

# **SYLLABUS FOR COMBINED TECHNICAL EXAM**

## **FOOD TECHNOLOGY (DEGREE/POST GRADUATE)**

### **PAPER I**

#### **1. INTRODUCTION TO FOOD PRESERVATION**

History of Food Preservation, canning Industry, sanitary or open top cans. Principles of food preservation. Methods of preservation – Asepsis; Preservation by high temperature - pasteurization, sterilization, aseptic canning: details of process, hot pack or hot fill; Preservation by low temperature – Cellar storage, refrigeration, or chilling, freezing; Preservation by chemicals – preservatives definition and types; Preservation by drying, filtration, carbonation, sugar, fermentation, salt, oil & spices, antibiotics, irradiation – concept and application. Canning & Bottling of Fruits & Vegetables – Principle & process of canning, causes and spoilage of canned foods. Drying, Dehydration and concentration – definition, factors affecting drying of food products, advantages of dehydration over sun drying. Drying/dehydration techniques: Natural & Artificial Drying – definition, concept, method, types, applications; Sun, solar drying, shade drying, osmotic dehydration. Common dryers used for dehydration – air convection driers (Kiln dryer, cabinet dryer, tunnel/continuous belt driers, belt though drier, air lift drier, fluidized bed driers, spray driers); drum or roller driers; vacuum driers (vacuum shelf driers, continuous vacuum belt driers, freeze drying). Differences between conventional and freeze drying; Atmospheric drying of foams; Process flow of drying/dehydration of fruits & vegetables; Treatment before drying- concept and method; Blanching & sulphuring. Food concentration – definition, methods, and application. Methods of concentration – Solar concentration, open kettles, flash evaporators, thin film evaporators, vacuum evaporators, freeze concentration, ultrafiltration & reverse osmosis/hyperfiltration. Freezing – History, principles, concepts, methods; Sharp freezing/slow freezing, quick freezing, cryogenic freezing, dehydro-freezing, freeze drying; Direct and indirect contact quick freezing: advantages & disadvantages, air blast freezing: fluidized bed freezing, plate freezing; Changes during freezing and storage- Principles and types; Physical changes: Recrystallization, sublimation, and denaturation; and chemical changes; Process flow – freezing of beans, cauliflower, peas, carrot, guava, orange.

#### **2. FOOD CHEMISTRY**

Enzymes in the food industry – definition, important properties of enzymes, enzymes used in food industry: type of enzyme, source, application, and general functions of Amylase, proteases, lipases, phytase, lipoxygenase and pectic enzymes. Immobilized enzymes: definition and advantages. Browning reactions – definition, types, principle. Enzymatic browning & non-enzymatic browning (Maillard reaction, Caramelization). Fermentation - definition, process, types, microorganisms involved, application in food, general biochemical reaction - Acetic fermentation, Lactic fermentation, alcoholic fermentation. Water activity & growth – principle,  $A_w$  of food,  $A_w$  and microbial growth. Physico-chemical properties of foods – General physical properties of solutions (vapour pressure, boiling point, freezing point, osmotic pressure, viscosity, surface & interfacial tensions, specific gravity). Hydrogen-ion concentration – definition and general principle. Denaturation and coagulation of proteins – desirable and undesirable effects. Colloidal system – Definition, general principle, types; Diphasic colloidal dispersion in foods; SOLS – definition, characteristics; Emulsifying agent, emulsifiers: application in food industry; Reversible & irreversible colloids; Hydrophilic & hydrophobic colloids; Effects of electrolyte on hydrophobic and hydrophilic colloids; Protective and denaturing colloids; GELS: definition, swelling of gels, effect of added substances on gel

swelling, syneresis. Food colours, additives, brominated vegetable oil (B.V.O) and flavours. Food colours – Natural colours (Chlorophylls, carotenoids, anthocyanin, flavonoids, anthoxanthins, tannins, quinones & xanthenes, betalains) & synthetic colours (approved coal tar dyes); Banned colours. Food additives – Functions & uses, classifications; Antioxidants, preservatives, sequestrants, surface active agents, colouring agents, buffers/acids/alkalies, stabilizers/thickeners, nutrient supplements, non-nutritive/special dietary sweeteners, flavouring agents/flavour enhancers, anticaking agents/humectants, bleaching/maturing agents/flour improvers/starch modifiers, other additives. Brominated vegetable oil (B.V.O). Food Flavours – Types of flavour, flavour compounds (flavonoids, terpenoids, sulphur compounds, other volatile components); Flavour additives

### **3. FOOD MICROBIOLOGY & SPOILAGE**

Types of microorganisms in various foods – Raw and ready to eat meat products; raw and pasteurized milk; shell egg and liquid egg; fish and shellfish; vegetables, fruits & nuts; cereals, starches, and gums; canned foods; sugars & confectioneries; soft drinks, fruits & vegetable drinks; mayonnaise & salad dressings; spices & condiments. Water activity & growth – principle,  $A_w$  of food  $A_w$  & microbial growth. pH & growth – principle, pH of Food, pH & microbial growth. Redox potential, oxygen & growth – principle, redox potential in food, redox potential & microbial growth. Food spoilage – Types and factors responsible for food spoilage; Microbial spoilage – most important bacteria, yeast, moulds; Enzymatic spoilage; Spoilage by insects parasites & rodents; Spoilage due to characteristics & storage condition of food (composition, acidity, moisture, temperature, oxygen, light, duration); Mechanical damage. Classification of foods according to ease of spoilage.

### **4. FOOD PROCESSING ENGINEERING**

Unit operation in food engineering, units and dimensions, mass and energy balance, fluid flow - fluid statics, fluid dynamics, measurement of rate of flow of fluids, process heat transfer, modes of heat transfer - conduction, convection and radiation, overall heat transfer, Fourier's law, heat exchange equipments, natural convection, forced convection. Thermal processing: evaporation - introduction, different evaporator equipments; drying – introduction, equipment; blanching; pasteurization; sterilization; distillation – introduction, theory, general equipment for distillation; and crystallization – introduction, theory of crystallization, equipment. Mechanical Separation: filtration – introduction, mechanisms of filtration, factors influencing filtration, filter media and filter aids, equipments; Ultra filtration/reverse osmosis; centrifugation – introduction, theories of centrifugation, classification of centrifuges, equipment. Mechanical handling: conveying and elevation – introduction, equipment; size reduction – introduction, mechanisms of size reduction, modes of stress applied in size reduction, equipment; size separation – introduction, equipment for size separation; Mixing – introduction, equipment for mixing solids, mixing vessels for liquids, mixing devices, equipment, mixing of semi solids, equipment.

### **5. FOOD PACKAGING**

Introduction to food packaging & definition. Classification of packaging material and properties. Types and properties- tin cans, electrolytic tinning, steel base, tin coating, glass, plastics and films, paper, laminations. Modern packaging materials & forms – glass containers, metal cans, composite containers, aerosole containers, rigid plastic packages, solid & corrugated board containers, wooden boxes & crates, semi rigid packaging materials and packaged forms, flexible packaging materials. Plastic - Thermoplastic & Thermosets: Definition & properties. Application of plastic packaging in food industry; Advantages of plastics for packaging; Hazards of Plastic packaging. Packages of Radiation stabilized foods –

Rigid Containers: Base metal, can coating, sealing components, enamels, Container shape; Flexible Containers: influence of radiation on plastic packaging, general method for establishing radiation stabilization. Radiation – kinds & measurement of ionizing radiation, uses & mode of action. Packages of dehydrated products – Orientation, metallization, co-extrusion of multilayer films, stretched blow moulding, thermo form fill sealing. Packaged forms and techniques: Aseptic packaging, retortable containers modified & controlled atmosphere packaging, skin/shrink/cling film packaging, micro ovenable containers, other package forms and components of plastics.

## **6. FOOD SAFETY, QUALITY, EVALUATION AND ANALYSIS.**

Evaluation of foods – Definition & types; Subjective evaluation: paired comparison, triangle test, duo trio test, ranking, scoring, flavour profile method; Objective evaluation – texture measurement, flavour measurements, food adulteration, standards and labelling: definition. PFA Act and rules in India: Basic history and objective; adulterated food article; Standards under PFA Act and rules, food adulterants and simple tests to detect food adulteration; quality enforcement, prevention of food adulteration tips to consumers and general food laws. Food Standards – Definition, principle, and types. Market standards, end user standards, health ministry standards. Food Labelling – Objective, type of standards (Part I, Part II, Part III). Examples of labelling system – FPO labelling, ISI mark, FPO marking, Agmark Marking etc. Quality – Intrinsic and acquired; Quality Centres – Types & Objectives; PFA, AGMARK, FSSAI, FAI, BIS, consumer protection act, Export inspection council. Hazard analysis critical control point - principles, development and application of HACCP plan. Global and domestic Food Safety Standards: ISO 22000:2005-food safety management system, ISO 9001:2000 – quality management system. Quality characteristics of fruits & vegetables for processing – definition, types, characteristics; Sensory characteristics, Hidden characteristics & Quantitative characteristics. Factors affecting fruit & vegetable quality: environmental factors, cultural factors, post-harvest factors. Analysis of food products – Types, reagents, procedure, calculation; Determination of TSS; determination of Acids (Citric & Acetic acids); determination of Ascorbic acids by titration; estimation of sugars by Shaffer-Somogyi micro method; estimation of starch; determination of pigments; determination of total pectin as calcium pectates; total minerals by dry ashing; non- enzymatic browning.

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## **FOOD TECHNOLOGY (DEGREE/POST GRADUATE)**

### **PAPER II**

#### **1. CEREALS, MILLETS & LEGUMES PRODUCT, PROCESS & TECHNOLOGY**

**RICE** – Structure & composition of rice grain, nutrients, processing techniques, products & by-products; Basic methods, operations, machines & products of rice processing. Huller operations – Underrunner disc huller, rubber roller disc huller, husk separation, whitening & polishing, glazing. Definition, principles & processes of parboiling – CFTRI hot soaking process, chromate soaking process, advantages & disadvantages of parboiling. Non waxy rice; major processed rice products: pre-cooked and quick-cooking rice, noodles, instant rice, ready-to-eat cereals, flaked rice, puffed rice, popped rice, rice cakes, fermented rice cakes & puddings. Rice Bran – Utilization of rice bran.

**WHEAT** – Structure & composition of wheat grain, processing techniques, products & by-products; Basic methods, operations, machines & products of wheat processing. Wheat milling – selection & blending, cleaning, tempering, conditioning. Milling operations – breaking, sifting, purifying, reduction, scratching, entoleter, air classification, conveying system; Gluten & its Characteristics; Flour treatments; factors affecting gluten formation & development. Products – wheat popcorn, shredded products, granular products, gold fingers, vermicelli, papad, biscuits, cookies & confectionery products.

**MILLETS** – Types, uses & composition; Pearl millet, finger millet, proso millet. Malting – General method. Milling – Traditional methods, improved methods. Convenience food products – instant food mixes, dehydrated foods, breakfast foods, snack foods, baked foods, infant & weaning foods.

**MAIZE** – Structure & composition of Maize, varieties, processing techniques, products & by-products; Basic methods, operations, machines & products of maize processing. Maize shelling, milling. Maize products – whole maize meal, degermed maize meal, puffed corn, corn flakes, corn starch & syrups.

**LEGUMES** – Nutrient composition, processing techniques, products & by-products; Basic methods, operations, machines & products of legume processing. Decortication & milling: Wet process, dry process. Products – papad, cereal-pulse mixes, quick cooking pulses, puffing, protein concentrates & isolates. Antinutritional factors & methods of its elimination.

#### **2. NUTS, OILSEEDS, FATS & OILS PRODUCT, PROCESS & TECHNOLOGY**

**NUTS & OIL SEEDS** – Nutrient composition of commercial crops: coconut, groundnut, oil palm. Processes of edible cake & oil – Mechanical pressing, screw pressing, prepress solvent extraction, direct solvent extraction. Soya bean products and processing techniques; Soy protein concentrates, protein isolates, soya milk, textured vegetable protein & meat extenders. Extruded products, general extrusion technology, advantages of extrusion cooking.

**FATS & OILS** – Nutritional importance, functions of oils & fats in foods. General processing of oils & fats – Rendering, pressing, solvent extraction & refining. Process flow for extraction of oil from soyabean, groundnut meal, sesame, coconut, cottonseed, sunflower seed. Types of oil from animal and its uses in food products. Hydrogenation & winterization, homogenization & emulsification. Preparation of peanut butter.

### **3. FRUITS & VEGETABLES PRODUCT, PROCESS & TECHNOLOGY**

General classification, composition, nutritional contribution, preservation & processing techniques. Methods, processes, machinery & ingredients involved – Dehydration of fruits & vegetables, canning, pickling, freeze drying, frozen foods, juice, nectar, squash, cordials, crush, syrup, RTS, fruit juice concentrates, fruit juice powder, carbonated beverages, jam, jelly, marmalades, preserve, candied & crystalized fruits & vegetables, tomato sauce/ketchup, potato/tapioca (chips & flour), ginger/garlic (paste & powder), fruit pulp. Vinegar – Types, steps involved in vinegar production, preparation of vinegar (Slow process, Orleans slow process, quick process). Storage of fruits & vegetables.

### **4. BEVERAGES PRODUCT, PROCESS & TECHNOLOGY**

COFFEE – Common varieties, chemical composition & type of product & processing. Wet & dry processing. Coffee making – vacuum coffee, drip coffee, percolator coffee, steeped coffee, espresso coffee, iced coffee & soluble coffee.

TEA - Common varieties, chemical composition & type of product & processing. Processing of black tea, green tea & oolong tea.

COCOA – Processing techniques and product. Chocolate & cocoa beverages.

SOFT DRINKS – Processing, ingredients & types

ALCOHOLIC BEVERAGES – Types, fermentation & processing methods. Wine, beer, distilled spirits, traditional eastern alcoholic beverages.

### **5. CONDIMENTS, SPICES, & MISCELLANEOUS FOODS PRODUCT, PROCESS & TECHNOLOGY**

Popular condiments & Spices in India – Chief Constituent (CC), application in food industries, processing, and preservation methods.

Sugar – Composition of sugar & sugar cane, manufacturing methods of raw cane sugar, caramelization, hydrolysis, crystallization, crystalline & non-crystalline sugar, fondant, amorphous non-crystalline confectionery. Types of sugar & its processing– refined sugar, white sugar. Gur (Jaggery) – Composition & processing techniques.

Confectionery & chocolate products – Ingredients, starch & its derivatives, confectionery fats, colours, flavours, gums, pectin & gelatin in confectionery. Chocolate ingredients & processing methods.

By-products of sugar cane – Types, composition & application in food industry. Molasses, syrups. Honey & Cocoa butter– composition & processing.

### **6. MILK & MILK PRODUCTS PRODUCT, PROCESS & TECHNOLOGY**

Milk & Milk Products – Nutritional composition, methods of sterilization (clarification & pasteurization), homogenization, preservation of milk. Asepsis, removal of microorganisms. Preservation by heat, preservation by low temperature, use of preservatives, use of irradiations, use of enzymes in milk products, membrane technology, ultra filtration, UHT treatment of mil. Milk products and processing techniques – Curd, buttermilk, butter, ghee, evaporated milk, condensed milk, toned milk, dry milk, cheese (paneer, cottage cheese, cream cheese & other cheeses). Traditional milk preparations – Khoa, gulab jamun, rasgolla, basundhi&srikhand. Milk beverages & other products – Skim & Low-fat milks, concentrated milks, canned & frozen whole milks, soft curd milk, low sodium milk, malted milk, cultured milk, flavoured milk, milk drinks, fermented milk.

### **7. EGGS, MEAT, POULTRY & FISH PRODUCT, PROCESS & TECHNOLOGY**

EGGS – Structure, nutrient composition, changes during storage. Methods of preservation of shell eggs – Wet immersion methods, lime water method, water glass method, dry methods,

thermos-stabilization method & cold storage or refrigeration. Process for manufacturing of egg powder. Properties of egg protein in food preparations.

MEAT & POULTRY – Types, nutritional composition, methods of slaughtering. Preservation & processing methods – Refrigeration, freezing, thermal processing, drying, freeze drying, curing, chemical preservation, ionizing radiation, pickling.

FISH – Types, Nutritional composition, preservation & processing techniques.

## **8. BAKERY & NOVEL FOOD PRODUCTS, PROCESS & TECHNOLOGY**

Baking – Types of flour, application of ingredients & its effect (leavening, shortening, sugar, eggs, milk, water salt, flavour, yeast, baking powder), equipment for measuring dough quality. Types of baking ovens. Processing techniques for various bakery products – Biscuits, bread, cake, cookies, sponge cake, pastry, pizza. Icing & fillings – Preparation methods & types of icings & fillings.

NOVEL FOOD PRODUCTS - Mushroom processing (Canning, dehydration, steeping preservation, freezing), Spirulina production and its application, Leaf Protein Concentrates (LPC) production processes. Processing techniques for By-products of oil seeds – soyabean meal, groundnut meal, cotton-seed meal, sesame meal, coconut meal, sunflower seed meal, rapeseed meal, protein isolates. Food analogue – Textured vegetable proteins, spun vegetable protein, meat analogues, dairy analogues.