REVISED REGULATION, CURRICULUM AND SYLLABI

(With effect from the academic year 2012-13 onwards)

M.Sc Food Science and Technology

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

M.Sc Food Science and Technology

REGULATIONS

Of late, with increasing demand for processed food and increased export of food and food products, food technology has gained so much importance that economists and policy makers look for a tremendous boost in the GDP of our country. The changing urban life style coupled with compulsions has enabled the food industry to become lucrative and prosperous. Food technology provides an effective and timely platform for researchers in Universities and industries as well to develop and innovate cutting edge processing technologies for the development of our nation. Development of curriculum in consultation with the constellation of food industries would open up new vistas for employment to the graduates. Therefore, it is timely and challenging to offer this course in Pondicherry University.

Programme of study:

M.Sc Food Technology programme is interdisciplinary in nature comprising of microbiology, biotechnology, biochemistry, Food Science and Technology and nutrition, engineering etc. The main thrust would be hands on experience in different areas of food processing, nutrition, packaging, preservation and marketing. The students admitted in the programme shall be required to take up dissertation work on any emerging areas of food technology which demand attention. Field visits, industrial visits, etc by the students would immensely help them to understand and analyze in depth the problems, challenges, remedial measures and management of industries.
**Entrance Examination:**

The entrance examination shall be conducted on the specified dates and locations as given in University brochure.

**Infrastructural facilities:**

The department of Food science and Technology offers an M.Sc degree programme in Food Science and Nutrition besides M.Sc Food Technology programme. The department has well qualified teaching faculty specialized in various disciplines of food technology. The department has spacious and well lit class rooms and laboratories. All the sophisticated facilities including equipments are available in multiples where necessary. The University has a central instrumentation facility where SEM, X-ray diffraction UNIT; NMR, FTIR, etc are available. Since the food technology programme is interdisciplinary in nature the faculties are drawn from other departments such as biotechnology, biochemistry and molecular biology, statistics etc, and this adds credence to the quality of education, imparted to the students.

**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 and other life science related subjects. **Maths at +2 / P.U.C. level is compulsory.**

**Duration of course:** Two years
## Curriculum – M.Sc Food Science and Technology

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Title</th>
<th>Credit/Hours</th>
<th>Nature of the course</th>
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<td>I</td>
<td>FS&amp;T411</td>
<td>Food Chemistry</td>
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<td>FS&amp;T412</td>
<td>Food Microbiology</td>
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<td>Fermentation Technology</td>
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**Hard core**   |                                                        |         |
FS&T411        | Food Chemistry                                         | 3       |
FS&T412        | Food Microbiology                                      | 3       |
FS&T413        | Food Processing and Preservation Technology             | 3       |
FS&T414        | Food process engineering                               | 3       |
FS&T415        | Research Methodology and Biostatistics                 | 3       |
FS&T451        | Food Chemistry Lab                                     | 1       |
FS&T452        | Food Microbiology Lab                                  | 1       |
FS&T453        | Food Processing and Preservation Technology Lab         | 1       |
FS&T454        | Techniques in Food Analysis Lab                         | 2       |
**Soft core**   |                                                        |         |
FS&T426        | Food Toxicology                                        | 3       |
FS&T427        | Technology of Cereals, Legumes and Oil Seeds           | 3       |
FS&T455        | Technology of Cereals, Legumes and Oil Seeds Lab        | 1       |
UNIT - I  
10 hours

Water and Ice: Physical properties, structure of water and ice, water soluble interaction, water activity and relative vapor pressure. Dispersed systems: Surface phenomena, colloidal interactions, Liquid dispersions, gels, emulsions and Foam.

UNIT - II  
9 hours

Carbohydrates: Monosaccharides, Oligosaccharides, Polysaccharides, Starch, Cellulose, Guar and Locust Bean Gum, Xanthan, Carrageenans, Algins, Pectins, Gum Arabica and Dietary fiber

UNIT - III  
9 hours

Lipids: Classification, physical aspects, chemical aspects, chemistry of fats and oil processing, role of food lipids in flavor, physiological effects of Lipids.

UNIT - IV  
9 hours

Amino Acids, Peptides and Proteins: Physiochemical properties of amino acids, protein structure, protein denaturation, functional properties of proteins, nutritional properties of proteins, processing induced physical and chemical changes of protein.

UNIT - V  
11 hours

Food colorants: pigments in animal and plant tissues. Flavors: Taste and nonspecific saporous sensations, vegetable, fruit and spice flavor. Food additives: Acid, bases, buffer systems, chelating agent, antioxidant, antimicrobial agent, sweeteners, fat replacers and Mastigatory substances.

Text books and Reference materials

Importance and significance of microorganisms in food science. Micro-organisms importance in food - Factors affecting the growth of micro organisms in food - Intrinsic and Extrinsic parameters that affect microbial growth.

UNIT II
Determination of micro organisms 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-Chenical, immunological and nucleic acid based methods; Culture independent techniques – PCR Based, DGGGE, Metagenomics, etc.; Analytical methods for microbial metabolites- microbial toxins and metabolites.

UNIT III
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
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
Text books and reference materials

UNIT I  
9 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  
10 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. Drying – water activity, microbial spoilage due to moisture. Dehydration of fruits, vegetables, milk, animal 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: 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, sun-drying, 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. Ultra-filtration, reverse osmosis, Freeze drying and freeze concentration.

UNIT V  
10 hours  
Processing and preservation by non-thermal methods: High pressure, pulsed electric field, hurdle technology. GRAS and permissible limits for chemical preservatives and legal aspects for gamma irradiation. Use and application of enzymes and microorganism in processing and preservation of foods; food fermentations, pickling smoking etc; Food additives; Definition, types and functions, permissible limits and safety aspects.

Text books and Reference materials  
UNIT -I  
10 hours

UNIT -II  
11 hours
Heat processing of food: Mechanism of heat 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 curves, equilibrium moisture, adsorption isotherms and relation to storage, water activity, absolute humidity and relative humidity. Drying of milk, fruit juices and liquid foods as well as convective drying for solid foods.

UNIT -IV  
9 hours
Principles of mass and energy balance. Factors affecting heat and mass transfer. 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, irradiation and other non-thermal technologies.

Text Books and Reference Materials

FS&T 415  RESEARCH METHODOLOGY AND BIOSTATISTICS  CREDIT 3

UNIT I  10hours

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  10 hours


UNIT III  9 hours


UNIT IV  10hours

Basic concept of hypothesis testing - Type I and type II errors. Tests based on Means & Proportions on Normal, t & F. One way analysis of variance (CRD), Two way analysis of variance (RBD), LSD, - Multiple comparison tests (DMRT, Bonferonni, Dunnett’s). Carrying out Data Analysis using MS- excel: Descriptive Statistics – Diagrammatic representation – 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  
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: LD50 and TD50. In vitro and in vitro studies; Clinical trials.

UNIT – II  
9 hours  
Natural Toxins in Food: Natural toxins of importance in food- Toxins of plant and animal origin; Microbial toxins (e.g. Algal toxins, bacterial toxins and fungal toxins). Natural occurrence, toxicity and significance. Food poisoning; Mycotoxicoses of significance. Determination of toxicants in foods and their management.

UNIT – III  
10 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 allergenicity of GM foods. Safety of toys and children consumables.

UNIT – IV  
10 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 adultrants.

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: nitrosocompounds, heterocyclic amines, Dietary Supplements and Toxicity related to Dose: Common dietary supplements; relevance of the dose; possible toxic effects.

Text Books and Reference material
UNIT - I  9 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  10 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. Determination of boiling point and freezing point of water
2. Estimation of sugars
3. Stages of sugar cookery
4. Estimation of gluten content
5. Estimation of polyphenols
6. Determination of acidity
7. Determination of gelatinization
8. Determination of natural pigments in foods
9. Fat acidity in foods-flour
10. Determination of refractive index of fats
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
10. Visit to food processing and preservation UNIT.
1. Estimation of moisture content
2. Estimation of soluble and insoluble ash content
3. Estimation of sugars
4. Estimation of fat
5. Estimation of free fatty acids
6. Estimation of Iodine number
7. Estimation of Peroxide value
8. Estimation of protein
9. Estimation of crude fibre
10. Estimation of ascorbic acid
11. Estimation of calcium
12. Estimation of Total Antioxidants
13. Estimation of thiamine
14. Estimation of Riboflavin
15. Estimation of Vitamin A
16. Estimation of β carotene
17. Estimation of cholesterol
18. Estimation of calorific value
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
10. Visit to related processing industries.
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UNIT - I
Milling Equipments: Types of equipment used for milling rice and wheat, pearling and flaking equipment; dhal mills.

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

UNIT - III

UNIT - IV
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.

UNIT - V
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

Department of Food Science and Technology  21
### 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
10 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
10 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
10 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  8 hours

Food needs and consumer preference: market survey and its importance in; designing a questionnaire to find consumer needs for a product or a concept; advantages of processed foods in urbanized modern society; why people buy processed foods. Developing a product to meet the requirements.

UNIT II  11 hours

Designing new products new food product development (NPD) process and activities, 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; recent development in food ingredients/additives flavorings, colourings, emulsifiers, stabilizer and sweeteners; Involvement of consumers, chefs and recipe experts; selection of materials/ingredients for specific purposes; modifications for production on large scale, cost effectiveness, nutritional needs or uniqueness.

UNIT III  9 hours

Standardization & large scale production: process design, equipment needed and design; establishing process parameters for optimum quality; sensory evaluation; lab requirements; different techniques and test; statistical analysis; application in product development and comparison of market samples; stages of the integration of market and sensory analysis.

UNIT IV  11 hours

Quality, safety and 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  

9 hours

Advertisement, marketing and case studies; product performance testing; market positioning, marketing; developing test market strategies; various tools and methodologies to evaluate consumer attitudes, preferences and market acceptance factors; case studies of some successes and failures – factors that influence NPD success, innovation case studies to highlight best practice in terms of the integration of technological and marketing approaches to NPD; food choice models and new product trends.

Text books and Reference materials


UNIT I  
10 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 micro organisms; 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  
9 hours

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

UNIT III  
9 hours

Fermentor design, Instrumentation and control, Types of fermentors (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 Kₐ 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  
10 hours

Fermentative Production: a) Foods: Processes for preparing fermented products including Yogurt (curd) and other Traditional Indian Products like idli, dosa, dhokla, shrikhand, etc., Soya based products like soya sauce, natto, etc., Cocoa, Cheese etc.; Alcoholic Beverages based on fruit juices (wines), cereals (whisky, beer, vodka etc.), sugar cane (rum) etc. Process description, quality of raw materials, fermentation process controls etc.b) Industrial chemicals: Fermentative Production of Organic acids like (Citric Acid, Lactic Acid), Amino Acids (Glutamic acid, Lysine), Antibiotics (Erythromycin, Penicillin), Polysaccharides (Dextran, Xanthan) etc.; steroids transformation; process descriptions and key controls for optimal production.
**Text books and Reference material**


UNIT - I

Environment and Pollution: Components of environment; Environmental pollutions, its measurements and management; Air pollution and its control; Water pollution and its control; Xenobiotic compounds; Pesticides and pest management; processes; Solid wastes and management; 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.

UNIT - II

Control of Air Quality: Air duct design and room air distribution; air conditioning systems; clean-room air conditioning; important pollutants of air; properties of particulate matter and air pollution control methods; air quality in the processing plants, legal requirements.

UNIT - III

Waste Water Treatment: 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

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; pests & their control.

UNIT - V

Utilization of Waste: Methods of utilizing wastes to make value added products-
CASE STUDIES: Pectin, food colourants, antioxidants from fruit peels (citrus, mango, 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.

Reference

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 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 gastrointestinal 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. Symbiotics.

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. Use of anotechnology in functional food industry.
Text Books and Reference materials

UNIT-I


UNIT-II

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


UNIT-IV

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

Product development

1. Permutation combination method
2. Response surface methodology

Evaluation of product

3. Analysis of physical properties
4. Analysis of chemical properties

Sensory evaluation

5. Selection of panel
6. Threshold test

Collection and analysis of sensory data

7. Statistical analysis
8. Interpretation
9. Reporting
1. Assay of enzymes for activity
2. Effect of pH on enzymes
3. Effect of temperature on enzymes
4. Immobilization of enzyme by entrapment and comparison with free enzyme
5. Enzyme deactivation by heat and / or relation with blanching
6. Enzymes in meat tenderization
7. Batch Sedimentation
8. Flocculation
9. Centrifugation
10. Enzyme Lysis
11. Brewery Industry Visit
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.
### Course Code | Title of the Course | Credits
--- | --- | ---
**Hard core**
| FS&T511 | Food Biotechnology | 3 |
| FS&T512 | Food Packaging | 3 |
| FS&T513 | Food Safety and Quality Control | 3 |
| FS&T514 | Technology of Animal Products | 3 |
| FS&T515 | Technology of Spices and Plantation Products | 3 |
| FS&T516 | Minor Project and Seminar | 2 |
| FS&T551 | Technology of Animal Products Lab | 1 |
| FS&T552 | Technology of Spices and Plantation Products Lab | 1 |
**Soft Core**
| FS&T527 | Food Plant Organization and Management | 3 |
| FS&T528 | Food laws and Regulations | 3 |
| FS&T529 | Technology of Fruits and Vegetables | 3 |
| FS&T553 | Technology of Fruits and Vegetables Lab | 1 |
| FS&T554 | Food safety and Quality Control Lab | 1 |
UNIT -I
9 hours

UNIT -II
10 hours

UNIT -III
9 hours
Traditional applications of food biotechnology - 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.

UNIT -IV
10 hours
Starter cultures – types, designing and development, micro encapsulation and packaging, scopes and challenge; Development and formulation of novel products such as probiotic foods. Nutrogenomics - concept, working, significance and relevance. Biosensors and novel tools and their application in food science.

UNIT -V
10 hours
Ethical issues concerning GM foods; testing for GMOs; current guidelines for the production, release and movement of GMOs; labeling and traceability; trade related aspects; biosafety; risk assessment and risk management. Public perception of GM foods. IPR. GMO Act –2004.

Text books and reference materials
UNIT I

9 hours


UNIT II

10 hours


UNIT 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, Edible packaging, Shrink and stretch packaging.

UNIT IV

10 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

10 hours

Packaging Design & Environmental Issues in Packaging: Food marketing and role of packaging-Packaging aesthetic and graphic design; Coding and marking including bar coding; Consumer attitudes to food packaging materials; Packaging Laws and regulations, safety aspects of packaging materials; sources of toxic materials and migration of toxins into food materials; Packaging material residues in food products; Environmental & Economic issues, recycling and waste disposal.
Text Books and Reference materials
3. Ahvenainen, R. (Ed.) 2003 Novel Food Packaging Techniques, CRC Press,
4. 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 regulation (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 10 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 9 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 11 hours
Food Safety regulations and management systems: National and international food quality regulations, Quality systems- Introduction to the legal system, principles in the
general food law, principles of self control, risk analysis on food, international food trade, Codex Alimentarius, traceability, EU-regulations on the hygiene of foodstuffs, and EU-regulations on the official food control. Food quality standard: IPM, GAP, Organic farming, GMP, Standard of food quality and food quality analysis, Environmental risk assessment in food safety aspect, Food hygiene and surveillance system, Standard of food quality and control system, Food industries and quality assurance in food production, ISO certifications. Indian Food regulations – History of Indian Food Regulations: BIS, ISI, FPO, PFA and FDA. Food Safety and Standards Act 2006

**Text books and Reference materials**

5. FSSAI, FSIS, EU and FAO website for updates
UNIT I  
9 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  
9 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, candeling, washing, coating, packaging and storage. Egg processing (Egg powder manufacturing, pasteurization, etc., Spoilage and its control.

UNIT V  
10 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.

Text books and References
UNIT - I

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

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

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

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

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

Text Books and Reference Materials

The Review of Literature and plan of work must be completed in this semester.

This would be evaluated internally.
FS&T527 FOOD PLANT ORGANIZATION AND MANAGEMENT CREDIT 3

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

UNIT -V 
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

9 hours

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

11 hours

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

10 hours

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

9 hours

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

9 hours

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

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

UNIT - II

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

UNIT - III

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

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

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


1. Slaughtering and dressing of meat animals; study of post-mortem changes; meat cutting and handling;


3. Preservation by dehydration, freezing, curing,

4. Evaluation of quality of eggs

5. Preservation of shell eggs

6. Preparation of meat products

7. Vacuum Packaging of meat and marine products

8. Preparation of fish based products

9. Evaluation of fish and other marine products

10. Visit to a meat processing industry
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, Scoville Heat UNITs in chilies,
5. Curcumin content of turmeric;
6. Storage and packaging of spices;
7. Detection of microbial quality and adulteration in spices;
8. Visit to Coffee and tea processing centers
9. Visit to other spice processing UNITs.
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
### PONDICHERRY UNIVERSITY

Department of Food Science and Technology

M.Sc Food Science and Technology

**Semester IV**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title of the Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>FS&amp;T571</td>
<td>Project work</td>
<td>6</td>
<td>HC</td>
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</table>
The Dissertation work continues in IV Semester. Preparation of Thesis report and Thesis Viva-voce are to be done in IV Semester.