

# **TAMIL NADU PUBLIC SERVICE COMMISSION**

## **SYLLABUS**

### **Food Technology/Food Processing/Food Process Engineering**

**(UG Degree standard)**

**Code : 455**

#### **UNIT I: PRINCIPLES OF FOOD TECHNOLOGY**

Introduction to food technology- Causes of food spoilage, sources of microbial contamination of foods, food borne illnesses, water activity and its relation to spoilage of foods - Spoilage of processed products and their detection- Principles and methods of food preservation-Methods of food preservation such as heat processing, pasteurization, canning, dehydration, freezing, freeze drying, fermentation, microwave, irradiation and chemical additives-Aseptic preservation, hurdle technology, hydrostatic pressure technology and microwave processing- Use of non-thermal technologies (microfiltration, bacteriofugation, ultra high voltage electric fields, pulse electric fields, high pressure processing, irradiation, thermosonication), alternate-thermal technologies (ohmic heating, dielectric heating, infrared and induction heating).

#### **UNIT II: HEAT TRANSFER, REFRIGERATION AND COLD CHAIN**

Basic transfer processes – conduction – Fourier’s fundamental equation – thermal conductivity and thermal resistance - linear heat flow – heat transfer through homogenous wall, composite walls, radial heat flow through cylinders and spheres – critical thickness of insulation -extended surfaces – Newton Rikhman’s law – film coefficient of heat transfer - convection – free and forced convection - Radiation heat transfer – concept of black and grey body - monochromatic total emissive power – Kirchoff’s law – Planck’s law – Stefan Boltzman’s law – emissivity - absorptivity, reflectivity and transmissivity.

Refrigeration – principles - refrigeration effect – coefficient of performance – units of refrigeration - vapour compression system- different types- Refrigeration components – compressor, condensers, evaporators, expansion device – types, construction, principle and working- Refrigerants – properties – classification, nomenclature – comparison and advantages – alternate refrigerants – Azeotropes - vapour absorption system- Electrolux refrigerator –construction and principles -Cooling load estimation.

#### **UNIT III: FOOD GRAIN PROCESSING**

Structure, composition of different grains like wheat, rice, pulses, oil seeds, barley, corn and millets. Milling of wheat. Wheat flour/semolina and its use in traditional/non-traditional foods like breads, biscuits, cakes, doughnuts,

buns, pasta goods, extruded, confectionary products, breakfast and snack foods. Milling and parboiling of rice; by-products of rice milling and their utilization - processed products from rice. Pearling, malting, brewing and preparation of malted milk feeds from barley. Wet and dry milling of corn, manufacture of corn flakes, corn syrup, corn starch, corn steep liquor and germ oil.

Milling and processing of pulses-Use in traditional products, protein concentrates and isolates. Oilseed processing. Oil extraction and its processing - oil refining. Production, packaging and storage of vanaspati, peanut butter, protein concentrates, isolates and their use in high protein foods. Millets: nutritional significance, structure and processing.

#### **UNIT IV: FRUITS AND VEGETABLE PROCESSING**

Post harvest handling and storage of fresh fruits and vegetables- Preparation of fruits and vegetables for processing- Minimally processed products. Cold chain logistic- ZECC (Zero Energy Cool Chambers), CCSR (Charcoal cool storage Rooms) Thermal processing and process time evaluation for canned products, process optimization, aseptic canning, methods for canning of different fruits, and vegetables; Dehydration and associated quality changes during drying and storage of dehydrated products. Solar drying. Intermediate moisture foods. Preparation and utilization of fruits and vegetables juices in non-fermented/ fermented/ aerated beverages, health drinks. Membrane technology-Processing methods of frozen fruits and vegetables, IQF products, packaging, storage and thawing.-Beverages, tea, cocoa and coffee processing - Spice Processing viz. cleaning, grading, drying, grinding, packaging and storage - Oleoresins and essential oils.

#### **UNIT V: TECHNOLOGY OF MILK AND MILK PRODUCTS**

Milk and Milk production in India. Importance of milk processing plants. Dairy plant operations viz. receiving, separation, clarification, pasteurization, standardization, homogenization, sterilization, storage, transport and distribution of milk. UHT, toned, humanized, fortified, reconstituted and flavoured milks. Technology of fermented milks. Milk products processing viz. cream, butter, ghee, cheese, condensed milk, evaporated milk, whole and skimmed milk powder, ice-cream, butter, khoa, channa, paneer and similar products. Judging and grading of milk products. Cheese spreads by spray and roller drying techniques. EMC (Enzyme modified cheese), Enzymes in dairy processing. Insanitization viz. selection and use of dairy cleaner and sanitizer. In plant cleaning system. Scope and functioning of milk supply schemes and various national and international organizations. Specifications and standards in milk processing industry. Dairy plant sanitation and waste disposal.

## **UNIT VI: TECHNOLOGY OF MEAT / FISH / POULTRY PRODUCTS**

Scope of meat, fish and poultry processing industry in India. Chemistry and microscopic structure of meat tissue. Ante mortem inspection. Slaughter and dressing of various animals and poultry birds. Post mortem examination. Rigor mortis. Retail and wholesale cuts. Factors affecting meat quality. Curing, smoking, freezing, canning and dehydration of meat, poultry and their products. Sausage making Meat tenderization and role of enzymes in meat processing. Utilization of by-products. Structure and composition of egg and factors effecting quality. Quality measurement. Preservation of eggs using oil coating, refrigeration, thermo stabilization and antibiotics. Packing, storage and transportation of eggs. Technology of egg products viz. egg powder, albumen, flakes and calcium tablets. Processing and preservation of fish and its products. Handling, canning, smoking and freezing of fresh water fish and its products.

## **UNIT VII: FOOD PROCESS EQUIPMENT DESIGN**

Materials for fabrication, mechanical properties, ductility, hardness, corrosion, protective coatings, corrosion prevention linings equipment, choice of materials, material codes; Design considerations: Stresses created due to static and dynamic loads, combined stresses, design stresses and theories of failure, safety factor, temperature effects, radiation effects, effects of fabrication method, economic considerations.-Storage vessels - Operating conditions, design conditions - Design of shell and its component, stresses from local load and thermal gradient, mountings and accessories - Design of fermenter vessel and design problems - Hazards and safety considerations - Design of agitators and separators.

Heat exchangers - Design of shell and tube heat exchanger - plate heat exchanger - scraped surface heat exchanger - tubular heat exchanger - sterilizer and retort - single effect and multiple effect evaporators- rising film and falling film evaporators. Design of crystallizer, centrifugal separator, freezing equipment- Types of freezers – Design of ice-ream freezers and refrigerated display system - Design of tray dryer, tunnel dryer, vacuum dryer, spray dryer and freeze dryer-Design of screw conveyor, bucket elevator and pneumatic conveyor - Design of extruders - Cold and hot extruder design, single and twin screw extruder.

## **UNIT VIII: FOOD GRAIN STORAGE**

Importance of scientific storage systems – production and marketing of grain – storage scenario at warehouses - traditional and modern storages - Grain bulk ecosystem – biotic and abiotic variables and their interaction – major stored product insects – characteristics – chemical, enzymatic, biological and mechanical spoilages – grain deterioration and quality loss -

Direct damages, indirect damages, causes of spoilage in storage (moisture, temperature, humidity, respiration loss, heat of respiration, sprouting) - destructive agents (rodents, birds, insects, etc.), sources of infestation and control.

Storage of grain - respiration of grain, moisture and temperature changes in stored grain - conditioning of environment inside storage through ventilation - Traditional storage structures, improved storage structures, modern storage structures - Farm silos - Horizontal silos, tower silos, pit silos, trench silos, size and capacity of silos - Design of storage structures - Functional and structural design of grain storage structures, pressure theories, pressure distribution in the bin, grain storage loads, pressure and capacities, warehouse and silos-Aeration and stored grain management - purposes of aeration, aeration theory, aeration system - design and operation - Fumigation - principles - properties and applications of fumigants.

## **UNIT IX: FOOD PACKAGING TECHNOLOGY**

Factors affecting the choice of packaging materials - Interactions of spoilage agents with environmental factors as water, oxygen, light, pH, etc. - Functions of Packaging - Packaging requirement for raw and processed foods, and their selection of packaging materials - Packaging of foods, requirement, importance and scope, environmental considerations - Disposal and recycle of packaging waste. Plastic packaging, different types of polymers used in food packaging and their barrier properties - Paper and paper board packaging, manufacture process, modification of barrier properties and characteristics of paper/ boards - Corrugated fiberboard boxes, Relative advantages and disadvantages of different packaging materials - Testing methods for flexible materials, Tests for paper, thickness, bursting strength, breaking length, stiffness, tear resistance.

Metal cans, manufacture of two piece and three piece cans- Coatings - Glass containers, types of glass used in food packaging, manufacture of glass and glass containers, closures for glass containers - Testing methods for rigid materials and semi rigid materials, Glass containers, visual defects, colour, dimensions, impact strength, etc. Metal containers, pressure test, product compatibility, etc. Machines for filling of liquid and wet products - to predetermined level and predetermined volume- filling of dry solids- by count- volume-weight - methods of wrapping and bagging - Form, fill and seal machines - various forms of packaging - Cartoning systems - Printing and Labelling - Container handling. CAS and MAP, shrink and cling packaging, vacuum and gas packaging - Aseptic packaging, Active packaging, Smart packaging, intelligent packaging - Retort packaging, principles, application.

## **UNIT X: FOOD QUALITY MANAGEMENT**

Objectives, importance and functions of quality control. Quality systems and tools used for quality assurance including control charts, acceptance and auditing inspections, critical control points, reliability, safety, recall and liability. The principles and practices of food plant sanitation. Food and hygiene regulations. Environment and waste management. Total quality management, good management practices, HACCP and codex in food. International and National food laws. US-FDA/ISO-9000 and FSSAI. Food adulteration, food safety. Sensory evaluation, panel screening, selection methods. Sensory and instrumental analysis quality control. Quality control of food at all stages and for packaging materials. Non-destructive food quality evaluation methods.