



KERALA UNIVERSITY OF FISHERIES AND OCEAN STUDIES

Panangad, Kochi- 682506, Kerala

M. Sc. Food Science and Technology Syllabus 2020

Regulations, Eligibility, Scheme and Syllabus For

M. Sc. Food Science and Technology

(Effective from 2017 Admission onwards)

All the general rules and regulations laid down by the Kerala University of Fisheries and Ocean Studies PG Curriculum shall be applicable.

SCOPE OF THE PROGRAMME

Food safety, security and quality assurance have today become subject of national importance. However, implementation needs skilled man power. There is now an urgent need to accomplish this task. M.Sc. Food Science and Technology offers great scope for employment as managers and quality control personnel needed for the food processing industries as there is ever growing demand for processed foods in coming years.

ELIGIBILITY CRITERIA.

Those students who possess Bachelor Degree in Food Science and Technology, Food Technology and Any Branch of Life Sciences are eligible for admission to M.Sc. Food Science and Technology Programme.

PROGRAMME AND SCHEME OF EXAMINATIONS

1. M.Sc. Food Science and Technology Programme shall have four semesters with 6 core courses and 2 core practical course, seven Core courses and 4 practical courses and five core courses and four practical courses each in 1st, 2nd and 3rd semesters, One elective course and one open elective course each in 2nd and 3rd semesters. 4th Semester is exclusively for dissertation.
2. There shall be external university examination of 3 hour duration for each theory courses at the end of the each semester, to be conducted after the completion of 80 working days.
3. Each practical examination is of 3 hour duration.
4. Project / dissertation evaluation and viva-voce shall be conducted at the end of the programme only.
5. Project / dissertations shall carry 20 credits.

EVALUATION AND GRADING

The evaluation scheme for each course shall contain two parts (a) Internal evaluation and (b) external evaluation. 50% marks shall be given to internal evaluation and the remaining 50% to external evaluation.

Internal evaluation: The internal evaluation shall be based on predetermined transparent system involving periodic written tests, assignments, seminars and attendance. In respect of theory courses and based on written tests, lab skill/records/viva and attendance in respect of practical courses. The weightage assigned to various components for internal evaluation is as follows.

Components of Internal Evaluation

	Component	Weightage
A	Assignment	10
B	Seminar/ Classroom participation	10
C	Attendance	5
D	Test	20
E	MOOC weightage, If any	5
	Practical exam	

To ensure transparency of the evaluation process, the internal assessment grade awarded to the students in each course in a semester shall be published on the notice board at least one week before the commencement of external examination. There shall not be any chance for improvement for internal grade.

The course teacher shall maintain the academic record of each student registered for the course, which shall be forwarded to the University, through the college Principal.

External evaluation: The external Examination in theory courses is to be conducted by the University with question papers set by external experts. The evaluation of the answer scripts shall be done by examiners based on a well-defined scheme of valuation. The external evaluation shall be done immediately after the examination preferably in a Centralized Valuation Camp.

IV. Grievance Redress Mechanism for internal evaluation

There is provision for grievance redresses at four levels- first at the level of teacher concerned; second, at the level of Department committee consisting of the Head of the Department, Departmental Coordinator and the teacher concerned; third, at the level of the Director of the School. HOD and a senior faculty member of the School nominated by the Director each year, and also a student member of that class nominated by the HOD. And fourth, at University level committee consisting of the Pro-vice chancellor, Director of the School and a subject expert nominated by the Vice-Chancellor, Controller of the Examination and the Convener of the Examination standing Committee.

Department and School level complaints will be filed within one week of the publication of the results and the decision taken within the next two weeks. Appeals, if any, on such decision shall be filed in the University level committee within a period of one week and decision taken within one month for the date of the submission of complaints. The time schedule in regard to the grievance redresses will be announced by the colleges concerned and the University in advance.

Normalization of continuous internal evaluation may be done by the university when there is inflation of grades in internal evaluation. The grades will be scaled down proportionately if the variation between the internal and external evaluation exceeds 40%.

V. Evaluation of Project Report/ Dissertation

Dissertation will be valued by two examiners (one internal and One External) who conduct the practical examination (external) at the time of 4th semester. Distribution of marks allotted for dissertation will be as follows

Methodology	20%Marks
Content	40%Marks
Presentation	10%Marks
Answering question	10%Marks
Originality or overall outlook	20%Marks

OUTCOMES-BASED CURRICULUM

A high priority task in the context of future education development agenda in India is fostering quality higher education enabling effective participation of young people in knowledge production and participation in the knowledge economy, improving national competitiveness in a globalized world and for equipping young people with skills relevant for global and national standards and enhancing the opportunities or social mobility. Sustained initiatives are required for institutionalizing an outcome-oriented higher education system and enhancing employability through learning outcomes-based curriculum framework, improving/upgrading academic resources and learning environment, raising the quality of teaching and research across all higher education institutions; technology use and integration to improve teaching-learning processes and reach a larger body of students through alternative learning modes such as open and distance learning modes and use of MOOCs.

Other priority areas of action of fostering quality education include translation of academic research into innovations for practical use in society and economy, promoting efficient and transparent governance and management of higher education system, enhancing the capacity of the higher education system to govern itself through coordinated regulatory reform and increasing both public and private sector investment in higher education, with special emphasis on targeted and effective equity-related initiatives.

The overall **OBJECTIVES OF THE LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK** are to:

- help formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes that are expected to be demonstrated by the holder of a qualification;
- enable prospective students, parents, employers and others to understand the nature and level of learning outcomes (knowledge, skills, attitudes and values) or attributes a graduate of a programme should be capable of demonstrating on successful completion of the programme of study;
- maintain national standards and international comparability of learning outcomes and academic standards to ensure global competitiveness, and to facilitate student/graduate mobility; and

- provide higher education institutions an important point of reference for designing teaching-learning strategies, assessing student learning levels, and periodic review of programmes and academic standards

AIMS OF THE POST-GRADUATE PROGRAMME IN FOOD SCIENCE AND TECHNOLOGY

- provide students with learning experiences that help instill deep interests in learning different areas of food processing technology such as fruits and vegetable processing technology, cereals, oil seeds processing technology, fish processing technology etc.;
- develop broad and balanced knowledge and understanding of key concepts, principles, and theories related to food science and technology; and equip students with appropriate tools of analysis to tackle issues and problems in the field of food science and technology.
- develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in the area,
- provide students with the knowledge and skill base that would enable them to undertake further studies in the subject and related areas or in multidisciplinary areas that involve food science and technology and help develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship

The **PROGRAMME LEARNING OUTCOMES** relating to M.Sc. Food Science and Technology degree programme may include the following:

- Demonstrate (i) a systematic or coherent understanding of the fundamental concepts, principles and processes underlying the academic field of food science and technology, its different subfields (food chemistry, nutrition, processing, engineering, etc.), and its linkages with related disciplinary areas/subjects; (ii) procedural knowledge that creates different types of professionals in the field of food science and technology and related fields such as food industry, teaching, research, , product quality, consumer goods industry, food products, cosmetics industry, etc.; (iii) skills related to specialisation areas within food science and technology, and other related fields of study, including broader interdisciplinary subfields (nanotechnology, patent filing, etc.).
- Apply appropriate methodologies in order to conduct analyses or other chemical investigations; and apply relevant knowledge and skills to seek solutions to problems that emerge from the subfields as well as from broader interdisciplinary subfields relating to the subject;
- Use techniques relevant to academia and industry, generic skills and global competencies, including knowledge and skills that enable students to undertake further studies in the field of food science and technology or a related field, and work in the industry sectors.
- Undertake hands on lab work and practical activities which develop problem solving abilities required for successful career in food industry, teaching, research, food quality monitoring, product quality, consumer goods industry, food products, cosmetics industry, etc.
- Recognize and appreciate the importance of the food sciences and its application in an academic, industrial, economic, environmental and social contexts.

COURSE-LEVEL LEARNING OUTCOMES

SEMESTER I (Core subjects: General Biochemistry, Food Chemistry and Nutrition, General Microbiology and Food Microbiology, and Statistical Methods)

- Describe molecular structure and bonding in biochemical molecules of nutritional significance; classify compounds by structure, use the IUPAC nomenclature, and identify conformational effects.
- Recognize the metabolic pathway of the biomolecules; understand and predict the role of biocatalyst in effecting these pathways
- Comprehend the significance of the biomolecules in health.
- Understand the chemical and physical nature/ structure of biomolecules and role of these in effecting food composition, texture, etc. Gain knowledge on the various analytical and instrumental techniques used in this field.
- Comprehend the general microbes and their world; and microbes specific to food which may be harmful or beneficial to health or may cause food spoilage.
- Appreciate the fundamentals of food preservation and effect of these on microbes.
- Recognize the importance of statistical evaluation of the biological and other data and its importance in science

SEMESTER II (Core subjects: Principles of Food Engineering and Plant layout, Technology of Spice and plantation processing, Technology of Cereals, legumes and oil seed processing, Technology of fruit and vegetable processing, Technology of Meat, poultry and dairy processing, Fish processing technology; Elective: Dietary foods and nutraceuticals)

- Distinguish the different principles of food processing and its application in different food industries such as fruits and vegetable industry, meat industry, dairy industry, poultry industry, seafood industry, etc.
- Comprehend the novel non-thermal processing techniques such as high-pressure processing, pulsed electric field, ohmic, microwave, etc. and its advantages over the conventional methods
- Recognize the influence of different post-harvest and processing techniques on nutritional quality of various groups of food
- Identify the importance of functional foods and nutraceuticals in improving health and minimizing the risk of several diseases
- Advances in food processing technology including nanotechniques, etc.

SEMESTER III (Core subjects: Food additives and flavour technology, Food packaging, Quality assurance and food safety, Food laws and environmental issues, Food business management and economics; Elective: Food biotechnology)

- Appreciate the importance of quality control and quality assurance in food industries.
- Comprehend the importance of food laws, food business management and economics and venture as entrepreneurs

- Diagnose the importance of packaging in maintaining food quality and understand the importance of active packaging, passive packaging and smart packaging technology, etc. in food chain
- Explain the structure and importance of flavouring agents and its role in maintaining food flavour.
- Recognize the importance of additives and preservatives in preserving or improving the food quality

SEMESTER IV

TEACHING-LEARNING PROCESSES

As a programme of study in food science and technology is designed to encourage the acquisition of disciplinary/subject knowledge, understanding and skills and academic and professional skills required for food science and technology-based professions and jobs, learning experiences should be designed and implemented to foster active/participative learning. Development of practical skills will constitute an important aspect of the teaching-learning process. A variety of approaches to teaching-learning process, including lectures, seminars, tutorials, workshops, peer teaching and learning, practicum and project-based learning, field-based learning, substantial laboratory-based practical component and experiments, open-ended project work, technology-enabled learning, internship in industry and research establishments etc. will need to be adopted to achieve this. Problem-solving skills and higher-order skills of reasoning and analysis will be encouraged through teaching strategies.

Syllabus of the Master's Programme

M.Sc. Food Science and Technology (With effect from academic year 2017)

Course Structure, Scheme & Syllabus

I Semester

Course	Course Code	Course Title	L	P	Exam Duration	Internal (%)	External (%)	Credits
Core	MFT2101	General Biochemistry	3		3 hrs	50	50	3
Core	MFT2102	Food Chemistry and Nutrition	3		3 hrs	50	50	3
Practical	MFT 2103	Biochemical and Food Analysis		4	3 hrs	50	50	2
Core	MFT2104	General Microbiology	3		3 hrs	50	50	3
Core	MFT2105	Food Microbiology	3		3 hrs	50	50	3
Practical	MFT 2106	Microbiology Practical		4	3 hrs	50	50	2
Core	MFT 2107	Biostatistics and Computer Applications in Food Industry	3		3 hrs	50	50	3
Practical	MFT 2108	Biostatistics and Computer Applications in Food Industry Practical		2	3 hrs	50	50	1
		Total Credits						20

II Semester

Course	Course Code	Course Title	L	P	Exam Duration	Internal (%)	External (%)	Credit
Core	MFT 2201	Principles of food Engineering and plant layout	3		3 hrs	50	50	3
Core	MFT 2202	Technology of Cereals, Legumes and Oil seed processing	3		3 hrs	50	50	3
Practical	MFT 2203	Technology of Cereals, Legumes and Oil seed processing practical		2	3 hrs	50	50	1
Core	MFT 2204	Technology of Fruit and vegetable processing	3		3 hrs	50	50	3
Practical	MFT 2205	Technology of Fruit and vegetable processing practical		2	3 hrs	50	50	1
Core	MFT 2206	Technology of Meat, poultry and dairy processing	3		3 hrs	50	50	3
Practical	MFT 2207	Technology of Meat, poultry and dairy processing		2	3 hrs	50	50	1
Core	MFT 2208	Fish processing technology	2		3 hrs	50	50	2
Practical	MFT 2209	Fish processing technology practical		2	3 hrs	50	50	1
Elective	MFT 2210 MFT 2211	Baking and confectionary technology Dietary foods and nutraceuticals	2		3 hrs	50	0	2
Open Elective	OST	Open Elective	3	-	3 hrs	50	50	3
		Total Credits						23

III Semester

Course	Course Code	Course Title	L	P	Exam Duration	Internal (%)	External (%)	Credits
Core	MFT 2301	Technology of Spice and plantation crops processing	2		3 hrs	50	50	2
Practical	MFT 2302	Technology of Spice and plantation crops processing practical		2	3 hrs	50	50	1
Core	MFT2303	Food Additives and Flavour technology	3		3 hrs	50	50	3
Practical	MFT2304	Food additives and flavour technology practical		4	3 hrs	50	50	1
Core	MFT2305	Food packaging technology	2		3 hrs	50	50	2
Practical	MFT2306	Food packaging technology practical		2	3 hrs	50	50	1
Core	MFT2307	Quality assurance and food safety	3		3 hrs	50	50	3
Practical	MFT2308	Quality assurance and food safety practical		2	3 hrs	50	50	2
Core	MFT2309	Food laws and environmental issues	2		3 hrs	50	50	2
Core	MFT2310	Entrepreneurship and Food Business Management	1		1hr	50	50	2
Elective	MFT2311	Dried, cured, smoked, marinated and fermented foods	3		3 hrs	50	50	Choose one 3 credits
	MFT 2312	Postharvest handling, transportation and storage						
	MFT 2313	Food biotechnology						
Open Elective	OST	Open Elective	3		3 hrs	50	50	3
*Practical Non-credit course	MFT 2314	Industrial Training						1
		Research methodology/ technical writing						
		Total Credits						27

IV Semester

Course	Course Code	Course Title	L	P	Exam Duration	Internal (%)	External (%)	Credits
Core		Dissertation			3 hrs		100	20
Total Credits 20								
Total Credits for the whole Programme								90

SYLLABUS

Semester I courses

MFT2101 General Biochemistry

3

Module I

12 hours

Carbohydrates- metabolic pathways: Aerobic and Anaerobic degradation. Glycogenesis ,glycogenolysis, Emden–Mayerhoff Pathway. Alternate pathways of carbohydrate metabolism. Hexose monophosphate shunt. Hormonal regulation of blood glucose.

Module II

10 hours

Bioenergetics- principle of bioenergetics. Free energy; endergonic and exergonic processes. Formation and breakdown of ATP. Biological oxidation and reduction. Oxidative phosphorylation. Enzymes involved in electron transport. Chemiosmotic theory. Inhibitors of respiratory chain.

Module III

10 hours

Composition, classification and mode of action of proteins: proteins and amino acids. Structure and classification. Protein degradation and denaturation. Urea cycle. Metabolism of amino acids. Biosynthesis of Proteins. Nucleic acids and nucleotides. Structural changes of proteins during food processing.

Enzymes: Classification, structure, activity and inhibition. Biosynthesis. Role of enzymes in digestion and metabolism. Role of enzymes in industrial food processing.

Protein hormones and their role in human health. Hormone action, regulation and biosynthesis.

Module IV

12 hours

Lipids: Fatty acids; saturated and polyunsaturated fatty acids; omega-3 and omega -6 fatty acids. Biosynthesis of fatty acids. Beta- oxidation. Triglycerides and phospholipids. Structure and composition of fatty acids of common edible oils. Auto-oxidation. Estimation of oxidative rancidity in foods- peroxide value, thiobarbituric acid value, role of antioxidants, Essential fatty acids and their role in human nutrition.

Module V

10 hours

Prostaglandins, thromboxanes and leucotrienes-formation from arachidonic acid and role of cyclo-oxygenases. Their structure and biosynthesis and role in pathology.

Regulatory metabolism: Inter relation of carbohydrates, lipids and proteins. Role of vitamins in human health and their deficiency diseases. Diabetics, types of diabetics.

Reference

Boyer, R.F. 2002. Concepts in Biochemistry, 2nd edn. Wiley, New York.C

Campbell, M.K. and S.O. Farrell. 2002. Biochemistry, 4th edn. Brooks/ Cole.

Metzler, D.E. 2003. Biochemistry, 2nd edn. Academic Press.

Moran, A. L., Horton, A. R., Scrimgeour, G., & Perry, M. (2011). Leninger Principles of biochemistry.

Nelson, D.L. and M.M. Cox. 2000. *Lehninger's Principles of Biochemistry*, 3rd edn. Macmillan Worth Publishers.

Tumpf, P.K., G.Bruening, and R.H. Doi. MM. 2001. *Outlines of Biochemistry*, 5th edn. H e i n e m a n n Medical Books.

MFT2102 Food Chemistry and Nutrition

3

Module I

10 hours

Food Chemistry – definition, scope and importance of water in food, physical properties of water and ice. Water activity and relative vapour pressure. Relative vapour pressure and food stability.

Principles of colorimetry, spectrophotometry, fluorometry, atomic absorption spectroscopy and chromatographic methods- HPLC and GC.

Module II

12 hours

Carbohydrates- classification, physical and chemical properties of sugars; functional properties and uses of pectic substances; gums and dietary fibre in food; browning reaction in food- enzymatic and non-enzymatic browning, their occurrence and application in food. Starches: functionality of starch in foods, gelatinization and retro gradation of starches, modified starches, resistant starch.

Module III

12 hours

Chemistry of amino acids and proteins. Classification of proteins, chemical and physical properties of proteins; techniques used in elucidation of protein structure. Protein conformation, functional properties of proteins in foods, hydrolysis of protein, major food proteins and their sources. Changes in proteins during processing, chemical modification of proteins. Enzymes– classification, mechanism of action, purification, commercial applications, food enzymes.

Module IV

10 hours

Oils and fats- their chemistry, occurrence, classification and composition. Physical and chemical properties of fats. Rancidity and flavor reversion, oil sources, extraction and refining, hydrogenation and interesterification.

Module V

10 hours

Vitamins, classification, properties and chemistry; enrichment and fortification; changes during processing. Emulsions, definition, classification and functional properties. Essential oils, chemistry, occurrence and extraction. Terpenoid oils and their uses in food.

Reference

Belitz, H.D. 2005. *Food Chemistry*. Springer Verlag.

Lee, F. (2012). *Basic food chemistry*. Springer Science & Business Media.

Srinivasan, Damodaran, Kirk, L. Park and Owen R. Fennema. 2008. *Food Chemistry*, CRC Press, Taylor and Francis Group, New York.

Varelis, P., Melton, L., & Shahidi, F. (2018). *Encyclopedia of Food Chemistry*. Elsevier.

Velisek, J., Koplik, R., & Cejpek, K. (2020). *The chemistry of food*. John Wiley & Sons.

MFT2103 Biochemical and Food analysis Practical**2**

- Estimation of glucose in food
- Estimation of sodium, potassium, calcium and iron in food
- Purification of proteins
- Separation of proteins by gel electrophoresis
- Chromatography- column, paper, thin layer, GLC
- Sampling techniques and sampling of foods for analyses
- Estimation of moisture, proteins, Nitrogen, fats, minerals, sugar, crude fibre in foods
- Estimation of amino acids
- Estimation of vitamins– ascorbic acid, carotene, thiamine
- Analysis of lipids– free fatty acid, acid value, saponification value and iodine value
- Determination of starch and pectin substances using different methods
- Isolation of starch and casein
- Estimation of lactose in milk

MFT2104 General Microbiology**3****Module****110 hours**

The scope and evolution of microbiology; the five-kingdom concept; prokaryotes and eukaryotes; types of microorganisms: bacteria, fungi and virus.

Microscopy- general principles, types of microscope- bright field, dark field, UV, fluorescent, phase contrast and electron microscopes. Microscopic examination of bacteria- wet mount, fixed and stained; microbiological stains- simple and differential staining, Gram, acid fast, spore and negative staining.

Characteristics of bacteria- morphology and fine structure- cell wall, flagella, fimbriae, capsules, internal structure- cytoplasmic membrane, cytoplasm, inclusion bodies, nuclear material, spores.

ModuleII**10 hours**

Cultivation of bacteria- nutritional requirements, nutritional types of bacteria, bacteriological media- types of media- general, selective media and differential media. Physical conditions for growth- effect of environment on growth.

Reproduction and growth of bacteria- cell division and new cell formation, growth rate and generation time, growth curve. Batch culture and continuous culture, measurement of growth. Isolation of bacteria, cultural characteristics of bacteria, maintenance and preservation of bacterial culture, type culture collections

Module III**10 hours**

Bacterial metabolism- energy production and utilization, fundamental principles of energetics, oxidation- reduction reactions and energy production, respiratory chain. Energy metabolism in heterotrophic and chemoautotrophic bacteria, anaerobic respiration, energy utilization by bacteria.

Bacterial modifications, mutation and genetics- phenotypical modifications- morphological, cultural and biochemical, genotypical modifications- mutation, types of mutations, replica plating, bacterial recombination, conjugation, transformation and transduction.

Bacterial taxonomy- nomenclature and classification, classification schemes, Bergy's and Adansonian Classifications.

Module IV**12 hours**

Fungi- moulds and yeasts. Distinguishing characteristics of moulds- morphology and cell structure. Reproduction- sexual and asexual spores. Physiology and nutrition of moulds- cultivation of moulds. Morphological examination- classification of moulds, important groups of moulds. Yeasts- morphology and structure, cultural characteristics, reproduction, physiology of yeasts, classification of yeasts.

Viruses- animal viruses; Virion- structure and composition, replication of viruses, isolation and identification, cultivation of animal viruses. Bacterial viruses- bacteriophages, general characteristics, morphology and structure, isolation and cultivation, reproduction of bacteriophages- lytic and lysogenic cycles; bacteriocins.

Module V**12 hours**

Control of microorganisms- fundamentals of control- control by physical agents. Heat sterilization- dry and moist heat, steam under pressure, autoclaves- laboratory and industrial models, pasteurization. Control by low temperature, desiccation, osmotic pressure, radiations- UV, X-ray, electron beam, radurisation and radappertisation. Filtration sterilization- bacterial filters, Seitz filter, Berkfield, Chamberland filters, sintered glass filters, membrane filters, HEPA filters. Chemical control of microorganisms- disinfectants, germicides, sanitizing agents. Groups of antimicrobial agents- phenols, alcohols, halogens, hypochlorites, chloramines, heavy metals- oligodynamic action. Antimicrobial action of dyes, quaternary ammonium compounds, glutaraldehyde and formaldehyde, ethylene oxide, beta- propionolactone. Evaluation of disinfectant action- the phenol coefficient. Control by antibiotic and therapeutic agents.

Reference

Ananthanarayanan and Jayaram Paniker. *Text Book of Microbiology*.

Pelczar, Reid and Chan. *Microbiology*. Tata McGraw hill edition.

Salle, mA. J. *Fundamental Principles of Bacteriology*. TMH Edn.

Surendran, P.K., Nirmala Thampuran, V. N. Nambiar and K. V. Lalitha. *Laboratory Manual on Microbiological Examination of Seafood*. CIFT, Cochin.

MFT2105**Food Microbiology****3****Module I****10 hours**

Microorganisms of importance in foods- major genera usually found in foods. Morphological, cultural and physiological characters of bacteria, moulds and yeasts important in foods. Industrially important moulds. Intrinsic and extrinsic factors in food affecting growth of microorganisms. Sources of microbial contamination of food- General principles underlying spoilage of food- causes of spoilage, classification of foods based on ease of spoilage.

Module II**12 hours**

Principles of food preservation- preservation by use of high temperature- heat resistance of microorganisms and their spores, thermal death time, TDT curve, decimal reduction time, D-value, z- value and F-value. Determination of thermal process, 12 D concept. Preservation by retorting and pasteurization.

Low temperature preservation of foods- effect of chilling and freezing on microorganisms. Preservation by curing and drying- effect of water activity; microbiology of dried foods.

Module III**10 hours**

Contamination, preservation and spoilage of different food items– cereal and cereal products, sugar and sugar products, vegetables and fruits, meat and meat products, fish and other seafood, eggs, poultry and milk and milk products. Spoilage of canned foods- causes of spoilage, classification of canned foods based on acidity; aerobic and anaerobic spoilage of canned foods. Spoilage of dried and cured products. Spoilage of oils, bottled beverages, spices, etc.

Module IV**10 hours**

Food borne infections and intoxications. Bacterial food poisoning- infection types, *Vibrios*, *Salmonella*, enteropathogenic *E.coli*, *Clostridium perfringens*, *Campylobacter*, *Shigella*. Intoxication type- *Clostridium botulinum* and botulism, *Staphylococcus aureus*, *Bacillus cereus*. Mycotoxins- aflatoxin, ochratoxin. Food-borne viral infections- Enteroviruses, Hepatitis virus, Polio virus. Algal toxins- paralytic shellfish toxin, ciguatera toxin. Parasites- protozoa.

Module V**12 hours**

Fermented food products. Fermentation- definition, types of food fermentations- lactic acid fermentation, bacterial cultures involved, homo fermentation and hetero fermentation. Pathways of fermentation- propionic acid fermentation, cultures involved; alcoholic fermentation, cultures involved, pathways of alcohol production from different substrates. Products of fermentation- dairy products, bread, malt beverages- beer- different types, wines, distilled liquors, vinegar fermentation, fermented vegetables, tea, coffee and cocoa fermentation.

Reference

Doyle, M. P., Diez-Gonzalez, F., & Hill, C. (Eds.). (2020). *Food microbiology: fundamentals and frontiers*. John Wiley & Sons.

Jay, James, M. 2000. *Modern Food Microbiology*, 2nd edn. CBS Publisher.

Shen, C., & Zhang, Y. (2017). *Food Microbiology Laboratory for the Food Science Student: A Practical Approach*. Springer.

Surendran, P.K., Nirmala Thampuran, V. N. Nambiar and K. V. Lalitha. *Laboratory Manual on Microbiological Examination of Seafood*. CIFT, Cochin.

MFT2106 Microbiology Practical**2**

- Introduction to good laboratory practice and safety in the microbiology laboratory
- Microscopy- lens system, proper use and care
- Sterilization of petri dishes, pipettes, tubes, etc. by dry sterilization; Sterilization of culture media by steam sterilization, preparation of culture media- nutrient agar (in flasks and as slants), nutrient broth, diluents (in flasks and in test tubes)
- Preparation of bacterial stains- Simple (methylene blue), Gram- stains; Culture transfer techniques- use of inoculation loop and needle
- Bacterial motility - plain and cavity slides; Bacterial transfers, isolating single colonies, streak dilution for pure cultures, colony morphology; Staining of bacterial cultures- simple staining (methylene blue), differential staining (Gram staining), spore staining, negative staining, flagella staining
- Determination of total bacterial count of a sample- pour and surface (spread), plating techniques; MPN

techniques for indicator bacteria- coliforms, faecal coliforms and *E.coli*; Biochemical reactions of isolated cultures- nitrate reduction, indole production; Starch hydrolysis, sugar fermentation, MR VP tests, catalase and cytochrome oxidase tests; Presumptive identification of bacterial isolate

- Effect of environment on bacterial growth- effect of salt, incubation temperature, pH; Testing of antibiotic sensitivity of bacteria- agar diffusion method.
- Isolation of yeast and mould– plating of a commercial food product on potato dextrose agar/ DRBC agar/ RBC agar; Isolation and staining of mould and yeast; Phenol coefficient method for comparing disinfectant action
- Determination of total bacterial population of a given food (raw) material/ commercial spice sample/ cereal flour sample using nutrient agar/ TG agar
- Determination of lactic acid bacterial (LAB) count of curds/ fermented product using MRS agar with agar overlay
- Estimation of mould and yeast count of wheat flour/ commercial spice powders using PD agar and DRBC/ RBC agar
- Determination of total coliforms and *E. coli* in a commercial fish/ meat sample using VRBGA and T7 agar; *Staphylococcus aureus* using BP agar; faecal streptococci in a given sample using KF agar; *Salmonella* in raw fish/ meat sample by adopting a standard procedure; *V. cholera*/ *V. parahaemolyticus*
- Estimation of SO_3 -reducing clostridia in a given sample; commercial sterility

MFT2107**Biostatistics and Computer applications in Food Industry****3****Module I****10 hours**

Elementary concepts in Statistics: Concepts of statistical population and sample from a population; qualitative and quantitative data; nominal, ordinal, ratio, interval data Collection and scrutiny of data, Sampling and nonsampling errors, Sample size determination, Cluster and Multistage Sampling, Examples based on biostatistical experiments, Presentation of data: Diagrammatic and graphical representation of data; histogram. Descriptive statistics: measurement of uncertainty, Concepts of central tendency, Absolute and relative measures of dispersion; Box plot, Lorenz curve.

Module II**14 hours**

Analysis of Bivariate data and Probability: Correlation: Scatter diagram, Principle of least squares, Karl Pearson's correlation coefficient, rank correlation, partial and multiple correlations. Linear regression: Simple linear regression, multiple regression, fit of polynomials and use of orthogonal polynomials. skewness and kurtosis (theory only). Concepts of probability and random variable, Evaluation of probabilities from the binomial and Poisson distributions. Central limit theorem (no derivation) and its application, Sampling distributions (chi-square, t, F, no derivations), Distribution of sample mean from the population.

Module III**10 hours**

Theory of Estimation and Testing of hypothesis:: Point estimation and interval estimation (mean) Basic principles of Experimental Designs, Elements of Quality Control: types, sample procedure, control charts, Testing of hypothesis, Parametric tests, testing of significance based on Z-test, t-test, F-test, Chi-square test, Analysis of Variance, one way and two way classifications

Module IV**10 hours**

Sensory and consumer data: The nature and quality of sensory and consumer data, experimental design issues, survey data, trained panel sensory data, analysis of relationships. Instrumental data: Quality and nature of instrumental data, sampling and replication, experimental design issues,

statistical analysis, chemical analysis applications, analysis of relationships. Product formulation: design application in food product development, single ingredient effects, two or more ingredient effects, screening of many ingredients, formulation by constraints. Statistical quality control: types, sample procedure, control charts, acceptance sampling.

Module V:

10 hours

Artificial intelligence, robotics, Simulation and Food process modelling, familiarization of applications of computer and software in food industries. Application of computers in instrumentation and control of food machinery, inventory control, process control. Visit to Industry and case study.

References

- Agarwal B.L. Basics Statistics, New Age International (p) Ltd.
 Cochran, W.G. (2002). Sampling Techniques. Wiley
 Croxton, F.E., Cowden, D.J. Klenis, S. Applied General Statistics, Prentice Hall.
 Daniel, W. W. (2007). Biostatistics- A Foundation for Analysis in the Health Sciences, Wiley.
 Pagano, M. & Gauvreau, K. (2007). Principles of Biostatistics.
 Dutta, N. K. (2004). Fundamentals of Biostatistics, Kanishka Publishers.
 Gurumani N. (2005). An Introduction to Biostatistics, MJP Publishers.
 Nabendu Pal and Sahadeb Sarkar (2013) . Statistics - Concepts and Applications. PHI Learning Private Limited, New Delhi.
 Rengasamy R. (2013) A Text book of Agricultural New Age International (p) Ltd.
 Rossi R.J. (2010). Applied Biostatistics for Health Sciences, Wiley.
 Sampath S. (2005). Sampling Theory and Methods.
 Wilcox, R. R. (2009). *Basic statistics: understanding conventional methods and modern insights*. Oxford University Press on Demand.

MFT2108 Biostatistics and Computer applications in Food Industry Practical

1

- Sample techniques
- Data analysis using Excel/ SPSS/ SAS/ MINITAB
- Graphical representation of data, computation of various measures of central tendency and dispersion.
- Computation of correlation coefficient, fitting of simple linear regression.
- Construction of confidence intervals concerning mean.
- Parametric tests of Hypothesis concerning mean.
- Chi-square tests for goodness of fit and independence.
- ANOVA and ANACOVA
- Student's t-test
- Consumer survey and data analysis
- Quality control data collection and analysis
- Sensory panel data collection and analysis
- Instrumental data analysis

Semester II courses

MFT2201 Principles of Food Engineering and Plant Layout

3

Module I

10 hours

Introduction to food engineering. Mass and energy balance, fluid dynamics, fluid flow applications. Factors influencing heat and mass transfer. Newtonian and non-Newtonian fluids. Viscosity and texture- significance in foods. Visco-elastic behaviour of dough/ paste. Instruments for measuring viscosity and texture.

Module II

12 hours

Mechanisms of heat transfer- conduction, convection, radiation. Thermal properties of foods. Conductive heat transfer in solid foods; convective heat transfer coefficient, forced convection, overall heat transfer coefficient. Heat exchangers, evaporators, condensers, jacketed kettles. Thermal processing principles- evaporation, pasteurization, sterilization, distillation, blanching, HTST, UHT. Batch and continuous operations. Types of retorts and pasteurizers.

Module III

12 hours

Phase change operations- evaporation, drying, sublimation. Mass and heat transfer, enthalpy. Factors influencing drying rate, water activity, equilibrium relative humidity, vapour pressure, drying curve, sorption isotherms. Types of dryers and evaporators.

Freezing and thawing- ice crystal formation- influence on rate of freezing; freezing and thawing curves. Principle of mechanical refrigeration; properties of refrigerants. Thawing techniques- air, water, dielectric, etc. Types of freezers.

Freeze drying- phase diagram and triple point of water.

Module IV

10 hours

Mechanical separations- filtration, membrane concentration, sieving, centrifugation, sedimentation. Mechanical handling of foods- conveying, elevation. Size reduction- mixing, kneading, blending. Other process techniques- irradiation, infra-red, pulsed electric, etc.

Module V

10 hours

Plant designs: process designs development and general design considerations.

Process economics: Economic feasibility of projects using order of magnitude cost estimates

plant and equipment cost estimations, product cost estimations; batch versus continuous operations.

Factors to be considered for location and layout of food plants. Regulatory requirements of food industries. Decision processed for raising efficiency, productivity and quality in food plant operation.

Reference

Berk, Z. (2018). *Food process engineering and technology*. Academic press.

Das, H. 2005. *Food Processing Operations Analysis*. Asian Books.

Heldman, D. R. (Ed.). (2012). *Food process engineering*. Springer Science & Business Media

Majumdar, A.S. 2004. *Dehydration of Products of Biological Origin*. Oxford and IBH Publication.

Rao, G.C. 2006. *Essentials of Food Process Engineering*. BS Publications.

Rao, M.A, S.S.H. Rizvi and A.K. Datta. 2005. *Engineering Properties of Food*, 3rd edn. Taylor and Francis.

MFT2202 Technology of Cereal, Legume and Oils Seed processing

3

Module I

12 hours

Current status, growth rate, and economic importance of bakery and confectionary industry in India. Product types, nutritional and safety of products, pertinent standards and regulations. Post harvest management, handling, transportation and storage, infestations and pest control.

Production of cereals, legumes and oil seeds in India, production statistics. Commercially important varieties. Harvest, transport, storage.

Wheat: Types and characteristics. Milling. Wheat based products and by products. Gluten content in wheat. Wheat flour and *atta*- manufacture *atta*, commercial methods.

Module II

8 hours

Rice: Types of germ plasm. Physical and chemical characteristics and proximate composition of commercially important varieties. Starch content. Processing of rice- milling, par-boiling. Rice bran and rice bran oil. Effect of different types of processing on storage and keeping quality of rice.

Rice based products, Production of rice powder. Rice based commercial products and by-products. *Basmathi* rice and its flavour components.

Module III

10 hours

Other cereals: Maize, corn, barley, oats, sorghum and millets- varieties, chemical composition; nutritive value. Methods of processing. Products and value added products.

Module IV

10 hours

Legumes: Commercially important species. General composition, characteristics and processing. Products and value added products.

Module V

8 hours

Oils seeds: Major commercial species. Methods of production of oil.

Vegetable oils- fatty acid composition, methods of commercial extraction, refining, bleaching and deodorization, coconut processing and coconut oil extraction

Module VI

6 hours

Bakery Products: Ingredients and processes for breads, biscuits, cookies and crackers, cakes and pastries, doughnuts, rusks, other baked products.

Equipment, product quality characteristics, faults and corrective measures for bakery products. Defining and assessing quality of ingredients and products, breakfast cereals, macaroni products, sprouted grains.

Reference

Chakraborty, M.M. 2003. *Chemistry and Technology of Oils and Fats*. Prentice Hall.

Delcours, Gunstone, F. (Ed.). (2011). *Vegetable oils in food technology: composition, properties and uses*. John Wiley & Sons.

Dendy, D.A.V. and Dobraszczyk, B.J. 2001. Cereal and Cereal Products. Aspen.

Owens, G. (Ed.). (2001). *Cereals processing technology*. CRC Press.

Pylar, E.J. and L.A. Gorton. 2009. *Baking: Science and Technology*, Vol. II: Formulation and Production, 4th edn. Sosland Publishing Co., Kansas City.

MFT2203 Technology of Cereal, Legume and Oils Seed Processing Practica I1

- Estimation of proximate composition of cereals
- Estimation of proximate composition of oil seeds
- Estimation of proximate composition of legumes
- Estimation of rheological properties of rice and wheat
- Determination of gluten content of wheat
- Parboiling of rice and practical training of milling at domestic/ industrial establishments
- Estimation of amylose content of rice
- Malting, puffing and popping of grains
- Extraction of rice bran oil and purification
- Preparation of bread and cakes
- Preparation of buns
- Preparation of cookies and biscuits in the laboratory
- Visit to industrial establishments

MFT2204 Technology of Fruit and Vegetable Products

3

Module I

12 hours

Global production trends. Climacteric and non climacteric fruits. Physiology of maturity, ripening, and senescence in fruits, and vegetables. Maturity indices and harvesting of vegetables. Post-harvest losses, phases of loss and measures to reduce the losses.

Preservation, handling, packing and transport of fresh fruits and vegetables; pre-processing, grading, cleaning and storage- chilled storage, modified atmosphere packing.

Scope of fruits/vegetables of commercial importance in Kerala: Mango, Banana, Jackfruit, Pineapple, Papaya, Guava, Passionfruit, Rose Apple, Custard Apple, Breadfruit, Gooseberry, Bimbli, Carambola, Mangosteen, Rambutan, Tapioca and Yams.

Module II

10 hours

Processing methods by drying and osmotic dehydration using sugar. Flavour, colour and nutritional changes during drying and storage. Production of fruits juice powders by vacuum drying, spray drying and freeze drying. Production of marinades and pickles.

Module III

12 hours

Production of juices, jams, pastes and marmalades. Pectin content of fruits, role of pectin in products. Pasteurisation, Canning of fruits in sugar syrup; vegetables in brine. Bottling, canning and retort pouch packing of fruit and vegetable products, Retorts. Preservatives and antioxidants used in fruit processing.

Tomato based products like purees and sauces. Fermented fruit juices. Aseptic packing of fruits and vegetables and their extracts.

Module IV

12 hours

Freezing of fruits and vegetables: methods and equipment. Problems associated with freezing
Fruit and vegetable based value added products. Jellies, soups, sugar preserved candies, fruit bars-
methods of production.

Fruit preservatives and flavour enhancers. Extraction of natural colours from fruits and vegetables for
use in food industries and their standards and quality parameters.

Module V

8 hours

Technology of production of wine, beer and alcohol production from sugars, starches and fruits juices.
Technology of processing of drinking water. Waste utilization- ensilage using vegetables.

Reference

Alzamora, S.M., M.S. Tapia and A. Lopez- Malo. 2005. *Minimally Processed Fruits and Vegetables: Fundamental Aspects and Applications*. Springer.

CBS. 2005. *Hand Book of Fruit Science and Technology: Production, Storage and Processing*. Marcel, Dekker.

Salunkhe, D.K. and S.S. Kadam. 2005. *Handbook of Fruit Science and Technology: Production, Composition, Storage and Processing*. Marcel Dekker.

Vaclavik, V.A. and E. W. Christian. 2005. *Essentials of Food Science*. 2nd edn. Springer.

MFT2205 Technology of Fruit and Vegetable Products Practical

1

- Quality evaluation of fruits and vegetables by visual and sensory methods
- Extraction of fruit juices and processing drinks using sugar and preservatives
- Pre-processing of vegetables
- Preparation of dried fruits and vegetables
- Preparation of jams
- Preparation of jellies and marmalades
- Freezing preservation of fruit and vegetable products
- Pickling of fruits
- Pickling of vegetables
- Industrial training in commercial establishments/factories.
- Extension of shelf life of various foods/ agricultural produce by irradiation
- Modified atmospheric packaging to extend shelf life of vegetables and fruits
- Determination of water activity and drying curve of foods

MFT2206 Technology of Meat, Poultry and Dairy Products

3

Module I

12 hours

Meat: Different types of meat- beef, mutton, pork, rabbit meat, etc.- their physical and chemical characteristics, and proximate composition.

Structure of muscle and its properties as meat: the muscle cell and different classes of proteins in meat. Muscle contraction- rigor mortis. Cold shortening, muscle aging. Muscle structure and meat toughening.

Collagen: Role of collagen in meat texture and quality. Drip loss. Effect of cooking- loss of water. Recent advances in the chemistry of rancidity of fat in meat. Autoxidation and free radical mechanism. Estimation of rancidity in meat. Chemistry of meat flavor. Chemistry of meat binding. Meat microbiology and safety; microbial spoilage of meat.

Module II

10 hours

Abattoirs- layout and requirements. Stunning methods, methods of slaughtering and dressing, hoisting facilities, tenderization. Fresh meat inspection.

Processing of meat and preservation- drying, smoking, pickling, canning and freezing methods; vacuum and gas packing of meat. Meat based products like salami, kebabs, sausages, minces and intermediate moisture foods.

Module III

10 hours

Poultry industry. Production of broiler chicken and meat quality. Poultry processing plant, processing operations- bleeding, scalding, de-feathering.

Microbiology of poultry meat. Preservation by chilling and freezing. Poultry meat products- dressed chicken, sausage, cutlets, etc. Packing of products.

Eggs: Chicken and duck eggs and their basic differences; composition, vitamin and cholesterol contents; nutritive value. Products- whole egg, egg powder, egg yolk products. Production, packing, transport and storage techniques.

Module IV

10 hours

By products of meat industry: Gelatin, albumins and important biochemical- insulin, bile salts, haemoglobin, etc. and their production methods and applications in industry/ medicine. Extraction of wool and wool processing.

By-products of poultry industry: Gelatin from egg and its commercial uses. Use of poultry waste.

Module V

12 hours

Dairy products: Composition of milk of different animals. Testing of milk. Preservation- pasteurization and bottling of milk. Operations in a dairy plant. High temperature processing (UHT) of milk and packing. Production of whole/ skim milk powder, condensed milk, and milk based products like cream, butter, cheese, yogurt, *ghee*, *khoa*, *burfi*, *paneer*, other milk sweets. Freezing preservation of milk and milk products, Microbial changes in freeze preservation. Technological aspects of freezing (freezing methods). Phase diagrams and freezing curves for pure water and water in foods. Freezing point depression, nature of freezing process, crystallization. Frozen storage, thawing.

Ice cream- various types, characteristics; additives- their roles; and preservatives used in manufacture. Standards for ice creams as per Bureau of Indian Standards and other international agencies like USFDA and *Codex Alimentarius*.

Reference

Aneja, R.P., Mathur, B.N., R.C. Chandan and A.K. Banerjee. 2002. *Technology of Indian Milk Products*. Dairy India Publ.

Gopakumar, K. 1997. *Tropical Fishery Products*. Oxford and IBH.

- Hui, Y.H. 2001. *Meat Science and Applications*. Marcel and Dekker.
 Kerry *et al.* 2002. *Meat Processing*. Woodhead Publ. CRC Press.
 Mead, M. 2004. *Poultry Meat Processing and Quality*. Woodhead Publ.
 Stadelman, W.J. and O.J. Cotterill. *Egg Science and Technology*, 4th edn. CBS.
 Walstra, P. (Ed.). 2006. *Dairy Science and Technology*, 2nd edn. Taylor and Francis.

MFT2207	Technology of Meat, Poultry and Dairy Products Practical	2
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- Meat preservation by drying, curing, smoking, salting and pickling
- Estimation of shelf life of meat subjected to different types of processing
- Estimation of proximate composition of meat and egg
- Preparation of meat and egg based products
- Training of meat production in slaughter houses, evaluation of meat bone yield ratio under commercial conditions at slaughter homes and industrial establishments
- Production and processing of milk; application of HTST process.
- Testing of milk for quality
- Preparation of cheese, yogurt and butter, milk powder, khoa, paneer, etc. and their evaluation
- In- house factory training at meat, milk and ice creams industrial establishments
- Preservation by different freezing techniques
- Study on the effect of rate of freezing on foods and ice crystal formation; Study on freezing preservation of various foods; Operation of freezers and cold stores; Construction of freezing curve of foods
- Familiarization with canning equipment and instruments; Canning of various foods- meat, fish, other products; Construction of survivor curve, TDT curve and determining F-value and cook value
- Drying and salting of meat, fish, vegetables, etc.

MFT2208	Fish processing technology	2
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Module I**6 hours**

Chilled preservation and products: sashimi grade fish, steaks, loins and minced meat. Frozen products: types of frozen fish, shellfish, crabs, lobsters, squid and cuttlefish. Accelerated freeze dried products.

Module II**6 hours**

Salt cured and dried products: sun dried, mechanically dried and salt dried products; Colombo cured and other cured products. Water activity, water activity and microbial spoilage, water sorption, chemical changes during drying. Drying methods, psychrometrics, drying calculation, cured products, microbial spoilage in cured and dried products.

Smoke cured products: chemistry of wood smoke, smoking methods- cold and hot methods, smoke generation, carcinogens in smoke, smoke kilns; use of smoke liquid. safety and nutritive value.

Marinades: Processing of marinades; fish pickle; shelf life and spoilage.

Fermented products: methods, indigenous products, principles of preservation.

Module III**6 hours**

Thermally processed products- canned products, retort pouch products. Thermal process calculation, D-value, F-value; storage changes and spoilage. High temperature short time (HTST) processed products. Canning- containers for canned food, thermal destruction of bacteria, Heat transfer in canned food, process lethality, predicting the process. Effect of heat processing on food, process calculations, cook values, aseptic canning, storage of canned food, canning operations, problems in canned products and solution. Retorts.

Module IV**6 hours**

Food Irradiation: History and mechanism, electro-magnetic spectrum, forms of radiant energy, Principles of using electromagnetic radiation and non-ionising radiation, advantages and disadvantages, effect of radiation on food components, control of considerable changes in food during irradiation. High pressure in food preservation, industrial high pressure system, commercial application, high pressure food processing conditions, pressure inactivation of vegetative cells and micro-organisms, high pressure freezing, Membrane filtration techniques in food preservation, high intensity light, ultra sound as preservation technologies. MAP, pulsed electric fields, hurdle technology and minimal technology.

Module V**6 hours**

Battered and breaded products: different types- coated prawn, fish fillet, patties, burger, roll, etc.; and their preparation, nutritional and economic significance of products.

Technology of processing and preservation of gel forming fish flour; its property and utilisation. Surimi and fish paste products- fish sausage, fish cake, etc. Unit operations in analogue product preparation- crab sticks, moulded lobsters.

Module VI**6 hours**

Fish protein concentrate: Methods of production, functional properties, types of FPC, texturized products/ marine beef. Fish protein powder- production and properties.

Fish hydrolysates: Production and utilisation, biochemical composition and importance in food and nutrition. Incorporation of FPC/ hydrolysates into various food products.

Miscellaneous products: Protein extract from shrimp and crab shell and squilla; shark fin/ fin rays; fish liver/ body oil; processing of snail meat and jelly fish. Production, product characteristics and composition.

Other products: beche-de-mer, processing of snail meat and jelly fish, shark fin/ fin rays, seaweed products- agar, algin, carrageenan- use in foods.

By-products from underutilized fish or fish processing waste: fish meal, fish silage, chitin, chitosan, fish maws, fish oil, squalene, etc.- product characteristics, methods, uses.

Reference

Balachandran, K.K. 2001. *Post-harvest Technology of Fish and Fish Products*. Daya Publishing House, Delhi.

Borda, D., Nicolau, A. I., & Raspor, P. (Eds.). (2017). *Trends in fish processing technologies*. CRC Press

Gopakumar, K. 1997. *Tropical Fishery Products*. Oxford and IBH.

Gopakumar, K. (Tech. Ed.). 2002. *Textbook of Fish Processing Technology*. ICAR, New Delhi.

Ninawe, A.S. and K. Rathnakumar. 2008. *Fish Processing Technology and Product Development*.

Narendra Publishing House, Delhi.

Sen, D.P.2005. *Advances in Fish Processing Technology*. Allied Publishers.

MFT2209	Fish processing technology Practical	1
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- Dressing styles of fish and shellfish
- Smoke curing of foods
- Preparation of pickles/ marinated products
- Chilled products- dressed fish, prawn
- Frozen products- fish, prawn, crab, cuttlefish, squid- in various forms
- Preparation of dried, salted, smoked and pickled fish products
- Thermally processed products in can and retort pouch- fish, prawn, etc. in brine, s a u c e ,
curry; cut out test of canned products
- Preparation of battered and breaded fish products- breaded prawn, breaded fish fillet,
fish patties, fish burger
- Quality evaluation of coated products
- Production of surimi, fish sausage; quality evaluation
- Preparation of FPC, fish hydrolysates, fish wafers
- Extraction of fish oil; study of its characteristics
- Familiarization with fish meal, fish silage, beche-de-mer, shark fin rays, agar, algin,
carrageenan, fish maws, chitin and chitosan

Elective I (MFT 2210, 2211)	3 Credits
Open Elective I	3 Credits

Semester III courses

MFT2301 Technology of Spice and Plantation Crops processing

2

Module I

8 hours

Spices, condiments, seasonings and culinary herbs- classification. Major Indian spices- pepper, cardamom, chilli, turmeric, ginger, garlic, clove, cumin, coriander, cinnamon, fenugreek, mace, mint, vanilla, nuts (cashewnut)- chemical composition, processing, packaging, fumigation, irradiation. Effects on food- flavour, antimicrobial effects.

Module II

7 hours

Oleoresins and essential oils- chemistry of volatiles, methods of manufacturing- steam distillation and solvent extraction methods; super critical fluid extraction using liquid carbon dioxide. By-products of oleo resin industry.

Enzymatic synthesis of flavour identical. Adulteration problems in spices, storage changes, quality control.

Module III

7 hours

Tea: Harvesting of tea leaves, chemical composition. Types of tea- CTC, green, oolong- manufacturing processes. Tea products- tea concentrate, instant tea, decaffeinated tea, flavoured tea, etc. Grading of tea- tea tasting. Preparation of tea- black, with milk, etc. Packing and storage of tea- storage changes.

Module IV

7 hours

Coffee: Ripening of coffee beans, drying, pulping. Production of coffee- fermentation, roasting, brewing, etc. Types of coffee- coffee powder, decaffeinated coffee, instant coffee- blending with chicory, other coffee products. Preparation of coffee for drinking, quality evaluation of coffee. Packing and storage of coffee- storage changes.

Module V

7 hours

Cocoa: Chemical composition of cocoa beans, fermentation of beans. Products- cocoa powder, cocoa liquor, cocoa butter, chocolates; technology of manufacturing products. Factors influencing quality, quality evaluation. Confectionary products: Hard-boiled candies, toffees, fruit drops, chocolates and other confections, chewing and bubble gums - ingredients, equipment, processes, product quality parameters, faults and corrective measures.

Reference

Banerji, B. 2002. *Tea Production and Processing*. Oxford Univ. Press.

Baser, Husnu; Can, K.; and Buchbauer, Gerhard. 2010. *Handbook of Essential Oils, Science, Technology and Application*. Boca Raton, FL : CRC Press, Taylor and Francis Group

Mathew Attokaran 2011 *Natural Food Flavors and Colorants* © Blackwell Publishing Ltd. and Institute of Food Technologists. ISBN: 978-0-813-82110-8

NIIR. 2004. *Handbook of Spices*. National Institute of Industrial Research Board, Asia Pacific Business Press Inc.

MFT2302 Technology of Spice and Plantation Crops processing Practical**1**

- Estimation of moisture in spices
- Estimation of volatile oil contents of spices
- Determination of aromatic compounds in spices
- Estimation of capsaicin content, Scoville Heat Unit of chillies
- Estimation of curcumin content of turmeric
- Studies on packaging and storage of spices
- Determination of microbial quality of spices
- Determination of adulteration of spices
- Estimation of caffeine in tea and coffee
- Determination of aflavin and thearubigens in tea
- Sensory evaluation of tea, coffee and chocolate
- Determination of components of chocolates
- Extraction of organic natural colours from aromatic plants and vegetables

MFT2303 Food Additives and Flavour Technology**3****Module I****10 hours**

Introduction: Types of additives, benefits of additives, risk of additives, regulations. Estimation of food additive intake- NOEL, ADI, toxicological classification of food additives

Nutritional additives: Vitamins- chemistry, units and requirements, properties, commercial forms, amino acids, fatty acids, minerals and trace minerals, regulations and nutritional additives. FSSAI permitted food additives and their limits

Module II**10 hours**

Preservatives (antimicrobials): Chemical and biological preservatives. Mechanisms of action.

Antioxidants: phenolic antioxidants- applications, natural antioxidants; oxidation and use of antioxidants. Oxidation measurement, oxidative stability and antioxidant effectiveness, analysis of antioxidants, regulation of phenolic antioxidants.

Module III**12 hours**

Sweeteners: theory of sweetening, non-nutritive sweeteners, nutritive sweeteners, choice of sweeteners.

Food colours: History of the use of colours, role and use of colorants, types of colorants, toxicological considerations.

Emulsifiers: Emulsifier chemistry, emulsifier function and mechanism of action, emulsifier selection.

Application in foods: Cereal-based products, dairy products, candy products and miscellaneous applications.

Polysaccharides in foods: Starch, chemically modified starches, glycogen, cellulose and hemicelluloses, pectic substances, plant gums.

Module IV**10 hours**

Enzymes: Functional aspects, mechanism of enzyme action, application of enzymes in the food

industry, regulations on the use of enzymes, toxicology.

Acid, bases and buffers (pH control agents)

Miscellaneous food additives: Firming agents, formulation aids, processing aids, propellants, solvents, chelating agents, synergists.

Methods used in safety evaluation. Hypersensitivity to food additives. Risks and benefits of food additives.

Module V

12 hours

Flavour technology: Flavouring agents- flavours – their nature, creation and production.

Function of flavours and their utilization, flavour regulations, flavour safety.

Flavour enhancers: Chemical properties, function in food, use of glutamate in food and regulations, toxicology, applications. Synthetic ingredients of food flavourings.

Quality control of flavourings and their raw materials, beverage flavourings and their applications. Fruit juices, flavouring of confectionery and bakery products, flavours of snack and crisps. Thermal process of flavourings. Dairy flavourings.

Reference

Attokaran Mathew 2011 Natural Food Flavors and Colorants © Blackwell Publishing Ltd. and Institute of Food Technologists. ISBN: 978-0-813-82110-8

Mahindru, S.N. 2008. *Food Analysis: Characteristics, Detection and Estimation*. APH Publishing Corporation.

Msagati, T.A. (2012). *The chemistry of food additives and preservatives*. John Wiley & Sons.

Rahman, M.S. 2007. *Handbook of Food Preservation*, 2nd edn. CRC Press.

Wood, R., Foster, L., Damant, A., & Key, P. (2004). *Analytical methods for food additives*. Elsevier.

MFT2304 Food Additives and Flavour Technology Practical

1

- Estimation of vitamins in foods
- Determination of minerals and sodium chloride in foods
- Determination of preservative content- benzoate, sulphite, metabisulphite, sorbate propionate
- Study of antioxidant activity; determination of peroxide value and content of BHA/ BHT, propyl gallate
- Effect of sweeteners; determination of taste threshold value
- Study of food coloring agents- effect on food
- Starch- study of properties of starch in relation to food
- Determination of starch content
- Study of properties of gums- gel formation, stabilization, thickening effect, etc.
- Determination of chelating agents, acidulants and phosphates in food products
- Detection of certain intentional and unintentional food additives in foods
- Organoleptic evaluation of flavours and pigments
- Extraction of flavours and pigments and evaluation

MFT2305 Food Packaging Technology**2****Module I****8 hours**

Basic concept of packaging, definition, importance and scope of packaging foods, criteria for packing foods. Functions and design of food package, package development, current status and trends in food packaging.

Packaging materials and containers: Origin of packaging materials; different types; properties, advantages and disadvantages of each material- glass containers, metal cans- tins, aluminium, TFS; aluminium foil. Protective lacquers and coatings for metal containers.

Cellulose based materials- paper, paperboard, corrugated fibreboard pouches- bags and boxes.

Module II**6 hours**

Plastic films- polyethylene, polypropylene, polyamides, polyester, PVC, PVDC, PVA, EVOH, polycarbonates, cellophane, inomers, copolymers, phenoxy, acrylic and polyurethanes.

Laminates- objectives, types, methods of lamination. Containers- bags, pouches, retort pouch.

Properties of packaging films- mechanical, sealing and barrier. Advantages and disadvantages of each packaging material.

Module III**6 hours**

Manufacture of flexible films: Blown film extrusion, cast film extrusion, film orientation process, co-extrusion process, conversion process. Container manufacture- sheet thermoforming, injection moulding.

Packaging machinery: Bottling, can former, form fill and seal machines, bags- their manufacturing and closing, vacuum packs unit, shrink pack unit, 'tetra pak' unit

Module IV**10 hours**

Packaging requirements and their selection for raw and processed foods for meat, fish, poultry, eggs, milk and dairy products, fruits and vegetables, cereal grains and baked food products, beverages, snacks, etc.

Packaging material testing: Global and specific migration, WVTR, GTR, bursting strength, Cobbs value, tensile strength, tearing strength, impact strength, bond strength, puncture resistance, heat seal strength, transport worthiness tests (drop test, vibration test, compression strength, rolling test), identification of plastics. Safety of packaging materials.

Module V**6 hours**

Recent trends in food packaging: vacuum packaging, modified atmospheric packaging, shrink packaging, retort pouch packaging, aseptic packing, active packaging, intelligent packaging, smart packaging. Advanced packaging technologies, alternative packaging systems to plastic material, nanotechnology. Packaging laws and regulations.

Reference

Ahvenainen, R. (Ed.) 2003. *Novel Food Packaging Techniques*. CRC Press.

Coles, R., D. McDowell and M.J. Kirwan (Eds). 2003. *Food Packaging Technology*. CRC Press.

Gopakumar, K. 1993. *Fish Packaging Technology: Materials and Methods*. Concept Publishing Company, New Delhi.

Han, J.H. (Ed.) 2005. *Innovations in Food Packaging*, Elsevier Academic Press.

Raija, A. (Ed.) 2003. *Novel Food Packaging Techniques*. In: Food Science and Technology Series, Woodhead Publishing.

Robertson, G.L. 2006. *Food Packaging: Principles and Practice*, 2nd edn. Taylor & Francis.

Srinivasa Gopal, T.K. 2007. *Seafood Packaging*. CIFT Golden Jubilee Series, CIFT, Cochin.

Ft2306 Food Packagingtechnology Practical

1

- Identification of different types of packaging materials; Measurement of thickness of packaging materials
- Determination of global migration
- Determination of tensile strength and elongation at break of plastic films
- Determination of tearing strength of paper
- Determination of bursting strength, puncture resistance, Cobbs value of CFB
- Determination of heat seal and bond strength of laminates
- Determination of gas (oxygen, carbon dioxide) transmission rate
- Determination of water-vapour transmission rate
- Determination of transport worthiness of containers
- Determination of grease resistance of different packaging materials
- Demonstration of vacuum packaging, modified atmosphere packaging, shrink wrapping, active packaging, retort pouch processing, etc.
- Visit to manufacturing units of packaging materials (flexible films, metal cans, duplex cartons and corrugated fibre board boxes)
- Visit to food processing establishments – milk products, fruit and vegetable products, fishery, meat and poultry products, confectionary, beverages, etc.

MFT2307 Quality Assurance and Food Safety

3

Module I

10 hours

Sanitation and hygiene: Definition and application to food industry and food service. Microorganisms- normal flora and pathogenic microorganisms; sources of food contamination, origin and contamination along food chain. Foodborne illness.

Sanitizers- chemical and physical properties, mechanisms of action of most common sanitizers used in food industry; cleaning compounds, classification of cleaning compounds. Sequestrants, detergents- chemical and physical characteristics of detergents. Sanitizing methods, precautions to food industry, food safety issues in different foods, prevention and control of contamination of food.

Module II

10 hours

Food handling and personal hygiene. Food service control points; regulatory requirements. Food contact surfaces; biofilms. Environmental sanitation- premises, equipment, furniture and fixtures. Food safety- definition and controlling hazards in food safety systems. Pest control- insect, rodents, other pests.

Introduction to concepts of food quality, food quality assurance and food quality management;

objectives, principles of food quality assurance, good manufacturing/ management practices (GMP), good hygienic practices (GHP), good laboratory practices (GLP), food safety and HACCP principles.

Module III

10 hours

Biological, chemical and physical quality in food processing. Ingredient specifications; product formulation, product attractability, in-process monitoring and records. SOP and SSOP. Introduction to sensory evaluation - types of sensory tests- detection, threshold and dilution tests, different tests for sensory evaluation discrimination, descriptive, affective; flavor profile and tests, ranking tests, methods of sensory evaluation of different food products. Sanitation programme and quality assurance. Chemical hazards- contaminants, additives. Food allergens, natural toxins, etc.

Module IV

12 hours

Quality standards: Methods of determining quality- objective and subjective methods. Definition and organization of the quality control function in the food industry. Preparation of specifications. In-plant quality control and end product inspection. Instrumental and sensory methods of evaluation. Statistical process control (SPC). Quality evaluation and testing laboratories.

Factory layout and design, regulations for processing units, flow sheet of operations, drainage and sweet water connections. Ware housing of products and raw materials. Utilities for manufacturing units. Water treatment, boilers, types of boilers, quality of steam.

Module V

12 hours

Food laws and standards: FDA regulations, USDA regulations, EPA, EFSA regulations, *Codex Alimentarius* Commission, Food Safety and Standards Regulations for different products, the Prevention of Food Adulteration Act, 1954, Export and Import Laws and Regulations, Export (Quality Control and Inspection) Act, 1963., etc. Packaging and labelling laws, regulations.

Concept of food traceability for food safety, traceability, Food safety and Standards Act 2006: Role of national and international regulatory agencies- Bureau of Indian Standards (BIS), AGMARK, Food Safety and Standards Authority of India (FSSAI). Introduction to WTO agreements- SPS and TBT agreements, *Codex Alimentarius* Commission, USFDA, International Organization for Standards (ISO) and its standards for food quality and safety- ISO 9000 series, ISO 22000, ISO 15161, ISO 14000.

Reference

- Bremner, H.A. *Safety and Quality Issues in Fish Processing*. CRC Press, New York.
- de Vries, J. *Food Safety and Toxicity*. Library of Congress Cataloging – in - Publication data.
- Farber, J.M., Evan C.D. Todd (Eds). *Safe Handling of Foods*. Marcel Dec Inc. New York.
- Heredia, N., J. Westley and S. Garcia (Eds). *Microbiologically Safe Foods*. John Wiley & Sons Inc., New Jersey.
- Hubbard, M. R. 2003. *Statistical Quality Control for the Food Industry*, 3rd edn. Springer.
- Longree, K. and Armbruster, G. *Quantity Food Sanitation*. John Wiley & Sons, New York.
- Mehta, Rajesh and J. George. 2005. *Food Safety Regulations, Concerns and Trade: The Developing Country Perspective*, Macmillan.
- Newslow, D.L. 2001. *The ISO 9000 Quality System: Applications in Food and Technology*, John Wiley & Sons.
- Rees, M. and D. Watson. 2000. *International Standards for Food Safety*. Aspen Publishers, Inc., Maryland

Rees, N. and D. Watson. 2000. *International Standards for Food Safety*. Aspen Publication.
The Prevention of Food Adulteration Act, 1954, Commercial Law Publishers (India) Pvt. Ltd.

MFT2308 Quality Assurance and Food Safety Practical
1

- Determination of sanitary quality of plant and personnel- TPC, pathogenic count of utensils, processing table tops, hands of personnel
- Estimation of coliforms/ *E.coli* in water and ice- by MPN technique
- Analysis of microflora up to generic level- using microscopic observations and chemical tests
- Determination of MIC and MCC of disinfectants
- Sensory evaluation methods: taste threshold test, hedonic scaling, three-sample tests, rank order test, etc.; designing score sheet
- Measurement of viscosity by viscometer
- Measurement of texture and colour using texture analyzer and colour comparator, respectively
- Determination food components- moisture, protein, carbohydrate, fat, minerals, fibre
- Estimation of chemical parameters of food quality
- Detection of toxins in food
- Determination of pesticides in food
- Detection of adulterants in food
- Examination of market samples of foods for quality evaluation

MFT2309 Food Laws and Environmental Issues
2**Module I****6 hours**

Historical perspectives including necessity of food laws. Necessity of ensuring quality of food to prevent adulteration.

Food quality, safety and testing: Quality of foods and quality standards like BIS, Agmark and other optional standards; mandatory standards. Food safety systems: quality systems standards including ISO; auditing; Good Manufacturing Practice and HACCP, TACCP, VACCP.

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 and food supply sector. Standards of weights and measures, British Regulatory Consortium (BRC), American Institute of Bakers (AIB). Important issues of GM foods. Fortification, nutrition information on label. Organic foods. Safety of additives, processes, etc., affecting consumers and industry.

Module II**6 hours**

Food Safety and Standards Act 2006 and the provisions therein; Integrated Food Law- multi departmental - multilevel to single window control system; Consumer Protection Act. Functioning of Food Safety Commissioner. Patents-IPR, National Accreditation Board for Testing and Calibration Laboratory (NABL), ISO 17025, ISO 17034

Module III**6 hours**

International scenario in food regulation: USFDA, EFSA, UK, Canada, A & N Z, Japan, Malaysia, Singapore. Consumer movements; Intellectual Property Rights and trademarks. Protection of investment and efforts in research and development by patenting, criteria of patentability, national and international patent, terms of patents, copyright. International agencies in food regulation: Food *Codex Alimentarius*; 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.

Module IV**8 hours**

Environment and pollution: components of environment; pollution measurements and management; xenobiotic compounds; pesticides and pest management. Microorganisms as components of the environment; microorganisms as indicators of environmental pollution; inorganic pollution; microbial toxicants and pollutants, and their bio-degradation; biodegradation of plastics, biofouling and biofilms; bioremediation.

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.

Module V**10 hours**

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.

Storage and disposal of waste: types of waste generated; non-degradable and biodegradable wastes, waste disposal methods- land-filling, burial, incineration, recycling. Biological treatment of food industry wastes; legal aspects related to storage and disposal; environmental laws; pests and their control.

Utilization of waste: Methods of utilizing wastes to make value added products. Case studies: pectin, food colourants, antioxidants from fruit peels, lycopene from tomato peel, vegetable seed oils, biomolecules and enzymes from meat processing. Generation of biogas, SCP, microalgae, animal feeds, zero emission plants; recovery and recycling of materials.

Reference

- Hubbard, M.R. 2003. *Statistical Quality Control for the Food Industry*, 3rd edn. Springer.
- Mehta, R. and J. George. 2005. *Food Safety Regulations, Concerns and Trade: The Developing Country Perspective*. Macmillan.
- Moorthy, C.K. 2003. *Principles and Practices of Contamination Control and Clean Rooms*. Pharma Book Syndicate.
- Newslow, D.L. 2001. *The ISO 9000 Quality System: Applications in Food and Technology*. John Wiley & Sons.
- Rees, N. and D. Watson. 2000. *International Standards for Food Safety*. Aspen Publication.
- The Prevention of Food Adulteration Act, 1954*. Commercial Law Publishers (India) Pvt. Ltd.
- Wilson, C.L. 2008. *Microbial Food Contamination*. CRC.

MFT2310 Entrepreneurship and Food Business Management**2****Module I****10 hours**

Entrepreneurship: Importance and growth, characteristics and qualities of entrepreneur, role of entrepreneurship, ethics and social responsibilities; Entrepreneurship development: Assessing overall business environment in the Indian economy; Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs; Globalization and the emerging business/entrepreneurial environment

Module II**10 hours**

Concept of entrepreneurship, entrepreneurial and managerial characteristics, managing an enterprise, importance of planning, monitoring, evaluation and follow-up, managing competition, decision making, costing, pricing, demand analysis, SWOT analysis, generation, incubation and commercialization of ideas and innovations; Women entrepreneurship: Role and importance, problems; Corporate entrepreneurship: Role, mobility of entrepreneur; Entrepreneurial motivation; Planning and evaluation of projects: Growth of firm, project identification and selection, factors inducing growth.

Module III**8 hours**

Government schemes and incentives for promotion of entrepreneurship; Government policy on small and medium enterprises (SMEs/SSIs); Export and import policies relevant to food processing sector, Venture capital; Characteristics of Indian food processing industries and export; Social responsibilities of business.

Module IV**8 hours**

IT for managers, enterprise support applications, systems acquisition and implementation practices, facilitating end-user support, and telework and e-business opportunities, Business plan preparation.

References:

- L.M. Prasad. 2001. Principles and practices of management, 9th Ed. S. Chand & Sons, New Delhi
- Koontz Harold. Principles of Management. Tata McGraw-Hill Education Private Limited, New Delhi.
- PC Thomas. Managerial Economics, 9th Ed. Kalyani Publishers
- KK Dewett and MH Navalur Modern Economics theory. S. Chand & Sons, New Delhi
- Zimmerer, T. W., & Scarborough, N. M. (2005). Essentials of entrepreneurship and small business management. Prentice-Hall.
- Drucker, P. (2014). Innovation and entrepreneurship. Routledge.
- Katz, J. A., & Green, R. P. (2009). Entrepreneurial small business (Vol. 200). New York, NY: McGraw-Hill/Irwin.

MFT 2311, 2312, 2313	Elective- II	(as per list given under Elective Course)
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Elective courses

MFT 2212	Baking and confectionary technology	2
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Module 1	5 hours
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Current status, growth rate, and economic importance of bakery and confectionary industry in India. Product types, nutritional and safety of products, pertinent standards and regulations.

Module II	5 hours
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Milling technology- cereals used for milling in India, changes occurring, quality aspects. Equipment used.

Module III	10 hours
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Theory of bakery and bakery fundamentals, Bakery Products: Ingredients and processes for breads, biscuits, cookies and crackers, cakes and pastries (short crust, choux, flaky, pies, tarts, eclairs, puff), gateaux, croissant, donuts, rusks, other baked products.

Equipment, product quality characteristics, faults and corrective measures for bakery products. Defining and assessing quality of ingredients and products. Different types of icing and design- Butter, Royal, Fresh Cream, basic cake decoration

Basic knowledge of baking/ heating, refrigeration, freezing, chilling, interaction of element

Module IV	10 hours
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Confectionary products: Hard-boiled candies, toffees, fruit drops, chocolates and other confections- ingredients, equipment, processes, product quality parameters, faults and corrective measures. Basic chocolate making

Module V	6 hours
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Production and quality of chewing and bubble gums, cocoa products, breakfast cereals, macaroni products, sprouted grains. Basic sugar craft, exotic desserts,

Reference

Beckette. *Industrial Chocolate Manufacture*.

Edwards, W.P. 2007. *The Science of Bakery Products*. Royal Society of Chemistry.

Faubion, Faridi. *Dough Rheology and Baked Product Texture*. CBS Publications.

Matz, Samuel A. *Bakery Technology and Engineering*. CBS Publications.

Matz, Samuel A. *Cookies and Cracker Technology*.

NIIR Board. 2009. *The Complete Technology Book on Bakery Products*, 2nd edn. National Institute of Industrial Research.

Pyler, E.J. and L.A. Gorton. 2009. *Baking: Science and Technology*, Vol. II: Formulation and Production, 4th edn. Sosland Publishing Co., Kansas City.

Turret, R.A.I. 2003. *Grain and Feed Milling Technology*.

MFT 2213 Dietary Foods and Nutraceuticals
2
Module I
8 hours

Concept on nutraceuticals: nutraceutical and functional foods, nutraceuticals as new dietary ingredients, biological significance of nutraceuticals, nutraceuticals and dietary supplement, world market for nutraceuticals, regulatory issues.

The role of nutraceuticals/ functional foods in disease prevention: angiogenesis and cardiovascular diseases, cancer, diabetes, cholesterol management, obesity and inflammation dosage levels.

Module II
8 hours

Health benefits of nutraceuticals, natural pigments (chlorophyll, chlorophyllin, carotenoids). Anthocyanin, proanthocyanidins, glucosinolates, isoflavonoids, phytoestrogens, omega-3 and omega-6 fatty acids, chitin and chitosan.

Module III
6 hours

Antioxidants, phytosterols; dosage for effective control of disease or health benefit with adequate safety. Generalised protective mechanisms of phytochemicals. Bioavailability of bioactive compounds.

Module IV
6 hours

Prebiotics and probiotics: usefulness of probiotics and prebiotics in gastro intestinal health and other benefits, beneficial microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes, resistant starch, fructo-oligosaccharides as probiotic food components.

Module V
8 hours

Definition, development of functional foods, isolation, storage, processing and stability of phytochemicals/ bioactive compounds.

Nutrigenomics: an introduction and its relation to nutraceuticals. Effects of processing conditions and storage. Effect of environmental conditions in food matrix. Development of biomarkers to indicate efficacy of functional ingredients.

Reference

Brigelius-Flohé, J. and Joost, H.G. 2006. *Nutritional Genomics: Impact on Health and Disease*. Wiley VCH.

Chi-Tang Ho, Mohamad M Rafi and Geetaa Ghai. 2008. *Fennema's Food Chemistry*, 4th edn. CRC Press, Taylor and Francis Group, Boca Raton

Cupp J. and Tracy T.S. 2003. *Dietary Supplements: Toxicology and Clinical Pharmacology*. Humana Press.

Gibson, G.R. and William, C.M. 2000. *Functional Foods- Concept to Products*.

Losso J.N. 2007. *Angi-angiogenic Functional and Medicinal Foods*. CRC Press.

Neeser, J.R. and German, B.J. 2004. *Bioprocesses and Biotechnology for Nutraceuticals*. Chapman & Hall.

Robert E.C. 2006. *Handbook of Nutraceuticals and Functional Foods*, 2nd edn. Wildman.

Shi, J. 2006. *Functional Food Ingredients and Nutraceuticals: Processing Technologies*. CRC Press.

Webb, G.P. 2006. *Dietary Supplements and Functional Foods*. Blackwell Publ.

MFT 2310

Dried, Cured, Smoked, Marinated and Fermented Foods

3

Module I

10 hours

Fundamentals of drying- drying curve and sorption isotherms. Factors influencing drying process. Methods and equipment-sun drying, mechanical dryers, solar dryers. Changes in products, spoilage.

Freeze-drying- principle, phase diagram of water, equipment; accelerated freeze-drying.

Module II

10 hours

Salt curing- principle of preservation; methods of salting various food products; factors influencing salt uptake by foods; quality of salt and products.

Module III

12 hours

Smoke curing- chemistry of wood smoke; methods of smoking- cold smoking and hot smoking. Smoke kilns, use of liquid smoke and smoke powder. Problems associated with smoking- carcinogens, purification of smoke. Measurement of extent of smoking, various smoked products.

Module IV

10 hours

Marinated products. Basic principles of marinating. Pickle making- use of vinegar and other ingredients- role of each. Packing of pickles.

Module V

12 hours

Fermented Products: use of lactic acid bacteria, yeasts, etc. Optimum conditions required for fermentation. Various fermented products of India- methods of preparation. Control of fermentation process, spoilage problems.

Reference

Eastman, Wilbur, F. Jr. 2002. *A Guide to Freezing, Canning and Smoking Meat, Fish and Game*. Storey Publishing.

Kuila, A., & Sharma, V. (Eds.). (2018). *Principles and Applications of Fermentation Technology*. John Wiley & Sons.

NIIR Board. 2009. *The Complete Technology Book on Processing, Dehydration, Canning and Preservation of Fruits and Vegetables*. National Institute of Industrial Research.

Zeuthen, P. and Leif Bogh-Sorensen. 2003. *Food Preservation Techniques*. Woodhead Publishing Ltd.

MFT 2311**Postharvest Handling, Transportation and Storage****3****Module I****10 hours**

Maturity indices, methods of maturity determination. Harvesting and handling of important fruits and vegetables. Harvesting tools, primary processing factors affecting postharvest losses. Processing of fruits/ vegetables, wax coating, pre-packing, irradiation, physiological postharvest disorders, chilling injury and disease, prevention of postharvest diseases and infestations, handling and packaging of fruits and vegetables – citrus, mango, banana, tomato, papaya and carrot. Principles of transport and commercial transport operations. Measures to prevent harvesting losses, biotic and abiotic factors affecting the crops during storage, safe storage guidelines, various types of storage structures (traditional and modern)

Module II**10 hours**

Effect of feed, breed and management on meat quality Measures to prevent losses, biotic and abiotic factors affecting the raw and processed products during storage, safe storage guidelines for various meat-based products, various types of storage structures (traditional and modern)

Module III**12 hours**

Handling of fish onboard and landing centres. Chill storage-CSW/ RSW, icing ice production, packaging and storage, transportation of fresh fish/ products, microbiology of fresh fish. Chilled/ refrigerated vehicles for transport. Measures to prevent losses during harvest from wild and culture farms, biotic and abiotic factors affecting raw and processed products during storage, safe storage guidelines for various fishery products, various types of storage structures (traditional and modern)

Module IV**10 hours**

Raw milk quality testing, processing, transportation of fresh milk to dairy plant. Measures to prevent losses during collection, processing, storage and transportation, biotic and abiotic factors affecting the storage, safe storage guidelines for various dairy products, various types of storage structures (traditional and modern)

Module V**12 hours**

Storage and transportation of cereals, pulses and oil seeds; care after harvesting- prevention of germination, pests. Initial drying and storage in silo. Cold storage, recent developments in transportation and storage. Measures to prevent harvesting losses, biotic and abiotic factors affecting the crops during storage, safe storage guidelines for various commodities, various types of storage structures (traditional and modern), infestation and pest control, impact of modernization of technology

Reference

- Brennan, James, G. (Ed.). 2012. *Food Processing Handbook*. Wiley-VCH Verlag GmbH Co.
- FAO. 2004. *Post-harvest Manual*. FAO Corporate Document Repository.
- Fellows, P. J. (2009). *Food processing technology: principles and practice*. Elsevier.
- Varzakas, T., & Tzia, C. (Eds.). (2015). *Handbook of food processing: food safety, quality, and manufacturing processes* (Vol. 35). CRC Press.

MFT 2312**Food Biotechnology****3****Module I****12 hours**

Introduction to biotechnology- DNA and RNA, structure of DNA, Watson and Crick model, DNA replication, gene, nature of gene, genetic code, gene expression, protein synthesis.

Genetic engineering: Restriction enzymes, PCR, cloning, DNA sequencing, genetic engineering and improvement of food crops, genetically modified plants and animals for enhanced food production; safety of GM food.

Module II**10 hours**

Natural antimicrobials for food preservation: Phyto-alexins, essential oils and their components; bacteriocins: nisin, pediocins, etc.; use of bacteriocins in food systems as bio-preservatives.

Module II**12 hours**

Protein engineering in food technology: methods, applications of protein engineering to produce enzymes- glucose isomerase, Lactobacillus beta-galactosidase and peptide antibiotic- nisin. Biotechnological routes to food flavour production- microbial, enzymatic, etc.

Module IV**10 hours**

Biotechnology and food ingredients: biogums, fat substitutes, bio-colours, organic acids and sweeteners. Transgenic plant foods: Golden rice, Bt-brinjal, maize, tomato, potato, soybean, etc.

Module V**10 hours**

Biotechnology for food security: prospects and problems, ethical issues concerning GM foods; trade related aspects of biotech foods; intellectual property rights (IPR) and bio-piracy problems; effect of biotech foods on the food business of developing and developed countries.

Reference

Alexandru Mihai Grumezescu, Alina Maria Holban (2018). Advances in the biotechnology of food industry

Byong H Lee (2015). Fundamentals of Food Biotechnology. Wiley-Blackwell

Debasis Bagchi, Francis C. Lau, Dilip K. Ghosh (2010). Biotechnology in Functional Foods and Nutraceuticals. CRC Press

Kuddus, M. (Ed.). (2018). *Enzymes in food biotechnology: production, applications, and future prospects*. Academic Press.

Rai, Ravishankar. (2016). Advances in food biotechnology. Wiley- Blackwell