

Gautam Buddha University
School of Vocational Studies and Applied Sciences
Course Curriculum of B.Tech. (Food Processing and Technology)
Durations - 4 years (8 Semesters)
(Effective from 2019-20)

SEMESTER –I

Course Type	Subject Code	Courses	L	T	P	Credits
	THEORY					
	CY101/PH102	Engineering Chemistry/ Engineering Physics	3	1	0	4
	MA105	Engineering Mathematics – I	3	1	0	4
	EC101/EE102	Basic Electronics engineering/Basic Electrical Engineering	3	1	0	4
	CS101/ME101	Fundamentals of Computer Programming/ Engineering Mechanics	3	0	0	4
	BS101	Human Values & Buddhist Ethics	2	0	0	2
	EN101	English Proficiency	2	0	0	2
	Practical courses					
	CE103/ME102	Engineering Graphics/ Workshop Practice	1	0	2	2
	CY 103/PH104	Engineering Chemistry Lab/engineering Physics Lab	0	0	2	1
	CS 181/EN151	Computer Programming Lab/Language Lab	0	0	2	1
	EC 181/EE103	Basic Electronics Lab/Basic Electrical Engineering Lab	0	0	2	1
	GP	General Proficiency	0	0	0	
		Total	17	3	8	25
		Total Contact Hours	28			

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SEMESTER-II

Course Type	Subject Code	Courses	L	T	P	Credits
	THEORY					
	PH102/ CY101	Engineering Physics/ Engineering Chemistry	3	1	0	4
	MA102	Engineering Mathematics – II	3	1	0	4
	EE102/ EC101	Basic Electrical Engineering/ Basic Electronics engineering/	3	1	0	4
	ME101/ CS101	Engineering Mechanics/ Fundamentals of Computer Programming	3	1	0	4
	FT 111	Introduction to food technology	2	0	0	2
	ES101	Environmental studies	3	1	0	4
	ME102/ CE103	Workshop Practice/ Engineering Graphics	0	0	2	2
	Practical courses					
	EN151/ CS 181	Language Lab/ Computer Programming Lab	0	0	2	1
	EE103/ EC 181	Basic Electrical Engineering Lab/ Basic Electronics Lab	0	0	2	1
	GP	General Proficiency	0	0	0	
		Total	17	5	6	26
		Total Contact Hours	28			

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SEMESTER- III

Course Type	Subject Code	Courses	L	T	P	Credits
THEORY						
C	FT-201	Principles of Food Processing & Preservation	3	0	0	3
C	FT-203	Food Microbiology	3	0	0	3
C	ME-201/207	Material Science	3	1	0	4
GEI		Generic Elective 1	3	1	0	4
GEII		Generic Elective 2	3	1	0	4
OE1		Open Elective	3	0	0	3
PRACTICALS						
C	FT-251	Food Microbiology Lab	0	0	3	2
GEIII		Generic Elective 3	0	0	3	3
		Total	18	3	6	26
		Total Contact Hours	27			

Generic Elective (GE) 1:

1. BT-207 Introductory Bioinformatics*
2. BT-209 Biochemistry and Biotechnology[#]

Generic Elective (GE) 2:

1. MA-201 Engineering Mathematics-III
2. MA-205 Quantitative Techniques in Food Technology

Generic Elective (GE) 3:

1. FT-213 Laboratory-I: Cell biology, Microbiology and Biochemistry[#]
2. BT-215 Laboratory-II: Basic Bioinformatics Lab*

Open Elective (OE): Courses from other School

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SEMESTER- IV

Course Type	Subject Code	Courses	L	T	P	Credits
THEORY						
C	FT-202	Food Chemistry and Nutrition	3	0	0	3
C	FT-204	Unit Operations in Food Processing	3	0	0	3
C	ME-206/208	Fluid Mechanics	3	1	0	4
SEC	EE-202	Measurements and Instrumentation	2	0	0	2
C	FT-206	Food Process Engineering	3	1	0	4
OE2		Open Elective	3	0	0	3
PRACTICALS						
C	FT-252	Food Chemistry Lab	0	0	3	2
C	FT-254	Food Processing Lab	0	0	3	2
SEC	EE-216	Measurements and Instrumentation Lab	0	0	2	1
	GP	General Proficiency	0	0	0	0
		Total	17	2	8	24
		Total Contact Hours	27			

Skill Enhancement Course (SEC)

1. EE-202 Measurements and Instrumentation
2. EE-216 Measurements and Instrumentation Lab

Open Elective (OE): Courses from other School

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SEMESTER- V

Course Type	Subject Code	Courses	L	T	P	Credits
THEORY						
C	FT-301	Food Packaging	3	0	0	3
C	FT-303	Fruit and Vegetable Processing	3	0	0	3
C	FT-305	Advances in food process technology	3	0	0	3
C	ME-304/306	Refrigeration and Air conditioning	3	1	0	4
GEV		Generic Elective	3	1	0	4
PRACTICALS						
C	FT-353	Food packaging and Food Quality Lab	0	0	3	2
C	FT-355	Fruit, Vegetable and Milk Products Processing Lab	0	0	3	2
		General Proficiency	0	0	0	0
		Total	15	2	6	21
		Total Contact Hours	23			

Generic Elective (GE):

1. FT 309 Entrepreneurship Development
2. FT-311 Food Additives

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SEMESTER- VI

Course Type	Subject Code	Courses	L	T	P	Credits
THEORY						
C	FT- 302	Technology Of Cereals, Pulses And Oilseeds	3	0	0	3
C	FT- 304	Food Texture and Rheology	3	0	0	3
C	FT-306	Plantation Products and Spices Technology	3	0	0	3
C	ME-301	Heat and Mass transfer (HMT)	3	1		4
DSEI		Discipline Specific Elective I	3	0	0	3
DSEII		Discipline Specific Elective II	3	0	0	3
PRACTICALS						
C	FT- 352	Cereal and Pulse Processing Lab	0	0	3	2
C	FT- 354	Food Engineering Lab	0	0	3	2
	FT-356	Seminar	0	0	2	2
		General Proficiency	0	0	0	0
		Total	18	1	8	25
		Total Contact Hours	27			

Discipline Specific Elective (DSE) I:

1. FT-310 Technology of Fats and Oils
2. FT- 308 Food Process Equipment Design

Discipline Specific Elective (DSE) II:

1. FT- 312 Food Processing Waste Management
2. FT-314 Technology of Frozen Foods

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SEMESTER- VII

Course Type	Subject Code	Courses	L	T	P	Credits
THEORY						
C	FT- 401	Bakery and Confectionary Technology	3	0	0	3
C	FT-403	Food Storage Engineering	3	0	0	3
C	FT- 405	Dairy process technology	3	0	0	3
C	FT- 407	Traditional and Fermented Foods	3	0	0	3
C	FT- 417	Food Safety, Quality and Regulation	3	0	0	3
DSEIII		Discipline Specific Elective III	3	0	0	3
GEVI		Generic Elective	3	1	0	4
PRACTICALS						
	FT-551	Advance Food Processing Lab	0	0	0	2
SEC	FT453	*Training	0	0	0	2
SEC	FT- 455	Project I	0	0	8	4
		General Proficiency	0	0	0	0
		Total	21	1	8	30
		Total Contact Hours	30			

*(After VI Sem students will go for industrial training of 4 – 6 weeks)

Discipline Specific Elective (DSE III):

1. FT- 409 Food Dehydration Technology
2. FT-411 Meat Fish Poultry Processing Technology

Generic Elective (GE):

1. FT-413 **Functional Foods and Nutraceuticals**
2. FT-415 Flavour Technology

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SEMESTER- VIII

Course Type	Subject Code	Courses	L	T	P	Credits
SEC	FT-454	Project II	0	0		15
MOOCS courses -I		(Open elective)	3	0	0	03
MOOCS courses-II		(Open elective)	3	0	0	03
MOOCS courses-III		(Open elective)	0	0	0	02
		Total Contact Hours				23

Total Credits 195

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SEMESTER –II

FT-111 Introduction to Food Technology (2-0-0)

OBJECTIVE:

- The course aims to introduce the students to the area of Food Processing. This is necessary for effective understanding of a detailed study of food processing and technology subjects. This course will enable students to appreciate the importance of food processing with respect to the producer, manufacturer and consumer.

Unit-I: Scope, Opportunities & Challenges

Food Science and Technology, Status of food processing industry in India and abroad
Reasons For slow growth of Indian food industry, Market scenario and scope - Dairy, Bakery, Confectionary, Beverages and Snack foods etc Potential and prospects of Indian food Industry.

Unit-II: Concept of Food Nutrition and Human Health

Human nutrition and health, Recommended Dietary Allowances (RDA), Factors affecting Bioavailability of nutrients, Desirable and potentially undesirable food constituents and their Importance. Common nutritional deficiencies such as PEM, iron, vitamin A, iodine, calcium and vitamin D, zinc etc, Emerging common degenerated disorders.

Unit-III: Basic biology related to food

Living cells, organization of living system, characteristics, Plant and animal diversity, digestion and absorption of biomolecules.

Unit-IV: Microbiological Aspects of Food

Characterization, classification and identification of microorganisms, Microscopy, Morphology and Structure, Pure culture and its characteristics, Reproduction Growth and Cultivation, Control of microorganisms, beneficial uses of microbes in foods, General Principles of food hygiene.

OUTCOMES:

No. of Lecture

30

On completion of the course, the students are expected to

- Be aware of the different methods applied to processing foods.
- Be able to understand the significance of food processing and the role of food and beverage industries in the supply of foods.

Reference Books

Nutritive value of Indian Foods by C. Gopalan

Food Chemistry by L. H. Mayer

Quality control for Food Industry by Kramner & Twigg

Food facts and Principles by Manay N.S. Shadakshasawamy M
Microbiology by M.J. Pelczar
Principle of biochemistry by A.L. Lininger (2004)

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SEMESTER –III

FT-201 Principles of Food Processing and Preservation (3+0+0)

OBJECTIVE:

- To expose the students to the principles and different methods of food processing and preservation.

Unit –I

Aim and Objective : Aim and objectives of preservation and processing of foods, degree of perishability of natural foods, Quality deterioration and spoilage of perishable foods, intermediate moisture foods, types of food spoilage, viz. microbiological, enzymatic, chemical, physical and their effects on food quality.

Unit -II

Low temperatures Preservation: Storage of foods at chilling temperature, applications and procedures, controlled and modified atmosphere storage of foods, post storage handling of foods. Freezing process, slow and fast freezing of foods and its consequences etc. Technological aspects of pre-freezing, Actual freezing, frozen storage and thawing of foods.

Unit -III

High temperature Preservation: Principles of thermal processing, pasteurization and sterilization, Death Time (TDT) curve; ultra-heat treatment UHT processing; Industrial applications of canning and bottling: commercial canning operation, spoilage of canned food and its quality evaluation.

Unit -IV

Chemicals Preservation: Definitions and classifications, bacteriostatic agents, fungistatic agents, germicidal agents, antioxidant, neutralizers, stabilizers and firming agents, use of sulphur dioxide and benzoic acid, tolerance of chemical preservative, use of antibiotics, sugars and salts. Preservation by fermentation and irradiation; technological aspects and applications of sugar and salt, antimicrobial agents.

Unit-V Radiation Preservation: Irradiation of foods type of radiations, physical and chemical changes induced by radiations, interaction of radiation with living organisms. Radiated foods, cost, shelf life, nutrient and other losses, wholesomeness, safety of working personnel and dosimetry.

OUTCOMES

No. of Lecture:

- To understand the principles of food processing and preservation.
- To understand the role of different methods the processing of different foods and their impact on the shelf life, quality, and other physical and sensory characteristics of foods.
- To familiarize with the recent methods of minimal processing of foods to understand the materials and types of packaging for foods

Books Recommended:

1. "Principles of Food Science-Part-II": Physical Method of Food Preservation by M.Karel, O.R. Fennema and D.B.Lund, Marcel Dekkar Inc.
2. 'Principles of Food Preservation' by V.Kyzlink,Elsevier Press.
3. Preservation of fruits and Vegetable processing by Girdhari Lal (2009)
4. Khetarpaul, Neelam. "Food Processing and Preservation." Daya Publications, 2005
5. Singh, M.K. "Food Preservation" Discovery Publishing, 2007.
6. Fellows, P.J. "Food Processing Technology: Principles and Practice". 2nd Edition, CRC Wood Head Publishing, 2000.
7. GopalaRao, Chandra. "Essentials of Food Process Engineering". B.S. Publications, 2006

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SEMESTER –III

FT-203 Food Microbiology (3-0-0)

OBJECTIVE:

- To provide awareness about nutrition and growth of microorganisms.
- To impart knowledge about role of microorganisms in air, water and soil.
- To understand the role of microorganisms in fermented foods, food spoilage, food infections and intoxications.

Unit- I

Introduction, history and scope of food microbiology. Source of microorganism in foods, Factors affecting growth of microorganisms: Intrinsic and extrinsic factors. Importance of microorganism in food industry. Growth curve.

Unit- II

Normal Microbiological quality of Foods and its significance: milk and milk products, fruits and vegetables, cereals and cereal products, meat and meat products, fish and other sea foods, poultry and eggs; sugar and sugar products, salts and spices and canned foods.

Unit- III

Preservation by Moist Heat, Heat Resistance of microorganisms and spores. Decimal reduction time (D values), 12D concept, Thermal Death Time curves. The behaviour of microorganisms under freezing and refrigeration environment. Growth and lethal effects of low temperature treatments on microorganisms in raw and processed foods. Preservation by drying.

Unit- IV

Foods microbiology and public health - Types of food poisonings, important features and control; Overview of algal, fungal and viral food borne illnesses. Physical and chemical agents used in microbial control, disinfectants and its dynamics. Control of Microorganisms & Food Preservation methods, HACCP & Hurdle Technology and its applications

OUTCOMES:

No. of Lecture: 45

After the completion of the course, the students will be able to:

- Appreciate the role played by microorganisms in the field of food
- Know about microorganisms, history, diversity, classification and role of microorganisms in nature.
- Understand about nutrition, growth and metabolism in microorganisms.

Reference Books

1. "Microbiology" by M. J. Pelczar Jr., E.C.S. Chan and N.R. Krieg, Vth edn., TMH Book Company (1993).
2. "Modern Food Microbiology" by James M. Jay, IVth edn. CBS Publishers Delhi (1993).
3. "Food Microbiology" by W. C. Frazier & D.C. Westhoffs, IV th edn., TMH (1993).
4. Bibek Ray and Arun Bhunia. 2008. Fundamental Food Microbiology, 4th Ed., CRC press, Taylor and Francis Group, USA.

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SEMESTER-IV

FT-202 Food Chemistry and Nutrition (3+0+)

OBJECTIVE:

- The course aims to develop the knowledge of students in the basic area of Food Chemistry.
- This is necessary for effective understanding of food processing and technology subjects.
- This course will enable students to appreciate the similarities and complexities of the chemical components in foods.

Unit-I

Water and Carbohydrate: Water in Foods: Structure, Properties, Interactions, Water activity and sorption isotherm, molecular mobility and food stability Carbohydrates: Classification, Functions, Reactions and properties of simple and complex carbohydrate, Selection of Natural or Modified carbohydrates for incorporation into processed food.

Unit-II

Lipids: Classification, Consistency of commercial fat, Lipolysis, Auto oxidation, Thermal decomposition and effect of ionizing radiation, Refining of oils, Modification of oils and fats, Role of food lipids in flavor, Nutritional and safety aspects of natural and modified fats.

Unit-III

Proteins: Classification, nutritional and functional properties of food proteins, Nutritive value and its Determination, Chemical reactions and interactions of amino acids and proteins, De-naturation and its implications, Functional properties of food proteins, Modification of food proteins in Processing, storage, and its implications.

Unit-IV

Vitamins, Minerals and Pigments : Sources, Functions, Deficiency diseases, Chemistry and stability of water and fat-soluble vitamins during processing, Chemical properties of minerals and their bioavailability, Enrichment and fortification. Natural pigments in foods and their retention in processed foods.

Unit-V

Food Nutrition: Concepts of nutrition, Basal metabolism- BMR, Body surface area and factors affecting BMR. BV, NPU, BMR, PER calculations, Classification of balanced diet, Malnutrition, Type of Malnutrition, Causes and preventions of malnutrition.

OUTCOMES

No. of Lecture: 45

On completion of the course the students are

- Be able to understand and identify the various food groups; the nutrient components (macro and micro), proximate composition.
- Be able to understand and identify the non-nutritive components in food, naturally present.
- Understand and use effectively, food composition tables and databases.
- Grasp the functional role of food components and their interaction in food products in terms of colour, flavour, texture and nutrient composition.

References:

1. Food Chemistry by O.R. Fennema
2. Food Facts and Principal by N. Shakuntala Manay & M. Shadaksharaswamy
3. Chopra, H.K. and P.S. Panesar. "Food Chemistry". Narosa, 2010
4. 5Mann, Jim and Stewart Truswell "Essentials of Human Nutrition". 3rd Edition. Oxford University Press, 2007.
5. Hand book of analysis and quality S.control for fruits and vegetable products Ranganna

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SEMESTER-IV

FT-204 Unit Operations in Food Processing (3+0+0)

OBJECTIVE:

- To understand the principles involved in separation methods.

Unit -I

Introduction to Unit operation, cleaning grading and sorting, Mixing, Kneading, Blending, Homogenization , Sedimentation, Extraction, Leaching, Agitation. Unit operations involved in development of various food products.

Unit-II

Drying of solids: Principle of drying. equilibrium moisture content Curve (Phase equilibria). Equilibrium and free moisture content. Rate of drying for porous and non-porous solids under constant drying conditions. (a)- Constant rate period (b)- Critical moisture content and falling rate period, Non-porous solids, diffusion, shrinkage and case hardening, flow of moisture in porous solids by capillary action. Calculation of drying time equation under constant drying conditions.

Unit-III

Leaching: Leaching, leaching by percolation through stationary solid beds, moving bed and dispersed solid leaching counter current leaching operating line, number of ideal stages for constant under flow.

Unit-IV

Principles of size reduction, energy and power requirements in connection to Crushing efficiency Rittinger's and Kick's law, Bond's crushing law and work index.

Unit-V

Mechanical separation: Screening, material balance over screen, screen effectiveness, capacity and effectiveness, capacity and effectiveness of screens capacity of actual screens.

OUTCOME

No. of Lecture: 45

- To understand Principles of separation methods used in the process industry. To appreciate different equipment developed for separation.

Reference Books

1. Unit Operations of Agricultural Processing by Sahay K.M. and Singh K.K., Vikas Publishing House.
2. Physical Properties of Plant and Animal Products by Mohsenin N.N., Gordon and Breach.
3. Unit operations of chemical engineering by McCabe and Smith, McGraw-Hill.
4. Introduction to Food Engineering, 3rd Edition, R Paul Singh, Dennis R Heldman, Academic Press, USA.
5. Food Processing Technology: Principles and Practice, by P J Fellows, Woodhead Publishing Limited, Cambridge England.

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Semester-IV

FT-206 Food Process Engineering (3+1+0)

OBJECTIVES:

1. To understand the area of Food engineering
2. To elaborate the basic concepts of material and energy balance, fluid dynamics, thermal process calculations etc.

Unit-I

Introduction to food process engineering. Material balance for two component system, equation for operating lines and feed line. Numerical problems on material and energy balance related to food processing. Kinetics of biological reactions - kinetics of reactions occurring in processed foods, reaction velocity constant, order of reaction; quality changes during storage of foods; application of Arrhenius equation to biological reactions.

Unit-II

Evaporation: Boiling point elevation, Duhring rule, basic principles of evaporators; capacity and economy of evaporator; multiple effect evaporator: operation and various feeding systems, calculation of heat transfer area in single and multiple effect evaporators; Thermal vapour recompression and Mechanical vapour recompression system to improve evaporator economy; numerical problems.

Unit-III

Principles of thermodynamics and heat transfer applied to food engineering; fundamentals of heat and analogy to mass transfer in food processing. Modes of heat transfer and overall heat transfer coefficient; thermal properties of foods: specific heat, thermal conductivity; Fourier's law, steady state and unsteady state conduction; energy balances; rate of heat transfer; thermal boundary layer; natural and forced convections heat transfer; heat transfer to flat plate and in non Newtonian fluids; heat transfer in turbulent flow; heating and cooling of fluids in forced convection outside tubes.

Unit-IV

Principle of filtration, types of filtration equipments, settling classifiers, flotation and centrifugation, types of centrifuge.

Unit-V

Freezing and Crystallization: Basic concepts, theories of crystallization; Depression in freezing point, Planks equation and other modified equations for prediction of freezing time, freezing time calculations for a product having uniform temperature (negligible internal resistance), different types of freezers and crystallizers.

OUTCOMES:**No. of Lecture: 60**

After the completion of the course, the students will be able to:

- Understand various basic aspects of food engineering.
- Grasp the knowledge about fluid flow of foods.
- Comprehend the thermal process calculations.
- Understand the processing of foods by thermal and freezing process.

Reference Books

1. Food Engineering Operation – Brennan, Butters, Cowell and Lilly.
2. Food Process Engineering – Heldman, D. R. and Singh, R. P.
3. Fundamental of Food Process Engineering – Romeo T. Toledo
4. Unit Operation of Chemical Engineering – Mc Cabe, Smith and Harriot
5. Mass Transfer Operation – Treybal, R. E.
6. Chemical Engineering (Vol. I and II) – Coulson, J. M. and Richardson, J. F.

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Semester-V

FT-301 Food Packaging (3+0+0)

OBJECTIVE:

- The course aims to develop the knowledge of students in the area of packaging of foods and the related technology used.
- This course will enable students to appreciate the application of scientific principles in the packaging of foods.

Unit-I

Objectives and functions of packaging and packaging material. Current status and global trends in food packaging. Packaging requirements and selection of packaging materials, properties of materials such as tensile strength, bursting strength, tearing resistance, puncture resistance, impact strength, tear strength, their methods of testing and evaluation.

Unit-II

Packaging Materials: **Paper as Package Material:** Pulping, Manufacture, Types of paper, Paperboard Products. Glass Packaging Materials: Introduction. Composition and Structure. Physical Properties. Manufacture. **Metal Packaging Materials:** Introduction. Manufacture of Tinplate: Manufacture of Pig Iron, Steelmaking, Tinplating. Manufacture of ECCS. Manufacture of Aluminium. Container-Making Processes

Plastics: Plastic as package material, types of plastic films and their properties, Extrusion, Coating and Laminating, Injection Molding, Blow Molding, Edible Packaging Materials, Biobased and Biodegradable Packaging Materials.

Unit-III

Barrier Properties of Thermoplastic Polymers: Theory of permeability, Steady-State Diffusion, Unsteady-State Permeation, Permeability Coefficient Units, Factors Affecting the Diffusion and Solubility Coefficients, Permeability of Multilayer Materials, Measurement of Permeability: Gas Permeability, Water Vapor Permeability, Permeability of Organic Compounds.

Unit-IV

Prediction of shelf life of foods, selection and design of packaging material for different foods Different packaging system for dehydrated foods, frozen foods, dairy products, fresh fruits and vegetables, meat, poultry and sea foods.

UNIT V

Environmental issues in packaging: Coding and marking including bar coding and Environmental, ecological & Economic issues, recycling and waste disposal.

OUTCOMES
45

No. of Lecture:

To gain knowledge on

- The different types of materials and media used for packaging foods.
- Hazards and toxicity associated with packaging materials and laws, regulations and the monitoring agencies involved food safety, labelling of foods
- Methods of packaging, shelf life and food factors affecting packaging

Reference Books

1. Food Packaging Materials by M. Mahadeviah and R.V. Gowramma
2. Principles of Food Packaging by Saclarow and R.C. Griffin
3. A Handbook of Food Packaging Frank A. Paine Blackie Academic
4. Food Packaging Materials N.T.Crosby Applied Science
5. Plastic Films for Packaging; Technology, Calvin J. Bening Technomic
6. Food Packaging: Principles and Practice Gordon L. Robertson Marcell Dekker

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Semester-V

FT-303 Fruit and Vegetable Processing (3+0+0)

OBJECTIVES:

- The course aims to develop the knowledge of students in the area of vegetable and fruit processing and technology.
- This course will enable students to appreciate the application of scientific principles in the processing of fruits and vegetables

Unit-I

Structural, Compositional and Nutritional aspects of fruits and vegetables. Post-harvest changes, storage, handling and preservation of fresh fruits and vegetables, controlled and modified atmosphere storage. Present scenario of fruits and vegetable industry in india.

Unit-II

Techniques of processing and preservation of fruits and vegetables by refrigeration and freezing, canning and bottling, drying and dehydration.

Canning: Machinery and equipments, canning of different fruits and vegetables.

Unit-III

Technology of fruits and vegetable products: Juices and pulps, Concentrates and powders, Squashes, cordials nectars, fruit drinks and carbonated beverages and its quality control.

Unit-IV

Other fruits and vegetables products: Jam, Jellies and Marmalades. Preserves, candies and crystallized fruits. Tomato products: Puree, Paste, Ketchup, Sauce and soup. Chutneys, pickles and other products.

Unit-V

Condiments, spice oils, oleoresins, Processing of cashew nuts, coffee and cocoa beans, and tealeaves, Specialty fruit and vegetable products.

OUTCOME

No. of Lecture: 45

- To develop skills related to Preservation and analytical techniques in fruit and vegetable products.
- Use of various techniques and additives for fruit and vegetable processing and quality analysis.

Books Recommended:

1. Food science by B.Srilakshami;New Age International.
2. Fundamentals of Foods and Nutrition by R. Madambi and M.V. Rajgopal.
3. Foods :Facts and Principles by N Shakuntalamanay;New Age International (P) Ltd.
4. Preservation of Fruits and Vegetable by Girdharilal and Sidappa; CBS Publications
5. Chocolate, Cocoa and Confectionary: Science and Technology by Bernard. W. Minifie
6. An introduction to the Post-harvest physiology and handling of fruitsand vegetables by R.H.H. Wills

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SEMESTER- V

FT- 305 Advances in Food Process Technology (3+0+0)

OBJECTIVES:

- The course aims to develop the knowledge of students in the area of emerging or alternative technologies applied to food processing.
- This course will enable students to understand the advantages and disadvantages over existing technologies.

Unit – I

Modeling of Microbial Food Spoilages: Microbial growth dynamics models, partial differentiation equation models, application of models in thermal preservation, Concept, mechanism of microbial destructions, equipments etc.

Membrane Technology: Introduction to pressure activated membrane processes, performance of RO/UF and NF and industrial application.

Unit – II

Supercritical Fluid Extraction: Property of near critical fluids (NCF), solubility and efficiency of NCF extraction, equipment and experimental techniques used in NCF extraction and industrial application.

Use of Microwave Energy in Foods: Theory of microwave heating, dielectric properties of food materials, working principle of magnetron, microwave blanching, sterilization and finish drying.

Unit – III

Hurdle Technology: Types of preservation techniques and their principles, concept of hurdle technology and its application.

High Pressure Processing of Foods: Concept of high-pressure processing, quality changes, effects of pressure on microorganisms and its application in food processing.

Unit – IV

Ultrasonic in Food Processing: Properties and generation of ultrasonic, ultrasonic imaging, application of ultrasonics as an analytical tool and processing techniques

Newer Techniques in Food Processing: Application of technologies of high intensity light, pulse electric field, ohmic heating, micronization in food processing and preservation

Nanotechnology: Principles, mechanism and applications in foods

OUTCOMES:

Number of Lectures : 45

On completion of the course the students are expected to

- Be able to understand and identify the different processing technologies and their application.

- Understand the application of scientific principles in the processing technologies specific to the materials.

Books Recommended:

1. G. W. Gould. New Methods of Food Preservation (Non Thermal Processing of Foods)
2. R. P. Singh. Introduction to Food Engineering
3. Food processing technology. Fellows, P. J.

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Semester-V

FT-309 Entrepreneurship Development (3+1+0)

OBJECTIVES:

1. Will teach the importance, the ways and management of new product into the market.
2. Will impart the basic knowledge of taxes, patent rules, excise rules, act of wages.
3. Explain the Government policies on small, medium and large scale industries.
4. Provide the working of various government & private agencies & apex bodies of food.

Unit I

Entrepreneurship: Definition of Entrepreneur, Internal and External Factors, Functions of an Entrepreneur, Entrepreneurial motivation and Barriers, Classification of Entrepreneurship, Theory of Entrepreneurship, Concept of Entrepreneurship, Development of entrepreneurship; Culture, stages in entrepreneurial process.

Unit II

Creativity and Entrepreneurial Plan: Idea Generation, Screening and Project Identification, Creative Performance, Feasibility analysis, Economic, Marketing, Financial and Technical; Project Planning: Evaluation, Monitoring and Control segmentation. Creative Problem Solving, Heuristics, Brainstorming, Synectics, Value Analysis, Innovation.

Unit III

International Entrepreneurship Opportunities: The nature of international entrepreneurship, Importance of international business to the firm, International versus domestic entrepreneurship, Stages of economic development. Institutional support for new ventures: Supporting Organizations; Incentives and facilities; Financial Institutions and Small scale Industries, Govt. Policies for SSIs.

Unit IV

Family and Non Family Entrepreneur: Role of Professionals, Professionalism vs family entrepreneur, Role of Woman entrepreneur. Venture Capital: Venture capital, Nature and Overview, Venture capital process, locating venture capitalists.

OUTCOMES:

No. of Lecture : 60

After the completion of the course, the students will be able to:

- Understand the importance of various aspects agribusiness management.
- Able to introduce new product and its marketing strategies.
- Will guidance entrepreneurs in legal matters and tax management.
- Able to handle the import and export of various commodities.

Books Recommended:

1. Bridge S et al (2003), Understanding Enterprise: Entrepreneurship and Small Business, Palgrave
2. Holt (1990) Entrepreneurship, New Venture Creation, Prentice-Hall
3. Dollinger MJ (1999) Entrepreneurship, Prentice-Hall
4. Desai A.N (1990), Entrepreneurship And Environment
5. Roy, Rajeev. Entrepreneurship Management. Oxford University Press

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Semester-V

FT-311 Food Additives (3+1+0)

OBJECTIVES:

1. To get an insight into additives that are relevant to processed food industry for shelf life extension, processing aids and sensory appeal.
2. To explain about role of food additives in food quality control.
3. To explain the techniques of best use of food additives.
4. To describe the role of food additives in health maintenance and cure of diseases

UNIT - I

Food Additives: definitions, classification and applications, food preservatives- classifications, antimicrobial agents, types and their action, safety concerns, regulatory issues in India, international legal issues; Antioxidants (synthetic and natural, mechanism of oxidation inhibition); Chelating agents: types, uses and mode of action; Coloring agents: color retention agents, applications and natural colorants, sources of natural color, misbranded colors, color extraction techniques, color stabilization.

UNIT - II

Flavoring Agents: flavors (natural and synthetic flavors), flavor enhancers, flavor stabilization, flavor encapsulation; Flour improvers: leavening agents, humectants and sequesterant, hydrocolloids, acidulants, pH control agents buffering salts, anticaking agents.

UNIT - III

Sweeteners: natural and artificial sweeteners, nutritive and non-nutritive sweeteners, properties and uses of saccharin, acesulfame-K, aspartame, corn sweeteners, invert sugar sucrose and sugar alcohols (polyols) as sweeteners in food products; Emulsifiers: types, selection of emulsifiers, emulsion stability, functions and mechanism of action.

UNIT - IV

Nutrient supplements & thickeners: polysaccharides, bulking agents, antifoaming agents, synergists, antagonists; additives food uses and functions in formulations, permitted dosages, indirect food additives; harmful effects/side effects associated with various additives (various diseases).

OUTCOMES:

No. of Lecture: 60

After the completion of the course, the students will be able to:

1. Understand about the use of food additives in food formulations.
2. Apprehend the suitable application of food ingredients in health foods and convenience food preparation.
3. Grasp the techniques of food additives stability and use level.
4. Understand the role of food additives in health maintenance and cure of diseases

Books Recommended:

1. Branan A. L., Davidson P. M., and Salminen S. (2001) *Food Additives*. 2nd Ed. Marcel Dekker.
2. George A. B., (1996) *Encyclopedia of Food and Color Additives*. Vol. III. CRC Press.
3. George A. B., (2004) *Fenaroli's Handbook of Flavor Ingredients 5th Ed*. CRC Press.
4. Morton I. D., and Macleod A. J., (1990) *Food Flavours. Part A, B & C*. Elsevier.
5. Stephen A. M., (2006) *Food Polysaccharides and Their Applications*. Marcel Dekker.

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Semester-VI

FT-302 Technology of Cereals, Pulses and Oilseeds (3+0+0)

OBJECTIVE:

- The course aims to develop the knowledge of students in the area of pulse and oil seed processing and technology.
- This is necessary for effective understanding specific aspects of food processing related to these foods. This course will enable students to appreciate the application of scientific principles in the processing of these materials.

Unit-I

Composition, Structure and Processing characteristic of Cereal grains and Pulses, Post-harvest, Processing practices for their safe storage. Parboiling and Milling of paddy, Quality characteristics, curing and aging of rice, processed rice products.

Unit-II

Wheat and its quality characteristics for milling into flour and semolina, Flour milling, Turbo grinding and air classification, Flour grades and their suitability for baking purposes, Assessment of flour quality and characteristics, Milling of Durum wheat, Macaroni products.

Unit-III

Dry and Wet milling of corn, Starches and its conversion products, malting of barley, Pearling of Millets, Milling of legume-pulses by traditional and improved processes.

Unit-IV

Anti-nutritional factors in pulses and there methods of inactivation; pre-treatments; Traditional and modern milling methods and equipment involved; By-products of pulse milling and their utilization.

Unit-V

Processing of Oilseeds: Processing of oil seeds for direct use and consumption, Oil and protein products, Refining, Hydrogenation and Interstrification of oil, Processing of de-oiled cake into protein concentrates and isolates, Textured protein, Functional protein preparations, Peanut butter, Margarine and Spread.

OUTCOMES

No. of Lecture:

45

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for pulses and oil seeds and the various products derived from these materials.
- Understand the application of scientific principles in the processing technologies specific to the materials.

- Grasp the changes in the composition of foods with respect to the type of processing technology used.

Books Recommended:

1. Food Science by N.N.Potter
2. Cereal Technology by S.A.Matz
3. Bakery Technology S.A.Matz
4. Technology of Cereals, by NL. Kent, Pergamon Publisher
5. Chakraverty A & De DS. 1981. *Post-harvest Technology of Cereals, Pulses and Oilseeds*. Oxford & IBH.
6. **Unit Operations** of Agricultural Processing. By **K M Sahay**, K.K. Singh. Edition, 2, Publisher, Vikas Publishing House Pvt
7. Practical manual on Processing of Pulses and Oilseeds, Practical manual on Processing of Cereals and Value Addition, published by Indian Institute of Food Processing Technology
(<http://www.iifpt.edu.in/uploads/1-to-2-week-modules.pdf>)
8. Mysore Manuals on Rice and its Processing C.F.T.R.

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Semester-VI

FT-304 Food Texture and Rheology (3+0+0)

OBJECTIVE:

- To expose the students to the fundamental knowledge of food, its properties and different methods of food processing

UNIT I

Rheology and texture of food materials: Concept of rheology, elastic, plastic and viscous behaviour, viscoelasticity, rheological models and constitutive equations. Methods of texture evaluation, subjective and objective measurements. Aerodynamic and hydrodynamic characteristics. Application to separation, pneumatic handling and conveying. Material handling: Material handling machines and conveyors.

UNIT II

Thermal processing: Concept of thermo bacteriology: Arrhenius analogy, its application in design. Determination of heat resistance of micro organisms. Thermal processing: Blanching, Pasteurizations and Sterilization - principles, different methods and equipments. Processing in containers, process time Shelf life: Calculation of shelf life. Shelf life requirements, Deteriorative reactions. Accelerated testing. Transport properties of barriers. Simulations of product - package environment interaction. Shelf life simulation for moisture, oxygen, and light sensitive products.

UNIT III

Water binding and drying: Raoult's Law. Water sorption Isotherms - Hysteresis. Water activity measurement method. Water binding and its effect on enzymatic and non-enzymatic reactions and food texture. Control of water activity and moisture. Permeability: Theoretical considerations. Permeability of gases and vapours. Permeability of multilayer materials. Permeability in relation to packaging requirement of foods.

UNIT IV

Methods of food processing: Membrane processes: Ultra filtration, Reverse osmosis, Electrodialysis, per-evaporation and micro filtration. High Temperature: Extrusion: Extrusion cookers, cold extrusion, single and twin screw extrusion. Low pressure and high-pressure extrusion, properties of Food materials, its significance in equipment design, processing. Non – Thermal Methods: Microwave and Dielectric & Infrared heating: Physical parameters. Heat transfer phenomenon. Equipment and application. Irradiation - Principle and its equipments, Blending and pulverization equipments.

UNIT V

Layout and cost estimation : Technology scaleup -Product and process layout - Expansion and Improvements of Existing Facilities- Inventory control - Cost Indexes - Capacity vis-a-vis Costs - Factored Cost Estimate – Break – even point - Improvements– Module Cost Estimation - Unit Operations Estimate- Detailed Cost Estimate- Accuracy of Estimates- Case Study: Capital Cost Estimation.

OUTCOMES:

No. of Lecture: 45

- Students will understand the importance of quality control and food packaging in shelf life of foods.
- Understand thermal processing of food and hygiene practices in food industry.

Books Recommended:

1. Toledo, Romeo T. "Fundamentals of Food Process Engineering" II Edition. CBS Publishers, 2000.
2. Fellows P. J "Food Processing Technology" Woodhead Publishing, 1998.
3. Smith P. G "Introduction to Food Process Engineering". Springer, 2005
4. Earle, R.L, "Unit Operations in Food Processing". Pergamon Press. Oxford. U.K, 2003

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Semester-VI

FT-306 Plantation Products and Spices Technology (3+0+0)

OBJECTIVES:

To enable the students to understand about

- Coffee and its processing techniques, instant coffee, and quality grading
- Different types of tea and its manufacturing techniques, instant tea, quality parameters of tea

Unit I

Coffee : Occurrence, chemical constituents, fermentation of coffee beans, changes taking place during fermentation, drying, roasting, Process flow sheet for the manufacture of coffee powder Instant coffee, Quality grading of coffee

Unit II

Tea: Occurrence, chemistry of constituents, types of tea – green, oolong and ctc, chemistry and technology of CTC tea, manufacturing process, Green tea manufacture, Instant tea manufacture, Grading of tea

Unit III

Occurrence and Chemistry of the cocoa bean, changes taking place during fermentation of cocoa bean, Processing of cocoa bean, cocoa powder, cocoa liquor manufacture

Unit IV

Major spices: Pepper, Cardamom, ginger and turmeric, Oleoresins and essential oils, Method of manufacture, Chemistry of the volatiles, Enzymatic synthesis of flavour identical, Quality control

Unit V

Minor spices: Cumin, Coriander, Cinnamon, fenugreek, Garlic, Clove and Vanilla, Oleoresins and essential oils, Method of manufacture, Chemistry of the volatiles, Quality control, Present trends in synthesis of volatiles, micro-organisms, plant suspension cultures

OUTCOMES:

No. of Lecture :

45

- On completion of the subject, students will be able to understand the processing steps involved for different plantation products and spices.

Books Recommended:

1. Salunkhe, D.K. and Kadam S.S. Ed. 1998. Hand book of Vegetable Science and Technology, Marcel Dekker, New York, USA.
2. Chocolate, Cocoa and Confectionery Technology, Minifie Bernard W., III Edition, Aspen Publication, 1999.
3. Handbook on Spices, National Institute of Industrial Research (NIIR) Board, AsiaPacific Business Press Inc., New Delhi 2004.

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Semester-VI

FT-308 Food Process Equipment Design (3+0+0)

OBJECTIVE:

- To understand the construction requirements, process design, fabrication and installation of equipments and to enhance the knowledge in the design of food processing equipments.

Unit-1

Introduction: Design and selection criteria for process equipment. Stresses created due to static and dynamic loads, design stress, elastic instability, combined stresses and theories of failure, brittle fracture, creep, temperature effects, radiation effects, effects of fabrication methods.

Unit-II

Design of Material Handling and Equipment

Belt Conveyor : Design, maximum length of belt in open and cross belt, diameter and speed of pulley, slip, thickness of belt, tension in slack side and tight side, to find horse power required to operate the belt conveyor, design of bucket elevator.

Chain conveyor: Number of teeth and length of chain for chain conveyor, horsepower required, type of chain conveyor thermal power requirement of the trolley, scrapes, Screw Conveyor : Its importance and various uses in food industry, design factor.

Pneumatic conveyor: Importance in food industry, design considerations. Design of pneumatic conveyor.

Unit-III

Dryers: Structural and thermal design, selection of dryer.

Pressure Vessel Design: Introduction, Operating Conditions, Design conditions and stress, Design of shell and its component, Stresses from local load and thermal gradient, Design problems.

Unit-IV

Heat Exchanger: Design of heat exchanges, functional difference between plate and tube heat exchangers, calculation of maximum area required, overall heat transfer coefficient for milk and water, design considerations for heat exchangers.

OUTCOME:

No. of Lecture : 45

- Ability to design, fabricate and operate processing equipments .

Books Recommended:

1. Process Equipment Design by Joshi MV and Mahajani VV. Macmillan India Ltd
2. Process Equipment Design by Brownell and Young. John Wiley
3. Process Equipment Design by Bhattacharya BC. Macmillan India Ltd
4. Strength and Elasticity of Materials by Brooks WH. Asia Publishing Hous

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Semester-VI

FT-310 Technology of Fats and Oils (3+1+0)

OBJECTIVES:

- The course aims to develop the knowledge of students in the area of Fat and Oil processing and technology.
- This is necessary for effective understanding specific aspects of food processing related to these foods.
- This course will enable students to appreciate the application of scientific principles in the processing of these materials

Unit I:

Physical and chemical properties: Sources of vegetable oils, production status-oil content – coconut , palm, peanut , rice bran, sesame, mustard and sunflower seeds oil – physical and chemical properties of fats and oils, chemical reactions of oil, hydrolysis, hydrogenation, oxidation and polymerization.

Unit II:

Extraction methods: Oil extraction methods: mechanical expression, ghani, power ghani, rotary, hydraulic press, screw press, expellers, filter press - principle of operation and maintenance, solvent extraction Process – steps involved, batch and continuous-continuous solvent extraction process for rice Bran, soybean and sunflower-oil extraction process for groundnut and cotton seed-production of special oils – palm oil, virgin coconut oil – extraction process.

Unit III:

Refining of Oils: Refining of oils: objectives, characterization, degumming, zeneath process, deacidification Process, continuous acid refining, bleaching of oil, continuous bleaching process decolorizing agents, deodorization process, winterization processes, hydrogenation of oil batch type hydrogenation, production process of vanaspati, ghee and margarine, special fats, butter, partial sterilization, emulsification, chilling, kneading and rolling, incorporation of salt, colouring substances.

Unit IV:

Packaging of edible oils: Packaging of edible oils requirements, types – tinplate, semi rigid, glass, Polyethylene Terephthalate, Poly Vinyl Chloride, flexible pouches – packaging for vanaspati and ghee changes during storage of oil –rancidity – causes – atmospheric oxidation and enzyme action – free fatty acid – colour-non edible oils – castor oil, linseed oil, vegetable waxes – production and processing.

Unit V: Industrial applications and quality standards

Industrial applications of fats and oils – quality regulations - manufacture of soap, candle, paints and varnishes - ISI and Agmark standards – site selection for oil extraction plant

OUTCOMES:**No. of Lecture: 45**

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for Fats and oils
- Understand the application of scientific principles in the processing technologies specific to the materials.

Books Recommended:

1. Harry Lawson. 1997. Food oils and Fats, Technology, Utilization and Nutrition. CBS Publishers and Distributors, New Delhi
2. Weiss, T.J. 1970. Food Oils and their uses. The AVI Publishing Company, Inc. Westport, Connecticut.
3. Acharia, K.T. 1990. Oil seeds and oil milling in India. Oxford and IBH publication, New Delhi.
4. Panda, H. 2000. Essential oils – Hand book – National Institute of Industrial Research – ISBN, New Delhi.
5. Anonymous. 2004. Handbook of oils, fats and derivatives with refining and packaging technology. Engineers India Research Institute, New Delhi.

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Semester-VI

FT-312 Food Processing Waste Management (3+0+0)

OBJECTIVES:

To impart knowledge of wastes and by-products of food processing, their effects on the quality of environment, and measures to minimize the production of wastes and food processing waste management

Unit – I

Food Industry Wastes and Environmental Pollution: Characterization of food industry effluents, Physical and chemical parameters, Oxygen demands and their interrelationships; Residues (solids), fats, oils and grease; Forms of nitrogen, sulphur and phosphorus, anions and cations, surfactants, colour, odor, taste and toxicity; Unit concept of treatment of food industry effluents, screening, sedimentation /floatation as pre-and primary reactants.

Unit – II

Food Industry By-products and their Utilization: Characterization and utilization of by-products from cereals, pulses, oilseeds, fruits, vegetables, plantation products, fermented foods, milk, fish, meat, egg and poultry processing industries.

Unit – III

Biological Oxidation: Objectives, Organisms involved, Reactions, Oxygen requirements, Aeration device systems: Lagoon, Activated sludge process, Oxidation ditch, Rotating biological contactor-their variations and advanced modifications.

Unit – IV

Waste Water Management: Wastewater treatment systems, Physical separations, Micro-strainers, Filters, Ultra filtration and reverse osmosis, Physico-chemical separations-activated carbon adsorption, ion-exchange, electro dialysis and magnetic separation; Chemical oxidation and treatment-coagulation and flocculation, disinfection, Handling disposal of sludge.

Unit – V

Standards and Acts: Food industry wastes, Food waste treatment-ISO 14001 standards, Standards for emission or discharge of environmental pollutants from food processing industries according to Environment (Protection) Act 1986, Elements of importance in the efficient management of food processing wastes.

OUTCOMES:

No of Lecture: 45

- Awareness of Importance in treating waste product from food industry.
- Knowledge of Treatment methods and recycling of waste product from food industry

Reference Books

1. Lawrence K. W., Howard, H. Y. and Yapijakis, C. 2005. Waste Treatment in the Food Processing Industry, CRC Press, New York.
2. Loannis, P. and Arvanitoyannis, S. 2008. Waste Management for the Food Industries, Elsevier Publishers, New York.
3. M.N. Rao and A.K. Datta. 2008. Waste Water Treatment, Oxford and IBH Publishing Co Pvt. Ltd, New Delhi.
4. Metcalf, P. and Eddy, L. 2013. Wastewater Engineering Treatment and Resource Recovery, 5th Edition, McGraw Hill Publication, New York.

5.Wang, C. and Taylor, Lo H. 2006. Waste Treatment in the Food Processing Industry, CRC Press, New York.

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Semester-VI

FT-314 Technology of Frozen Foods (3+0+0)

OBJECTIVES:

- To understand the underlying principles of operation in different Refrigeration & cold storage systems and its components.
- To provide knowledge on design aspects of cold storage systems

Unit – I

Fundamentals of Freezing: Glass transitions in frozen foods and biomaterials, Microbiology of frozen foods, Thermophysical properties of frozen foods, Freezing loads and Freezing time calculation, Innovations in freezing process

Unit – II

Facilities for the Cold Chain: Freezing methods and equipment, Cold store design and maintenance, Transportation of frozen foods, Retail display equipment and management, Household refrigerators and freezers, Monitoring and control of the cold chain.

Unit – III

Quality and Safety of Frozen Foods: Quality and safety of frozen meat and meat product, Quality and safety of frozen poultry and poultry products, Safety and quality of frozen fish, Shellfish, and related products, Quality and safety of frozen vegetables, Quality and safety of frozen fruits, Quality and safety of frozen dairy products, Quality and safety of frozen ready meads, Quality and safety of frozen bakery products, Quality and safety of frozen eggs and egg products

Unit – IV

Monitoring and Measuring Techniques for Quality and Safety: Chemical Measurements, Sensory analysis of frozen foods, Foodborne illnesses and detection of pathogenic microorganisms, Shelf-life prediction of frozen foods.

Packaging of Frozen Foods: Introduction to frozen food packaging, Plastic packaging of frozen foods, Paper and card packaging of frozen foods, Packaging of frozen foods with other materials, Packaging machinery.

OUTCOME

No. of Lecture: 45

- Upon completion of this course, the students will be able to demonstrate the operations in different Refrigeration & cold storage systems and also able to design Refrigeration & cold storage systems.

Reference Books

1. Quality in Frozen Foods by Marilyn C. Erickson, Yen-Con Hung
2. Handbook of Frozen by Isabel Guerrero Legaretta
3. Managing Frozen Foods by Managing Frozen Foods
4. Stringer, Mike and C. Dennis. "Chilled Foods: A Comprehensive Guide". 2nd Edition, CRC / Woodhead Publishing, 2002.

5. Kennedy, Christopher J. "Managing Frozen Foods". CRC / Woodhead Publishing, 2000.
6. James, S.J. and C. James. "Meat Refrigeration". CRC / Woodhead Publishing, 2002

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Semester-VII

FT-401 Bakery and Confectionary Technology (3+0+0)

OBJECTIVES:

This course will enable the student to

- Familiarize with the commercial methods of baking bread and recent advances in bakery industry
- Learn microbiological aspects of bakery products, sanitation and hygiene of baking industries.

Unit-I

Wheat flour and wheat flour treatments

Grade of flour, constituents of flour – ageing of flour – Tests for flour quality. Yeast Characteristics, Preparation, Handling & Storage, Adequacy for use in bakery industry. Ingredients, Technology and quality parameters for baked products: Bread, Biscuits and cakes.

Unit-II Bakery equipment and machinery

Different types of Mixers, kneaders and cutters. Different types of ovens. Packaging machinery for bread and biscuits. Quality control in bakery industry. Quality control of raw materials. Quality control of finished products. Quality control of packaging materials.

Unit-III Technology of bread making Different methods

Process steps and their significance. Characteristics of good bread. Defects in bread their causes and remedies.

Unit-IV Technology of Cakes Manufacture

Different cake making processes. Sugar batter method, Flour batter method, Modified sugar batter method Whipping method, Blending method etc. Process steps and their significance. Importance of baking time and temperature. Recipe balancing .Defects in cakes, their causes and remedies.

UNIT-V Biscuits

Definition and types. Fermented dough biscuits. Cookies. Types of cookies and their manufacture. Cream biscuits. Process steps and their significance. Defects in biscuits their causes and remedies.

OUTCOMES

No. of Lecture : 45

- Better understanding of process technology of bakery and confectionery products
- Complete learning - use of sanitation and safety practices in bakery and confectionery production

Reference Books

1. E.J Pyler: Baking Science and Technology: Vol.1 & 2, 3rd Edition, Sosland, 1988
2. Samuel A.Matz: Bakery Technology and Engineering, Springer US
3. Samuel A.Matz: Cookie and Cracker technology, AVI Publications
4. H. Faridi: The Science of Cookie and Cracker Production, CBS Publishers & Distributors, N Delhi

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Semester-VII

FT-403 Food Storage Engineering (3+0+0)

OBJECTIVES:

- The course aims to develop the knowledge of students in the area of Food storage
- This is necessary for effective understanding specific aspects of food storage

UNIT I

Cold storage: Cold storage- Moist air and applied psychrometry, Estimation of cooling load, Air conditioning systems, Evaporators, Compressors, Condensers, Expansion devices, Cooling towers, Different types of refrigerants, Transmission and distribution system of cool air, Thermal and vapor insulation materials, Design of small capacity cold storage, Instrumentation and climate management in cold storage.

UNIT II

Frozen storage : Quality losses in frozen foods- Physical changes, Chemical changes in food components, Nutritional aspects of freezing, Microbiology of frozen products, Glass transitions temperature and stability of frozen foods, Temperature requirements during frozen storage, Shelf-life of frozen foods- shelf-life testing, Modelling loss of quality in frozen foods, Time-Temperature integrators, Packaging of frozen foods, Different types of freezers.

UNIT III

Controlled atmospheric storage: Biochemical considerations of CAS, Gas exchange mechanisms, Mass balance principles, Gas generators, Equipment's for producing and regulating controlled atmosphere, Design of controlled atmosphere storage chambers.

UNIT IV

Modified atmospheric storage : Overview of Modified atmospheric storage, Gases and Vapor applied to modified atmosphere processing operations, MAP modelling- Kinetics of food deteriorative reactions, Shelf-life testing, Enzyme kinetics applied to MAP, MAP design with oxygen modelling .

UNIT V

Hypobaric storage: History of Hypobaric storage, Experimental errors in hypobaric storage research, Gas and vapor mass transfer at low pressure, Requirements for installation-measurement devices (Relative humidity, Pressure, Air-change rate, Oxygen, Carbon dioxide, Ethyl alcohol, Acetaldehyde, hypobaric acid vapor), Flow control, Humidity control, Effects on food, Effects on microbes.

OUTCOMES

No. of Lecture : 45

- On completion of the course the students are expected to Understand the application of scientific principles in the processing technologies specific to the materials.

Reference Books

1. "Hypobaric storage in food industry- Advances in technology and theory"- Stanley.P.Berg
2. "Frozen food science and Technology"- Judith.A.Evans
3. "Engineering for storage of fruits and vegetables"- Chandra Gopala Rao FD8022

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Semester-VII

FT- 407 Traditional and Fermented Foods (3+0+0)

OBJECTIVES:

- To understand the Enzyme kinetics, Inhibition kinetics, Immobilization
- To understand the concept of basic fermentation processes and its control systems etc.
- To help students acquire a sound knowledge on diversities of foods, food habits and patterns in India with focus on traditional foods.

Unit -I

Indian traditional sweet, savory and snack food products: Sweetmeats, Namkins, Papads Idli and Dosa.

Unit -II

Preparation and Maintenance of Bacterial, Yeast and Mold cultures for food fermentations. Lactic acid bacteria-activities and health-promoting effects. Mushrooms: Cultivation and preservation.

Unit -III

Fermented Dairy Products: Cheeses, Curd and Yoghurt, Buttermilk and the fermented milks. Spoilages and defects of fermented dairy products and their control. Fermented meat and fish products

UNIT IV

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT V

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods

OUTCOMES:

45

The student will be able to

No. of Lecture:

- Understand the fundamentals of Enzyme kinetics, Inhibition kinetics and Immobilization
- Understand the concept of basic fermentation processes and its application during scaleup operations.

Reference Books

1. K.H. Steinkrus Handbook of Indigenous Fermented Foods
2. Sukumar De Outlines of Dairy Technology
3. Prescott & Dunn Industrial Microbiology
4. L.E. Casida Industrial Microbiology
4. Bailey, J.E. and Ollis, D.F. "Biochemical Engineering Fundamentals", 2nd Edition, McGraw Hill, 1986.

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Semester-VII

FT 417 Food Safety, Quality and Regulation (3+0+0)

OBJECTIVES:

- To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
- To help become skilled in systems for food safety surveillance
- To be aware of the regulatory and statutory bodies in India and the world

UNIT I

Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labeling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection, ISO 22000 – Importance and Implementation

UNIT II

Food quality: Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities.

UNIT III

Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system. Food inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system to monitor food safety, risk communication

UNIT IV

Indian and global regulations: FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)

UNIT V

Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.

OUTCOMES:

No. of Lecture : 45

- Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments

- Awareness on regulatory and statutory bodies in India and the world

Reference Books

1. Handbook of food toxicology by S. S. Deshpande, 2002
2. The food safety information handbook by Cynthia A. Robert, 2009
3. Nutritional and safety aspects of food processing by Tannenbaum SR, Marcel Dekker Inc., New York 1979
4. Microbiological safety of Food by Hobbs BC, 1973
5. Food Safety Handbook by Ronald H. Schmidt, Gary E. Rodrick, A John Wiley & Sons Publication, 2003

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Semester-VII

FT- 409 Food Dehydration Technology (3+0+0)

OBJECTIVES:

To explain the dehydration, drying curve, freeze drying and equipments required for carrying out these operations.

Unit I

Principles of drying– Fundamentals of air-water mixtures – psychrometric chart – Heat and mass transfer in ideal dryers – with and without recirculation. Theories of drying – constant and falling rate period - diffusion theory, capillary theory, evaporation – condensation theory, Luikov, Philip and De Vries theory. Water content in foods and its determination – Theoretical and empirical models for determining water activity

Unit II

Fundamentals of cabinet drying – Mass and Heat balances in dryers (batch and continuous) (simple problems only) – description of batch and continuous dryers – Application in Food industry – Vacuum and Drum driers

Unit III

Fundamentals –Nozzles, Rotary atomizers and two fluid feeds- Interaction of droplets with air- Drying of droplets with soluble and insoluble solids – Microstructure of spray dried products – Reconstitution – Foam spray drying – Applications in the Food industry

Unit IV

Fundamentals of freeze drying – Freezing and drying steps – Combined heat and mass transfer (only theory) – Structural changes and volatile retention during freeze drying – Freeze dehydration related processes :prefreezing, preconcentration, condensation, defrosting – Industrial freeze driers – Atmospheric freeze drying - Applications in food industry.

Unit V

Fluidised bed drying – Batch and Continuous dryers – Pneumatic dryers, Extrusion cooking – Single and Twin-screw extruders Packaging of dehydrated products

OUTCOMES:

Able to understand the principle and application of dehydration and freezing.

No. of Lecture : 45

Reference Books

1. Dehydration of Foods by Gustavo V. Barbosa –Cánovas and Vega-Mercado
2. Food Drying Science and Technology, Microbiology, Chemistry, Application, by Y. H. Hui
3. Handbook of Industrial Drying, Arun S. Mujumdar

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Semester-VII

FT-411 Meat, Fish and Poultry Processing Technology

OBJECTIVES:

- The course aims to develop the knowledge of students in the area of animal product processing and technology.
- This course will enable students to appreciate the application of scientific principles in the processing of these materials.

UNIT I

Introduction: Recent trends in meat processing. Types of Meat and its sources, composition, structure, of meat and meat products. Ante mortem handling, slaughtering of animals, Mechanical deboning, inspection and grading of meat. Post-mortem changes of meat. Color, flavors, microbiology and spoilage factors of meat and meat products.

UNIT II

Meat Processing Factors affecting post-mortem changes, properties and shelf-life of meat. Meat tenderization and Meat quality evaluation. Modern abattoirs, slaughter house and its features. Preservation of meataging, pickling, smoking. Dried and Cured meat. Canned meat, Frozen meat, Cooked and Refrigerated meat, Sausages.

UNIT III

Fish Processing: Types of fish, composition, structure and spoilage factors of fish. Post-mortem changes in fish. Handling and transportation of fish. Bacteriology of fish, Chilling of fish, Freezing and Individual quick freezing. Canning and smoking operations, Salting and drying of fish, pickling. Radiation processing of fish and fish products. Seafood quality Assurance, Advances in fishery by products technology.

UNIT IV

Poultry: Introduction, Types and characteristics of poultry products, composition, nutritive value, calculation of nutritive value of poultry products. Unit operation involved in poultry processing.

UNIT V

Egg processing: Structure, composition, nutritive value, calculation of nutritive value and functional properties of eggs, Factor affecting egg quality and measures of egg quality. Preservation of egg by different methods. Egg powder processing.

OUTCOME:

No. of Lecture: 45

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for meat and such foods and the various products derived from these materials.

- Grasp the changes in the composition of foods with respect to the type of processing technology used.

Reference Books

1. Govindan. T.K, "Fish Processing Technology", Oxford and IBH Publishers, New Delhi, 1985.
2. Lawrie, R.A. "Meat Science", Second Edition. Pergamon Press, Oxford, UK. 1975.
3. Stadelmen, W.J. and Cotterill, O.J., "Egg Science and Technology", Second Edition, AVI, Westport, 1977. ty of Chemistry, 2003.

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Semester-VII

FT-413 Functional Foods and Nutraceuticals (3+1+0)

OBJECTIVES:

- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease

UNIT I

Introduction and significance: Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoo chemicals and microbes in food, plants, animals and microbes

UNIT II

Analysis of phytochemicals: Qualitative and quantitative methods: phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, Chitin; Carotenoids - Factors affecting bioavailability, chemical and histochemical characterization of cell wall polysaccharides in almond seed in relation to lipid bioavailability.

UNIT III

Assessment of antioxidant activity: In vitro and In vivo methods for the assessment of antioxidant activity, Comparison of different In Vitro methods to evaluate the antioxidant, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; 83 Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources

UNIT IV

Role in health and disease: Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and symbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

UNIT V

Safety issues Health Claims, regulations and safety issues- International and national.

OUTCOMES:

No of Lecture: 60

- Knowledge of the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction
- Understand the role of Nutraceuticals and functional food in health and disease

Reference Books

1. Bisset, Normal Grainger and Max Wich H “Herbal Drugs and Phytopharmaceuticals”, II Edition, CRC, 2001.
2. Wildman, Robert “Handbook of Nutraceuticals and Functional Foods”. CRC, 2006.
3. Webb, P P. “Dietary Supplements and Functional Foods”. Blackwell, 2006.
4. Ikan, Raphael “Natural Products: A Laboratory Guide”, 2nd Edition, Academic Press / Elsevier, 2005.
5. Tipnis, H.P. “Bioavailability and Bioequivalence: An Update” New Age International,

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Semester-VII

FT- 415 Flavour Technology (3+1+0)

OBJECTIVES:

- To understand the flavour compounds involved in development of flavor
- To understand the analytical techniques involved in flavor analysis

UNIT I

Introduction: Problems in flavour research – classification of food flavours; chemical compounds responsible for flavour.

UNIT II

Flavour compounds: Chemical compound classes and their flavour responses; flavour development during biogenesis, flavour development during food processing; use of biotechnology to develop flavours.

UNIT III

The chemical senses anatomy of the chemical senses; neural development of the chemical senses; receptor mechanisms, neural coding; the control of eating.

UNIT IV

Flavour analysis: Subjective versus Objective methods of analysis; psychophysics and sensory evaluation and its types, ENOSE, ETONGUE; Instrumental analysis; sample handling and artifacts; data handling

UNIT V

Teaching flavour concepts: Problem based learning; tongue and nose; Onion-Beverage-Maillard reaction-Thio-stench

OUTCOMES:

No of Lecture: 60

- Better understanding and knowledge of contribution of different compounds for the development of flavor and Analytical techniques involved in flavor analysis.

Reference Books

1. Fisher, Carolyn and Thomas R. Scott. "Food Flavours: Biology and Chemistry". The Royal Society of Chemistry, 1997.
2. Heath, H.B. and G. Reineccius. "Flavor Chemistry and Technology". CBS Publishers, 1996.
3. Reineccius, Gary. "Flavor Chemistry and Technology". II Edition, Taylor & Francis, 2006.
4. Shahidi, Fereidoon and Chi-Tang Ho. "Flavor Chemistry of Ethnic Foods". Kluwer Academic / Plenum, 1999.
5. Ashurst, Philip R. "Food Flavorings". III Edition, Aspen Publication

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Semester-VII

FT-405 Dairy Process Technology (3-0-0)

OBJECTIVE

- To introduce the students to dairy industry, properties and processing of milk, manufacture of dairy products, sanitation and effluent treatment in dairy industry

Unit-I

Milk-Types-Composition-Physical-Chemical and Thermal Properties-Heat Capacity, Density Freezing-Boiling point-Expansion-Agitation-Viscosity-Classification of milk Market and Special Milk Handling-effects of Merits on Milk-toxicity of metals.

Unit-II

Production, collection, testing quality, cooling, storage, and transportation of liquid milks. Receiving and quality assessing of liquid milk in dairy industry for detection of adulteration, decision for acceptance/rejection of the milk, Defects in market milk

Unit-III

Standardization and/or processing (pasteurization, sterilization and Ultra High Temperature processing), storage, packaging and distribution of liquid milks: whole, standardized, toned, double-toned, and skimmed milk. Recombined, reconstituted, and flavoured milks. Cleaning and sanitization of dairy equipment's and plant.

Unit-IV:

Milk Products: Definition, composition, methods of preparation/production, quality and/or grading parameters, packaging, storage characteristics, uses and shelf-life of cream, Technology and chemistry of Ice-Creams, butter and ghee; evaporated and condensed milks, skimmed, whole and instants milk powders.

Unit-V

Dried Milk Products

Evaporated and condensed milk: Method of manufacture, packaging and storage. Roller and

spray drying of milk solids, flow ability, reconstituability, dispersability, wet ability, sink ability and appearance of milk powders.

OUTCOME:

No. of Lecture: 45

- The students will gain knowledge about dairy processing and understand the manufacturing processes of various dairy products

Books Recommended:

1. Outlines of Dairy Technology by SukumarDe, Oxford University Press.
2. Dairy Engineering and Management by Taufilahmed
3. Principles of Dairy Processing by James N. Warner, Wiley Eastern Ltd.
4. Milk and Milk Products by Eckles, Combs; and Macy, Tata McGraw Hill.
5. Technology of Indian Milk Products by Aneja et al. A Dairy India Publication.

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Semester-VIII

FT-454	Project II	(15Credits)
MOOCS courses –I	(Open elective)	(3Credits)
MOOCS courses –II	(Open elective)	(3Credits)
MOOCS courses –III	(Open elective)	(2Credits)