REVISED CURRICULUM AND SYLLABI

(With effect from the academic year 2017 – 2018 onwards)

M.Sc Food Science and Technology

DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY
PONDICHERRY UNIVERSITY
R. Venaktaraman Nagar, Kalapet
Puducherry – 605 014
INDIA
PONDICHERY UNIVERSITY

M.Sc Food Science and Technology

REGULATIONS

The course prepares students with a broad knowledge of the biological, physical and engineering sciences to develop new food products, design innovative processing technologies, improve food quality and nutritive value, enhance the safety of foods and ensure the wholesomeness of our food supply. Food Science majors apply the principles learned in the basic sciences such as food chemistry, biochemistry, microbiology, food engineering and nutrition to provide consumers with safe, wholesome and attractive food products that contribute to their health and well-being. The objective of the curriculum is to prepare Food Scientists for career opportunities in food and allied industries.

Programme of study:

M.Sc Food Science and Technology programme is interdisciplinary in nature comprising of microbiology, biotechnology, biochemistry, Food Science and Technology and nutrition, engineering etc. The course provide promising career opportunities in areas such as food product/process design, technical service, research and development, quality assurance, food safety, food law, regulatory oversight, technological innovation, marketing, corporate sales, sensory evaluation, and operations management. The students admitted in the programme shall be required to take up dissertation work on any emerging areas of food technology which demand attention.

Eligibility for Admission

B.Sc/B.Tech Degree in Agriculture / Agricultural Engineering/ Food Technology/ Home Science/ Food Science and Nutrition/ Food Science and Quality Control/ Clinical Nutrition/ Biochemistry/Biotechnology/ Microbiology. Mathematics at +1/+2 / P.U.C. level is compulsory (exempted for students with B.Sc/ B.Tech Food Science and Technology / Food Technology)
### CURRICULUM – M.Sc FOOD SCIENCE AND TECHNOLOGY

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# PONDICHERRY UNIVERSITY

## Department of Food Science and Technology

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Unit I
8 HOURS

Unit II
9 HOURS
Amino acids: classification, physical properties, chemical reaction, synthesis of amino acids in food fortification. Peptides: Nomenclature, physical and sensorial properties, individual peptides, Proteins: conformation, physical properties, chemical and enzyme catalyzed reactions in protein processing.

Unit III
9 HOURS
Monosaccharides: structure and nomenclature, conformation, physical and sensory properties, chemical reaction and derivates. Oligosaccharides: Structure and nomenclature, properties and reaction. Polysaccharides: classification and structure, conformation, properties, Individual Polysaccharide, enzyme degradation of polysaccharides, analysis of Polysaccharides.

Unit IV
10 HOURS

Unit V
9 HOURS

Text books and Reference materials
UNIT I  
8 HOURS

History and development of Microbiology-Importance and significance of microorganisms in food science. Factors affecting the growth of microorganisms in food – Intrinsic and Extrinsic parameters

UNIT II  
10 HOURS

Determination of microorganisms and their products in food: Sampling, sample collection, transport and storage, sample preparation for analysis. Microscopic and culture dependent methods- Direct microscopic observation, culture, enumeration and isolation methods; Chemical and Physical methods-Chemical, immunological and nucleic acid based methods; Culture independent techniques – PCR Based, DGGE, Metagenomics, etc.; Analytical methods for microbial metabolites- microbial toxins and metabolites.

UNIT III  
9 HOURS

Protection and preservation of Foods: Chemical, Modified atmosphere, Radiation in foods from the microbiological angle. Indicators of water and food safety and quality: Microbiological criteria of foods and their Significance. The HACCP and ISO systems for food safety.

UNIT IV  
8 HOURS

Food spoilage: characteristic features, dynamics and significance of spoilage of different groups of foods - Cereal and cereal products, vegetables and fruits, meat poultry and sea foods, milk and milk products, packed and canned foods.

UNIT V  
10 HOURS

Text books and reference materials
UNIT I  8 HOURS

Principles of fresh food storage: Nature of harvested crop, plant, animal; product storage; effect of cold storage and quality – storage of grains.

UNIT II  9 HOURS

Processing and preservation by heat: Blanching, pasteurization, sterilization and UHT processing, canning, extrusion cooking, dielectric heating, microwave heating, baking, roasting and frying. Retort processing of Ready to eat (RTE) products. Newer methods of thermal processing – batch and continuous.

UNIT III  9 HOURS

Processing and preservation by low Temperature: refrigeration, freezing, CA, MA, and dehydro-freezing. Food irradiation, history and mechanism, the electro-magnetic spectrum, forms of radiant energy. Principles of using electromagnetic radiation in food processing, ionizing radiations and non-ionizing radiations, advantages and disadvantages. Controlling undesirable changes in food during irradiation.

UNIT IV  10 HOURS

Processing and preservation by drying, concentration and evaporation: Drying – water activity, microbial spoilage due to moisture. Dehydration of fruits, vegetables, milk, animal products. Various methods employed in production of dehydrated commercial products, selection of methods based on characteristics of foods to be produced, advantages and disadvantages of different methods, sundrying, tray or tunnel drying, spray drying, drum drying, freeze drying, fluidized bed drying. Physical and chemical changes during drying control of chemical changes, desirable and undesirable changes. Packaging and storage of dehydrated products. Food Concentration- methods of food concentration, freeze concentration, Ultra-filtration, reverse osmosis.

UNIT V  9 HOURS

Processing and preservation by non-thermal methods: High pressure, pulsed electric field, hurdle technology. GRAS and legal aspects for gamma irradiation. Permissible limits for chemical preservatives. Use and application of enzymes and microorganism in processing and preservation of foods; food fermentations, pickling smoking; Food additives; Definition, types and functions, permissible limits and safety aspects. Chemical Preservatives- type I and type II.
**Text books and Reference materials**


5) Sivasankar, B (2005). Food processing and preservation. Prentice - Hall of India


13) Zeuthen, Peter (2005). Food preservation techniques. Woodhead publishing ltd,


UNIT -I  
9 HOURS


UNIT –II  
10 HOURS

Heat processing of food: Mechanism of heat transfer, Factors affecting heat and mass transfer. Study of heat exchangers, boiling and condensation, Evaporation. Multiple effect evaporators in sugar and fruit juice industry. Thermal processing as applicable in canning, sterilization, microbial death rates. Batch and continuous processing. Operation of plate heat exchangers, shell and tube and other designs for aseptic processing, HTST, UHT.

UNIT -III  
9 HOURS

Drying: water activity and Microbial growth rate, equilibrium moisture, adsorption isotherms and relation to storage, absolute humidity and relative humidity. Batch Drying, Drying Curves, Drying of milk, fruit juices and liquid foods as well as convective drying for solid foods. Psychrometry- Wet bulb and dry bulb temperature, psychrometri charts.

UNIT –IV  
8 HOURS

Principles of mass and energy balance. Phase change operations - Freezing and thawing. Mechanical refrigeration and refrigerants.

UNIT - V  
9 HOURS

Principles of other food processing such as membrane filtration (ultra, osmosis and reverse osmosis, dialysis), pulsed electric, High Pressure Processing, ohmic heating, Radio Frequency Heating, Food irradiation.

Text Books and Reference Materials

UNIT I 9 HOURS

Research Methodology: Meaning, objectives and types of research, research approaches, Significance of research, Research and scientific methods, research process and criteria of good research definition and identification of a research problem – Selection of research problem, Justification, theory, hypothesis, basic assumptions, limitations and delimitations of the problem.

UNIT II 9 HOURS


UNIT III 9 HOURS


UNIT IV 9 HOURS

Basic concept of hypothesis testing - Type I and type II errors. Tests based on Means & Proportions on Normal. Two way analysis of variance (RBD), LSD, - Multiple comparison tests (DMRT, Bonferonni, Dunnett’s).– t test for independent samples, paired samples, F test two sample variances: One-way ANOVA, two-way ANOVA, Correlation & Regression(three variables).

UNIT V 9 HOURS

Framing Proposal for acquiring grants: The question to be addressed – Rationale and importance of the question being addressed – Empirical and theoretical framework – Presenting pilot study / data or background information - Research proposal and time frame – Specificity of methodology – Organization of different phases of study – Expected outcome of study and its implications – Budgeting - Available infra-structure and resources - Executive summary.

Text books and Reference materials


UNIT I

9 HOURS

Introduction, Food Regulations and Standards - Sampling methods - Sample preparation for analysis; Statistical evaluation of analytical data - Official Methods of Food Analysis. Moisture in foods - determination by different methods - ash content of foods, wet, dry ashing, microwave ashing methods; Significance of Sulphated Ash, water soluble ash and acid insoluble ash in foods; titratable Acidity in foods, determination of dietary fiber and crude fiber.

UNIT II

10 HOURS

Determination of Total fat in foods by different methods; Analysis of oils and fats for physical and chemical parameters, Quality standards, and adulterants; different methods of determination of protein and amino acids in foods; determination of total carbohydrates, starch, disaccharides and simple sugars in foods.

UNIT III SPECTROSCOPIC TECHNIQUES

9 HOURS

Basic Principles- Spectrophotometric analysis of food additives and food Components -IR Spectroscopy in online determination of components in foods; AAS and ICP-AES in mineral elements and toxic metals analysis; use of fluorimeter in vitamin assay- specific use of Tintometer in vanaspathi analysis.

UNIT IV

9 HOURS

Chromatographic Techniques- Basic principles and types of:- Paper chromatography, thin layer chromatography, column chromatography, Ion exchange chromatography, HPTLC, HPLC, UHPLC, GC,GC-MS, Types of detectors ,Uses and applications of chromatographic techniques.

UNIT V

8 HOURS

Basic Principles, application of electrophoresis in food analysis, refractive indices of oils and fats, total soluble solids in fruit juice and honey, specific rotation of sugars, estimation of simple sugars and disaccharides by polarimeter; Immunoassay techniques and its applications in foods.

Text books and Reference materials


UNIT- I  10 HOURS

Principles of Toxicology: classification of toxic agents; characteristics of exposure; spectrum of undesirable effects; interaction and tolerance; biotransformation and mechanisms of toxicity. Evaluation of toxicity: risk vs. benefit; experimental design and evaluation: prospective and retrospective studies; Controls: Statistics (descriptive, inferential): animal models as predictors of human toxicity; Legal requirements and specific screening methods as per OECD guidelines *in vitro* and in vivo studies; clinical trials.

UNIT – II  8 HOURS

Natural toxins in food: natural toxins of importance in food: toxins of plant and animal origin; microbial toxins (e.g., bacterial toxins, fungal toxins and Algal toxins), natural occurrence, toxicity and significance, determination of toxicants in foods and their management.

UNIT – III  9 HOURS

Food allergies and sensitivities: natural sources and chemistry of food allergens; true/untrue food allergies; handling of food allergies; food sensitivities (anaphylactoid reactions, metabolic food disorders and idiosyncratic reactions); Safety of genetically modified food: potential toxicity and allergenesity of GM foods. Safety of children consumables.

UNIT – IV  9 HOURS

Environmental contaminants and drug residues in food: fungicide and pesticide residues in foods; heavy metal and their health impacts; use of veterinary drugs (e.g. Malachite green in fish and β-agonists in pork); other contaminants in food, radioactive contamination of food, Food adulteration and potential toxicity of food adulterants. Endocrine disrupters in food.

UNIT – V  9 HOURS

Food additives and toxicants added or formed during food processing: safety of food additives; toxicological evaluation of food additives; food processing generated toxicants: nitroso-compounds, heterocyclic amines, dietary Supplements and toxicity related to dose: common dietary supplements; relevance of the dose; possible toxic effects.

**Text books/ Resources**

UNIT - I  
8 HOURS

General introduction and production and utilization trends; Structure and composition of common cereals, legumes and oilseeds.

UNIT - II  
10 HOURS

Wheat: Types and physicochemical characteristics; wheat milling -products and byproducts; factors affecting quality parameters; physical, chemical and rheological tests on wheat flour; additives used in bakery products; flour improvers and bleaching agents; manufacture of bakery products, pasta products and various processed cereal-based foods; manufacture of whole wheat atta, blended flour and fortified flour. Production of starch and vital wheat gluten.

UNIT - III  
9 HOURS

Rice: Classification, physicochemical characteristics; cooking quality; rice milling technology; by-products of rice milling and their utilization; Rice bran stabilization, oil extraction and refining, parboiling methods of rice criteria of quality of rice: aging of rice – quality changes; processed products based on rice.

UNIT - IV  
9 HOURS

Corn: Types and nutritive value; dry and wet milling, processing of corn in breakfast cereals, snacks, tortilla etc., production of glucose syrups, dextrose, high fructose corn syrups, modified starches.
Barley: composition, milling, malting of barley, chemical and enzymatic changes during malting, uses of malt.
Oat: composition, processing of oat, byproducts of oatmeal milling.

UNIT - V  
9 HOURS

Legumes and oilseeds: composition, anti-nutritional factors, processing and storage; processing for production of edible oil, meal, flour, protein concentrates and isolates; extrusion cooking technology; snack foods; development of low cost protein foods. Oil extraction process – mechanism, solvent, SCE, oil refining, utilization of biproducts of oil milling.

Text books and Reference materials

1. Water activity and moisture isotherm
2. Specific gravity and Refractive Index
3. Emulsions and foaming properties of proteins
4. Millard Reaction, qualitative test for protein
5. Quantitative estimation of protein by biuret method, factors affecting protein quality
6. Fehling’s test for reducing sugars, Microscopic examination of starch
7. Starch Gels, Viscosity curves of starch pastes
8. Lipids: Solubility, specific gravity and refractive index of fats,
9. Water absorption and plasticity of fats, Oxidative rancidity
1. Preparation of common laboratory media and special media.
2. Staining: Gram’s staining, acid-fast, spore, capsule and flagellar staining, Motility of bacteria, Staining of yeast and molds.
3. Identification of important molds and yeast.
4. Microbiology of milk.
5. Microbiology of water.
6. Microbiology of hand and effect of sanitation on the hand microbiology in a small food joint.
7. Microbiological analysis of typical processed food.
8. Microbiological analysis of a typical unprocessed food.
9. Isolation of specific culture.
1. Blanching and browning control
2. Preparation of fruit preserves (jam, jelly).
3. Preparation of vegetable preserves (pickle)
5. Tomato processing
6. Fruit pulping / juice / beverage preparation
7. Preparation and standardization of traditional Indian fermented foods
9. Confectionery
1. Physical-tests on wheat and rice
2. Physicochemical and rheological properties;
3. Determination of gluten content in wheat flour;
4. Conditioning of wheat; Milling of wheat and rice by laboratory mill;
5. Parboiling of rice;
6. Quality tests of rice: Amylose content determination in rice;
7. Malting, puffing and popping of grains;
8. Preparation of protein concentrates and isolates and their evaluation for protein content and solubility;
9. Extraction of oil using expeller and solvent extraction methods
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Milling Equipments: Types of equipment used for milling rice and wheat, pearling and flaking equipment; dhal mills.

Washing, Filtration & Centrifugation equipment. Different Fruits and Vegetable washing systems; Filtration of liquid foods (dairy, fruit & vegetables); centrifugation systems: Solid bowl and disc bowl centrifuges; cyclone separator and self cleaning centrifuge. Conveyor belts - types, material of construction, product specific conveyors. Screw, bucket, belt, oscillating and vibratory conveyors.


Mixing, Blending, extrusion & Filling Equipments: Agitation and mixing of liquid foods, powders and pastes; Mixers - ribbon blenders, augur, nauta, cone.

Cold and hot extruders, single screw, twin screw, extrusion cooking.

Screening; Types of screens; Grizzly; Revolving screen; Shaking screen, Rotary screen, Vibratory screen; Horizontal screen; Perforated metal screens; Wiremesh screens; Ideal and Actual screens; Effectiveness of screen; Air-screen cleaners; Separators

Storage: Direct damages; Indirect damages; Sources of infestation; Traditional storage structures; Improved storage structures; Modern storage structures; Storage of agricultural perishables; Controlled and modified atmosphere storage.

Text Books and Reference materials


UNIT -I

9 HOURS

Enzymes classification, properties, characterization, kinetics and immobilization; fermentative production of enzymes (amylases, proteases, cellulases, pectinases, xylanases, lipases) used in food industry and their downstream processing.

UNIT -II

9 HOURS

Enzymes for starch modification (maltodextrins and corn syrup solids: liquefaction, saccharification, dextrinization, isomerization for production of high-fructose-corn-syrup, fructose and fructo-oligosaccharides). Enzymes for protein modification (hydrolysates and bioactive peptides), Enzymes for Lipid modification.

UNIT III

9 HOURS

Enzymes as processing aids: Role of enzymes in Dairy processing (cheese making and whey processing). Role of enzymes in meat processing (tenderization and flavour development) and fish processing (De-skinning, collagen extraction etc.,) Egg processing.

UNIT IV

9 HOURS

Role of enzymes in Brewing, Baking (fungal -amylase for bread making; maltogenic -amylases for anti-staling; xylanases and pentosanases as dough conditioners; lipases or dough conditioning; oxidases as replacers of chemical oxidants; synergistic effect of enzymes);

UNIT V

9 HOURS

Role of enzymes in the production of flavours (enzyme-aided extraction of plant materials for production of flavours, production of flavour enhancers such as nucleotides, MSG; flavours from hydrolyzed vegetable/animal protein)

Text books and References

UNIT I

FOOD NEEDS & CONSUMER PREFERENCE - Market survey and its importance in; designing a questionnaire to find consumer needs for a product or a concept. Developing a Product to Meet the Requirements. Product life cycle. Creating brand value for the Product. The SWOT analysis.

UNIT II

DESIGNING NEW PRODUCTS - New Food Product Development (NPD) process and activities, The Stage-Gate model NPD success factors, new product design, food innovation case studies, market-oriented NPD methodologies, organization for successful NPD; Recipe Development; use of traditional recipe and modification; involvement of consumers, chefs and recipe experts; selection of materials/ingredients for specific purposes; modifications for production on large scale, cost effectiveness and return on investment, nutritional needs or uniqueness; use of novel food ingredients and novel processing technologies.

UNIT III

STANDARDIZATION & LARGE SCALE PRODUCTION - Process design, equipment needed; establishing process parameters for optimum quality; Sensory Evaluation; Lab requirements; different techniques and tests; statistical analysis; application in product development and comparison of market samples; stages of the integration of market and sensory analysis.

UNIT IV

QUALITY, SAFETY & REGULATORY ASPECTS - Product Stability; evaluation of shelf life; changes in sensory attributes and effects of environmental conditions; accelerated shelf life determination; developing packaging systems for maximum stability and cost effectiveness; interaction of package with food; Regulatory Aspects; whether standard product and conformation to standards; Approval for Proprietary Product.
UNIT V

PRODUCT COMMERCIALIZATION, LAUNCH, EVALUATION & CASE STUDIES -
Outcomes and activities in product commercialization, Pre-launch trial, Steps in product launch,
Evaluation of the Launch, product performance testing, developing test market strategies,  Case
Studies of some successes and failures, food choice models and new product trends.

REFERENCES

1. Jacqueline H. Beckley, M. Michele Foley Elizabeth J. Topp &_J. C. Huang Witoon
Publishing Company. IFT Press. USA

Food Product Development. Taylor and Francis Group, LLC.USA

Publishing Limited and CRC Press LLC.USA


sensory analysis in food product development and quality control.
Chapman & Hall, 2-6 Boundary Row, London.
UNIT I  
9 HOURS  
Fermentation, types of fermentation, Fermentation Pathways for Industrial Products: Biochemical pathways of metabolic reactions for utilization of carbon sources and formation of different metabolites by microorganisms; Strain Development -Various techniques of modifying the strains for increased production of industrial products. Use of chemicals, UV rays, genetic engineering to produce newer strains.

UNIT II  
8 HOURS  
Typical media, Media formulation:-Carbon Source, Nitrogen source, Minerals, Growth Factors, Buffers, Precursors and Inhibitors, O₂ requirement and antifoams.

UNIT III  
8 HOURS  
Fermenter design, Instrumentation and control, Types of fermenters (Shake flask, Batch/stir tank, Continuous, Bubble column, airlift and Tower fermenter), Types of fermentation processes ,aeration and agitation (The oxygen requirement for industrial fermentation , Determination of KLa values).

UNIT IV  
10 HOURS  
Downstream Processing: Various equipment for product recovery; micro-filters and Ultrafiltration systems for separation of cells and fermentation medium and for concentration of medium containing product; chromatographic systems of separation; extraction of product with solvent; evaporation and crystallization; centrifugation, different types of centrifuges; drying techniques; instrumentation and controls.

UNIT V  
9 HOURS  
Fermentative Production: a) Foods: Processes for preparing fermented products including Yogurt (curd) and other Traditional Indian Products like idli, dosa, dhokla, shrikhand,.., Soya based products like soya sauce, natto,.., Cheese.; Alcoholic Beverages based on fruit juices (wines), cereals (whisky, beer, vodka,), sugar cane (rum) Process description, quality of raw materials, fermentation process controls.  
b) Industrial chemicals: Fermentative Production of Organic acids

Text books and Reference material
UNIT -I  
9 HOURS
Environment and Pollution: Components of environment; Environmental pollutions, its measurements and management; Air pollution and its control: Air duct design and room air distribution; air conditioning systems; important pollutants of air; properties of particulate matter. Biofuels and non - conventional energy

UNIT -II  
8 HOURS
Xenobiotic compounds; Organo chloride Pesticides and pest management; processes; Microorganisms as components of the environment; microorganisms as indicators of environmental pollution; bioorganic pollution; microbial toxicants and pollutants, and their bio-degradation; biodegradation of plastics, biofouling and biofilms; bioremediation, toxic metals/metalloids- Arsenic and lead.

UNIT -III  
10 HOURS
Water pollution and its control-Waste water sources characteristics - standards for disposal of water, physical, chemical and biological characteristics of waste water; measurement of organic content in waste water; Physical UNIT operations in waste water treatment - screening; racks, mixing, flocculation, sedimentation, floatation, elutriation, vacuum filtration, incineration; chemical UNIT operations in waste water treatment - reaction kinetics; chemical precipitation, aeration and gas transfer process, rate of gas transfer, adsorption, disinfection; biological UNIT operations - aerobic and anaerobic.

UNIT -IV  
9 HOURS
Storage & Disposal of Waste: Types of waste generated; Non- degradable & biodegradable wastes, Solid waste storage and disposal methods- land-filling, burial, incineration, recycling; Biological treatment of food industry wastes, storage and disposal of liquid and gaseous waste; legal aspects related to storage and disposal; environmental laws and regulations.

UNIT -V  
9 HOURS
Utilization of Waste: Methods of utilizing wastes to make value added products CASE STUDIES: Pectin, food colorants, antioxidants from fruit peels (citrus, mango, and pomegranate), lycopene from tomato peels, vegetable seed oils, biomolecules and enzymes from meat processing. Generation of biogas, SCP, microalgae, animal feeds, zero emission plants; recovery & recycling of materials.

References
UNIT -I


UNIT -II

Natural occurrence of certain phytochemicals- Antioxidants and flavonoids: omega – 3 fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinates; organosulphur compounds. Dosage for effective control of disease or health benefit with adequate safety; studies with animals and humans; acute and chronic studies. Regulatory issues.

UNIT -III

Isolation of phytochemicals from plant materials: Care in handling and storage of raw materials with minimal damage to sensitive bioactive compounds; Extractive methods for maximum recovery and minimal recovery and minimal destruction of active material; stability studies. Recent developments in the isolation, purification and delivery of phytochemicals.

UNIT -IV

Prebiotics, probiotics and symbiotics- Probiotics: Definition, types and relevance; Usefulness in gastro intestinal health and other health benefits; development of a probiotic products; recent advances in probiotics; Challenges and regulatory issues related to probiotic products. Prebiotics: Prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes; health benefits of prebiotics; recent development in prebiotics. Synbiotics.

UNIT -V

Functional foods - Definition, development of functional foods, use of bioactive compounds in appropriate form with protective substances and activators; Effect of environmental condition and food matrix; Effects of processing conditions and storage; Development of biomarkers to indicate efficacy of functional ingredients; Research frontiers in functional foods; delivery of immunomodulators /vaccines through functional foods. Nutrigenomics-concept of personalized medicine.
Text Books and Reference materials


UNIT-II 8 HOURS
BAKERY EQUIPMENT: Introduction to utensils and equipments used in bakery UNIT and their uses small equipments, big equipments and oven. Bulk handling of ingredients, Dough mixing and mixers, dividing, rounding, sheeting, and laminating, fermentation enclosures and brew equipment. Ovens and Slicers, Packaging materials and equipment.

UNIT-III 10 HOURS

UNIT-IV 9 HOURS
BISCUITS AND COOKIES: Production of cakes and cookies/biscuits. Types of biscuit dough’s – Developed dough, short dough’s, semi-sweet, enzyme modified dough’s and batters – importance of the consistency of the dough. Cake making: Ingredients and their function structure builders. Tenderizers, moisteners and flavor enhancers – Selection and preparation of mould Temperature and time required for different type of cake, problems of baking.
UNIT-V


Text Books and Reference materials

Survey on types of convenience foods / consumer behavior / analysis of food labeling

**Group projects to Develop Food Products at Laboratory scale**

**Project Identification:** Products/Processes Review, Project Feasibility, Design and Product Specification

**Project Planning:** Identifying Objectives, Identifying Tools/Methods, - Permutation and Combination, Response Surface Methodology, Use of Information/ Communication Technology

**Project Execution:** Product Trials and Standardization, Evaluation of product- Analysis of Physical and Chemical Properties and Sensory Evaluation

**Project Presentation:** Documentation and Report, Viva Voice
1. Effect of pH & temperature on enzymes
2. Separation of enzymes - SDS Page
3. Effect of inhibitors on the activity of enzymes
4. Immobilization of enzyme by entrapment and comparison with free enzyme
5. Enzymes in meat tenderization
6. Downstream processing – precipitation- organic solvents, salts, Thin layer chromatography, column chromatography
7. Extraction of alkaline phosphatase from liver.
8. Extraction of lipase from plants
9. Estimation of lipase activity
1. Study of ingredients (major and minor): Characteristics of flour, yeast, shortening, sugar, egg and salts.
2. Experiment on leavening action of baking powder, sodium-bicarbonate and ammonium-bi-carbonate.
3. Estimation of gluten content (atta and maida)
4. Estimation of water absorption power (atta and maida)
5. Determination of yeast-ferment test and dough rising capacity
6. Studies of flour and dough characteristics
7. Preparation of biscuits – different types
8. Preparation of cookies-different types
10. Preparation sugar boiled confectionary.
11. Preparation of chocolates, fruit drops.
12. Preparation of fruit toffees candies and preserves.
13. Preparation of pastries and pie
14. Determination of friction factor for dough and batter
### PONDICHERRY UNIVERSITY
#### Department of Food Science and Technology

**M.Sc Food Science and Technology**

<table>
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FS&T511 FOOD BIOTECHNOLOGY AND NANOTECHNOLOGY    CREDIT 3

UNIT -I         9 HOURS

UNIT -II         9 HOURS
Traditional applications of biotechnology in food - Fermented foods: eg dairy products, oriental fermentations, alcoholic beverages, and food ingredients. Health benefits of fermented foods. Types of fermented foods and importance of food fermentation in food preservation and nutritional enhancement. Examples of genetically modified crops- Bt brinjal , Bt maize and golden rice.

UNIT -III         9 HOURS
Plant and animal culture, transgenic plants, application of genetic engineering in food science and technology. Genetically modified foods – concept, types and application. Regulations concerning Genetically Modified Foods in India and at the International level; Ethical issues concerning GM foods; testing for GMOs; current guidelines for the production, release and movement of GMOs; labeling and traceability; trade related aspects; bio safety; risk assessment and risk management. Public perception of GM foods.IPR.

UNIT -IV         9 HOURS

UNIT -V         9 HOURS
Biological synthesis of nanoparticles: Biosynthesis of Nanoparticles: Biomineralization -Microbial Nanoparticle production. Biofunctionalizaion of gold nanoparticles – phospholipids polymer nanoparticles – magnetic nanoparticles–metallic nanoparticle. Application of nanotechnology in food Science in brief: Nanosensors for microbial, chemical contaminants; Foods incorporated with nanoscale antimicrobial compounds, antioxidants and flavours which would improve shelf-life or sensory characteristics such as flavour, odour.

Text books and reference materials
UNIT I  
9 HOURS


UNIT II  
9 HOURS


UNITs III  
9 HOURS

Packaging Systems and methods: Vacuum Packaging, Controlled atmospheric packaging, Modified atmospheric packaging, Aseptic Packaging, Retort processing, Microwave packaging, Active Packaging, intelligent packaging, ecofriendly Edible packaging, Shrink and stretch packaging.

UNIT IV  
9 HOURS

Packaging of fresh and processed foods: Packaging of Fruits and vegetables, Fats and Oils, Spices, meat, Poultry and sea foods, Dairy Products, Bakery, beverages, Dehydrated and frozen foods. Liquid and powder filling machines – like aseptic system, form and fill (volumetric and gravimetric), bottling machines. Form Fill Seal (FFS) and multilayer aseptic packaging machines.

UNIT V  
9 HOURS

Packaging Design & Environmental Issues in Packaging: Food marketing and role of packaging- bar coding, Migration in food packaging. FSSAI regulations for packaging and food labeling.

Text Books and Reference materials

5. Ahvenainen, R. (Ed.) 2003 Novel Food Packaging Techniques, CRC Press,
6. Han, J.H. (Ed.) 2005 Innovations in Food Packaging, Elsevier Academic Press,
UNIT I 9 HOURS
Food safety concept - Importance of food safety in the food processing industry. Risk classification, National and international food regulatory agencies, General food laws and food safety regulations, Nutritional labeling regulations (mandatory and optional nutrients, nutritional descriptors and approved health claims); Microbial contamination (including cross-contamination/indirect contamination) Chemical contamination, Physical contamination, Allergen contamination

UNIT II 9 HOURS

UNIT III 9 HOURS
Hazard Analysis and Risk Assessment: Physical hazards (metals, glass, etc), Chemical hazards (food additive toxicology, natural toxins, pesticides, antibiotics, hormones, heavy metals and packaging components), Biological hazards (epidemiology of biological pathogens: virus, bacteria and fungi), Evaluation of the severity of a hazard Controlling Food Hazards. Hazard Analysis Critical Control Point (HACCP) system.

UNIT IV 8 HOURS
Food Hygiene Programs: Personal hygiene, Training programs, Infrastructure, Personal habits, Hygiene verification, Water in the food industry, Water sources, Water uses, Water quality, Treatments, Cleaning and sanitation, Cleaning agents, Sanitizing agents, Equipment and systems, Evaluation of sanitation efficacy., Pest Control, Pest Classification (insects, rodents and birds), Prevention and control

UNIT V 10 HOURS
Food safety regulation in India: An overview of Food Regulation in India; Food Laws and Regulations; Structure, organization and duties of regulatory system; Duties and responsibilities of food business operator; Registration and Licensing process and requirements; Labeling of Food Products; Traceability; Import and Export of Foods; Liability for Defective Products; Food safety management systems and certifications; Regulation of special category Foods: Regulation of Irradiated foods; Regulation of Biotechnology and Genetic Modifications; Regulation of Dietary Supplements, Functional Foods and Nutraceuticals.
**Text books and Reference materials**

8. FSSAI, FSIS, EU and FAO website for updates
UNIT I 8 HOURS
Meat composition from different sources; muscle structure and compositions; post-mortem muscle chemistry; Factors influencing the quality of meat. Meat Microbiology and safety.

UNIT II 10 HOURS

UNIT III 8 HOURS
Processing and preservation of meat: Chilling and freezing of meat, Canning, cooking, drying, pickling, curing and smoking; prepared meat products like sausages, kebabs, etc.. Intermediate moisture and dried meat products, Packaging of meat products.

UNIT IV 10 HOURS
Poultry: methods of slaughtering, Slaughtering equipment and operations, dressing, handling, storage and preservation of poultry meat. Spoilage and its control. Freezing and chilling of poultry. Whole sale and retail cuts.

Eggs: Composition, handling, candling, washing, coating, packaging and storage. Egg processing (Egg powder manufacturing, pasteurization, etc.), Spoilage and its control.

UNIT V 9 HOURS
Commercially important marine products from India, Proximate composition, Post mortem changes in fish muscle. Handling, Preservation and transportation of fish. Indices of fish quality, Microbiology of fish and shell fish, Freezing of fish and shell fish. FSSAI guidelines on FSMS compliance for meat and meat products

Text books and References
UNIT -I  
10 HOURS

Coffee: Occurrence, chemical constituents; harvesting, fermentation of coffee beans; changes taking place during fermentation; drying; roasting; process flow sheet for the manufacture of coffee powder; instant coffee technology; chicory chemistry; quality grading of coffee.

UNIT -II  
10 HOURS

Tea: Occurrence, chemistry of constituents; harvesting; types of tea – green, oolong and CTC; chemistry and technology of CTC tea; manufacturing process for green tea and black tea manufacture; instant tea manufacture; quality evaluation and grading of tea.

UNIT -III  
10 HOURS

Cocoa: Occurrence, chemistry of the cocoa bean; changes taking place during fermentation of cocoa bean; processing of cocoa bean; cocoa powder; cocoa liquor manufacture; chocolates—types, chemistry and technology of chocolate manufacture; quality control of chocolates.

UNIT -IV  
10 HOURS

Major spices: Pepper, cardamom, ginger, chili and turmeric—Oleoresins and essential oils; method of manufacture; chemistry of the volatiles; enzymatic synthesis of flavour identicals; quality control; fumigation and irradiation of spices.

UNIT -V  
5 HOURS

Other plantation crops processing: vanilla, coconut, cashew, Oil palm. arecanut, palmera.

Text Books and Reference Materials

UNIT -I  
9 HOURS
Operation Research, definition and scope, techniques in operation research. Food plant management. Factors bearing on location and layout of food plants. Regulatory requirements of food industries.

UNIT -II  
9 HOURS
Structure and operation of food plants. Executive design making in a food plant. Decision protocols. Evolution and role of management planning, organising and controlling. Decision processed for raising efficiency, productivity and quality in food plant operation. System analysis, its need and methodology.

UNIT -III  
9 HOURS
Model building- deterministic and probabilistic models. Management decision making, problems of productions, production intending, marketing-sales forecasting, inventory, finance-Break down maintenance, inventory, finance replacement and maintenance, inventory, finance replacement and maintenance.

UNIT -IV  
9 HOURS
Network models. Computer applications, database operating systems, networking project management, spread sheeting and Statistical Quality Control (SQC).

UNIT -V  
9 HOURS
Industrial cost accounting, purchase procedure, stores procedure, material accounting, overhead costing, budget and budgetary control, process costing. Cost factor in fixation of prices, job costing and product costing.

Text Books and Reference Materials

UNIT - I

Historical Perspectives including necessity of Food Laws. Establishment of US Pure Food Law in early 1900s and of Food & Drug Administration to enforce safety of food products; Urbanisation of population and necessity of processed and preserved foods and the necessity of ensuring quality of food to prevent adulteration

UNIT - II

Food Quality, Safety & Testing: Quality of Foods and Quality Standards like BIS; Agmark and other optional standards; the difference between mandatory and optional standards; enforcement of optional standards; Food Safety Systems: Quality systems standards including ISO; Auditing; Good Manufacturing Practice and HACCP. Various ways of testing the safety of foods; Detection of harmful chemicals and microbes in foods; Testing of ingredients and additives; using animals for evaluating safety; Clinical studies. Responsibility of agriculture, food industry & food supply sector; Standards of Weights & Measures, British Regulatory Consortium(BRC), American Institute of Bakers(AIB) and some provisions under these regarding food products such as requirements of labelling and giving information therein, size of packages etc. Important Issues of GM Foods, Fortification, Nutrition Information on Label, Organic Foods, Safety of Additives, Processes etc. affecting consumers and industry.

UNIT - III

Food Laws & Implementing Agencies-National: Prevention of Food Adulteration Act 1954 & Rules 1955 established in India to enforce safety and purity of food products; Various aspects of defining adulteration, taking samples of food for analysis by public analyst, prosecution for adulteration and punishment; Standards of various food products; FPO; Infant Milk Substitute Act; Laws relating to vegetable oils; Use of permitted additives like colours, preservatives, emulsifiers, stabilisers, antioxidants. Food Safety & Standards Act 2006 and the provisions therein; Integrated Food Law - Multi departmental - multilevel to single window control system, consumer protection Act

UNIT - IV

International Scenario in Food Regulation USFDA, EFSA, UK, Canada, A & NZ, Japan, Malaysia, Singapore; Consumer Movements; Intellectual Property Rights and Trade Marks: Protection of investment and efforts in research and development by patenting; Criteria of patentability; National and international patent; Terms of patents; Copyright.

UNIT - V

International Agencies in Food Regulation: Food Codex Alimentarius: The necessity of harmonised Food Standards for international trade; various aspects and relation with domestic laws; Codex Nodal agency, FAO, WHO, WTO, TUV, Consumer protection forums.

References


UNIT -I  

9 HOURS

Indian and global scenario on production and processing of fruits and Vegetable. Pre-processing: Fresh fruits and vegetables – Handling, grading, cleaning, pretreatments, transportation, pre cooling, chilling, modified atmosphere packaging, Controlled atmosphere storage, packaging, transportation, quality assurance.

UNIT -II  

8 HOURS

Freezing of Fruits and Vegetables: Different freezing methods and equipments, problems associated with specific fruits and vegetables;

UNIT -III  

9 HOURS

Dehydration of Fruits and Vegetables: dehydration – different methods of drying including sun, tray, cabinet, drum, spray, vacuum, tunnel, spray, low temperature drying process, process calculations, osmotic dehydration and other modern methods, choice of suitable methods, preserving the colour, flavour and nutrient content of the products

UNIT - IV  

10 HOURS

Canning, Juices & Concentrates: Different UNIT operations involved in fruit and vegetable Pulp/ juice extraction, concentration, Bulk aseptic packaging of fruit and vegetable pulps, juices and concentrates; aseptic packaging of fruit drinks, juices and other products

Bottling, canning - essential principles, different types of cans, UNIT operations in canning

blanching, exhausting, processing conditions. Fruit Juice / pulp/ Nectar/Drinks, concentrates – General and specific processing, different packing including aseptic; Vegetable Purees/pastes - processing of Tomato and tomato products

UNIT -V  

9 HOURS

Fruit and Vegetable Products & Standards: Ready to eat vegetable products, Jams/Marmalades, Squashes/cordials, Ketchup/sauces, Chutneys, Fruit Bar, Soup powders, Candied Fruits, Natural colors, Fruit and Vegetable Fibres - specific processing, different packing including aseptic, Product specifications and standards; food regulations with respect to fruit and vegetable products

Reference


UNIT I  
Food additives – definitions, classification and function, chemistry, food uses and functions in formulations; toxicological evaluation of food additives. Proteins, starches and lipids as functional ingredient; isolation, modification, specifications, functional properties and applications in foods.

UNIT II  

UNIT III  
Additives to improve acceptability, permitted food colors, natural and artificial, food flavours, natural and artificial, sweeteners natural and artificial, acidulents, antimicrobials, aerating agents, ant staling agents, bodying agents, clouding agents, curing agents clarifiers, dietary supplements, dietary fiber, emulsifiers, enzymes, fat replacers, gelling agents, leavening agents, stabilizers, surfactants, tenderizers, texturizers, thickeners, vitamins, nutraceuticals, viscosity modifiers, whipping agents.

UNIT IV  
Flavor technology; types of flavours, flavours generated during processing – reaction flavours, flavor composites, stability of flavours during food processing, analysis of flavours, extraction techniques of flavours, flavours emulsions; essential oils and oleoresins; authentication of flavours etc.

UNIT V  
Text books and Reference materials

UNIT I  WASTE UTILIZATION FROM RICE MILL INDUSTRY  10 hours


UNIT II  UTILIZATION OF FRUIT AND VEGETABLE WASTES  10 hours

Different sources of wastes from fruit and vegetable industries and their availability in India- Status and types of waste available- possible byproducts- Utilization of mango, citrus, apple, guava, grape waste-vinegar production-SCP production-organic acid production-Utilization of moringa, potato, leafy vegetable waste- Distillation for production of alcohol.

UNIT III  FISH AND POULTRY WASTE UTILISATION  9 hours

Fish industry by products- methods and production of fish meal, fish protein concentrate-fish and body oils- poultry waste recycling.

UNIT IV  TUBER CROPS WASTE UTILISATION  9 hours

Tapioca waste utilization- furfural production methods-paper making from cellulosic waste

UNIT V  BY- PRODUCT UTILIZATION OF COCONUT PROCESSING  10 hours


Text Books and Reference material

1. P. N. Chereminoff & A.C Morresi, 1976, "Energy from Solid Wastes"
2. A. Chakravarthy & De, "Agricultural Waste and By Product Utilisation".
3. Bor S. Luli (ed), "Rice Production and Utilisation"
4. E. Beagle, "Rice Husk Conversion to Energy"
1. Slaughtering and dressing of meat animals; study of post-mortem changes; meat cutting and handling;


3. Preservation by dehydration, freezing.

4. Evaluation of quality of eggs

5. Preservation of shell eggs

6. Preparation of meat products

7. Tenderization of various meat

8. Preparation of fish based products

9. Evaluation of fish and other marine products
1. Estimation of extractives, caffeine in tea and coffee; the aflavin and thearubigens of tea and total solids
2. Estimation of moisture and volatile oil content of spices
3. Estimation of aromatic compounds in spices
4. Estimation of capsaicin content
5. Scoville Heat Units in chilies
6. Curcumin content of turmeric
7. Storage and packaging of spices
8. Detection of microbial quality and adulteration in spices
1. Evaluation of pectin content
2. Canning of fruits and vegetables
3. Quality evaluation of fruits
4. Fruit preserve and candy
5. RTs products
6. Dehydrated products of fruits
7. Dehydrated products of vegetables
8. Preparation of pickles
9. Wafers from vegetables and fruits
Market sample evaluation and statistical application of:

1. Qualitative tests for detection of adulterants
2. Test for assessment of purity of water
3. Test for assessment of quality of milk and milk products
4. Test for assessment of quality of cereals/millets
5. Test for assessment of quality of pulses
6. Test for assessment of quality of fats and oils
7. Test for assessment of quality of meat/fish products
8. Test for assessment of quality of canned/bottle fruits and vegetables
9. Test for assessment of quality of baked foods
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Students will work on specific project attached to a supervisor and submit a thesis at the end of the semester. The assessment will be based on the midterm evaluation, evaluation of final report and viva-voce examination.