

Regulations, Course Structure & Syllabus
of
5-year Integrated UG and PG Food Technology
Programme



Centre of Food Technology
Institute of Professional Studies
University of Allahabad

Objectives of the Programme

- To impart knowledge of various areas related to Food Science and Technology.
- To familiarize the students about the processing and preservation techniques of pulses, oilseeds, spices, fruits and vegetables, meat, fish, poultry, milk, & milk products.
- To emphasize the importance of food safety, food quality, food plant sanitization, food laws and regulations, food engineering and packaging in food industry.
- To inculcate ability to develop new food products and establish own enterprise.

Regulations for 5-year Integrated UG and PG*Food Technology Programme Eligibility for admission:

S.No.	Eligibility	Entry Point	Exit Point after successful completion	Degree offered
1.	A candidate must have passed 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture having scored not less than 50% marks (45% for SC&ST candidates) in aggregate.	First Semester	Second Semester / One year	Certificate (Food Technology)
		-	Fourth semester / Two year	Diploma (Food Technology)
		-	Sixth semester / Three year	UG (Food Technology)
		-	Eight Semester/ Four year	UG (Food Technology) 'With Research'
		-	Tenth Semester/ Five year	5-year Integrated UG and PG Food Technology Programme

*Presently B.Sc. and M.Sc.

I. Duration of Programme:

- (i) The UG programme shall extend over a period of 8 consecutive semesters spread over 4 academic years – two semesters constituting one academic year with multiple exit points outlined in S. No. I and 5-year Integrated UG and PG Food Technology Programme shall extend over a period of 10 consecutive semesters spread over 5 academic years. The duration of each semester shall normally be 15 weeks excluding examinations.

II. No. of Seats

5-year Integrated UG and PG Food Technology: **50**

(University reservation policy will be implemented for admission)

III. Fees:

The fees (per semester) in 5-year Integrated UG and PG Food Technology Programme is as follows:

S. No.	Semester	Amount (Rs.)
1	Semester I	30,000/- + 5000/- (caution money Refundable as per rule) = 35,000/-
2.	Semester II	30,000/-
3	Semester III	30,000/-
.4.	Semester IV	30,000/-
5.	Semester V	30,000/-
6.	Semester VI	30,000/-
7.	Semester VII	35,000/-
8.	Semester VIII	35,000/-
9.	Semester IX	35,000/-
10.	Semester X	35,000/-

IV. Examination and Assessment, Scheme of examination, Revision of Regulations and Curriculum will be as per "University of Allahabad Regulations for Choice Based Credit System (CBCS) on the academic programmes in the University (Framed under Clauses 1(a)(i) and 3(a)(x) of Ordinance LX: The Organization and Conduct of Examinations.)" vide letter no. CoE/456/2016 dated 23/8/2016.

Types of Courses

- **Core Course (CC):** A course which should compulsorily be studied by a candidate as a core requirement is termed as a Core Course.
- **Elective / Minor Course:** Generally, a course which can be chosen from a pool of courses which may be very specific, specialized or advanced or supportive to the discipline / subject of study which provides the extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called and Elective Course.
- **Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University /Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).
- **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/ subject, with an intention to seek exposure is called a Generic Elective.
- **Ability Enhancement Course (AEC)/Foundation Course:** An elective course offered as a part of foundation course aiming in building the basic skills and abilities to increase the proficiency of the candidate is called Ability Enhancement Course.
- **Skill Enhancement Course (SEC):** An course chosen from specific courses related to the subject expertise of the programme to develop expertise and skills in the concerned field is called as Skill Enhancement Course.
- **Dissertation/ Thesis/Project:** An elective course design to acquire special/advanced knowledge such as supplement study/support study through a project work and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called Dissertation/Thesis/Project.

Revised Course Structure

5-year Integrated UG and PG Food Technology Programme

Sem I	Title	Credits	Course Type	Exit Qualification
FFT 131	Fundamentals of Food Processing	2-0-1-3	Core Course (CC)	Certificate(Food Technology)
FFT 132	Concepts of Food Science	3-0-1-4	Core Course (CC)	
FFT 133	Basic Food Chemistry-I	3-0-1-4	Core Course (CC)	
FFT 105	General Bioscience	2-0-0-2	Generic Elective (GE)	
FFT 106	Conversation and Documentation Skills	2-0-1-3	Ability Enhancement Course (AEC)/Foundation course	
FFT 107	Concepts of Laboratory Techniques	0-0-2-2	Skill Enhancement Course (SEC)	
Total		18		
Sem II	Title	Credits	Course Type	
FFT 134	Introduction to Food Hygiene and Sanitation	2-0-1-3	Core Course (CC)	
FFT 135	Principles of Food Microbiology	2-0-1-3	Core Course (CC)	
FFT 136	Food Packaging	2-0-1-3	Core Course (CC)	
FFT 137	Fruits and Vegetable Processing	2-0-1-3	Skill Enhancement Course (SEC)	
FFT 108	Environmental Studies*	3-0-0-3	Foundation / Ability Enhancement Course (AEC)	
FFT 104	Introduction to Computer Application*	2-0-1-3	Foundation / Ability Enhancement Course (AEC)	
Total		18		
Grand Total		36		
Sem III	Title	Credits	Course Type	Exit Qualification
FFT 231	Basic Food Chemistry-II	2-0-1-3	Core Course (CC)	Diploma (Food Technology)
FFT 232	Food Quality and Analysis	3-0-1-4	Core Course (CC)	
FFT 233	Food Processing Operations	3-0-0-3	Core Course (CC)	
FFT 234	Technology of Cereals, Pulses and Oilseed	3-0-1-4	Core Course (CC)	
FFT 208	Disaster and Risk Management	2-0-0-2	Generic Elective (GE)	
ELECTIVE-I (Any Two)				
FFT 255	Bakery and Confectionery Products Technology	2-0-1-3	Discipline Specific Elective (DSE)	
FFT 256	Beverage Technology		Discipline Specific Elective (DSE)	
FFT 257	Basics of Nutrition	3-0-0-3	Discipline Specific Elective (DSE)	
Total		22		
Sem IV	Title	Credits	Course Type	
FFT 235	Meat, Fish and Poultry	2-0-1-3	Core Course (CC)	
FFT 236	Dairy Science	3-0-1-4	Core Course (CC)	
FFT 237	Food Quality Management and Quality Assurance	3-0-1-4	Skill Enhancement Course (SEC)	
FFT 209	Data Analysis	1-1-0-2	Generic Elective (GE)	
FFT 210	Technical Writing*	1-0-0-1	Foundation / Ability Enhancement Course (AEC)	
FFT 280	Industrial Training for 15-30 days	0-0-2-2	Skill Enhancement Course (SEC)	
FFT 258	Crop Production	2-0-02	Generic Course	
Total		19		
Grand Total		77		

Sem V	Title	Credits	Course Type	Exit Qualification
FFT 331	Fundamentals of Food Engineering	3-0-1-4	Core Course (CC)	Three Year UG Degree (Food Technology)
FFT 332	Biochemistry and Human Nutrition	3-0-0-3	Core Course (CC)	
FFT 333	Concepts of Biotechnology	2-0-1-3	Generic Elective (GE)	
FFT 334	Waste Management Practices	2-0-0-2	Generic Elective (GE)	
FFT 380	Seminar	0-0-1-1	Skill Enhancement Course (SEC)	
ELECTIVE-II (Any Two)				
FFT 353	Technology of Indigenous milk Products	2-0-1-3	Discipline Specific Elective (DSE)	
FFT 356	Food Fermentation Technology		Discipline Specific Elective (DSE)	
FFT 357	Nutraceuticals and Functional Foods	3-0-03	Discipline Specific Elective (DSE)	
	Total	19		
Sem VI	Title	Credits	Course Type	
FFT 335	Food and Agribusiness Management	2-0-0-2	Skill Enhancement Course (SEC)	
FFT 336	Plant Design and Layout	2-0-0-2	Skill Enhancement Course (SEC)	
FFT 385	Industrial Project (10 weeks which may extend during summer vacation)	0-0-10-10	Core Course (CC)	
FFT 358	Medicinal Plants	2-0-0-2	Generic Course (SEC)	
	Total	16		
Grand Total		109		

Sem VII	Title	Credits	Course Type	Exit Qualification
FFT 504	Research Methodology and Statistics	3-1-0-4	Generic Elective (GE)	Four year UG Degree (Food Technology) 'With Research'
FFT 555	Food Additives	2-0-0-2	Discipline Specific Elective (DSE)	
FFT 390	Thesis	0-0-10-10	Discipline Specific Elective (DSE)	
	Total	16		
Sem VIII	Title	Credits	Course Type	
FFT 390	Thesis	0-0-20-20	Discipline Specific Elective (DSE)	
Grand Total		147		

Sem IX	Title	Credits	Course Type	5-year Integrated UG&PG Food Technology Programme
FFT 503	Instrumentation and Analytical Techniques	3-0-1-4	Core Course (CC)	
FFT 557	Spices and Flavour Technology	3-0-0-3	Skill Enhancement Course (SEC)	
FFT 509	Food Quality, Safety Standards and Certification	3-0-0-3	Core Course (CC)	
ELECTIVE-Any Four				
FFT 651	Entrepreneurship in Food Processing	2-0-0-2	Discipline Specific Elective (DSE)	
FFT 653	Food Rheology		Discipline Specific Elective (DSE)	
FFT 654	Food Product Development		Discipline Specific Elective (DSE)	
FFT 658	Food By-product management		Discipline Specific Elective (DSE)	
FFT 659	Advanced Food Chemistry		Discipline Specific Elective (DSE)	
FFT 553	Speciality Foods		Discipline Specific Elective (DSE)	
	Total	18		
Sem X				
FFT 507	Packaging of Food Materials	3-0-0-3	Core Course (CC)	
FFT 508	Food Engineering	3-1-0-4	Core Course (CC)	
FFT 510	Advanced Food Microbiology	3-0-1-4	Core Course (CC)	
Elective- Any Two				
FFT 660	Processing of Fruits and Vegetables	1-0-1-2	Discipline Specific Elective (DSE)	
FFT 552	Intellectual Property Rights	2-0-0-2	Discipline Specific Elective (SEC)	
FFT 554	Fundamentals of Nutrition		Discipline Specific Elective (SEC)	
FFT 652	Food Fermentation and Microbial Technology		Discipline Specific Elective (SEC)	
FFT 641	Seminar	0-0-1-1	Skill Enhancement Course (SEC)	
	Total	16		
	Grand Total	181		

CC: Core Course, AEC: Ability enhancement Course/ Foundation course, SEC: Skill Enhancement Course, GE: Generic Elective, DSE: Discipline Specific Elective, Elective / Minor courses to be opted from other dept. relevant to research work

SEMESTER-I**Core Course FFT 131 :Fundamentals of Food Processing****Credits: (2-0-1-3)****Level:** Undergraduate**Semester:** Autumn**Pre-requisite:** 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture**Objective:** To acquaint with principles of different techniques used in processing and preservation of foods.**Course Content****UNIT I**

5 lectures

Introduction: Definition and scope of Food Science and Technology, Sources of food, scope and benefit of industrial food preservation, perishable, non perishable food, causes of food spoilage.

UNIT II

10 lectures

Thermal processing methods of preservation: Principle: Canning, blanching, pasteurization, sterilization, evaporation.

Use of low temperature: Principle and effect on quality. Chilling, cold storage, freezing.

Preservation by drying dehydration and concentration: Principle, Methods and effect on quality.

Preservation by radiation: Definition, Methods of Irradiation, Direct & Indirect effect, measurement of radiation dose, dose distribution, effect on microorganisms.

UNIT III

5 lectures

Presentation of foods by Preservatives: chemicals, antioxidants, mold inhibitors, antibodies, acidulants etc.

Preservation by salt & sugar: Principle, Method and effect on food quality.

UNIT IV

5 lectures

Preservation by fermentation: Definition, Advantages, disadvantages.

UNIT V

5 lectures

Recent methods in preservation: Pulsed electric field processing, High pressure processing, processing using ultrasound, dielectric, ohmic and infrared heating.

Practical

- Introduction to food laboratory.
- To study the effect of enzymatic browning in fruits and vegetables.
- To study different types of blanching of fruits and vegetables.
- Preservation of food by canning.
- To perform cut out analysis of canned product.
- Preservation of food by high concentration of sugar i.e. jam.
- Preservation of food by high concentration of salt/acid i.e. pickle.
- Preservation of food by addition of chemicals i.e. tomato ketchup.
- Preservation of food by drying in a cabinet drier.
- Preservation of fruits & vegetables by freezing.
- Preservation of milk by pasteurization and sterilization.

Reference Books:

- Food Processing Technology by P.J.Fellows, Woodhead publishing Ltd.
- Food Science by N.N. Potter, CBS publishing.
- Physical principles of Food Preservation. Vol. II by M. Karel, O.R. Fenema and D.B. Lurd, Maroel, Dekker Inc. New York.
- The technology of food preservation by N.W.Desrosier and J.N. Desrosier, CBS publishing.

Core Course FFT 132: Concepts of Food Science**Credits: (3-0-1-4)****Level:** Undergraduate**Semester:** Autumn**Pre-requisite:** 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture**Objective:** To impart knowledge of various areas related to Food science and technology.**Course Content****UNIT I**

14 lectures

Introduction to Food Science: Historical development of food science and technology, Evolution of Food Processing from prehistoric times till date, Introduction to various branches of Food Science and Technology

Cereals and Millets: Wheat- structure and composition, types (hard, soft/ strong, weak). Process of malting, Gelatinization of starch, types of browning. Rice- Composition of rice obtained by different dehulling methods, parboiling of rice- advantages and disadvantages. Millets -Varieties, composition and uses of maize, sorghum, barley, rye, oats, triticale, pearl millet and finger millet.

Pulses: Introduction, common names and scientific names of different pulses. Chemical composition of pulses, processing of pulses- soaking, germination, decortications, cooking and fermentation. Toxic constituents in pulses and its detoxification processes.

UNIT II

6 lectures

Fats and Oils: Classification of lipids, types of fatty acids - saturated fatty acids, unsaturated fatty acids, essential fatty acids, trans fatty acids. Refining of oils, types- steam refining, alkali refining, bleaching, steam deodorization, and hydrogenation. Rancidity - hydrolytic and oxidative rancidity and its prevention. Definition margarine, butter, hydrogenated vegetable oil, lard.

UNIT III

8 lectures

Fruits and Vegetables: Classification of fruits and vegetables, general composition, enzymatic browning, names and sources of pigments. Post harvest changes in fruits and vegetables – Climacteric rise, horticultural maturity, physiological maturity, physiological changes, physical changes, chemical changes during the storage of fruits and vegetables.

UNIT IV

12 lectures

Flesh Foods - Meat, Fish, Poultry: Meat - Definition of carcass, composition of meat, concept of red meat and white meat. Fish - Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish, spoilage of fish. Poultry - Structure of hen's egg, composition and nutritive value, egg proteins, characteristics of fresh egg, deterioration of egg quality.

Milk and Milk Products: Definition of milk, typical chemical composition of milk of different species i.e. buffalo, cow, goat. Composition of milk, its constituents, various steps in processing of milk. An overview of types of market milk and milk products-cheese, paneer, ice cream, ghee, butter, flavoured milk, imitation milk.

Condiments and spices: Composition and importance of spices.

UNIT V

5 lectures

Sensory evaluation of food: Objectives, type of food panels, characteristics of panel member, layout of sensory evaluation laboratory, sensitivity tests, threshold value, paired comparison test, duo-trio test, triangle test, hedonic scale, chemical dimension of basic tastes.

Practical

- To study the gelatinization temperature range and % sag of various cereal starches.
- To study the factors affecting gelatinization of cereal starches.
- To study germination of whole pulses and legumes.
- To study fermentation in cereals and pulses.
- To study non-enzymatic browning; caramelization in various sugars.
- To detect the adulteration in fats and oils by qualitative tests.
- To detect the presence of adulterants in milk.
- To perform the recognition test for the four basic tastes.
- To perform the sensitivity / threshold tests for four basic tastes.
- To recognize few odors and to learn to memorize them.

Reference Books:

- Food Science by B. Srilakshmi, publishing, New Age International (P) Ltd. publications.
- Food Science by N.N. Potter, CBS publishing.
- Food Science by S. Manay, New Age International (P) Ltd. publications.

Core Course FFT 133 : Basic Food Chemistry-I**Credits: (3-0-1-4)****Level:** Undergraduate**Semester:** Autumn**Pre-requisite:** 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture**Objective:**

- To understand the chemistry of foods - composition of food, role of each component and their interaction.
- To understand the functional aspects of food components and to study their role in food processing.

Course Content**UNIT I**

8 lectures

Introduction to Food Chemistry: Definition, Composition of food, Water: Definition of water in food, Structure of water and ice, Types of water, Sorption phenomenon, Water activity and packaging, Water activity and shelf-life

UNIT II

10 lectures

Lipids: Classification of lipids, Physical properties-melting point, softening point, specific gravity, refractive index, smoke, flash and fire point, turbidity point; Chemical properties-reichertmeissel value, polenske value, iodine value, peroxide value, saponification value; Effect of frying on fats; Changes in fats and oils- rancidity, lipolysis, flavor reversion, Auto-oxidation and its prevention; Technology of edible fats and oils- Refining, Hydrogenation and Interesterification, Fat Mimetics

UNIT III

10 lectures

Proteins: Protein classification and structure; Nature of food proteins(plant and animal proteins); Properties of proteins (electrophoresis, sedimentation, amphotericism and denaturation); Functional properties of proteins eg. organoleptic, solubility, viscosity, binding; gelation / texturization, emulsification, foaming.

UNIT IV

9 lectures

Carbohydrates: Classification(mono, oligo and poly saccharides); Structure of important polysaccharides(starch, glycogen, cellulose, pectin, hemicellulose, gums); Chemical reactions of carbohydrates –oxidation, reduction, with acid & alkali; Modified celluloses and starches

UNIT V

8 lectures

Vitamins: Structure, Importance and Stability; Water soluble vitamins; Fat soluble vitamins

Flavour: Definition and basic tastes; Chemical structure and taste; Description of food flavours; Flavour enhancers

Practicals:

- Preparation of primary and secondary solutions
- Estimation of moisture content
- Determination of gelatinization temperature range (GTR) of different starches and effect of additives on GTR.
- Determination of refractive index and specific gravity of fats and oils.
- Determination of smoke point and percent fat absorption for different fat and oils.
- Determination of percent free fatty acids
- Estimation of saponification value
- Estimation of reducing and non-reducing sugars using potassium ferricyanide method.

Reference Books:

- Fennema, Owen R, Food Chemistry, 3rd Ed., Marcell Dekker, New York, 1996
- Whitehurst and Law, Enzymes in Food Technology, CRC Press, Canada, 2002
- Wong, Dominic WS, Food Enzymes, Chapman and Hall, New York, 1995
- Potter, N.N. and Hotchkiss, J.H, Food Science, 5th Ed., Chapman & Hall, 1995
- DeMan, J.M., Principles of Food Chemistry, AVI, New York, 1980

Generic Elective Course FFT 105: General Bioscience**Credits: (2-0-0-2)****Level:** Undergraduate**Semester:** Autumn**Pre-requisite:** 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture

Objective: Fundamentals of Bioscience is based on the structural organisation of the human body and the general functions of the body systems, emphasizing the relationship between structure and function.

Course Content:

UNIT I Level of organization in life (water to protein).	3 lectures
UNIT II Cytology - cell composition, structure and function.	5 lectures
UNIT III Animal systems and plant physiology with introductory food biochemistry. Plant and animal taxonomy - With reference to edible groups and their identification. Domestication, improvement and disease control of animal and plants species.	9 lectures
UNIT IV Economic biology - Cereals, pulses, fruits, Vegetables, Beverages, Meat, Dairy, Piggery, aquaculture, and other edible animal and plant product. Introduction of Ecology and environment of edible species of plant and animals.	7 lectures
UNIT V Brief introduction of genetics and evolution of Taxa with human interaction. Plant and animal breeding, genetic engineering and GM Food (a brief introduction).	6 lectures

Reference Books:

- Biosciences by Taylor, Cambridge University Press.
- Biology by Storer, Viva publishing.

Ability Enhancement Course FFT 106: Conversation and Documentation Skills Credits: (2-0-1-3)

Level: Undergraduate

Semester: Autumn

Pre-requisite: Basic knowledge of English

Objective: To equip the students with skills to write to communicate and articulate in English (verbal as well as writing) and to acquaint the students with the knowledge and use of computers and to introduce the basic principles, organization and operational aspects of computers.

Course Content

UNIT I Introduction to Communication & Grammar: Consonant & Vowel Sounds, Indianism, Syllable & Syllable Stress, Determiners, Articles, Tense & Time, Preposition, Prepositional Phrases, Subject-Verb Agreement, Active – Passive Voice, Intonation & Modulation, Conjunctions	6 lectures
UNIT II Formal Writing Skills: Composition Writing: Business Letters (Functions of a Business Letter, Layout of a Business Letter, Salient Features of a Business Letter, Kinds of Business Letter, Application Writing)	7 lectures
UNIT III Conversation Skills: Nature of Conversation, Purpose of Conversation, Guidelines for Effective Conversation Skills, Proverbs used in Everyday Conversation with their Meanings/Explanations	5 lectures
UNIT IV Documentation Skills: Introduction to Documentation: Meaning, Purpose, Need.	5 lectures
UNIT V A short introduction to Computers, digitalized era, global connection via net, Drafting of Text, Excel, E Mails, Making Presentations, MS Word	7 lectures

Practical

Communication Skills

- Verbal & Non Verbal Communication
Verbal Communication - Extempore, Just a Minute, Declamation, Dialogue, Monologue
Non verbal Communication - Guess the Mime, Dumb Charades, Formal & Informal Writing, Facial Expressions, Dressing & Clothing

- Oral Communication - Day to today talk, formal talk, informal talk, conversation
- Body Language
Right body postures, Eye Contact, Pet Fiddles, how to walk, talk and present oneself.
- Group Discussion Skills (Meaning, Characteristic, Do's & Don'ts, Relevance, Moderating a group Discussion)
- Presentation Skills - Confidence, Effective Delivery of ideas, Convincing the audience, basic courtesies
- Public Speaking - Oration, Debates
- English Movie Sessions

Documentation Skills

- Basics of Computers, usage of short cut keys, taking out print outs, page set ups.
- Making of Power point Presentation
- E- Mail (Subject line, salutation, subscription, how to mark cc, drafting, sending of mails, reverts, forwarding of mails, attaching pictures and documents, attaching ppts)
- Differentiation between hardware and software and practical usage of both.
- Diagrammatic representation of pie-charts, tabular presentation of data/info, Etc
- Basic use of MS Excel/Spread Sheets

Reference Books:

- High School English Grammar and Composition - Wren & Martin, Publisher - Churchill Livingstone
- Anthology of English Language and Communication Skills - Sharma S R, Jacob, Mark Publications
- Language and Communication Skills - Shastri, Rameshchandra, ABD Publications
- A Course in Academic Writing - Renu Gupta, Orient Blackswan Publications.

Skill Enhancement Course FFT 107: Concepts of Laboratory Techniques

Credits: (0-0-2-2)

Level: Undergraduate

Semester: Autumn

Pre-requisite: 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture

Objective: To acquaint the students with handling and analyzing the high end equipment and to learn the concept and principles of food analysis equipment.

Course Content

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; washing, drying and sterilization of glassware

Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution, Handling techniques of solutions; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values.

Preparation of different agro-chemical doses in field and pot applications

Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sand bath, water bath, oil bath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability

Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy

General Laboratory Safety: Preparing for laboratory work, during laboratory work and cleaning up before leaving, General Characteristics & procedure for handling & storage of hazardous materials and control of hazards.

Reference Books

- Furr A.K. 2000. CRC Hand Book of Laboratory Safety. CRC Press.
- Gabb M.H. & Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

SEMESTER-II**Core Course: FFT 134: Introduction to Food Hygiene and Sanitation****Credits: (2-0-1-3)****Level:** Undergraduate**Semester:** Spring**Pre-requisite:** 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture**Objective:**

The knowledge and skills required to produce healthy meals for the family with regard to safety, effective organisation and management of family resources, and the needs and lifestyles of family members

Course Content

UNIT I	2 lectures
Principles of hygiene and its relation to food preparation.	
UNIT II	8 lectures
General hygienic and sanitary practices to be followed by different food business operators - fruits and vegetable, milk and milk product, meat and meat product, catering etc.	
UNIT III	10 lectures
General hygienic and sanitary requirements for different areas - location and surroundings, layout and design of food establishment premises, equipment & containers, facilities, food operations and controls, management and supervision, food testing facilities, audit, documentation and records, sanitation and maintenance of establishment premises, personal hygiene, product information and consumer awareness, training.	
UNIT IV	5 lectures
Water quality - water standards and analysis of physical, chemical and microbiological characteristics of water.	
UNIT V	5 lectures
Waste treatment - fundamentals of physical, biological & chemical waste treatments.	

Practical

- Analysis of water used in food industries
 - Determination of acidity of the given sample of water.
 - Determination of alkalinity of the given sample of water.
 - Determination of the total hardness of Water.
 - Determination of pH of the given sample of Water.
 - Determination of Conductivity of the given sample of Water.
 - Determination of Total Solids of the given sample of Water.
 - Determination of Total Dissolved Solids of the given sample of Water.
 - Determination of Turbidity of the given sample of Water.
- Assessment of surface sterilization using swab and rinse method.
- Case Study of food hygiene and sanitation (GMP/GHP) of a food industry.
- Preparation of HACCP Plan

Reference Books:

- Food plant sanitation – Packer and Litchfield (Reinhold Publ.)
- Handbook of analysis and quality control for fruits and vegetables products by S. Ranganna, Mcgraw Hill Pub. Co. New York.

Core Course FFT 135: Principles of Food Microbiology**Credits: (2-0-1-3)****Level:** Undergraduate**Semester:** Spring**Pre-requisite:** 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture

Objective

To acquaint with different groups of micro-organisms associated with food, their activities, destruction and detection in food.

Course Content

UNIT I	5 lectures
Introduction of microbiology, History and significance of food microbiology.	
Classification of microbes, Structure of microbes, Metabolism of microbes.	
UNIT II	5 lectures
Environmental microbiology: microbiology of air and water.	
UNIT III	5 lectures
Food contamination and public health: food poisoning	
UNIT IV	10 lectures
Food microbiology and spoilage of fruits and vegetables, milk and milk products, cereals and cereal products.	
Industrial microbiology: Industrial application of microbes.	
UNIT V	5 lectures
Thermal inactivation of microbes: pasteurization, sterilization etc. concept of TDT, F, Z and D values. Factors affecting heat resistance.	
Antimicrobial agents: mechanism and action	

Practical

- An introduction to microbiology, aseptic technique and safety.
- Preparation of culture media.
- To sterilize the media and equipment.
- To prepare serial dilutions.
- Plating techniques
- Culturing the bacteria on a solid media by using serial dilution method and determining the number of viable cells in the culture (standard plate count).
- Introduction to microscopy and to study cell morphology with simple staining.
- To study cell morphology and cell arrangement with negative stain.
- To stain bacteria with gram stain.
- To stain bacterial cells by wet-mount technique to check the mobility (flagellin) in bacterial cell.
- To stain bacterial cells with malachite green stain to check the presence of endospore.

Reference Books:

- Food microbiology by V. Ramesh, MJP publishing.
- Food microbiology by W.C. Frazier, 1st Edition by McGraw Hill Pub. Co. New York.
- Modern Food Microbiology, J.M. Jay. CBS publisher.

Core Course FFT 136: Food Packaging

Credits: (2-0-1-3)

Level: Undergraduate

Semester: Spring

Pre-requisite: A basic course on food processing

Objective: To acquaint the students with packaging methods, packaging materials, packaging machineries, modern packaging techniques etc.

Course Content

UNIT I	7 lectures
Packaging—Concepts, definition, Significance, classification. Deteriorative changes in food and packaging methods for prevention.	
UNIT II	7 lectures
Primary packaging media – Properties and application of Paper, paper boards, metals, plastics, glass. Food containers-rigid containers and flexible packaging materials. Application of different packaging materials in food industry. eg. bags, pouches, wrappers, cartons etc.	

UNIT III

8 lectures

Factors determining the packaging requirements of various foods, Packaging of perishable and processed foods.

UNIT IV

8 lectures

Advancements in packaging: Biodegradable packaging, Edible packaging, Active packaging, Modified atmosphere packaging, Vacuum packaging, Aseptic packaging

Practical

- Familiarization of different types of packaging materials.
- To perform vacuum packaging of food sample and carry out its storage study.
- To perform modified atmospheric packaging of food sample and carry out its storage study.
- Cut out analysis of canned food
- Determination of wax absorptiveness of paper

Reference Books

- Robertson, G.L. "Food Packaging: Principles and Practice". 2nd Edition. Taylor & Francis, 2006.
- Ahvenainen, Raija. "Novel Food Packaging Techniques". Wood Head Publishing, 2003.
- Mathlouthi, M. "Food packaging and Preservation". Aspen Publications, 1999.
- Paine, F.A. and Paine, H.Y. 1983. A Handbook of Food Packaging. Leonard Hill, Glasgow, UK.

Core Course FFT 137: Fruits and Vegetable Processing**Credits: (2-0-1-3)****Level:** Undergraduate**Semester:** Spring**Pre-requisite:** A course on Food Science**Objective**

To acquaint with the proper handling technologies of fruits and vegetables to reduce post harvest losses and acquaint with principles and methods of preservation of fruits and vegetables into various products.

Course Content

UNIT I 2 lectures

Pre-packaging of fresh fruits and vegetables. Storage techniques for fresh fruits and vegetables.

UNIT II 6 lectures

Primary processing: grading, sorting, cleaning, washing, peeling, slicing and blanching

UNIT III 6 lectures

Dehydration of fruits and vegetables using various drying technologies like sun drying, solar drying, osmotic, tunnel drying, fluidized bed drying, freeze drying.

UNIT IV 8 lectures

Processing of juices: Processing of vegetable juice, Processing of fruit juice

Manufacturing of fruit juices concentrates, puree and pastes, Preparation of jam, jellies and marmalades.

UNIT V 8 lectures

Preparation of preserve and candied fruits, Pickling of fruits and vegetables, Waste management in fruits and vegetable processing units

Practical

- Determination of ascorbic acid, acidity, total soluble solid.
- Evaluation of pectin content.
- Preparation and quality evaluation of fruit jam, fruit jelly, fruit marmalade; squash
- Processing of tomato products; Ketchup
- Preparation of dehydrated vegetables.
- Determination of chemical preservatives- benzoic acid, KMS
- Visit to commercial storage, and canning unit.

Reference Books

- Lal G, Siddapa GS & Tandon GL. 1986. Preservation of Fruits and Vegetables. ICAR.
- Salunkhe DK, Bolia HR & Reddy NR. 1991. Storage, Processing and Nutritional Quality of Fruits and Vegetables. Vol. I. Fruits and Vegetables. CRC.

- Thompson AK. 1995. Post Harvest Technology of Fruits and Vegetables. Blackwell Sci.
- Verma LR. & Joshi VK. 2000. Post Harvest Technology of Fruits and Vegetables. Indus Publ.

Ability Enhancement Course FFT 108: Environmental Studies

Credits: (3-0-0-3)

Level: Undergraduate

Semester: Spring

Pre-requisite: 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture

Objective

To acquaint the students with the natural resources and the ecosystem, and ecology.

Course Content

UNIT I

5 lectures

The Multidisciplinary Nature of Environmental Studies: Definition, Scope and Importance.

Natural Resources: Renewable and Non-Renewable Resources, Natural Resources and Associated Problems, Renewable Resources

UNIT II

15 lectures

Ecosystems: Concept of an Ecosystem, Structure and Functions of an Ecosystem, Energy Flow in the Ecosystem: The Water Cycle, The Carbon Cycle, The Oxygen Cycle, The Nitrogen Cycle, The Phosphorus Cycle, The Sulphur Cycle, The Energy Flow, Integration of Cycles in Nature, Food Chains, Food Webs and Ecological Pyramids, Introduction, Types, Characteristic Features, Structure and Functions.

UNIT III

3 lectures

Biodiversity: Biodiversity at Global, National and Local Levels, India as a Mega-Diversity Nation, Conservation of Biodiversity: In Situ and Ex Situ.

UNIT IV

15 lectures

Pollution: Definition, Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Nuclear Hazards, Solid Waste Management: Causes, Effects and Control Measures of Urban and Industrial Waste, Pollution Case Studies, Social Issues and the Environment From Unsustainable to Sustainable Development, Urban Problems Related to Energy, Water Conservation, Rainwater Harvesting, Watershed Management, Consumerism and Waster Products

Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents an Holocaust.

UNIT V

7 lectures

The Environmental (Protection) Act- The Air (Prevention and Control of Pollution) Act, The Water (Prevention and Control of Pollution) Act

Value Education: Environmental Values, Valuing Nature, Valuing Cultures, Social Justice, Human Heritage, Equitable Use of Resources, Common Property Resources, Ecological Degradation.

Reference Books

- Kumarasamy, K., A. Alagappa Moses And M. Vasanthy, 2004. Environmental Studies, Bharathidasan University Pub, 1, Trichy
- Rajamannar, 2004, Environmental Studies, Evr College Pub, Trichy
- Kalavathy, S. (Ed.) 2004, Environmental Studies, Bishop Heber College Pub., Trichy

Ability Enhancement Course FFT 104: Introduction to Computer Application**Credits: (2-0-1-3)****Level:** Undergraduate**Semester:** Spring**Pre-requisite:** 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture**Objective:** To acquaint the students with the knowledge and use of computers and to introduce the basic principles, organization and operational aspects of computers.**Course Content****UNIT I**

5 lectures

Microsoft Word and its applications (in relation with Food Industry)

Font formatting, Paragraph formatting, Inserting images, auto shapes symbols, diagrams, header & footer, References, watermarks and Hyperlinks, Style & Formatting, Mail Merge through word, Excel, Access database, Page setup, Printing a document

UNIT II

5 lectures

MS Excel and its applications (in relation with Food Industry)

Making column chart & pie chart and chart formatting, Use of general functions & formula (autosum, using basic arithmetic operators: +, -, *, /), Use of filter & sorting, Cell references, header & footer, page setup, use of page break preview, printing worksheets.

UNIT III

10 lectures

MS PowerPoint and its applications (in relation with Food Industry)

Creating own design, formatting objects on a slide, Use of Slide Master to control the design & formatting of a presentation, Use of Image, audio, video in the presentation, Slide show setup, slide transition, use of animation, Use of narration in presentation, Print setup & Printing handouts of a presentation.

UNIT IV

5 lectures

Internet & Web Applications (in relation with Food Industry)

UNIT V

5 lectures

Websites, Internet applications, Google Applications (G mail, Google search, G Drive, Google Docs) and other Email Services, Industry customer approach.

Practical

- Applications of MS Excel to solve the problems of food technology
- Statistical quality control, Sensory evaluation of food, and Chemical kinetics in food processing;
- Use of word processing software for creating reports and presentation;
- Familiarization with the application of computer in food industries -Milk plant, Bakery Units, Fruit & Vegetable processing Unit;
- Familiarization with software related to food industry;
- Ergonomics application in the same; Visit to Industry and case study problems on computer.
- Visit to Industry and case study problems on computer.

Reference Books

- Fundamentals of Computers by E. Balagurusamy (Author) Publisher: McGraw Hill Education (India) Private Limited
- Ms Office 2007 in a Nutshell by S. Saxena (Author) Publisher: S.Chand (G/L) & Company Ltd
- Computer Fundamentals Paperback – by P. K. Sinha (Author) Publisher: BPP

SEMESTER-III**Core Course FFT 231: Basic Food Chemistry - II****Credits: (2-0-1-3)****Level:** Undergraduate**Semester:** Autumn**Pre-requisite:** Basic Food Chemistry -I**Objective :**

To acquaint with properties and role of various constituents in foods, interaction and changes during processing.

Course Content**UNIT I**

8 lectures

Minerals: Major and minor minerals, Metal uptake in canned foods, Toxic metals

UNIT II

9 lectures

Natural Food Pigments: Introduction and classification; Food pigments(chlorophyll, carotenoids, anthocyanins and flavonoids, beet pigments, caramel)

UNIT III

10 lectures

Browning Reactions In Food: Enzymatic browning, Non – Enzymatic browning, Maillard reaction, Caramelization reaction, Ascorbic acid oxidation

UNIT IV

8 lectures

Enzymes: classification, General characteristics, Enzymes in food processing, Industrial Uses of Enzymes, Immobilized enzymes

UNIT V

10 lectures

Physico-chemical and nutritional changes occurring during food processing treatments: Drying and dehydration, Irradiation, Freezing, Canning

Practicals

1. Estimation of total ash
2. Estimation of minerals
3. Determination of thermal inactivation time of enzymes in fruits and vegetables.
4. Estimation of iodine value
5. Estimation of peroxide value
6. Determination of carotenoids w.r.t flour pigments.
7. Extend of non-enzymatic browning by extraction methods.

Reference Books:

1. deMan, John M., Principles of Food Chemistry ,3rd Ed., Springer 1999
2. Desrosier, Norman W. and Desrosier., JamesN.,The technology of food preservation , 4th Ed., Westport, Conn. : AVI Pub. Co., 1977.
3. Fennema, Owen R, Food Chemistry, 3rd Ed., Marcell Dekker, New York,1996
4. Fuller, Gordon W, New Product Development From Concept to Marketplace,CRC Press,2004.
5. Whitehurst and Law, Enzymes in Food Technology, CRC Press, Canada,2002

Core Course FFT 232: Food Quality and Analysis**Credits: (3-0-1-4)****Level:** Undergraduate**Semester:** Autumn**Pre-requisite:** A basic course in Laboratory Techniques**Objective**

To develop an understanding and methodologies of instrumental techniques in food analysis used for objective methods of food quality parameters.

Course Content**UNIT I**

10 lectures

Introduction to quality attributes: Appearance, flavour, textural factors and additional quality factors.

Sensory Analysis: Introduction to sensory analysis; general testing conditions, Requirements of sensory laboratory; organizing sensory evaluation programme. Factors influencing sensory measurements; Sensory quality parameters -Size and shape, texture, aroma, taste, color and gloss; Detection, threshold and dilution tests, discrimination, descriptive, affective; Ranking tests; Methods of sensory evaluation of different food products.

UNIT II

10 lectures

Colour: Importance and need of colour determination, methods of colour determination with Hunter Colour lab, CIE system and their applications. classification- artificial and natural.

Flavour: Importance of flavour, food flavours, factors affecting food product flavours, measurement of food flavours.

Texture: Food texture, Physical characteristics of food, working of texture measuring instruments such as Texture Analyser, Texture Profile Analysis (TPA).

UNIT III

10 lectures

Chromatography: Principle and working of Gas chromatography (GC), High pressure liquid chromatography (HPLC), Thin layer chromatography (TLC), Column Chromatography, chromatographic methods applied as quality control.

Spectroscopy: Beers and Lambert's Law. General principles of colorimeters and spectrophotometers, Atomic absorption spectroscopy, IR spectroscopy, Fluorimetry.

UNIT IV

7 lectures

Methods for food analysis: Estimation of carbohydrates, protein, fat, vitamins and minerals

Food Adulteration: Definition, types of adulterants and their detection.

UNIT V

8 lectures

Natural toxins. Contaminants formed during processing – nitrosamines, acrylamide etc. natural food contaminants and contaminants from packaging materials.

Food Additives: Introduction, need of food additives in food processing and preservation. Characteristics and classification of food additives. Safety and quality evaluation of additives and contaminants, Acute and chronic studies, NOEL, ADI, LD50.

Antimicrobial agents. -Nitrites, sulphides, sulphur-di-oxide, sodium chloride, hydrogen peroxide.

Antioxidants - Introduction, mechanism of action, natural and synthetic anti-oxidants, technological aspect of antioxidants.

Practical

- Preparation of standard solutions for the chemical analysis i.e. HCl, H₂SO₄, KMnO₄, Sodium Thiosulphate and Iodine.
- Determination of proximate composition of food- moisture, protein, crude fat, crude fiber, ash, total carbohydrates and Calorific Value by standard AOAC procedures
- Determination of minerals in food products: Calcium by Titration, Phosphorus by Spectrophotometer, Iron by Spectrophotometer,
- Determination of pH and total acidity of various food samples.
- Determination of total sugars, reducing and non-reducing sugars in various food samples.
- Detection of adulterants in various food (turmeric, red chilli, coffee, honey, flour) etc.
- Qualitative analysis of compounds by chromatography techniques- a) Thin layer Chromatography, b) Paper Chromatography: Descending, Ascending and Circular Paper chromatography.
- Estimation of metals - Fe, Ca, Cu, Pb, Zn, Sn and Cr- by atomic absorption spectrometer and flame photometer. Demonstration of AAS for estimation of metals.
- Colour measurement (L a b values) by X Rite.
- Use of electrophoresis in the determination of proteins.
- To conduct sensory evaluation of the given samples using descriptive method.
- To perform the difference testes (Paired comparison test, Duo trio test and Triangle test) in the given sample
- Texture analysis of raw and processed foods.

Reference Books

- Clifton M & Pomeranz Y. 1988. Food Analysis - Laboratory Experiments. AVI Publ.
- Gruenwedel DW & Whitaker JR. 1984. Food Analysis Principles and Techniques. Vol. I. Physical Characterization. Marcel Dekker.
- Nollet LML. 1986. Handbook of Food Analysis. Vol. I. Marcel Dekker.

Core Course FFT 233: Food Processing Operations**Credits: (3-0-0-3)****Level:** Undergraduate**Semester:** Autumn**Pre-requisite:** A course on food processing**Objective**

To acquaint with basic principle of Food Engineering and its Processes, with importance of various foods process and their evaluation.

Course Content**UNIT I**

5 lectures

Introduction: Basic principles of food processing, Conservation of mass and energy, Units and dimensions of engineering parameters, dimensionless ratios, and calculations involving various physical parameters.

UNIT II

10 lectures

Distillation: Distillation, Steam distillation, applications and equipment – determination of height equivalent of theoretical plate (HETP) – McCabe-Thiele method – reflux ratio. Molecular distillation, theory and examples. Mass transfer phenomenon applied to food systems

UNIT III

10 lectures

Evaporation: Needs, basic principles, Calculations, Single and multiple effect evaporation, Heat economy – enthalpy balances for evaporators, Vapour recompression, Thermo and mechanical systems, boiling point elevation, Falling film, climbing film tubular evaporators, plate evaporators, thin film and scraped surface evaporators.

UNIT IV

10 lectures

Contact Equilibrium Separation Processes: Concentrations, Gas-liquid equilibria, Solid liquid equilibria, Equilibrium concentration relationships, operating conditions; Basics of Solid-liquid extraction processes, liquid-liquid extraction, with food application examples, Crystallization

UNIT V

10 lectures

Leaching and Extraction: Leaching – Leaching equipments – principles of continuous and countercurrent leaching. Liquid extraction – extraction equipment – principles of extraction. Special extraction techniques – supercritical fluid extraction. Applications; extraction of Fatty acids, oleoresins and essential oils; Relative advantages, limitations and economics. Mechanical extraction – Expellers, screw press, filter press.

Reference Books

- Albert Ibarz, Cannovas, G.V. Unit Operations in Food Engineering. CRC Press. 2003.
- J.M. Coulson, J.F. Richardson, J.H. Harker - Coulson & Richardson's Chemical Engineering - Vol 2 Particle Technology and Separation Processes, Fifth Edition, 2002. Butterworth & Heinemann - Elsevier science Ltd.

Core Course: FFT 234 : Technology of Cereals, Pulses and Oil Seeds**Credits: (3-0-1-4)****Level:** Undergraduate**Semester:** Autumn**Pre-requisite:** A course in Food Science**Objective**

To acquaint with production and consumption trends, structure, composition, quality evaluation, and processing technologies for product development and value addition of various cereals, pulses and oilseeds.

Course Content**UNIT I**

2 lectures

Status, production and major growing areas of cereals, in India and world.

UNIT II

20 lectures

Wheat Processing: Wheat classification, Functionality of wheat flour components.

Rice Processing: Classification, paddy Processing, Parboiling and treatment for quality improvement, Milling, rice products.

Coarse Cereals Products: Maize- Dry and wet milling of corn, corn products, sorghum, pearl millet and small millets processing.

UNIT III

10 lectures

Pulses: Pre-treatment of pulses for milling, milling of major pulses. Methods to improve recovery, Nutrition and anti-nutritional factors in pulses.

UNIT IV

7 lectures

Oil seeds Processing: Groundnut, Mustard, Soybean, Sunflower, Safflower, Sesame and other oil seeds processing.

UNIT V

6 lectures

Special Topics: Processing & Utilization of Soya bean for value added products, Innovative products from cereals, pulses and oilseeds. Extrusion technology for cereals

Practical:

- Physico-chemical examination of wheat and its products test weight, kernel hardness, gluten content.
- Milling of rice with emphasis on quality and recovery.
- Physicochemical tests of rice and flour quality of wheat- gelatinization temperature, water absorption tests.
- Determination of Yeast activity used in fermented cereal products.
- Quality test for wheat flour used in the baked products. Maltose Number, Water Absorption, Sedimentation value, Alcohol Acidity
- Quality tests for oils.
- Texture profile analysis of baked cereal food products by texture analyzer.
- Products of Soybean- tofu, soya milk,
- Estimation of antinutritional factors in pulses- Trypsin inhibitors and tannins.
- Visit to dhal mills

Reference Books

- Chakrabarty MM. 2003. Chemistry and Technology of Oils and Fats. Prentice Hall.
- Dendy DAV & Dobraszczyk BJ. 2001. Cereal and Cereal Products. Aspen.
- Hamilton RJ & Bhati A. 1980. Fats and Oils - Chemistry and Technology. App. Sci. Publ.
- Hoseney RS. 1994. Principles of Cereal Science and Technology. 2nd Ed. AACC.

General Elective Course FFT 208: Disaster and Risk Management**Credits: (2-0-0-2)****Level:** Undergraduate**Semester:** Spring**Pre-requisite:** 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture**Objective**

To familiarize the students with the concept of disaster, how to response to disaster and field work to access the cause.

Course Content

UNIT I

10 lectures

Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and Local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

UNIT II

5 lectures

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

5 lectures

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction.

UNIT IV

5 lectures

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion.

UNIT V

5 lectures

Field work / Case studies, Hazard mapping of vulnerable areas, Vulnerability assessment (physical, social, organizational, economical, technological) Risk mitigation planning for vulnerable areas.

Reference Books

- Gupta HK. 2003. Disaster Management. Indian National Science Academy. Orient Blackswan.
- Hodgkinson PE & Stewart M. 1991. Coping with Catastrophe: A Handbook of Disaster Management. Routledge.
- Sharma VK. 2001. Disaster Management. National Centre for Disaster Management, India.

Discipline Specific Elective Course FFT 255: Bakery and Confectionery Products Technology**Credits: (2-0-1-3)****Level:** Undergraduate**Semester:** Autumn**Pre-requisite:** A course on processing of cereals technology**Objective**

To familiarize the students with different form of bakery confectionary and the analysis equipment involved, and to acquire the knowledge of manufacturing process of bakery and confectionary products in range.

Course Content

UNIT I

(6 lectures)

Bakery and Confectionery industry; raw materials and quality parameters; dough development; dough chemistry;

UNIT II

(6 lectures)

Rheological testing of dough-principles of Farinograph, Mixograph, Extensograph, Amylograph / Rapid Visco Analyzer, Falling number, Hosney's dough stickiness tester.

UNIT III

(6 lectures)

Technology for the manufacture of bakery products- detailed description of unit operations for the manufacturing of bread, biscuits, cakes and the effect of variations in formulation.

UNIT IV

(6 lectures)

Manufacturing of confectionary products: Characteristics and processing of raw material; Technology of manufacturing of toffee, chocolate, hard boiled candies, bars, chewing gums, bubble gums and Characteristics of finished products.

UNIT V

(6 lectures)

Equipment used in bakery and confectionary industry: Construction and working of various equipments like Mixers, proofing chambers, dough dividers, moulder and sheeter, baking ovens, cooling chamber, sealing and packaging machines, Rolling and cutting machines.

Practical

- Quality test for wheat flour used in the baked products. Maltose Number, Water Absorption, Sedimentation value, Alcohol Acidity
- Preparation and quality evaluation of cakes
- Preparation and quality evaluation of biscuits
- Preparation and quality evaluation of nan khatai
- Preparation and quality evaluation of cookies
- Effect of syrup consistency and temperature on the quality characteristics of hardboiled sweets
- Preparation and quality evaluation of chocolate
- Visit to bakery and confectionery industries.

Reference Books

- Dubey SC. 2002. Basic Baking. The Society of Indian Bakers, New Delhi.
- Francis FJ. 2000. Wiley Encyclopedia of Food Science & Technology. John Wiley & Sons.
- Manley D. 2000. Technology of Biscuits, Crackers & Cookies. 2nd Ed. CRC Press.

Discipline Specific Elective Course FFT 256: Beverage Technology**Credits: (2-0-1-3)****Level:** Undergraduate**Semester:** Autumn**Pre-requisite:** A basic course in Food Science**Objective**

In this the students will be exposed to the knowledge of beverage types and manufacturing process involved in different beverage manufacturing industries.

Course Content

UNIT I	6 lectures
Types of beverages and their importance; status of beverage industry in India;	
UNIT II	4 lectures
Manufacturing technology for juice-based beverages; synthetic beverages; technology of still, carbonated, low-calorie and dry beverages; isotonic and sports drinks;	
UNIT III	4 lectures
Specialty beverages based on tea, coffee, cocoa, spices, plant extracts etc.	
UNIT IV	8 lectures
Alcoholic beverages- types, manufacture and quality evaluation; the role of yeast in beer and other alcoholic beverages, ale type beer, lager type beer, technology of brewing process, wine and related beverages, distilled spirits.	
UNIT V	8 lectures
Packaged drinking water- definition, types, manufacturing processes, quality evaluation and raw and processed water, methods of water treatment, BIS quality standards of bottled water; mineral water, carbonated water.	

Practical

- Chemical and microbiological analysis of raw water quality;
- Preparation of regional fruit juices;
- Preparation of whey-based beverages;
- preparation of crush, nectar, blended juice
- Preparation of soy milk, fruit milkshakes, herbal beverages;
- Visit to relevant processing units.

Reference Books

- Srivastava RP & Kumar S. 2003. Fruit and Vegetable Preservation - Principles and Practices. International Book Distributors.
- Hardwick WA. 1995. Handbook of Brewing. Marcel Dekker.
- Hui YH. et al 2004. Handbook of Food and Beverage Fermentation Technology. Marcel Dekker.
- Priest FG & Stewart GG. 2006. Handbook of Brewing. 2nd Ed. CRC.
- Richard P Vine. 1981. Commercial Wine Making - Processing and Controls. AVI Publ.

Discipline Specific Elective Course FFT 332: Food Biochemistry and Human Nutrition**Credits: (3-0-0-3)****Level:** Undergraduate**Semester:** Spring**Pre-requisite:** 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture**Objective**

To acquaint the students about importance of human nutrition, basic concept of biochemistry and their integrated and role in health.

Course Content

UNIT I	9 lectures
Introduction to the Macro and Micronutrients. Digestion, absorption and Transport.	

Calorific value of food, BMR & factors affecting it, Specific Dynamic Action (SDA) of food, calculation of energy requirement (REE), Energy Expenditure.

Recommended Dietary Allowances (RDA)- principles and factors.

Sensory Evaluation of foods – *Organoleptic Analysis, Methods and Tests of Sensory Evaluation, Organizing Sensory Evaluation Programmes, Computer-Aided Sensory Evaluations*

UNIT II

10 lectures

Carbohydrates: Definition, Structure, Properties, Functions, Classification, Dietary Sources, Chemical Reactions, Deficiencies and Excess, Recommended Dietary Allowances

Resistant Starches and Dietary Fibre – *Definition, Sources and Functions*

Metabolic Pathways - *Glycolysis, Gluconeogenesis, Glycogenesis, Glycogenolysis, Citric Acid Cycle* Regulation of blood glucose level.

Diabetes mellitus – Types, etiology, diagnosis, prognosis, altered metabolism and pathophysiology. Hypoglycemia

UNIT III

9 lectures

Proteins & Amino Acids : Definition, Structure, Properties, Functions, Classification, Dietary Sources, Chemical Reactions, Deficiencies and Excess, Recommended Dietary Allowances. Protein Energy Malnutrition

Metabolic Pathways - *Transamination, Deamination, Decarboxylation, Urea Cycle*.

Stress and Anti-freeze Proteins; Protein Isolates and Concentrates. Denaturation of Proteins . Evaluation of Protein Quality .Biochemical Markers- types, examples and diagnostic applications. Immunoglobulins.

UNIT IV

8 lectures

Lipids & Fats: Definition, Structure, Properties, Functions, Classification, Dietary Sources, Chemical Reactions, Deficiencies and Excess, Recommended Dietary Allowances.

Metabolic Pathways - *Fatty Acid Oxidation, Biosynthesis of Fatty Acids* Synthesis and Functions of Cholesterol; Ketogenesis

Rancidity of Fats .Emulsions

UNIT V

9 lectures

Role of Water in Food and Human Health

Vitamins & Minerals: Classification, Functions, Dietary Sources, Deficiencies and Excess, Recommended Dietary Allowances

Anti-nutritional Factors in Foods.

Pigments, Phytonutrients, Antioxidants, Flavour Components – *Definition, Classification, and Functions* and its role in health, food and nutraceutical industry.

- Nelson, D. L. (2003). *Lehninger Principles of Biochemistry*. Macmillan Worth Publishers, India.
- Deb, A.C. (2004). *Biochemistry*. Book Agency (P) Ltd. Calcutta, India.
- Satyanarayana, U. (2009). *Biochemistry*. Books and Allied (P) Ltd. Calcutta, India
- Nutrition Science by B. Srilakshmi
- Fundamentals of Foods & Nutrition by Sumati R. Mudambi

SEM IV**Core Course: FFT 235: Meat, Fish and Poultry****Credits: (2-0-1-3)****Level:** Undergraduate**Semester:** Autumn**Pre-requisite:** A course on Food Science**Objective**

To provide an understanding of the technology for handling, processing, preservation and bi-product utilization of meat, poultry and fish products processing.

Course Content**UNIT I**

8 lectures

Development of meat and poultry industries in India. Ante-mortem examination of animals and poultry birds. Slaughter and dressing, post-mortem examination. Post-mortem changes in meat and factors affecting them.

UNIT II

5 lectures

Nutritive value of meat. Whole sale and retail cuts. Meat tenderization methods.

UNIT III

10 lectures

Canning of meat and meat products, Restructured meat products, sausages, curing and smoking of meat. Disposal and utilization of meat industry by-products

Chilling and freezing of carcass and meat; canning, cooking, drying, pickling, curing and smoking; prepared meat products like salami, kebabs, sausages, sliced, minced, corned; intermediate moisture and dried meat products; Packaging of meat products.

UNIT IV

10 lectures

Structure, composition and nutritive value of poultry eggs. Poultry dressing, Functional properties of eggs, internal quality of eggs and its preservation.

UNIT V

12 lectures

Fish structure and composition. Cold storage, freezing preservation and canning of fish. Picking of fish, fish protein concentrates, fish meal and by products of fish processing industry

Practical:

- Slaughtering and dressing of meat animals
- Study of post-mortem changes; meat cutting and handling
- Evaluation of meat quality
- Evaluation of quality of eggs
- Preparation of meat products
- Visit to meat processing plants.

Reference Books

- Forrest JC. 1975. Principles of Meat Science. Freeman.
- Govindan TK. 1985. Fish Processing Technology. Oxford & IBH.
- Hui YH. 2001. Meat Science and Applications. Marcel Dekker. 32
- Kerry J. et al. 2002. Meat Processing. Woodhead Publ. CRC Press.
- Pearson AM & Gillett TA. 1996. Processed Meat. 3rd Ed. Chapman & Hall.

Core Course FFT 236: Dairy Science**Credits: (3-0-1-4)****Level:** Undergraduate**Semester:** Spring**Pre-requisite:** A course in food science**Objective**

To acquaint with techniques and technologies of testing and processing of milk into various products and by products.

Course Content**UNIT I**

9 lectures

Physical properties of milk: Color, taste, pH and buffering capacity, refractive index, viscosity, surface tension, freezing, boiling point, specific heat, OR, electrical conductivity.

UNIT II

10 lectures

Lactose: Lactose (alpha and beta forms). Significances of lactose in dairy industry.

Milk fat: Composition and structure, and physical properties, crystallization, structure of fat granules, lipolysis, autoxidation, fat constants (saponification value, iodine value, RM value, Polenske value, peroxide value).

Protein and Enzymes: General structure, amphoteric nature, difference between casein and serum protein, different types of casein (acid and rennet), uses of casein, fractionation of protein. Enzymes- catalase, alkaline phosphatase, lipases and proteases.

UNIT III

10 lectures

Market milk industry and milk products: Systems of collection of milk, Reception, Platform testing, Various stages of processing: Filtration, Clarification, Standardization, Homogenization, Pasteurization, Sterilization, Packaging and Storage, Cleaning and Sanitation

UNIT IV

8 lectures

Description and working of clarifier, cream separator, homogenizer and plate heat exchanger.

UNIT V

8 lectures

Flow diagram for manufacture of following milk products: Flavoured milk, Butter, ice-cream, milk powder.

Practical

- To perform platform tests in milk. (Acidity and COB).
- To estimate moisture content in milk.
- To estimate skim milk protein by titration method.
- To estimate milk fat by Gerber method, SNF and specific gravity of milk.
- To check the efficiency of sterilization of milk by Turbidity test.
- To prepare casein and calculate its yield.
- Preparation of flavoured milk
- Preparation of butter
- Visit to a milk industry

Reference Books

- Aneja RP, Mathur BN, Chandhan RC & Banerjee AK. 2002. *Technology of Indian Milk Products*. Dairy India Publ., Delhi.
- De S. 1980. *Outlines of Dairy Technology*. Oxford Univ. Press Publ., New Delhi.
- Smit G. 2003. *Dairy Processing – Improving Quality*. CRC-Woodhead Publ.
- Walstra P, Geurts TJ, Noomen A, Jellema A & Van Boekel MAJS. 1999. *Dairy Technology – Principles of Milk Properties and Processes*. Marcel Dekker.

Skill Enhancement Course: FFT 237: Food Quality Management and Quality Assurance**Credits: (3-0-1-4)****Level:** Undergraduate**Semester:** Spring**Pre-requisite:** Course in Food hygiene and Food plant sanitation**Objective**

To acquaint the students about quality management in food production chain and the certifications involved in raw material food and industries and different organizational system such as HACCP, GMP/GHP and auditing and surveillance.

Course Content

UNIT I

5 lectures

Quality inspection, quality control, Quality Assurance.

Quality Management System- ISO 9000

UNIT II

10 lectures

Management Principles, Process Model, principles and requirements of ISO 9001

Total quality management; Good Manufacturing Practices, Good Agricultural Practices, Good Laboratory Practices, Quality Management systems QSS. Quality Circles, SQC.

UNIT III

10 lectures

Food Safety Management System- Key role, Principles of FSMS, ISO-22000.

UNIT IV

10 lectures

HACCP- Prerequisites; Principles and steps of HACCP Plan, Hazard Identification, Risk assessment Risk communication with communication agencies and Hazard analysis, CCP Decision Tree, HACCP Plan.

Cleaning and Sanitation, Pest Control, Recall Procedures.

UNIT V

10 lectures

Auditing, Surveillance; Audit, Mock audit, third party quality certifying audit, Auditors and Lead auditors.

Certification, Certification procedures, Certifying bodies, Accrediting bodies, International bodies.

Practical:

- To conduct Hazard Analysis & Risk Assessment of identified hazards
- Determination of CCP through CCP Decision Tree
- Formation of CCP Monitoring Checklist
- Identification of PRP's (GHP & GMP) of food plant
- Preparation of detail flow diagram of manufacturing process & identification of potential hazards of food at each step/process
- Preparation of sample pages of Quality Manual
- Preparation of sample pages of Management System Procedure (MSP)
- Preparation of sample pages of Standard Operating Procedure (SOP)
- Preparation of sample pages of Formats for Quality Management System
- Preparation of on-site audit plan
- Preparation of an Audit CheckList /Observation Sheet
- To conduct Document Review (Adequacy Audit) before Audit
- To conduct opening meeting of audit
- To conduct Closing Meeting
- Preparation of Audit Plan Schedule before an Internal Audit
- To conduct an Audit Meeting before conducting Internal/External Audit
- Preparation of Corrective /Preventive Action Recommendation for the organization after Audit (Report Writing)
- Preparation of report by auditee after correction of non-conformities
- To conduct audit Follow-up

Reference Books

- Early R.1995. Guide to Quality Management Systems for Food Industries. Blackie Academic.
- Krammer A & Twigg BA.1973. Quality Control in Food Industry. Vol. I, II. AVI Publ.

General Education Course FFT 209: Data Analysis**Credits: (1-1-0-2)****Level:** Undergraduate**Semester:** Spring**Pre-requisite:** 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture**Objective**

The students will be exposed to various research methods and statistical tools required to analyze the experimental data in food research and industry. The focus will be on providing knowledge related to research process, data collection and data analysis etc.

Course Content**UNIT I**

6 lectures

Scientific Approach to Research: Meaning, significance, variables

Research Process: Formulating the problem, objectives, hypothesis, Experimental design, sample design, collecting data, analysis of data, interpretation, preparation of report.

UNIT II

6 lectures

Sampling Techniques: Probability and non probability sampling.

Experimental designs: Randomized Block design

UNIT III

6 lectures

Measurements: measurement scale, Frequency distribution, graphical presentation of data.

Measures of Central Tendency: Mean, median and mode, their uses.

UNIT IV

7 lectures

Measures of variability: Mean deviations, Quartile deviation, standard deviation, their uses.

Correlation: Spearman and Pearson's techniques of correlation, Linear regression

UNIT V

5 lectures

Tests of significance of difference between means: t-test, F-test, One way ANOVA.

Applications to food quality assessments

Reference Books

- Aggarwal BL. 2003. Basic Statistics. New Age.
- Kothari CR. 1989. *Research Methodology*. Wiley Eastern.
- Gupta SP. 2004. *Statistical Methods*. S. Chand & Sons

Ability Enhancement Course FFT 210: Technical Writing**Credits: (1-0-0-1)****Level:** Undergraduate**Semester:** Spring**Pre-requisite:** A basic course on Communication and Documentation skills**Objective**

To equip the students/scholars with skills to write dissertations, research papers, etc. and equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Course Content

UNIT I

5 lectures

Grammar: Expressions, Modals & Moods, Word Stress, Fluency, Voice, Enhancing Vocabulary Punctuations

UNIT II

5 lectures

Technical Writing: Introduction to Technical writing – Definition, types, characteristics, Report Writing, CV & Resume making, Research paper

UNIT III

5 lectures

Effective Communication Skills: Power Point Presentations (Subject-Oriented), Soft Skills - Proper Body Postures, Right/Positive Body Language, Eye Contact, Public speaking, Interactive Communication Skills -Group Discussions, Debates, Conversations, Telephonic Etiquettes, Facing an interview

UNIT IV Tutorial

5 lectures

Communication Skills: How to make Delivery of Content Effective, Proper Articulation, Modulation, Voice Throw, Proper Stress on Words, Presenting PPT's, Confidence Building, Motivation, Writing Covering Letters, Filling Application Forms

UNIT V Tutorial

10 lectures

Technical Writing : Documentation of Academic credentials, Writing of Introduction, Acknowledgement, Abstract & Conclusion, Commonly used Abbreviations in the Thesis & Research Communication, Structuring the Presentation, Learning how to make PPT's, number of Slides, font, font size, Table Insertions, Picture, Clip Art, Chart, Grammatical Accuracy

Reference Books

- Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. Abhishek, Chandigarh.
- Shelton James H. 1994. Handbook for Technical Writing. NTC Business Books, Chicago.
- Wren PC & Martin H. 2006. High School English Grammar and Composition. S. Chand, New Delhi.

Skill Enhancement Course FFT 280: Industrial Training-II for 15 days**Credits: (0-0-2-2)****Level:** Undergraduate**Semester:** Spring**Pre-requisite:** Any course in Food Processing

Generic Course FFT 258: Crop Production**Credits: (2-0-0-2)****Level: Undergraduate****Semester:** Spring**Pre-requisite:** 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture**Objective**

To acquaint the students with the basics of agriculture and crop farming so as to learn the related field of food processing such as farm machinery, land & water resources, and horticulture.

Course Content**UNIT I**

5 lectures

Agriculture and its role in national development, food security; General features of climate - India; Crop environment, weather and significance of various weather elements;

Crop production - definition and scope, crop classification based on season, life cycle, taxonomy and economic use;

Growth and yield of crops, growth parameters, yield attributes and factors affecting them

UNIT II

5 lectures

Quality of good seed, ideal condition for germination, seed treatment, hybrid and composite seeds, categories of seeds (certified, foundation and breeder seed); Importance of sowing time, seed rate, sowing methods, plant population; Tillage and Inter-culture operations.

UNIT III

5 lectures

Irrigation - scheduling, methods and water use efficiency; Harvesting, threshing, winnowing, storage and processing.

UNIT IV

10 lectures

Crop rotations, mixed cropping, inter cropping, its objectives and importance; Definitions of mono-cropping, double cropping, multiple/intensive cropping, relay cropping.

Soil as a three phase disperse system, its physical chemical and biological properties; Soil fertility and soil productivity, manures and fertilizers,

UNIT V

5 lectures

Classification of vegetable crops; Types of vegetable farming; Principles of vegetable production; Raising of vegetable seedlings under different environmental conditions

Concepts in Horticulture - methods of propagation, systems of planting and layout, fruit growth and development, fruit maturity and ripening, Post harvest management of fruits.

Reference Books

- Batnakar S &Schware R. 2000. Information and Communication Technology in Development- Cases from India. Sage Publ.
- Meera SN. 2008. ICTs in Agricultural Extension: Tactical to Practical. Ganga- Kaveri Publ. House. JangamWadiMath, Varanasi.
- Willem Zip. 1994. Improving the Transfer and Use of Agricultural Information – A Guide to Information Technology. The World Bank, Washington.

SEMESTER V**Core Course FFT 331: Fundamentals of Food Engineering****Credits: (3-0-1-4)****Level:** Undergraduate**Semester:** Autumn**Pre-requisite:** A course on unit operations in food processing**Objective**

To acquaint with basic principle of Food Engineering and its Processes, with importance of various foods process and their evaluation.

Course Content

UNIT I	10 lectures
Process time calculations; Sterilizers and accessories used in canning industries; Engineering aspects of pasteurizer; homogenizer, evaporators (basic principle and single-effect evaporator) and concentrators used in food industries; Seaming machine.	
UNIT II	8 lectures
Construction of cold storage; Different types of freezers including plate contact freezer, air blast freezer, cryogenic freezing and refrigerated vans.	
UNIT III	9 lectures
Various types of driers (basic principle and drying time) – Tray drier, roller drier, spray drier, fluidized bed drier, freeze drier and solar drier.	
UNIT IV	9 lectures
Heat exchangers (including paraflow HEs); Extruders – Basic principles and types, Difference between single- and twin-screw extruders; Kneader; Oil expeller	
UNIT V	9 lectures
Advanced separation processes: Dialysis, ultrafiltration, reverse osmosis, electro dialysis and membrane separation.	

Practical:

- Determination of viscosity of Newtonian fluid, Non Newtonian fluids;
- Determination of conductivity, calorific value and filtration properties of food & water.
- Calculation of freezing time for some typical foods
- Determination of Textural characteristics TPA of food product
- Evaluation of Bulk density and basics of true and bulk density

Reference books

- Fundamentals of Food Engineering by Stanley Charm.
- Introduction to Food Engineering - R. Paul Singh, Dennis R.
- Fundamentals of Food Process Engineering; Toledo RT; 2nd ed, 2000, CBS Publishers.
- Food process engineering, D.R. Heldman and R.P. Singh

Core Course FFT 332: Biochemistry and Human Nutrition**Credits: (3-0-0-3)****Level:** Undergraduate**Semester:** Spring**Pre-requisite:** 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture**Objective**

To acquaint the students about importance of nutrition, balanced diets, therapeutic diets for health and role of food and nutraceuticals in health.

Course Content

UNIT I	8 lectures
Introduction to human nutrition.	
Macronutrients and micronutrients- Classification and functions.	
Digestion, absorption and assimilation of nutrients.	

UNIT II

10 lectures

Energy metabolism- Components of energy expenditure, Basal Metabolic Requirements and Activity, Recommended Dietary Allowances, Food Groups, Concept of a balanced diet, Methods of evaluation of nutritive value of foods.

Nutritional assessment and nutritional policies- Salient features, concept of community nutrition

UNIT III

10 lectures

Carbohydrates- Types, functions, sources, requirement, storage, Effect of deficiency and excess.

Proteins- Types, functions, sources, requirement, storage, Effect of deficiency and excess.

UNIT IV

7 lectures

Fat- Types, functions, sources, requirement, storage, Effect of deficiency and excess.

UNIT V

10 lectures

Vitamin- Types, functions, sources, requirement, storage, Effect of deficiency and excess.

Minerals- Types, functions, sources, requirement, storage, Effect of deficiency and excess.

Water and electrolytes- Concept and importance

Reference books

- Nutrition Science by B. Srilakshmi
- Fundamentals of Foods & Nutrition by Sumati R. Mudambi
- Textbook of Nutrition : A Life cycle approach by Ravinder Chadha

General Elective Course FFT 333: Concepts of Biotechnology**Credits: (2-0-1-3)**

Level: Undergraduate

Semester: Autumn

Pre-requisite: A course on basic microbiology

Objective

To acquaint the students with the fundamental of bio-technology, industrial microbiology and fermentation processes.

Course Content

UNIT I 6 lectures

Prospectus of biotechnology- definition, scope and importance, DNA structure, function and metabolism.

UNIT II 6 lectures

GMO, genetic recombination mechanisms and technique used for improvement in microbial strains; Methods of recombinant DNA technology; Nucleic acid hybridization; Plant and animal cell and tissue culture techniques and their applications.

UNIT III 6 lectures

Molecular markers and their applications; DNA sequencing; Genetic engineering and transgenics; Genomics, transcriptomics and proteomics.

UNIT IV 6 lectures

General application of biotechnology in food industry, pharmaceuticals and agriculture Public perception of biotechnology; Bio-safety and bioethics issues.

UNIT V 6 lectures

Introduction to nanotechnology, history and recent developments, sources of nanoparticles, microbial production of nanoparticles, advantages of microbial nanoparticles and their applications.

FFT 303 Introductory Biotechnology Practical

- Isolation of genomic DNA from different sources
- Gel electrophoresis techniques
- Restriction enzyme digestion, ligation, transformation and screening of transformants
- Demonstration of PCR

Reference Books

- Becker JM, Coldwell GA & Zachgo EA. 2007. Biotechnology – a Laboratory Course. Academic Press.
- Brown CM, Campbell I & Priest FG. 2005. Introduction to Biotechnology. Panima Pub.
- Gupta PK. 2004. Biotechnology and Genomics. Rastogi Publications.
- Sambrook J, Fritsch T & Maniatis T. 2001. Molecular Cloning – a Laboratory Manual. 2nd Ed. Cold Spring Harbour Laboratory Press.

- Singh BD. 2007. Biotechnology Expanding Horizon. Kalyani Publishers
- Fundamentals of Biotechnology, Prave. P. Faust, V. Sitih. W., Sukatsh, DA, 1987. ASM press.

Generic Elective Course FFT 334: Waste Management Practices

Credits: (2-0-0-2)

Level: Undergraduate

Semester: Autumn

Pre-requisite: A course on hygiene and plant sanitation

Objective

To acquaint the students with the major source of living i.e. water, its treatment, analysis and how to make it potable.

Course Content

UNIT I 6 lectures

Selection of sanitizing agents for cleaning, packaging sanitation, food storage sanitation, transport sanitation and water sanitation.

UNIT II 6 lectures

By-products obtained from cereals, pulses, legumes, oil seeds, fruit and vegetables, dairy plant, sugar and bakery, plantation crops and spices egg and poultry processing industry and meat, Fermentation industry.

UNIT III 6 lectures

Characterization of food industry wastes e.g., BOD, COD and total organic content, floatable and suspended solids in water.

UNIT IV 6 lectures

Pretreatment, secondary treatments of solid waste, sludge volume index, advanced techniques activated bio-filtration, biological fluidized bed reactor, dried bacteria culture process

UNIT V 6 lectures

tertiary treatments or advanced waste water treatment system (AWT); polishing ponds, DAF Techniques, micro trainers treatment and disposal of sludge, sand filters, removal of nitrogen, phosphorus, sulphur, physical chemical treatment process.

Reference Books

- Energy Conservation through Waste Utilization, American Society of Mechanical Engineers, New York.
- Kreit F & Goswami DY. 2008. Energy Management and Conservation Handbook. CRC Press.
- Murphy WR & McKay G. 1982. Energy Management. BS Publ. Patrick DR. 1982.. Energy Management and Conservation. Elsevier Publ.
- Patrick DR., Fardo SW, Richardson RE & Steven 2006. Energy Conservation Guidebook. The Fairmont Press.
- Wulfinghoff DR. Energy Efficiency Manual. Energy Institute Press

Skill Enhancement Course FFT 380: Seminar

Credits : (0-0-1-1)

Level: Undergraduate

Semester: Autumn

Pre-requisite: A course on Food Processing/Food Science

Discipline Specific Elective Course: FFT 353: Technology of Indigenous Milk Products

Credits: (2-0-1-3)

Level: Undergraduate

Semester: Autumn

Pre-requisite: A course on Dairy Technology

Objective

To acquaint the students with the milk and milk based product preparations and the nutritional composition and health effect (good/bad).

Course Content

UNIT I	2 lectures
Status and significance of traditional milk products in India.	
UNIT II	7 lectures
Khoa: Classification of types, standards methods of manufacture and preservation factors affecting yield of khoa. Physico-chemical changes during manufacture and storage of khoa. Confectioneries made from Khoa-Burfi, peda, Milkcake, Kalakhand, Gulabjaman and their compositional profile and manufacture practices.	
Rabri and Basundhi: Product identification, process description, factors affecting yield physico-chemical changes during manufacture.	
UNIT III	7 lectures
Channa: Product description, Standards method of manufacture, packaging and preservation.	
Chhana-based sweets, Mechanization of manufacturing process.	
Paneer: Product description standards method of manufacture packaging and preservation. Physico-chemical changes during manufacture and storage.	
UNIT IV	7 lectures
Srikhand: Chakka product description, standards method of manufacture, small scale and industrial, packaging and preservation aspects. Physico-chemical changes and quality assurance during manufacture and storage.	
Sandesh, Mistidahi: Product description method of manufacture and packaging process.	
Kheer and Payasam: Product description methods of manufacture, innovations in manufacturing and packaging processes.	
UNIT V	7 lectures
Microbiology of indigenous milk products: predominance of spoilage & pathogenic organisms in Curd, Khoa, Channa, Paneer, Shrikhand, control measures & legal specifications.	
Biopreservative principles in enhancing the shelf-life of indigenous milk products including active packaging.	

Practical:

- Preparation of khoa from cow and buffalo milk.
- Preparation of chhana from buffalo milk.
- Preparation of paneer from buffalo milk.
- Analysis of khoa, chhana and paneer for total solids, moisture, fat and acidity.
- Preparation of mistidahi, chhaka and srikhand.
- Microbiological examinations of traditional dairy products: Khoa, paneer, coliform counts, yeast and molds counts etc.

Reference Books

- Aneja RP, Mathur BN, Chandan RC & Banerjee AK. 2002. *Technology of Indian Milk Products*. Dairy India Publ.
- De S.1980. *Outlines of Dairy Technology*. Oxford Univ. Press.
- Rathore NS et al. 2008. *Fundamentals of Dairy Technology - Theory & Practices*. Himanshu Publ.

Discipline Specific Elective Course: FFT 356: Food Fermentation Technology**Credits: (2-0-1-3)****Level:** Undergraduate**Semester:** Autumn**Pre-requisite:** A course on basic Food Microbiology**Objective:**

To understand the principles of food fermentation technology and study the types of starters used in Food Industry

Course Content

UNIT I	(5 Lectures)
Importance in food (bacteria, fungi and viruses) Significance of spores.	
Types of Microorganisms in Food, Classification and Nomenclature, Morphology and Structure	
UNIT II	(6 Lectures)
Microbial Growth in Food: Bacterial growth curve, Factors affecting the growth of micro organisms in food.	
UNIT III	(6 Lectures)
Cultivation of Micro-organisms: Pure culture technique, Methods of isolation and cultivation, Enumeration of Microorganisms- qualitative and quantitative, Rapid Methods of Detection	

UNIT IV

(6 Lectures)

Fermentation –definition and types, Microorganisms used in food fermentations
Study of a Bio fermentor – its design and operation, Down Stream Processing and Product recovery.

UNIT V

(7 Lectures)

Fermented Foods-types, starter cultures and their types, methods of manufacture for vinegar, sauerkraut, yoghurt, soya sauce, tempeh, miso, beer wine and traditional Indian foods, Dairy Fermentations, concept of probiotics.

Practical:

1. Preparation and sterilization of nutrient broth and media
2. Morphological study of bacteria and fungi using permanent slides
3. Simple staining and Gram's staining
4. Standard Plate Count Method
5. Bacteriological Analysis of Water
6. Maintenance of starter cultures, biochemical confirmation tests
7. Development of fermented foods.

Reference books:

- 1) Frazier William C and Westhoff, Dennis C. Food Microbiology, TMH, New Delhi, 2004
- 2) Jay, James M. Modern Food Microbiology, CBS Publication, New Delhi, 2000
- 4) Pelczar MJ, Chan E.C.S and Krieg, Noel R. Microbiology, 5th Ed., TMH, New Delhi, 1993.
- 5) Microbiology of Fermented Foods. Volume II and I. By Brian J. Wood. Elsevier Applied Science Publication. 1997
- 6) Principles of Fermentation Technology by Stanbury, P.F., Whitekar A. and Hall. 1995., Pergamon. McNeul and Harvey.

Discipline Specific Elective Course FFT 357: Nutraceuticals and Functional Foods**Credits: (3-0-0-3)****Level:** Undergraduate**Semester:** Autumn**Pre-requisite:** 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture**Objective:**

To understand the interrelationship between nutraceuticals and health maintenance and to explain the nutraceutical benefits obtained from different types of foods.

Course Content**Unit 1**

(5 lectures)

Functional Food and Nutraceuticals- Definition, history, types and classification.

Perceived effect of diet on disease prevention

Understanding benefits of functional foods and nutraceuticals

Unit 2

(8 lectures)

Microbial and algal nutraceuticals : Probiotics- Important features of probiotic micro- organisms; Health effects of probiotics including mechanism of action; Probiotics in various foods: fermented milk products, non-milk products etc; Quality Assurance of probiotics and safety. Synbiotics for maintaining good health

Algae as source of omega - 3 fatty acids, antioxidants and minerals - extraction and enrichment.

Unit 3

(8 lectures)

Prebiotics- Definition, chemistry, sources, metabolism and bioavailability, effect of processing, physiological effects, effects on human health and potential applications in risk reduction of diseases. Perspective for food applications for the – Non-digestible carbohydrates/oligosaccharides, Dietary fibre, Resistant starch, Gums.

Unit 4

(12 lectures)

Nutraceuticals of plant and animal origin: Plant secondary metabolites, classification and sub-classification - Alkaloids, phenols, Terpenoids, Polyphenols: Flavonoids, catechins, isoflavones, tannins, Phytoestrogens, Phytosterols, Glucosinolates, Organo sulphur compounds, Other components – Phytates, Protease. Definition, chemistry, sources, metabolism and bioavailability, effect of processing, physiological effects, effects on human health and potential applications in risk reduction of diseases.

Animal metabolites: Sources and extraction of nutraceuticals of animal origin. Examples: chitin, chitosan, glucosamine, chondroitin sulphate and other polysaccharides of animal origin, uses and applications in preventive medicine and treatment. Concept of cosmoceuticals and aquaceuticals.

Unit 5

(12 lectures)

Malnutrition and factors responsible for nutritional disorders and anti-nutritional factors (cyanogens, lectins, enzyme inhibitors, phytoalexins and phytates). Concept of antioxidants - use of antioxidants as dietary supplements in prevention and treatment of cancer, obesity and stress. Role of nutraceuticals and functional foods in pediatrics, geriatrics, sports, pregnancy and lactation. Proteins, Peptides and nucleotides, Conjugated linoleic acid and n-3 fatty acids, Vitamins and Minerals.

Regulations of Nutraceuticals and Functional Foods in India and rest of the world.

Reference Books:

Aluko, Rotimi, Functional Foods and Nutraceuticals, Springer-Verlag New York Inc., 2012.

Satinder Kaur Brar, Surinder Kaur and Gurpreet Singh Dhillon, Nutraceuticals Functional Foods, 2014.

Robert E.C. Wildman, Robert Wildman, Taylor C, Handbook of Nutraceuticals and Functional Foods, Third Edition, Wallace, 2002.

Handbook of nutraceuticals Vol I by Yahwant Vishnupant Pathak, CRC press, 2009

Handbook of nutraceuticals Vol II by Yahwant Vishnupant Pathak, CRC press, 2011

SEMESTER-VI**Skill Enhancement Course FFT 335: Food and AgriBusiness Management****Credits: (2-0-0-2)****Level:** Undergraduate**Semester:** Spring**Pre-requisite:** 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture**Objective**

To give basic fundamentals to students for managing the food processing operations starting from raw material procurement to the end consumer and familiarizing them with international trade.

Course Content**UNIT I**

3 lectures

Business Management: introduction, theories and functions, food industry management, marketing management and human resource development, personal management. Sectors in food industry and scale of operations in India.

UNIT II

5 lectures

Human Resource Management: Study the basics about HR and related policies and capacity mapping approaches for better management.

UNIT III

7 lectures

Consumer behavior towards food consumption, Consumer Surveys by various Institutes and Agencies, various journals on consumer behavior and market research, internet based data search.

UNIT IV

8 lectures

International trade: basics, classical theory, theory of absolute advantage, theory of comparative modern theory, free trade- protection, methods of protection, quotas, bounties, exchange control, devaluation, commercial treaties, terms of trade, balance of payments, Exim policy, foreign exchange, mechanics of foreign exchange, GATT, WTO, role of WTO. International trade in agriculture. World trade agreements related with food business, export trends and prospects of food products in India.

UNIT V

7 lectures

World consumption of Food: patterns and types of food consumption across the globe. Ethnic food habits of different regions. Govt. Institutions related to international trade; APEDA, Tea board, spice board, wine board, MoFPI etc. management of export import organization, registration, documentation, export import logistics, case studies. Export and import policies relevant to horticultural sector.

Reference Books

- Chhabra TN & Suria RK. 2001. Management Process and Perspectives. Kitab Mahal.
- Jhingan ML. 2005. International Economics. 5th Ed. Virinda Publ.
- Kotler P. 2000. Marketing Management. Prentice Hall.
- Reddy SS, Ram PR, Sastry TVN & Bhavani ID. 2004. Agricultural Economics. Oxford & IBH.

Skill Enhancement Course FFT 336: Plant Design and Layout**Credits: (2-0-0-2)****Level:** Undergraduate**Semester:** Spring**Pre-requisite:** A course of unit operations in food processing**Objective**

To acquaint the students with the plant layout operation which is required by all industries to check their comparative factors as equipment position raw material handling and end product delivery

Course Content**UNIT I**

5 lectures

Introduction : Plant design concepts - situations giving rise to plant design problems - differences in design of food processing and non-food processing plants

UNIT II

8 lectures

General design considerations, Food Processing Unit Operations, Prevention of Contamination, Sanitation, Deterioration, Seasonal Production, Flow Chart for Plant Design, Identification Stage, Looking for a need, Finding a product, Preliminary Screening of ideas, Comparative rating of product ideas: Present Market, Market Growth potential, Costs, Risks,

UNIT III

6 lectures

Plant location: Introduction, Location Decision Process, Factors involved in the plant location decision, Subjective, Qualitative and Semi-Quantitative Techniques

UNIT IV

4 lectures

Food Plant Utilities: Process Water, Steam, Electricity, Plant Effluents.

UNIT V

7 lectures

Plant layout : Importance, Flow Patterns, Basic Types of plant layouts, Product or line layout, Process or functional layout, Cellular or group layout, and Fixed position layout, Plant Layout factors, Layout design Procedure., Maintenance of Food Plant Building

Reference Books

- Peters, M.s and Timmerhaus, K.D, Plant Designs and Economics for Chemical Engineers, 4th Edition McGraw Hill, 1991
- Biegler L., grossmann I.E. and Westeberg A.W., Systematic Methods of Chemical Engineering and Process Designs, prentice Hall, 1997.
- Z. B. Maroulis and G. D. Saravacos, Food Process Design, Marcel Dekker 2003.

Generic Course FFT 358: Medicinal Plants**Credits: (2-0-0-2)****Level:** Undergraduate**Semester:** Spring**Pre-requisite:** 10+2 science examination with PCB/PCBM/PCM/10+2 Agriculture**Objective**

To acquaint the students with Medicinal plant diversity & local healthcare

Course Content:**UNIT I**

5 lectures

MAPs: definition, history, importance and future prospects. Medicinal Plants – past and present status in world and India. MAPs as industrial crops - constraints and remedial measures. Medicinal plant diversity & local healthcare.

UNIT II

5 lectures

Promotion of medicinal plant sector at national level: National Medicinal Plant Board and State Medicinal Plant Boards - objectives and functions. Demand and supply of medicinal plants. Herbal industries.

UNIT III

6 lectures

Important medicinal plants of India with their systematics, geographical distribution and uses. Acorus calamus, Adhatodavasica, Abrus precatorius Aloe vera, Phyllanthus amarus, Stevia rebaudiana, Belladonna and Cinchona.

UNIT IV

5 lectures

Medicinal use of aromatic plants of India with their systematics, geographical distribution and uses. Introduction and historical background of aromatic plants.

UNIT V

9 lectures

Major, minor and less known aromatic plants of India. Uses of important aromatic plants – citronella, davana, damask rose, geranium, khus grass, large cardamom, lavender, lemon grass, mentha, holy basil, patchouli, rosemary Palmarosa, vetiver, artemisia, eucalyptus, thyme, marjoram and oreganum. Aromatic spices - clove, cinnamon, nutmeg, ajwain, dill, celery, tamarind, garcinia, curryleaf and saffron.

Reference Books:

- Medicinal Plants of Uttarakhand by C.P. Kala (2010). Syllabus - M. Sc. Medicinal and Aromatic Plants 2
- Indian Medicinal Plants by P.C. Trivedi (2009).
- Medicinal Plants of Indian Himalaya by S.S. Samant and U. Dhar.
- Hand Book of Aromatic Plants by S.K. Bhattacharjee (2004).
- Handbook of MAPs by S.K. Bhattacharjee (2009).

Core Course FFT 385 :Industrial Project

Credits (0-0-10-10)

SEMESTER-VII

General Elective Course FFT 504 : Research Methodology and Statistics

Credits: (3-1-0-4)

Level: Post Graduate

Semester:Spring

Pre-requisite: Basic knowledge of mathematics

Objective:

The students will be exposed to various statistical tools required to analyze the experimental data in nutrition and community research

Course Content

UNIT I (10 lectures)

Scientific Approach to Research: Meaning, significance, types of research studies.

Research Process: Formulating the problem, objectives, hypothesis, Experimental design, sample design, collecting data, analysis of data, interpretation, preparation of report.

UNIT II (15 lectures)

Sampling design: Census vs. sample survey. Steps, types.

Scaling techniques: Continuum, Reliability, Validity, Scale construction techniques.

Experimental designs: Randomized Block design

Processing of data: Development of code book.

UNIT III (15 lectures)

Measurements: Nature of measurements, types of measurement scale, Frequency distribution, graphical presentation of data.

Measures of Central Tendency: Computation of mean, median and mode, their uses.

Measures of variability: Computation of mean deviations, Quartile deviation and standard deviation, their uses.

UNIT IV (10 lectures)

Correlation: Regression, Meaning, Spearman and Pearson's techniques of correlation, Linear regression. Chi Square:

UNIT V

(10 lectures)

Tests of significance of difference between means: t-test. Analysis of Variance (ANOVA): One way and two ways.

Applications to food quality assessments

Reference Books

- Aggarwal BL. 2003. Basic Statistics. New Age.
- Kothari CR. 1989. Research Methodology. Wiley Eastern.
- Gupta SP. 2004. Statistical Methods. S. Chand & Sons.

Discipline Specific Elective Course FFT 555: Food Additives

Credits: (2-0-0-2)

Level: Post Graduate

Semester: Spring

Pre-requisite: A course of unit operations in food processing

Objective: To understand the principles of chemical preservation of foods and to understand the role of different food additives in the processing of different foods and their specific functions in improving the shelf life, quality, texture and other physical and sensory characteristics of foods.

Course Content:

UNIT I

Definition, role of food additives, classification of food additives based on their role, Risks and benefits of food additives. Safety in the use of food additives in foods; regulations and monitoring.

Preservatives – definition; natural preservatives; chemical preservatives; Permitted preservatives in foods, Antioxidants; natural and chemical antioxidants; mechanism of antioxidant function; primary and secondary antioxidants.

Unit II

Permitted Natural and synthetic colors; inorganic pigments; application of colors in food industry; Flavoring agents – concept of flavors in foods; natural flavors; nature identical flavors; artificial flavoring substances.

Unit III

Emulsifiers, Stabilizers and Thickeners: role of emulsifiers, different classes of emulsifiers and their chemical structure, their HLB values and role in emulsion stabilization; role of different stabilizers and other substances in emulsion stability; permitted emulsifiers and stabilizers and food applications. Thickeners – definition, chemical structure, role in food processing and product end characteristics, list of permitted thickeners and food applications.

Unit IV

Natural and chemical sweeteners; nutritive and non-nutritive sweeteners; chemical structure & sweetness; saccharine, acesulfame K, aspartame, sucralose, Food acids – their function and application in foods; permitted food acids; nutritive additives; enrichment of foods.

Unit V

Other Food Additives and Food Ingredients: Anticaking agents, Antifoaming, Glazing agents, Bulking agents, Humectants, Firming agents, Softening agents, Crystal modifiers, Flour improvers, Flour treatment agents, Dough conditioners, and Enzymes – definition, role and mode of action, permitted list of agents and food application. Proteins, starches and lipids as functional ingredient and their applications in foods.

Reference Books:

- Mahindru, S.N. "Food Additives: Characteristics, Detection and Estimation". Tata McGraw-Hill, 2000.
- Brennen, Alfred Larry. "Food Additives". 2nd Edition, CRC Press, Clydesdale, Fergus M. "Food Additives- Toxicology Regulation and Properties". CRC Press, Emerton, Victoria, "Food Colours". Blackwell Publishing, 2008.
- Wilson, Rachel. "Sweeteners" Blackwell Publishing, 2007.
- Hutchings, John B. "Food Color and Appearance". Aspen Publication, 1999.

Discipline Specific Elective Course FFT 390 : Thesis

Credits: (0-0-10-10)

SEMESTER-VIII

Discipline Specific Elective Course FFT 390 : Thesis Credits: (0-0-20-20)

SEMESTER-IX

Core Course: FFT 503 Instrumentation and Analytical Techniques Credits: (3-0-1-4)

Level: Post Graduate

Semester: Autumn

Pre-requisite: Graduation in any stream of science.

Objective: To develop an understanding and methodologies of instrumental techniques in food analysis used for objective methods of food quality parameters.

Course Content

UNIT I (6 lectures)

Preparation of chemical solutions: Concept of molar, molal, and normal solutions. pH and Buffers: Importance and measurement of pH.

UNIT II (11 lectures)

Chromatographic techniques: General principles. Partition and adsorption chromatography. Paper, thin layer, gas liquid, ion exchange and affinity chromatography. Gel filtration. Introduction to High Pressure Liquid Chromatography.

UNIT III (8 lectures)

Electrophoretic Techniques: General principles. Paper and gel electrophoresis. Polyacrylamide gel electrophoresis.

UNIT IV (11 lectures)

Spectroscopy: Beers and Lambert's Law. Extinction coefficient. General principles of colorimeters and spectrophotometers, Atomic spectroscopy, Emission spectroscopy, IR spectroscopy.

UNIT V (9 lectures)

Fluorimetry: Spectrofluorimeters. Flame photometry and atomic absorption spectrophotometry. Use of radioisotopes. Microbiological assays. Microscopy

Practical

- Qualitative analysis of compounds by chromatography techniques: Thin layer Chromatography, Paper Chromatography: Descending, Ascending and Circular Paper chromatography.
- Qualitative analysis of compounds By using High Performance Liquid Chromatography.
- Column chromatography: Separation of beta carotene
- Use of electrophoresis in the determination of proteins.
- Determination of Rheological properties by using texture analyzer.
- Learning Outcome: Students will get acquainted with analytical methods used for quality control analysis of raw material and processed food commodities.

Reference Books

- Hand Book of Food Analysis by Nollert & Toldra, CRC publishing Ltd.
- Hand Book of Analysis & Quality Control for Fruit & Vegetable Products by Rangana, Tata Mcgraw hill publishing.
- Introduction to the chemical analysis of foods by Nielson, CBS publishing.

Skill Enhancement Course: FFT 556 Spices and Flavour Technology**Credits: (3-0-0-3)****Level:** Post Graduate**Semester:** Autumn**Pre-requisite:** Graduation in any stream of science.**Objective:** To impart basic knowledge about the importance and production technology of spices and to know chemistry and physiology of taste, flavouring compounds in foods**Course Content**

Unit I (7 lectures)

Spice processing Introduction, classification, composition and functions. Standards specification of spices and flavours, Spice processing, spice reconditioning, spice grinding, post- processing treatments.

Unit II (7 lectures)

Processing of Major Spices: Pepper, cardamom, ginger, onion, garlic, vanilla, cinnamon, chilli and turmeric – method of manufacture; chemistry of the volatiles; enzymatic synthesis of flavour identical.

Unit III (8 lectures)

Processing of Minor Spices, herbs and leafy vegetables: processing and utilization, All spice, Annie seed, sweet Basil, Caraway seed, Cassia, Cinnamon, Clove, Coriander, cumin, Dill seed Fern seed nutmeg mint marjoram, Rose merry, saffron, sage.

Unit IV (11 lectures)

Spice extractives, Value added spice products: Spice volatile oils, spice oleoresins, Use of spice extractives, replacement of spices with oils and oleoresins, alternative products, Ground spices, processed spices, organic spices, curry powders. Packaging of spices and spice products

Unit V (12 lectures)

Chemistry and physiology of taste, flavouring compounds in foods, Separation, purification and identification of natural flavouring materials & Synthetic flavouring agents and their stability: Processing quality control of Savory, Thyme, Ajowan, Curry leaves, Asafoetida, Tea, Coffee, Cocoa, Vanilla and annatto. Flavours of soft drinks, Baking and confectionery industry.

Learning Outcomes: The students are expected to have learnt importance and production technology of spices and flavours.**Reference Books:**

- Spices – vol. II Parry J. W.
- Spice and condiments Pruthi J. S.
- Herbs and spices by Rosemary Hemphill
- The book of spices by Rosen garten, F. and Livingston Jr.
- Spices and herbs for the Food Industry by Lewies, Y.S.
- Spices Vol. I and II by Tropical Agril. Series. Purseglove, J. W. Brown E. G.,
- Green C. L. And Robbins SRJ. Food Flavourings P. R. Ashust.
- Food Flavouring composition, manufacture and uses. by J. Merrory

Core Course: FFT 509 Food Quality, Safety Standards and Certification**Credits: (3-0-0-3)****Level:** Post Graduate**Semester:** Autumn**Pre-requisite:** Completed basic course on Food Processing**Objective:** To acquaint with food quality parameters and control systems, food standards, regulations, specifications.

Course contents:

UNIT I (5 lectures)

Quality Assurance: Introduction, Importance and Difference. Food Quality and Food Safety: Scope and difference.

UNIT II

(12 lectures)

Raw materials & Finished product quality: Quality parameters and evaluation procedures: Appearance, color, texture, viscosity, consistency, flavor.

Sensory evaluation: Selection of panel of judges, sensory characteristics of foods, types of tests.

UNIT III

(12 lectures)

Food standards and laws: International – Concept of Codex alimentarius, HACCP, GMP, GHP, USFDA, ISO 9000, ISO 22000, ISO 14000. National – Introduction of BIS/IS, Food Safety and standards – 2006, Food Safety and standard regulation 2010, FPO, MPO, MMPO, Agmark. Prevention of food adulteration Act: Food Adulteration: definition, common adulterants in different foods, contamination, methods of detection. Food additives and legislation; coloring matter, preservatives, poisonous metals, antioxidants and emulsifying and stabilizing agents, insecticides and pesticides. PFA specification for food products, Nutritional labeling

UNIT IV

(6 lectures)

Quality Certification & Accreditation: Introduction and procedure.

UNIT V

(10 lectures)

Water Quality: Water standards and Analysis physical, chemical and microbiological characteristics of water analysis.

Waste treatment: Fundamentals of Physical, Biological & Chemical waste treatments

Learning Outcome: The students must have an understanding about food laws and standards, quality parameters and sensory evaluation of food.

Reference Books

Early R. 1995. Guide to Quality Management Systems for Food Industries. Blackie Academic.

Krammer A & Twigg BA. 1973. Quality Control in Food Industry. Vol. I, II. AVI Publ

Discipline Specific Elective Course FFT 651 : Entrepreneurship in Food Processing

Credits: (2-0-0-2)

Level: Post Graduate

Semester: Autumn

Pre-requisite: Completed basic course on Food Processing.

Objective: To enable the student to plan and prepare a project report for food processing unit and to provide capability to execute and evaluate the same and to introduce students to the methodology of project formulations and the implementation procedures and strategic planning of new projects.

Course contents:**UNIT I**

(6 lectures)

Aggregate Planning:- General design considerations, Financial Analysis, plant location and plant layout, Flowcharts and their design, equipment selection

UNIT II

(4 lectures)

Design of service facilities

UNIT III

(4 lectures)

Human resource planning: Planning and design of marketing system, worker's safety and plant hygiene

UNIT IV

(6 lectures)

Introduction to Marketing and economics: Demand, Supply, Sample survey techniques, marketing information, consumer trends, consumer behavior.

UNIT V

(10 lectures)

Introduction to Operations Research: Definition, applications. Inventory control, Linear Programming. Queuing Theory, Transportation and Assignment. Forecasting

Learning Outcome: The students would have been acquainted with designing and planning of food plant layout and operations research.

Reference Books:

- Chandra P. 2005. Project Management. Tata McGraw Hill.
- Gopal Krishan P & Nagarajan K. 2005. Project Management. New Age.
- Hisrich RD & Peters MP. 2002. Entrepreneurship. Tata McGraw Hill.
- Kaplan JM. 2003. Patterns of Entrepreneurship. John Wiley & Sons.
- Nandan H. 2007. Fundamentals of Entrepreneurship Management. Prentice Hall.

Discipline Specific Elective course: FFT 654 Food Product Development**Credits: (2-0-0-2)****Level:** Post Graduate**Semester:** Autumn**Pre-requisite:** Basic knowledge of Food Science.**Objective:**

To acquaint the students about the need, types, basic technique and details of food product development to plan nutritious products.

Course Content

UNIT I (6 lectures)

Concept of product development - product success and failure, factors for success, process of product development, managing for product's success. Innovation strategy - possibilities for innovation, building up strategy, product development programme.

UNIT II (5 lectures)

The product development process - product strategy, product design and process development, product commercialization, product launch and evaluation.

UNIT III (6 lectures)

The knowledge base for product development technology - knowledge and the food system, knowledge management, knowledge for conversion of product concept to new product, technological knowledge (product qualities, raw material properties, processing, packaging requirement, distribution and marketing.

UNIT IV (5 lectures)

Role of consumers in product development - consumer behaviour, food preferences, avoiding acceptance, integration of consumer needs in product development and sensory needs.

UNIT V (8 lectures)

Managing the product development process, - principles of product development management, people in product development management, designing the product development process, key decision points, establishing outcomes, budgets and constraints, managing and organizing product development process, innovative matrices, striving for continuous improvement, Improving success potential of new products, market exploration and acquisition, Legal aspects of new product launch.

Learning Outcome: The course must have acquainted the students with principles of food product design and development.

Reference Books:

- Clarke & Wright W. 1999. Managing New Product and Process Development. Free Press.
- Earle R, Earle R & Anderson A. 2001. Food Product Development. Woodhead Publ.
- Fuller 2004. New Food Product Development - from Concept to Market Place. CRC.

Discipline Specific Elective Course (DSE): FFT 658 Food By-Product Management**Credit: (2-0-0-2)****Level:** Post Graduate**Semester:** Autumn**Pre-requisite:** Basic knowledge of Food Science.**Objective:**

To acquaint the students about the types food by-products and techniques for their treatment especially from an industrial perspective.

Course Content

UNIT I (6 lectures)

Food industry By-products and Waste:

Introduction, status in India, definition, origin and type of waste and by products, their identification, classification, composition and characterization, need for treatment and utilization, impact on environment, food waste as source of biogenic raw material and energetic utilization .

UNIT II (6 lectures)

Introduction to Food Waste Treatment: Basic unit operations, techniques & equipment for treatment, primary treatments like screening, sedimentation, skimming, floatation coagulation & flocculation, flow equalization, filtration, adsorption, chemical oxidation, membrane separation, ion exchange. Anaerobic & aerobic digestion of organic wastes, activated sludge process, biomass generation & its utilization.

UNIT III (6 lectures)

Food Wastes and By-products Related to Specific Processing Industries: Like fruit and vegetables (apple, orange, mango, potato etc.), dairy industry, oil and oil seeds industry, sugar industry, grains and milling industry, fermentation (alcohol and beer), livestock and poultry, fish, meat.

UNIT IV (6 lectures)

Applications of By-product utilization involving (i) utilization of whey from dairy industry, (ii) Utilization of specific plant by-products for recovery of proteins, pectins, dietary fibres, antioxidants, colorants etc. (iii) Utilization of biomass for production of animal feed, compost and bio-gas.

UNIT V (6 lectures)

Introduction to Food Packaging Waste & Handling and treatment, Farm wastes. Incineration of solid food waste and its disposal. Future Trends: Introduction to legal and statutory requirements for food waste handling, treatment and disposal.

Reference Books:

- Waste Management for the Food Industries, by Ioannis S. Arvanitoyannis, First edition 2008, Elsevier Inc, USA.
- Food and Agricultural Wastewater Utilization and Treatment, Sean X. Liu, First edition 2007 Blackwell Publishing, Iowa 50014, USA.
- Managing Food Industry Waste, ROBERT R. ZALL, First edition, 2004, Blackwell Publishing Professional, Iowa, USA.

Discipline Specific Elective Course (DSE): FFT 653 Food Rheology**Credits: (2-0-0-2)****Level:** Post Graduate**Semester:** Autumn**Pre-requisite:** FFT 508**Objective:** To explain the basics of food rheology and to familiarize the students with rheological instruments and their use in relation to food products.**UNIT I**

(6 lectures)

Food rheology and structure: stress and strain tensors, viscometric properties, shear stress-shear rate relationships, units in rheological measurements, types of fluid flow behaviour, apparent viscosity, intrinsic viscosity, stress-strain behaviour of solid foods, linear viscoelasticity, phase transitions in foods.

UNIT II

(6 lectures)

Flow and functional models for rheological properties of fluid foods: Time independent flow behaviour, Apparent viscosity- shear rate relationships of shear- thinning foods, models for time dependent flow behaviour, role of solids fraction in rheology of dispersions, affect of temperature on viscosity, treatment of rheological data using models.

UNIT III

(6 lectures)

Tube viscometry, Rotational viscometry: introduction

UNIT IV

(6 lectures)

Viscoelasticity: introduction, transient tests for viscoelasticity, oscillatory testing. Rheology of food gum and starch dispersions: effect of heating, effect of sugar and protein, rheological behaviour of starch, rheology of starch- gum dispersions.

UNIT V

(6 lectures)

Rheological behaviour of processed fluid, semisolid foods and food gels: rheological tests to evaluate properties of gel systems, gel point and sol-gel transition by rheological measurements. Application of rheology to fluid food handling and processing

Learning Outcome: It is expected that the students would have learnt concepts of rheology and structure of food systems.

Reference Books:

- Bourne MC. 2002. Food Texture and Viscosity: Concept and Measurement. Academic Press
- Deman JM. et al. 1976. Rheology and Texture in Food Quality. AVI Publ.
- Mohsanin NN. 1989. Physical Properties of Plant and Animal Material. Vol. I, II. Gordon and Breach Science Publ.
- Steffe JF. 1992. Rheology and Texture in Food Quality. AVI Publ.

Discipline Specific Elective Course (DSE): FFT 659 :Advanced Food Chemistry**Credits: (2-0-0-2)****Level:** Post Graduate**Semester:** Autumn**Pre-requisite:** Basic knowledge of Food Science.**Objective:** To go beyond basic chemistry and nutrition in to advances with the aim of developing healthy and nutritious foods for normal and special category of population groups.**Course Content:****Unit I**

(12 lectures)

Interactions among food components and their effect on sensory, nutritional and processing quality, Natural antioxidants, mechanisms of action and their evaluation techniques, Free radical chemistry, photosensitized oxidation, metal catalyzed reactions. Antioxidants: chemistry and mechanisms of action, techniques of evaluation of antioxidant activity, uses.

Unit II

(11 lectures)

Water relationships in foods: water activity and its relevance to deteriorative processes in foods (chemical, enzymic, physical and microbial changes). Glass transitions and molecular mobility in foods, their relevance to quality and stability of food products.

Unit III

(12 lectures)

Fragrance and flavouring compounds: essential oils, terpenoids-oleoresins-biochemical pathways for the production of volatile compounds in specific plant species; Biological Interactions among food components and flavours, Interactions

among food flavours and packaging materials, Interactions among food additives and their significance in food processing.

Unit IV

(10 lectures)

Food Carbohydrates: structural, analytical, physicochemical, nutritional and functional aspects of small mol. wt. carbohydrates and polysaccharides of plant and microbial origin.

Chemistry of alkaloids, flavonoids and other phenolics.

Learning Outcome: It is expected that the students would have learnt concepts of interactions within Food constituents.

Reference Books:

- Aurand LW, Woods A & Wells MR. 1987. Food Composition and Analysis. AVI Publ.
- Baynes JW, Monnier VM, Ames JM & Suzanne R. 2005. The Maillard Reaction: Chemistry at the Interface of Nutrition, Aging, and Disease Thorpe. Annals of the New York Academy of Science.
- Birch GG & Lindley MG. 1986. Interactions of Food Components. Elsevier.
- Fennema OR. 1996. Food Chemistry. Marcel Dekker.
- Kumar A & Gaonkar G. 1995. Ingredient Interaction: Effect on Food Quality. Marcel Dekker.

Discipline Specific Elective Course FFT 553: Speciality Foods

Credits: (2-0-0-2)

Level: Post Graduate

Semester: Spring

Pre-requisite: Basic knowledge of Food Science and Nutrition at undergraduate level.

Objective:

To make students understand the need, importance and process of developing healthy and nutritious foods for special category of population groups.

Course Contents:

UNIT I

(6 lectures)

Need and scope of specialty foods: Specialty food based on ease in preparation cost health benefits; Functional foods, Convenience food, Health care and medical benefits, Nutritional status, Low cost foods.

UNIT II

(6 lectures)

Specialty foods based on sources; Cereals and millets, Legumes and pulses, Fruits and vegetables, Animal food sources, By product based, Non conventional foods.

UNIT III

(6 lectures)

Specialty foods based on process; Innovative process technology, Food additives basis, Bioactive components, Novel nutraceuticals products, Packaging techniques, Adaptable technology basis, Fast and PET foods.

UNIT IV

(5 lectures)

Specialty food based on genetics; Genetically modified foods, Transgenic foods, Biotechnological aspects of detoxification. Proprietary foods. Supplementary foods.

UNIT V

(7 lectures)

Therapeutic foods; Modification of diets in disorders, feeding purposes, Disease oriented of different organs ex: digestive tract, liver, cardiovascular system, kidney, metabolic disorders, allergy, endocrine disorders.

Specific consumer oriented foods; Defence persons, Space / astronaut, High altitude mountain climbers, Disaster situation – crises, care, maintenance. Specialty foods based on growing condition -organic, inorganic farming.

Learning Outcome: After completion of course the students would have an understanding of various specialty foods and their development based on variation of sources, process and genetics.

Reference Books

- Gibson GR & William CM. 2000. Functional Foods - Concept to Product.
- Robert EC. 2006. Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.
- Manson P. 2001. Dietary Supplements. 2nd Ed. Pharmaceutical Press.
- Bamji MS, Rao NP & Reddy V. 2003. Textbook of Human Nutrition. Oxford & IBH.

SEMESTER-X**Core Course: FFT 507 Packaging of Food materials****Credits: (3-0-0-3)****Level:** Post Graduate**Semester:** Spring**Pre-requisite:** FFT 501**Objective:** To acquaint the students with packaging methods, packaging materials, packaging machineries, modern packaging techniques etc.**Course Content:****UNIT I**

(11 lectures)

Definitions and functions of packaging and packaging materials. Packaging requirements and selection of packaging materials; Types of packaging materials: paper: pulping, fibrillation and beating, types of paper and their testing methods; Glass: composition, properties, methods of making bottles and jars; Metals: Tin plate containers, tinning process, components of tin plate, tin free steel (TFS), types of cans, aluminum containers, lacquers; Plastics: types of plastic films, laminated plastic materials, coextrusion, edible films and biodegradable plastics.

UNIT II

(11 lectures)

Properties of materials such as tensile strength, bursting strength, tearing resistance, puncture resistance, impact strength, tear strength, their methods of testing and evaluation; Barrier properties of packaging materials: Theory of permeability, factors affecting permeability, permeability coefficient, gas transmission rate (GTR) and its measurement, water vapour transmission rate (WVTR) and its measurement, prediction of shelf life of foods.

Different packaging systems for dehydrated foods, frozen foods, dairy foods, fresh fruits and vegetables, meat, poultry and sea foods.

UNIT III

(8 lectures)

Process of Packaging: Material handling, filling, air removal, sealing, retorting, Modified atmosphere packaging, vacuum and gas packaging. Package sterilization techniques, cushioning, unitizing, palletizing, stacking and containerization.

UNIT IV

(8 lectures)

Quality Control: Evaluation of Packaging materials, toxicity, corrosion prevention, shelf life testing, minimization of transport losses, Hazards in handling and storage and packaging and their minimization.

UNIT V

(7 lectures)

Packaging Laws and Regulations, Standards of Weights and Measures Act, Advancement in packaging Technology: Smart packaging, Active packaging, Anti-microbial packaging etc.

Learning Outcomes: Students will have learnt about packaging materials, methods and their applications in food industry.

Reference Books:

- Coles R, McDowell D and Kirwan MJ, Food Packaging Technology, CRC Press, 2003
- Robertson GL, Food Packaging – Principles and Practice, CRC Press Taylor and Francis Group, 2012
- Paine FA and Paine HY, A Handbook of Food Packaging, Blackie Academic and Professional, 1992

Core Course FFT 508: Food Engineering**Credits: (3-1-0-4)****Level:** Post Graduate**Semester:** Spring**Pre-requisite:** B.Sc. with Chemistry as one paper.**Objective:** To acquaint with basic principle of Food Engineering and its Processes, with importance of various foods process and their evaluation.**Course Content****UNIT I**

(9 lectures)

Mass, Energy balance and Heat transfer: Steam injection, steam infusion, plate heat exchangers, tubular heat exchangers and scraped surface heat exchangers, Pasteurization: Theory and application, pasteurization of packaged and unpacked foods, pasteurization calculations, equipments. Thermal processing: Death kinetics, thermal death curve, decimal reduction time. Z-factor, heat penetration curve, process time calculations, mathematical curve, process time calculations. Mathematical and graphical solutions

UNIT II

(10 lectures)

Size reduction process: Principles, theories and laws, energy considerations, equipments. Mixing and forming, theory and applications, mixing indices, equipments for solid and liquid. Separation processes: Filtration and centrifugation, theories and mathematical descriptions, constant rate and constant pressure filtration, equipment. Membrane Technology- Reverse osmosis and Ultra filtration, Micro filtration

UNIT III

(4 lectures)

Fluid flow, laminar, turbulent and transitional ranges, velocity distribution profiles, basic equations, thermal velocity calculations.

UNIT IV

(10 lectures)

Evaporation: heat and mass balance, steam economy, heat recovery, efficiency, process calculations, Food dehydration: constant and falling rate periods, drying rate calculations. Chilling, refrigeration and freezing: theories, characteristics curve, cooling rate calculations.

UNIT V

(12 lectures)

Advanced Technologies: Extrusion: Theory and applications, extrusion cookers and cold extrusion, single and twin screw extruders, design considerations., Supercritical gas extraction, Advances in fortification: Synthetic nutrients. Techniques of food fortification. Stability of nutrients in relation to processing. Encapsulations: design and structure of microcapsules, release rate and mechanism. Techniques of micro encapsulation, advantages and application of encapsulation. Non thermal Processing: High pressure processing, Pulsed electric processing, Ohmic heating.

Learning Outcomes: After completing the course the students shall be well acquainted about different food engineering processes and various principles working behind them.

Reference Books:

- S. K. Sharma, S.J.Mulvaney, and S.S.H.Rizvi, Food Process Engineering: Theory and Laboratory Experiments, Wiley and Sons, 2000
- H. Pandey, H.K. Sharma, R.C.Chouhan, B.C. Sarkar and M.C. Bera, Experiments in Food Process Engineering, CBS Publishers and Distributors, 2004
- M.A. Rao, S.S. H.Rizvi and A.K.Dutta, Engineering properties of Foods, 3rd ed., Marcel Dekker, 2005

Core Course FFT 510 : Advanced Food Microbiology**Credits: (3-0-1-4)****Level:** Post Graduate**Semester:** Spring**Pre-requisite:** Science (Biology) as a subject in Class X.

Objective: To acquaint with different groups of micro-organisms associated with food, their activities, destruction and detection in food.

Course Content:**UNIT I**

(10 lectures)

General characteristics of microorganisms: Classification and identification of yeasts, molds and groups of bacteria important in food industry. Source of contamination: Air, water, soil, sewage, post processing contamination. Intrinsic and extrinsic factors influencing growth of microorganisms in foods.

UNIT II

(8 lectures)

Classification of foods and general principles involved in their preservation. Effects on microbes of: Low temperature preservation, lethal effects of chilling, freezing and thawing; high temperature preservation. Heat resistance of microorganism, heat penetration and thermal processing. Pasteurization, sterilization, canning and dehydration; chemical preservation and its toxic effects; irradiations.

UNIT III

(9 lectures)

Food fermentations: Bacterial, yeast and mold cultures; single and mixed cultures, propagation, maintenance and evaluation of cultures; factors affecting activity of cultures, bacteriophages, residual antibiotics and chemicals.

UNIT IV

(8 lectures)

Microbiology of fermentation: Fermented milks. Cereal foods, vinegar, oriental foods, alcoholic beverages. Therapeutic value of fermented foods. Food Biotechnology: Use of biotechnologically improved enzymes in food processing industry

UNIT V

(10 lectures)

Food spoilage: Spoilage of fresh and processed fruit and vegetables, spoilage of meat, fish, eggs and poultry products. Microbial toxins.

Pathogens in foods: Microbial infections and intoxications. Growth and survival of pathogens in food.

Food borne diseases. Investigation and control

Practical:

- Determination of microbial counts: Total viable, thermophilic, proteolytic, lipolytic and aerobic spore formers, coliform counts, yeast and mold count.
- Determination of activity of starter cultures used in dairy industry.
- Dye reduction test.
- Determination of thermal resistance of enzymes and microorganisms

Learning Outcomes: After completing the course, the students will have knowledge about different groups of microorganisms and their beneficial as well as harmful effects related to food.

Reference Books:

- Food microbiology by V. Ramesh, MJP publishing.
- Food microbiology by W.C. Frazier, 1st Edition by McGraw Hill Pub. Co. New York.
- Modern Food Microbiology, J.M. Jay. CBS publisher.

Discipline Specific Elective Course FFT 660: Processing of Fruits and Vegetables

Credits: (1-0-1-2)

Level: Post Graduate

Semester: Spring

Pre-requisite: Introduction to Food Processing

Objective: To acquaint with the proper handling technologies of fruits and vegetables to reduce post harvest losses and acquaint with principles and methods of preservation of fruits and vegetables into various products.

Course Content**UNIT I**

(3 lectures)

Fruits and vegetables as living products: Chemical composition; pre and post harvest changes, maturity standards for storage, desirable characteristics of fruits and vegetables of processing.

Post harvest handling of fresh fruits and vegetables: Role of plant growth regulators in relation to storage; physical and chemical treatment to increase the shelf-life, conditions for transportation and storage, disease and injuries during marketing.

UNIT II

(5 lectures)

Storage of fresh fruits and vegetables. Containers: Tin, glass and other packaging materials used in fruits and vegetables preservations. Canning and bottling: quality of raw materials, preparation of materials, preparation of syrups and brines, canning and bottling, effect of canning and bottling on nutritive value, spoilage of canned foods, detection and control.

Fruit and vegetable juices: Preparation of juice, syrups, squashes, cordials, and nectars; concentrations and drying of juice, packaging and storage and concentrations and powders; fortified and soft drinks.

Preparation of preserve and candied fruits

UNIT III

(2 lectures)

Preservation by freezing, general methods for freezing of fruits and vegetables; problem relating to storage of frozen products; standards for frozen food products.

Dehydration of fruits and vegetables: Methods; packaging, storage, quality control during and after dehydration.

UNIT IV

(3 lectures)

Pickles and chutneys: Preparation of various types of pickles- theory and practice; preparation of sauces and chutneys; problems relating to the shelf life of pickles and chutneys; quality control.

Tomato products: preparation of various tomato products, food standards and quality control.

Pectin: Raw materials; processes and uses of pectin; products based on pectin manufacture and quality control.

UNIT V

(2 lectures)

Food additives: Use in fruit and vegetable preservation.

Vinegar: General methods of preparation, food standards and quality control. Uses

Utilization of waste from fruit and vegetables processing plant.

Practical

- Analysis of canned food products for chemical and microbiological spoilage.
- Tin coating test
 - Tin coating weight measurement (Clarke's Test)

- Determination of the continuity of tin coating
- Sulphide stain test and corrosion resistance test
- Determination of Ascorbic acid content in food products.
- Determination of lycopene content
- Determination of tannins in food products.
- Dehydration of fruits and vegetables
- Preparation of tomato products like ketchup, puree & past
- Preparation of Jam, Jelly, marmalade, preserve and fruit candy
- Pectin determination in fruits and vegetable products.
- Determination of chemical preservatives in fruits and vegetables products.
- Preparation and analysis of fruits beverages i.e. Squash and cordial.
- Use of flame photometry in the estimation of trace metals like Sodium and Potassium

Learning Outcomes: Students would have learnt different post harvest handling methods of fruits and vegetables.

Reference Books

- Lal G, Siddapa GS & Tandon GL. 1986. Preservation of Fruits and Vegetables. ICAR.
- Salunkhe DK, Bolia HR & Reddy NR. 1991. Storage, Processing and Nutritional Quality of Fruits and Vegetables. Vol. I. Fruits and Vegetables. CRC.
- Thompson AK. 1995. Post Harvest Technology of Fruits and Vegetables. Blackwell Sci.

Discipline Specific Elective Course (DSE): FFT 552 : Intellectual Property Rights Credits: (2-0-0-2)

Level: Post Graduate

Semester: Spring

Pre-requisite: Graduation in any stream.

Objective:

To sensitize the students regarding the essentials of Intellectual Property Rights, its fundamentals, legislations and significance to it in the development of agriculture, food and nutritional security.

Course Content

UNIT I (6 lectures)

Need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPs Agreement.

UNIT II (7 lectures)

Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties.

UNIT III (5 lectures)

Fundamentals of patents, copyrights, geographical indications, designs and layout, trademarks.

UNIT IV (6 lectures)

Protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection;

UNIT V (6 lectures)

International Treaty on Plant Genetic; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement

Learning Outcome: The course is expected to acquaint the students with different IPR and its their importance in protecting individual rights.

Reference Books:

- Erbis FH & Maredia K. 1998. Intellectual Property Rights in Agricultural Biotechnology. CABI, Wallingford.
- Ganguli, Prabudha. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill, New Delhi.

Elective Course FFT 554 : Fundamentals of Nutrition**Credits: (2-0-0-2)****Level:** Post Graduate**Semester:** Spring**Pre-requisite:** FFT 502**Objective:** To acquaint the students about importance of nutrition, balanced diets, therapeutic diets for health and role of food and nutraceuticals in health.**Course Content****UNIT I**

(7 lectures)

Introduction to human nutrition. Macronutrients and micronutrients - Classification and functions. Digestion, absorption and assimilation of nutrients. Energy metabolism- Components of energy expenditure, Basal Metabolic Requirements and Activity, Recommended Dietary Allowances, Food Groups, Concept of a balanced diet, Methods of evaluation of nutritive value of foods.

UNIT II

(5 lectures)

Carbohydrates- Types, functions, sources, requirement, storage, Effect of deficiency and excess.

UNIT III

(5 lectures)

Proteins- Types, functions, sources, requirement, storage, Effect of deficiency and excess.

UNIT IV

(5 lectures)

Fat- Types, functions, sources, requirement, storage, Effect of deficiency and excess.

UNIT V

(8 lectures)

Vitamin- Types, functions, sources, requirement, storage, Effect of deficiency and excess.

Minerals- Types, functions, sources, requirement, storage, Effect of deficiency and excess.

Water and electrolytes- Concept and importance. Nutritional assessment and nutritional policies- Salient features, concept of community nutrition

Learning Outcomes: The students would be well informed about human nutrition concepts and various food groups after completing the course.**Reference books:**

- Nutrition Science by B. Srilakshmi
- Fundamentals of Foods & Nutrition by Sumati R. Mudambi
- Textbook of Nutrition : A Life cycle approach by Ravinder Chadha

Discipline Specific Elective Course (DSE): FFT 652 Food Fermentation and Microbial Technology**Credits: (2-0-0-2)****Level:** Post Graduate**Semester:** Autumn**Pre-requisite:** Must have completed one course / paper on Microbiology / Food Microbiology.**Objective:** To familiarize about the various microbial processes/systems/activities which have been used for the development of industrially important products/processes.**Course Content****Unit I**

(6 lectures)

Fermentation: History, definition and types. Study of a Bio fermentor – its design and operation, Down Stream Processing and Product recovery. Its measurement and control in fermentation, Aeration and agitation in fermentation: Oxygen requirement, sterilization of air and media; scale up in fermentation.

Unit II

(6 lectures)

Recovery of particulate matter, product isolation, distillation, centrifugation, whole broth processing, filtration, aqueous two-phase separation, solvent extraction, chromatography and electrophoresis.

Unit III

(8 lectures)

Production of alcoholic beverages, organic acids, enzymes and immobilization of enzymes. Biological waste treatment.

Unit IV

(4 lectures)

Dairy Fermentations-starter cultures and their types, concept of probiotics.

Unit V

(6 lectures)

Microbial enzymes, role in various industrial processes, Bio-transformations, Immobilized enzymes based bioreactors; production of antibiotics, vaccines, and biocides; Bioconversion of substrates, anti-nutritional factors present in feeds; Microbial detoxification of aflatoxins; Bioinsecticides; Biofertilizers.

Learning Outcome: The course will make the students learn about fermentation techniques and industrial microbiology.

Reference Books:

- Hufnagle GB & Wernick S. 2007. The Probiotics Revolution: The Definitive Guide to Safe, Natural Health. Bantam Books.
- Nout RMJ, de Vos WM and Zwietering MH. 2005. Food fermentation. Wageningen Academic Publishers, Netherlands.

Skill Enhancement Course: FFT 641 Seminar
Credits: (2-0-0-2)