Cell wall- structure, chemical composition, synthesis and inhibition; cell membrane, cytoplasmic inclusions, cytoskeleton, cell appendages- capsule, flagella, pili; sporulation - structure of endospore, composition and function of spore constituents, induction and germination; Importance of yeasts and moulds, viruses and phages in dairy foods.

Unit II:
Microbial Growth and Physiology

Bacterial growth: Growth phases and kinetics; synchronous, continuous, and associative growth; factors affecting bacterial growth - Intrinsic factors and extrinsic factors; Growth measurement; sporulation; Bacterial nutrition; Nutrient media; Nutritional groups of bacteria; Role of growth factors; Transport of nutrients - active and passive transport; Energy metabolism: Electron transport chain, fermentation, respiration and photosynthesis.

Unit III:
Microbial Genetics

Macromolecules: DNA, RNA and their structure, types, organization, function and properties of macromolecules, DNA replication; Regulation and Gene Expression: Gene Expression and its regulation in Prokaryotes- Transcription, Genetic Code, Translation, Negative and Positive regulation in gene expression, Mutations - Spontaneous and Induced, Type of mutations, Mutagenic agents – physical and chemical; Plasmids and gene transfer systems: Plasmids and their properties, transposable elements, bacterial recombination, transformation, transduction and conjugation.

Unit IV:
Microbiology of Fluid Milk

Common microbes in milk and their significance, Microflora of mastitis milk, Sources of microbial contamination of raw milk during collection, transport and storage; Clean milk production, natural antimicrobial systems in raw milk; Microbial changes in raw milk during long storage, Microbiological grading of raw milk; Microbiological aspects of processing techniques - bactofugation, thermization, pasteurization, sterilization, boiling, UHT and non-thermal processes including membrane filtration; Role of psychrotrophic, mesophillic, thermophilic and thermoduric bacteria in spoilage of processed milks, their sources and prevention; Heat induced damage in bacteria and role of resuscitation in recovery of injured microbial cells.

Unit V:
Microbiology of Dairy Products

Microbiological quality of dairy products - fat rich, frozen, concentrated, dried milks, fermented, infant and indigenous dairy products; Legal standards; Sources of contamination and factors affecting microbial quality of these products during processing, storage and distribution; Shelf life of Dairy Products; Microbiological defects associated with these products and their control; Food poisoning- Food intoxications, Food infections and toxi-infections, pathogens associated with fluid milks, dairy products and their public health significance; Sources of pathogens and their prevention.

Unit VI:
Applications of Biotechnology in Dairy Industry

Recombinant DNA technology; Restriction enzymes, plasmid vectors, PCR and real time PCR; Genetic improvement of lactic starters to enhance their technological functions for industrial applications - acid, flavour, EPS, probiotic functions; Metabolic engineering of lactic acid bacteria; Production of recombinant dairy/ food enzymes/ proteins -chymosin, lactoferrin, lysozyme, lipases, proteases, immunoglobulins etc.; GMOs, GM foods and their safety from public health point of view; Probiotics, Prebiotics and synbiotics - concepts; Probiotic based functional dairy foods/ health foods and nutraceuticals; Nutrigenomics.

Unit VII:
Dairy Starter Cultures

Classification of starters; propagation and preservation of starter cultures (liquid, freeze drying and other methods); factors affecting propagation of starter cultures. Commercial starter preparations: concentrated and super concentrated starters; Production systems for bulk cultures: Lewis, Jones and Tetra-pack systems; growth media: nutritional requirements of lactic acid bacteria, growth media formulations; PIM/PRM, pH control during culturing; preservation of bulk starter cultures- frozen and freeze dried, spray dried cultures; direct vat starter cultures.Growth inhibition of lactic acid bacteria by antibiotics, bacteriocins, bacteriophages, cleaning and sanitizing agents and naturally occurring antimicrobial systems in raw milk; Examination of purity and activity of starter cultures.

Unit VIII:
Environmental Microbiology

Environmentally transmitted microbial pathogens (*Salmonella, E. coli, Campylobacter, Yersinia* etc.) and viruses (enteric and respiratory); indicator microorganisms - total and faecal coliforms, faecal streptococci, bacteriophage etc; Biofouling and biofilms; microbial toxicants and bio-organic pollutants; Waste water treatment: physical; biological unit operations- aerobic and anaerobic cycles; kinetics of biological growth, application of kinetics to treatment systems, aerobic waste treatment, anaerobic waste treatment; tertiary treatment - waste water utilization and disposal. Solid wastes management; environment laws.

Unit IX:
Microbial Food Safety and Quality Assurance

Principles of quality and safety functions in dairy processing unit; FSSAI - regulations and guidelines; ISO standards; principles of QMS and HACCP, SAFE, GMP, SSOP, FSMS, personnel hygiene and food handling in dairy industry; Bio-safety concepts - Sampling plan as per International council for microbiological standards for foods (ICMSF); Guidelines and specifications for different dairy foods as recommended by ICMSF, CODEX.

Unit X:
Analytical Techniques in Microbiology

Enumeration of composite microflorain milk and dairy products - aerobic & anaerobic; Conventional detection methods for indicator organisms – Standard plate count (SPC), coliforms, *E. coli*, yeast and mould (YMC), spore; enterobacteriaceae; Faecal streptococci; Dye reduction tests; Rapid techniques like D-count, Petrifilm, ATP bioluminance including VIDAS, SPR, RT-PCR and commercial kits, for monitoring safety indicators; Bio-sensors and micro-techniques for rapid monitoring of contaminants-antibiotics, pesticides, heavy metal, aflatoxin; Microscopy - Staining: simple, differential and special staining; Spectrophotometry, ELISA, protein and enzyme assays, microbiological assay, and microbial receptor assay; Quality requirements of water for dairy plant operations. Characterization of dairy and food industrial waste waters including BOD,COD; Detection of residual antibiotics/pesticides in waste water samples.