

**Proposed Syllabus For
B.Tech Food Technology for
Semester 5 to Semester 8
(A P J Abdul Kalam
Technological University)**

QUESTION PAPER PATTERN:

Part A (Module I and II) (answer any 2 out of 3)

1. a) 5 mark
- b) 5 mark
- c) 5 mark
2. a) 5 mark
- b) 10 mark
3. a) 5 mark
- b) 10 mark

Part B (Module III and IV) (answer any 2 out of 3)

4. a) 5 mark
- b) 5 mark
- c) 5 mark
5. a) 5 mark
- b) 10 mark
6. a) 5 mark
- b) 10 mark

Part C (Module V and VI) (answer any 2 out of 3)

7. a) 5 mark
- b) 5 mark
- c) 10 mark
8. a) 5 mark
- b) 5 mark
- c) 10 mark
9. a) 5 mark
- b) 5 mark
- c) 10 mark

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT301	Cereals & Legume Technology	3-1-0-4	2016

Course Objectives

- To study about cereal pulses milling process and the machinery used for it.
- To study Bulk Storage of grains.

Syllabus

Important cereals and pulses
Rice Milling
Wheat milling
Barley and millets
Maize and oats processing
Pulse milling
Storage and handling of grains

Expected outcome .

Students will get exposure to various technologies in cereal and pulse processing and milling. Also they will acquire knowledge about storage structures for grains

Text Book:

1. Matz, Samuel A. "The Chemistry and Technology of Cereals as Food and Feed". 2nd Edition, CBS, 1996.
2. N.L.Kent. "Technology of Cereals".
3. Chakraverty, A. —Post Harvest Technology of Cereals, Pulses and Oil Seeds , Third Edition,

Data Book (Approved for use in the examination):

References:

1. Delcour, Jan A. and R. Carl Hosney. " Principles of Cereal Science and Technology". 3rdEdition. American Association of Cereal Chemists, 2010.
2. Hosney, R.C. "Principles of Cereal Science and Technology"2ndEdition, American Association of Cereal Chemists, 1994.
3. Karl Kulp. "handbook of Cereal Science and Technology". 2nd Rev. Edition. CRC Press, 2000.
4. Manuals on Rice and its Processing by CFDRI.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Importance of cereals and legumes, cultivation and consumption- national and international scenario, utilization trends, staple food. Cereal and legume products- breakfast cereals, extruded products, protein isolates, noodles, pasta, bread, flaked, puffed products, malting, fermentation products etc.	6	15%

II	<p>Rice : Varieties, nutrient composition. Parboiling- traditional and modern methods, advantages and disadvantages. Modern rice mill, rice milling mechanism, unit operations, equipment used in each operation (cleaner, grader, huller, separator, colour sorter etc.) Bye-product utilization. Processed products (flakes, expanded, puffed rice etc.)</p>	10	15%
FIRST INTERNAL EXAMINATION			
III	<p>Wheat: Types, nutrient composition, characteristics, Milling, process flowchart, equipment used (break roll reduction roll, purifier, sifter etc.) Flour types, characteristics, testing, blending, processed products.</p> <p>Barley and millets: Barley- nutrient composition malting, processing Millets, nutrient composition (sorgum, ragi bajra etc), major, minor- processing Breakfast cereals, Snack foods, extruded products</p>	10	15%
IV	<p>Corn and oats: Corn types, nutrient composition and characteristics, milling- wet and dry, products (corn starch, flakes, syrup, HFCS etc.) AcidHydrolysis, Enzyme Hydrolysis- Processing for value added products -dextrose, malto dextrin and other products. Oats types, nutrient composition characteristics, processing,</p>	10	15%
SECOND INTERNAL EXAMINATION			
V	<p>Legumes: Types, nutrient composition characteristics, antinutritional factor, easy to mill, difficult to mill, pre-treatment, commercial hulling, processed products (roasting, parching etc.), germination Soya bean processing, products (milk, tofu, tempeh etc)</p>	10	20%
VI	<p>STORAGE AND HANDLING OF GRAIN Storage structure- Bag storage, Cover and plinth, CAP storage (Ceiling and Plinth Storage), Silos and large bins - Silos flow pattern, numericals- Fumigation Processes- Feeding and discharging of silos- conveyors and elevators for grain handling.</p>	10	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT303	Unit Operations in Food Processing	3-0-0-3	2016
Course Objectives To study principle and mechanism of various unit operations in Food Processing.			
Syllabus Agitation and mixing Filtration Membrane separation Evaporation Adsorption and Distillation Crystallization			
Expected outcome . Student will have in depth knowledge about agitation, mixing, Filtration, membrane searation, Evaporation, Adsorption, Distillation, Crystallization etc.			
Text Book: 1. <i>Unit operations of Chemical Engineering by McaBe W L, Smith J C, Harriott P</i> 2. <i>Transport Process and Unit Operations by Geankoplis C J</i> 3. <i>Unit Operations in Food Engineering by Albert Ibarz and Gustavo V B</i>			
Data Book (Approved for use in the examination):			
References: 1. <i>Foust, A.S. etal., “ Principles of Unit Operations ”, 2ndEdition, John Wiley & Sons, 1999.</i> 2. <i>Coulson, J.M. and etal. “Coulson & Richardson’s Chemical Engineering”, 6thEdition, Vol. I & II, Butterworth – Heinman / Elsevier, 2004.</i> 3. <i>Perry, Chilton & Green, Chemical Engineers’ Handbook, MGH</i>			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Agitation and mixing: Principle, mixedness, mixing index, mixing of low and moderate viscosity liquids-equipment, paddle mixer, turbine, propeller,etc. mixing of high viscosity liquid, pastes and plastic solids. Paddle pan mixer, kneader,continuous mixer, static inline mixer etc. mixing of dry articulate solids, ribbon, vertical screw. Fluidized bed mixing of gases and liquids	7	15%
II	Filtration: Introduction to liquid filtration, filter media, classification of liquid filtration, formation of filter cake, Darcy Equation, Constant rate/ Constant pressure, filtration, typical wine filtration conditions using dead-end filters, cross-flow filters, plate & frame filters, cartridge filters, types of filters; pressure, vacuum, centrifugal	7	15%
FIRST INTERNAL EXAMINATION			
III	Membrane Separation	7	15%

	Technology: Introduction to micro-filtration, Ultra-filtration, Reverse osmosis, Electro dialyses, physical characteristics of membrane separation, Factors affecting reverse osmosis process, Concentration polarization, Design of reverse osmosis and ultra filtration systems, Operation layout of the modules, Electrodialysis, per-vaporization, Fabrication of membranes, Application of membrane technology in food industry.		
IV	Evaporation: process, types of evaporators, natural, forced, thin film evaporators etc. single effect, multiple effect evaporators. Short tube, long tube, plate, agitated thin film, centrifugal evaporators Evaporator efficiency, vapour recompression, multiple effect evaporation sizing, Boiling and condensation	7	15%
SECOND INTERNAL EXAMINATION			
V	Adsorption, Distillation: Adsorption in columns, batch adsorption, ion exchange Distillation; batch, continuous distillation, Fractional distillation steam distillation, Leaching; process, equipment, counter current leaching Super critical fluid extraction, principles, extraction systems	7	20%
VI	Crystallization: Characteristics of crystals like purity, size, shape, geometry, habit forms, size and factors affecting them, solubility curves and calculation of yields. Supersaturation theory and its limitations, . Mier's supersolubility curve, nucleation mechanisms, crystal growth, study of various types of crystallizers, tanks, agitated batch,	7	20%
END SEMESTER EXAM			

Course code.	Course Name	L-T-P - Credits	Year of Introduction
FT305	Food Process Engineering	3-0-0-3	2016
Course Objectives To study different thermal and non-thermal food processes principles.			
Syllabus Raw material Preparation Blanching, Pasteurization, Sterilization Size reduction Drying, Psychrometry Refrigeration Baking, Frying, Extrusion, Sedimentation, Centrifugation Minimal Processing, Packaging, Cleaning			
Expected outcome. Student will have knowledge on various food processes like pasteurization, drying, refrigeration, centrifugation etc.			
Text Book: <ol style="list-style-type: none"> 1. <i>Introduction to Food Process Engineering</i> by P G Smith 2. <i>Food processing Handbook</i> by James G brennan 3. <i>Food process engineering and technology</i> by zeki Berk 			
Data Book (Approved for use in the examination):			
References: <ol style="list-style-type: none"> 1. Geankoplis, C.J. "Transport Processes and Separation Process Principles", 4th Edition, Prentice Hall, 2003. 2. McCabe W.L., Smith J.C. "Unit Operations in Chemical Engineering", 7th Edition, McGraw – Hill Int., 2001, 3. Richardson, J.E. et al., "Coulson & Richardson's Chemical Engineering" Vol.2 (Praticle Technology & Separation Processes") 5Th Edition, Butterworth – Heinemann / Elsevier, 2003. 			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Raw material Preparation and Thermal processing: Food process, Raw material properties, physical, functional, preparation; Cleaning; wet and dry, Peeling methods, sorting and grading, Blanching, Pasteurization, HTST, LTLT, UHT, pasteurizers, microbial inactivation, F, D, Z values	7	15%
II	Size Reduction: Size reduction of solids, principles, laws of size reduction, kicks. Bond, rittinger, equipment; roller mill, impact mill, attrition mill, tumbling mills, methods, particle size distribution, energy consumption, homogenization	7	15%
FIRST INTERNAL EXAMINATION			
III	Drying and Psychrometry: water activity, moisture content, drying rate curve, EMC,	7	15%

	isotherms, Driers;Tray, tunnel,puff, fluidized bed, spray. Rotary drier etc. Freeze dryingDrying time prediction. Dehydrated productsRehydration characteristics psychrometry, basic principles, psychrometric chart, terms, numerical solving		
IV	Refrigeration: Methods, equipment , VA, VC refrigeration systems, components; compressor, condenser, evaporator, refrigerant, COP Chilling and freezing , freezing kinetics-models, effect of low temperature on food spoilage, prediction of freezing time; Plank’s,Pham’s method, Thawing, Frozen food storage, freezer types. Refrigerated transportation; land, marine, air transportation Precooling methods	7	15%
SECOND INTERNAL EXAMINATION			
V	Baking and Frying process Baking Process, Frying process- principle, heat and mass transfer, machinery, products, frying oils, kinetics of oil uptake Extrusion, principle, extruded products Sedimentation and centrifugation; principle, basic equations, settling tank, baffled. Centrifugation, tubular, disc bowl,decanter, basket centrifuge.	7	20%
VI	Minimal processing : Ohmic heating, RF heating, Pulsed Electric field heating, High pressure processing, Food Irradiation, Ultrasound, Hurdle Technology Food filling and packaging systems, packaging materials, CAP, MAP, Vacuum.	7	20%
END SEMESTER EXAM			

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Course No.	Course Name	L-T-P - Credits	Year of Introduction
FT307	Food Analysis	3-0-0-3	2016
Course Objectives To study about food analysis techniques and instruments used for it.			
Syllabus Introduction, FSSA Sampling techniques Spectroscopy Chromotography Electrophoresis Analysis of carbohydrates			
Expected outcome . Student will be able to explain food analysis techniques, and working principles of instruments used for analysis.			
Text Book: 1. Nielsen S. S.: "Food Analysis", 2nd edition, Aspen Publishing, 1998 Water Analysis Handbook, 4th edition, HACH 2002. 2. Semib Ot/es, "Methods of Analysis of Food Components and Additives", Ege University Publishers - Taylor & Francis, London, Singapore.			
Data Book (Approved for use in the examination):			
References: 1. Leo M.L. Nollet: Handbook of Food Analysis Vols. I and /I 2. Joselyn, M.A., "Methods in Food Analysis': Academic Press, New York, 1970 3. King RD. "Developments in Food Analysis Techniques-1" Applied Science Publishers Ltd., London, 1978 4. Raghuramulu, N, Madhavan Nair, K and Kalyanasundaram, s. "A Manual of Laboratory Techniques': National Institute of Nutririon, ICMR, Hyderabad. 5. Belitz, Grosch and Schieberli Food Chemistry, 4 th edition, Springer, 2009.			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Introduction: Introduction to food analysis-significance, types of analysis, Government regulations, FSSA 2006,FSSAI,Analysis as per FSSA 2006,reporting of results, Codex Alimentarrious Commission, AOAC, Export Inspection Coucil, NABL accreditation	7	15%
II	Sampling : Types of sampling, factors considering for sampling, sampling plan, Sampling as per FSSA 2006,Proximate analysis, titrations in food analysis, Ash analysis	6	15%
FIRST INTERNAL EXAMINATION			

III	Spectroscopy: Spectroscopy principles, Beer lambet'z law, deviation from Beer Lamberz law, Construction of Calibration curve,UV Visible spectroscopy, Fluorescence spectroscopy: atomic absorption and emission, Mass Spectrometry	7	15%
IV	Chromatography principles, Column chromatography, Thin layer chromatography, Gel filtration Chromatography, Gas liquid chromatography, High performance liquid chromatography, Supercritical fluid chromatography	7	15%
SECOND INTERNAL EXAMINATION			
V	Electrophoresis : Principle, Gel electrophoresis, PAGE,SDS PAGE ,Capillary Electrophoresis, ,Isoelectric focussing1 D and 2 D electrophoresis Immunoassay: Homogeneous and Heterogeneous Immunoassay,Radio Immunoasay,Rocket Electrophoresis Protein Analysis: methods for protein analysis in foods	8	20%
VI	Analysis of Carbohydrate content, lipid analysis,Analysis of extraneous matter,Thermal Analysis, Application of Ion sensitive electrodes,Sensors and dry reagent strip in food analysis	7	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT331	Unit Operations in Food Lab	0-0-3-1	2016
<p>Course Objectives To get practical knowledge of instruments used to measure process parameters and unit operations in food process</p>			
<p>List of Exercises/Experiments : (List at least 18 experiments out of which 12 expts are mandatory. Along with each experiment indicate the name of equipment required for conducting the experiment. This is mandatory as per an order received from AICTE)</p> <ol style="list-style-type: none"> 1. Study of Power consumption in agitated vessel 2. Study of Steam distillation 3. Study of Venturimeter 4. Study of Orificemeter 5. Study of Adsorption isotherm 6. Study of Ternary liquid equilibrium 7. Study of Shell and tube heat exchanger 8. Study of Natural circulation dryer 9. Study of Fluidised bed dryer 10. Study of Rotary dryer 11. Study of Leaf filter 12. Study of Extraction 13. Study of Extraction 14. Study of Simple leaching 15. Study of Cross current leaching 16. Study of Counter current leaching 17. Study of Simple distillation 18. Study of Freeze dryer 			
<p>Expected outcome . Student will be able to get in depth knowledge of unit operations in Food Process.</p>			
<p>Text Book: 1. Richardson, J.E. et al., "Coulson & Richardson's Chemical Engineering" Vol.2 (Practical Technology & Separation Processes") 5th Edition, Butterworth – Heinemann / Elsevier, 2003.</p>			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT333	Food Analysis and Quality Evaluation Lab I	0-0-3-1	2016
<p>Course Objectives To provide knowledge of how to estimate various components in food particle.</p>			
<p>List of Exercises/Experiments :</p> <ol style="list-style-type: none"> 1. Estimation of moisture content of food 2. Determination of Ash content of food and ash analysis 3. Estimation of total Nitrogen by Kjeldhal method 4. Estimation of amino acid by Sorenson's formal titration method 5. Estimation of total carbohydrate by Phenol Sulphuric acid/Anthrone method 6. Estimation of fat by Soxhlet extraction 7. Estimation of Starch 8. Separation and analysis of pectin 9. Separation of crude fibre 10. Estimation of Iron 11. Estimation of Phosphorous 12. Estimation of Calcium 13. Estimation of Vitamin C 14. Experiments on chemical analysis of water 15. Estimation of total antioxidants: DPPH Assay 16. Estimation of beta carotene 17. Estimation of Calorific value of food: Bomb Calorimeter 18. Test for analysis of food adulteration. 			
<p>Expected outcome . Student will be able to estimate food constituents present practically.</p>			
<p>Text Book:</p> <ol style="list-style-type: none"> 1. <i>Manual of methods of Analysis of food additives, food safety and standard authority of India, 2012.</i> 2. <i>Manual of methods of Analysis of food adulteration, food safety and standard authority of India, 2012.</i> 3. <i>Food Analysis lab manual Nielsen, 2010 Springer, 2nd edition.</i> 4. <i>Hand book of analysis and quality control for fruits and vegetable products, 2nd edition, Rangana, 1986.</i> 			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT361	Modelling and Simulation in Food Processing	3-0-0-3	2016
Course Objectives To study modelling and simulation of heat and mass transfer processes in food processing.			
Syllabus Introduction to mathematical modelling and laws of modelling Modelling of heat and mass transfer process Modelling of complex shapes, food quality Examples of process models Simulation techniques Conservation equations			
Expected outcome. Student will be able to model and simulate basic heat and mass transfer operations in food process.			
Text Book: 1. Luyben W.L., "Process Modelling, Simulation, and Control for Chemical Engineering", Wiley 2. Hussain Asghar, "Chemical Process Simulation", Wiley Eastern Ltd., New Delhi,(1986)			
Data Book (Approved for use in the examination):			
References: 1. M.M. Denn, "Process Modelling", Wiley, New York, (1990) 2. C.D. Holland and A.L. Liapis, " Computer Methods for solving Dynamic Separation Problems", McGraw Hill, (1983) 3. C.D. Holland, "Fundamentals of Modelling Separation Processes ", Prentice Hall, (1975) 4. Joseph Irudayaraj, "Food processing operations modelling –Design and analysis", Marcel Decker Inc, (2002).			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Introduction: Introduction to mathematical modelling, Classification of models –Simple vs. dynamic, Transport phenomena based vs statistical; fundamental laws of modelling, model building, modelling difficulties. Population balance models and applications; Empirical models; Model parameters estimation	7	15%
II	Modelling thermal processes The principles of Modelling of heat and mass transfer; introduction diffusion equation, the Navier-stokes equations, heat and mass transfer in porous media Luikov's equation. Modelling thermal processes: cooling and freezing, introduction Modelling product heat load during cooling &	7	15%

	freezing.		
FIRST INTERNAL EXAMINATION			
III	<p>Modelling food quality</p> <p>Modelling foods with complex shapes, numerical solution of the heat conduction equation with phase change. Modelling thermal processes: heating, introduction, processing of packed and solid foods, continuous heating and cooling processes, Modelling food quality and microbiological safety.</p>	7	15%
IV	<p>Modelling batch process</p> <p>Batch process, equilibration in batch process, steady state flow process, non reacting systems, mixing flow pattern. Models in reactors (Plug Flow, CSTR, Batch etc.),</p>	7	15%
SECOND INTERNAL EXAMINATION			
V	<p>Simulation</p> <p>Introduction to flow sheet simulation; Sequential modular approach; Equation oriented approach; Partitioning and tearing; Recycle convergence methods, Simulation examples of fluid flow processes; Monte Carlo simulation. Inventory and queuing problem</p>	7	20%
VI	<p>Conservation equations</p> <p>Conservation equations for mass, momentum and energy; Comparison of various numerical techniques for CFD; Review of thermodynamic correlations for estimates of physical properties like phase equilibria, bubble and dew points etc.</p>	7	20%
END SEMESTER EXAM			

Course No.	Course Name	L-T-P - Credits	Year of Introduction
FT363	Bioprocess Engineering	3-0-0-3	2016
Course Objectives To study about industrial fermentation process, biological reaction systems and instruments used.			
Syllabus Recent developments in bioprocessing Industrial fermentation; principles and operations Biochemical and biological reaction systems Design and analysis of bioreactors Media and air sterilization and product recovery Bioprocess instrumentation			
Expected outcome. Student will have basic knowledge of bio process engineering and its application in food processing			
Text Book: 1. Shuler, M.L. and Kargi., F., "Bioprocess Engineering-Basic Concepts", 1992 2. Kumar, H. D. "A Textbook on Biotechnology" 2nd Ed., 1998 3. Prescott and Dunn., "Industrial Microbiology".			
Data Book (Approved for use in the examination):			
References: 1. Aiba, S., A.E. Humphrey and N.F.Mills., "Biochemical Engineering" 2nd Ed., 1973. 2. Baily, J.E. and Ollis. D.F., "Biochemical Engineering Fundamentals", 2nd Ed., 1986.			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Introduction Overview of the course and recent developments in bio-processing. Basic terms and explanation.	6	15%
II	Industrial Fermentations Basic principles and operations, batch and continuous growth of microorganisms, growth pattern and growth kinetics in batch and continuous system, submerged fermentation and solid state fermentation.	7	15%
FIRST INTERNAL EXAMINATION			
III	Biochemical and Biological Reaction Systems Bioenergetics, biocatalyst, enzyme kinetics, immobilized enzyme systems.	6	15%
IV	Basic Concepts in Design and Analysis of	7	15%

	<p>Bioreactors</p> <p>Ideal bioreactor (batch and continuous Stirred tank), feed-batch bioreactor, bubble column bioreactor, Immobilized biocatalysts reactor, animal and plant cell reactor, aeration and agitation systems.</p>		
SECOND INTERNAL EXAMINATION			
V	<p>Media and Air Sterilization</p> <p>Importance of sterilization, thermal death kinetics, design of sterilization equipment.</p> <p>Product Recovery Operation</p> <p>Recovery of cells and solid particles, filtration, centrifugation, sedimentation, emerging technologies, chromatography and fixed bed adsorption, membrane separation, reverse osmosis, ultra filtration, electrophoresis</p>	8	20%
VI	<p>Bioprocess Instrumentation</p> <p>Off-line analytical methods, physical and chemical sensors, On-line sensors, biosensors</p>	8	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT365	Food Product Design and Development	3-0-0-3	2016
Course Objectives 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.			
Syllabus Product development Process development, strategy, evaluation Knowledge base for product development Role of consumers Managing and improving product development process			
Expected outcome. Student will be able to prepare project report for food processing unit and execute and evaluate it.			
Text Book: 1. Clarke & Wright W. 1999. <i>Managing New Product and Process Development</i> . Free Press. 2. Earle R, Earle R & Anderson A. 2001. <i>Food Product Development</i> . Woodhead Publ			
Data Book (Approved for use in the examination):			
References: 1. Earle and Earle 2001. <i>Creating New Foods</i> . Chadwick House Group. . 2. Fuller 2004. <i>New Food Product Development - from Concept to Market Place</i> . CRC. 3. Brody, Aarn L. and John B. Lord “ <i>Developing new Food Products for a Changing Marketplace</i> ”, 2 nd Edition, CRC / Taylor & Francis, 2008.			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Concept: Concept of product development - product success and failure, factors for success, market survey process of product development, managing for product’s success. Innovation strategy -possibilities for innovation, building up strategy, product development programme.	7	15%
II	Product development process The product development process - product strategy, cost effectiveness, uniqueness, product design and process development, product commercialization, product launch and evaluation.	7	15%
FIRST INTERNAL EXAMINATION			

III	<p>Knowledge base for product development</p> <p>The knowledge base for product development technology - knowledge and the food system, knowledge management, knowledge for conversion of raw material properties, equipment needed and Design; establishing process parameters for optimum quality; Sensory Evaluation; Lab requirements; processing, packaging requirement, distribution and marketing.</p>	7	15%
IV	<p>Role of consumers</p> <p>Role of consumers in product development - consumer behaviour, food preferences, avoiding acceptance, integration of consumer needs in product development and sensory needs. ; statistical analysis; application in product development and comparison of market samples;</p>	7	15%
SECOND INTERNAL EXAMINATION			
V	<p>Managing the product development process, -</p> <p>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.</p>	7	20%
VI	<p>Improving the product development process -</p> <p>Improving the product development process - key message, evaluating product development, :Product Stability; evaluation of shelf life; changes in sensory attributes and effects of environmental conditions; innovative matrices, striving for continuous improvement, Improving success potential of new products, market exploration and acquisition, Legal aspects of new product launch.</p>	7	20%
END SEMESTER EXAM			

Course code.	Course Name	L-T-P - Credits	Year of Introduction
FT367	Nanotechnology in Food	3-0-0-3	2016

Course Objectives

- To provide basic information about nano materials for manufacturing nano particles.
- To learn about instrumentation for analyzing nanoparticles.
- To adopt nanotechnology techniques in food industries

Syllabus

Nanotechnology; definitions
Nanomaterial and manufacture
Nanoparticles
Nanotechnology for food industries
Nanotechnology based equipment

Expected outcome.

Student will get knowledge about nanotechnology and its application in food processing.

Text Book:

1. *Introduction to nanotechnology - Charles P. Poole; Frank J. Owens – 2008 – Wiley.*
2. **Nanotechnologies in Food – Qasim Chaudhary, Laurence Castle, Richard Watkins - 2010- RSC Publishing**

Data Book (Approved for use in the examination):

References:

1. *Q. Huang -Nanotechnology in the Food, Beverage and Nutraceutical Industries.* Woodhead Publishing Limited - 2010
2. *Lestie prey, “Nanotech in food products”, Wiley publications 2010.*
3. *Pandua W., “Nanotech research methods for foods and bioproducts”, Wileypublications 2012.*

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction Definition of nanotechnology, development, application of nanoscale materials, AFM, natural food nano substances and nanostructure – carbohydrate, protein, emulsion. Nanotechnology fo improving food quality, detection of contaminants	7	15%
II	Nano Ingredients and additives Nano materials for food applications- metal oxides, functionalized nanomaterials, nano additives, relation to digestion		15%

FIRST INTERNAL EXAMINATION			
III	<p>Nano technology in packaging</p> <p>Nano technology in food packaging, nano composites, nano coatings. Role in active packaging, intelligent packaging. Nano sensor. Nano membrane</p>	7	15%
IV	<p>Potential Benefits and hazards</p> <p>Industrial benefits, consumer benefits, Detection and characterization of nanoparticles in food, exposure, potential hazards.</p>	7	15%
SECOND INTERNAL EXAMINATION			
V	<p>Risks associated</p> <p>ENP, health risks- toxins, metabolism action etc. Risk governance- principle</p>	7	20%
VI	<p>Regulations</p> <p>General regulations, safety aspects in different regions, Regulation aspects of nano scale food ingredients, additives, FCMS.</p>	7	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT369	Non Thermal Processing of Food	3-0-0-3	2016

Course Objectives

To study non-thermal processes like high pressure, pulsed electric and light, ultrasonic and membrane separation process.

Syllabus

High Pressure processing
Pulsed electric field processing
Oscillating magnetic field and radiation type preservation
Ultrasonic processing
Ozone, dense phase CO₂ preservation
Other technologies; Membrane separation, image processing, packaging regulations

Expected outcome.

Student will get knowledge about non-thermal processes in food processing.

Text Book:

1. *Non Thermal Preservation of foods* by Gustavo V B, Usha R P, Enrique P, 1998, Marcel Dekker Inc.
2. *Non thermal Processing Technologies for food*, Howard Q Z, Gustavo V B, Balasubramaniam V M, et. Al, Blackwell Publishing Ltd, 2011
3. *Gould, G.W (Ed). 1996. New methods of food preservation. First Edition. Blackie Academic & Professional, London.*

Data Book (Approved for use in the examination):

References:

1. *Desrosier NW & James N. 1977. Technology of Food Preservation. 4 th Ed. AVI. Publ.*
2. *Fellows P.J. 2005. Food Processing Technology: Principle and Practice. 2 nd Ed. CRC.*
3. *Jelen P. 1985. Introduction to Food Processing. Prentice Hall.*
4. *Potter NN & Hotchkiss 1997. Food Science. 5th Ed. CBS.*
5. *Potty VH & Mulky M.J. 1993. Food Processing. Oxford & IBH.*
6. *Ramaswamy H & Marcotte M. 2006. Food Processing: Principles and Applications. Taylor & Francis.*

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	High pressure processing Emerging technologies in non thermal processing. High pressure processing: Concept, engineering aspects, biological effects, equipments for HPP treatment, mechanism of microbial inactivation and its application in food processing.	7	15%
II	Pulsed electric Equipments used in high voltage pulsed electric process –	7	15%

	construction details –design of static, continuous chambers, generation of different voltage waveforms, voltage and power consumption. Effect on micro organisms		
FIRST INTERNAL EXAMINATION			
III	Magnetic field and radiation Oscillating magnetic field in preservation, generating fields, effect on microbes Radiation preservation of foods – properties of ionizing radiation –advantage disadvantages, effecton microbes;quality of irradiated foods, Applications, Legislation	7	15%
IV	Ultrasonic processing: Properties of ultrasonic, application of ultrasonic as processing techniques. Use of Ultrasound - inactivation of microorganisms and enzymes, destructive effect, Mano-Thermo-Sonation (MTS) - effect on microorganisms and enzymes physicochemical effects of high intensity ultrasonication on food nutrients	7	15%
SECOND INTERNAL EXAMINATION			
V	Light and Ozone Light pulses for sterilization, generation of pulse, equipment U-V light treatment, pulsed X-rays in food processing Ozone in processing, sanitation. Dense Phase CO2 Processing, Chlorine Dioxide Processing	7	20%
VI	Other technologies: Solids, suspension separation. Membrane separation; Ultra Filtration, Micro filtration, Electro dialysis. Image processing; technology, applications. Chemicals and biochemical used for food preservation; Combination process(Hurdle Technology); examples	7	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT302	Dairy Technology	4-0-0-4	2016

Course Objectives

To study about unit operation in milk processing and manufacturing of dairy products and their packaging.

Syllabus

Properties, Reception, storage of Milk, CIP systems
 Pasteurization methods and pasteurizer
 Sterilization
 Homogenization
 Centrifugation and membrane separation
 Manufacture of dairy products

Expected outcome.

Student will have knowledge about milk properties and preservation

Text Book:

1. *Tufail Ahmed, "Dairy Plant Engineering and Management", CBS Publishers and Distributors, New Delhi, 2001.*
2. *Robinson R.K., "Modern Dairy Technology Vol. 1 "Advances in Milk Processing", Elsevier Applied Science Publishers, London, 1996.*

Data Book (Approved for use in the examination):

References:

3. *De Sumumar, "Outlines of Dairy Technology", Oxford University Press, New Delhi 1999.*
4. *Ananthakrishnan. C.P. and M.N. Sinha, "Technology and Engineering of Dairy Plant Operations", Laxmi Publications, New Delhi, 1997.*
5. *Farrall. A.W., "Engineering for Dairy and Food Products", John Wiley and Sons, New York, 1995.*

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	<p>PROPERTIES, RECEPTION AND STORAGE OF MILK</p> <p>Milk-Types-Composition-factors affecting composition of milk. Physical-Chemical and Thermal Properties.</p> <p>Reception and storage-cooling of milk - Different types of coolers and cooling systems</p> <p>Cleaning-basic principles-can washing - can washers-cleaning-in-centralised and decentralized CIP system - cleaning of various equipment-corrosion control.</p>	10	15%
II	<p>Pasteurization :</p> <p>Pasteurization - principles, objectives and methods.</p>	8	15%

	LTLT/holding pasteurization-types, advantages and disadvantages. HTST pasteurization-components and function of HTST pasteurizer, advantages and disadvantages - regeneration of heat.		
FIRST INTERNAL EXAMINATION			
III	Sterilization: Sterilization - In-bottle sterilization, UHT processing – vacreation - Indirect heating systems using plate heat exchanges, Direct heating – steam injection and infusion - Fouling of heat exchangers – types – ways to minimise fouling.	9	15%
IV	Homogenization : Homogenization theory, effect of homogenization of milk- Homogenizer components - valves. Pumps - functions and efficiency of process-operation and maintenance. Types of homogenizers-stages of homogenization-importance.	9	15%
SECOND INTERNAL EXAMINATION			
V	Centrifugation and membrane separation: Centrifugation-clarification-clarifiers and separators-separation efficiency-factors affecting fat percentage in cream-fat loss in skim milk. Construction of separator components-bactofuge treatment. Ultra filtration - Reverse osmosis process - Electro dialysis.	10	20%
VI	Manufacture of dairy products: Butter manufacture – methods - cheese manufacture-methods. Yogurt, paneer. Skimmed milk powder Drum dryer-spray dryer-construction, powder recovery systems agglomeration. Ice-cream manufacture-over-run-types of freezers.	8	20%
END SEMESTER EXAM			

Course No.	Course Name	L-T-P - Credits	Year of Introduction
FT304	Fat and Oil Processing Technology	3-0-0-3	2016
Course Objectives To identify different sources of fat and unit operations in oil refining and products made from oil and fats.			
Syllabus Properties of fat and oils Oil Extraction techniques Refining process Chemical adjuncts Other types of oil fats Bye-product utilization of oil and fat processing			
Expected outcome. Student will have knowledge about various oil refining process and products			
Text Book: 1. <i>Bailey's Industrial Oil & Fat Products, 4th ed. John Wiley & Sons.</i> 2. <i>The Industrial Chemistry of Fats & Waxes 3rd. by Balliere, Tindall & Cox.</i> 3. <i>Hamilton, R.J. and Bharti, A. Ed. 1980. Fats and Oils: Chemistry and Technology. Applied Science, London.</i>			
Data Book (Approved for use in the examination):			
References: 1. <i>Handling & Storage of Oiseeds, Oils, Fats & Meal by Paterson, HBW.</i> 2. <i>Modern Technology in the Oils & Fats industry by S.C. Singhal, OTA</i> 3. <i>Weiss, T.J., "Foods, Oils and Other Uses". AVI Publishing Co., 1970. ~.</i> 4. <i>Gillies, M.T. "Shortenings, Margarine and Food Oils". Noyes Data Corporation, 1974.</i>			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Properties: Sources; chemical composition; physical and chemical characteristics; functional and nutritional importance of dietary oils and fats. Physico-chemical Properties of Fats and Oils Hydrolysis, esterification and related reactions; Other reactions involving carboxyl groups; Reactions in the fatty acid chain; Oiliness and viscosity; Physical thermal and electrical properties; Smoke, fire and flash point; Solubility, miscibility, emulsions and emulsifiers: Optical properties.	8	15%
II	Extraction: Extraction of oil by mechanical expelling and solvent extraction and obtaining deoiled cakes suitable for edible purposes. Processing of other plant sources of edible oils and	5	15%

	fats like coconut, cotton seed, rice bran, maze germ, etc.		
FIRST INTERNAL EXAMINATION			
III	<p>Refining</p> <p>Degumming, refining, bleaching, hydrogenation, fractional crystallization, inter esterification, glycerolysis, molecular distillation, plasticizing and tempering Clarification, neutralization (alkali refining), bleaching, deodorization techniques / processes. Blending of oils</p>	8	15%
IV	<p>Chemical adjuncts-</p> <p>lecithins, monoglycerides and derivatives, propylene glycol esters, polyglycoesters. Hydrogenation, fractionation, winterization, inter-esterification etc. for obtaining tailor-made fats and oils. production of palm oil –rice bran oil, soybean oil</p>	7	15%
SECOND INTERNAL EXAMINATION			
V	<p>Special oils and fat</p> <p>Production of butter oil, lard, tallow, Margarine, Cocoa butter equivalents, shortenings, low fat spreads, peanut butter etc. Speciality fats and designer lipids for nutrition and dietetics, especially by biotechnology. Mayonnaise and salad dressings. Confectionery coatings. Bakery shortenings chemistry, formulation and technology. Immitation dairy products - peanut butter and vegetable ghee. Packing and storage of fats and oils, cocoa butter, fat substitutes.</p>	7	20%
VI	<p>By Products Utilization:</p> <p>Animal fats-sources-nutritive value- industrial applicationChanges during storage of oil seeds-rancidity-causes-atmospheric oxidation and enzyme action-free fatty acids-Non edible oil Food and non food uses of oilseed cakes and meals; Glycerine; Lecithin and other products. Measurement of lipid degradation parameters during deep-fat frying and storage of foods. Flavour emulsions and their stability.</p>	7	20%
END SEMESTER EXAM			

Course No.	Course Name	L-T-P - Credits	Year of Introduction
FT306	Bakery and Confectionary Technology	3-0-0-3	2016
Course Objectives To study fundamentals of equipment and raw material identification while focusing on the needs of bakers to understand measurements, scaling and basic baking techniques.			
Syllabus Introduction Baking unit operations Setting up bakery units Confectionery techniques and products manufacturing Chocolate processing			
Expected outcome. Students will develop and understanding of process technology of bakery and confectionery production.			
Text Book: 1. Matz, Samuel A., — <i>Bakery Technology and Engineering</i> , Third Edition, Chapman & Hall, London. 2. Cauvain, Stanley P, and Young, Linda S., — <i>Technology of Bread Making</i> , Second Edition Aspen publication. Maryland, 1999			
Data Book (Approved for use in the examination):			
References: 1. <i>Bakery products science and technology</i> ; Y H Hui, Blackwell Publishers 2. <i>The art of confectioner, sugar work and pastillage</i> , Ewald Notter, Wiley Publishers 3. Bernard. W. Minifie., PhD “ <i>Chocolate, Cocoa, and confectionery</i> ” (<i>Science and Technology</i>), 3 rd edition, CBS publishers and Distributors, New Delhi-110002.			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Introduction: History of bakery and confectionery-trends-Raw materials used in Bakery-Flour types-characteristics-water-salt-usage-function-yeast – production-enzymes used-function-role of sugar and milk-leavening agents-types-functions	10	15%
II	Bakery unit operations- mixing-fermentation-proofing-Baking-Bread making Technology- types of breads-bread faults-remedies-Biscuits/Cakes processing- types-ingredients-Processing of Pizza and pastry	8	15%
FIRST INTERNAL EXAMINATION			
III	Setting up of bakery units-	4	15%

	Equipments required-Quality and standards-Regulations to be followed-Packaging requirements for bakery products, Bakery unit layout		
IV	Confectionery: Types of confectioneries-classification-basic technical consideration of confectionery-TSS-PH-Acidity-Raw materials-types of sugar-role of sugar-alternative bulk sweetners –syrup production-enzymes used-Additives used	5	15%
SECOND INTERNAL EXAMINATION			
V	Confectionery products: General technical aspects of industrial sugar confectionery-composition effects-change of state-Boiled sweets-ingredients-processing-crystallized confectionery-Liquorice processing-Aerated confectionery-chewing gum-bubble gum-Tablets-Lozenges-sugar panning-granulated confectionery-medicated confectionery.	10	20%
VI	Chocolate Processing: Chocolate processing-steps-chocolate confectionery-ingredients-Quality and standards-Regulations to be followed-Packaging requirements for confectionery products	5	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT308	Fruits and Vegetable Processing	3-0-0-3	2016
Course Objectives To gain a sound knowledge about the processing and preservation technologies of fruits and vegetables.			
Syllabus Unit operations in fruit and vegetable processing Jam jelly Marmalade production techniques Fruit beverage processing Vegetable processing; Ketch up pickle, wafer etc Fermentation of fruits and vegetables Hygiene and sanitation in food processing			
Expected outcome. Students will gain knowledge about methods used for preserving fruits and vegetables; different operations involved in processing fruits and vegetables, technology behind intermediate moisture and minimally processed fruit and vegetable.			
Text Book: 1. <i>Fruit and vegetable processing-Improving quality; Jongen, Wim; Wood head publishers</i> 2. <i>Fruit and vegetable preservation-principles and practices;Srivastava R P,Sanjeev kumar;CBS Publishers</i>			
Data Book (Approved for use in the examination):			
References: 1. <i>Fruit and vegetable processing;Suman Bhatti, Uma Varma</i> 2. <i>Fruit and vegetable juice processing Technology;Tressler,Donald Kitley</i>			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Introduction: Scope of fruit and vegetable processing industry in India and world- present status-constraints-prospective-fruit and vegetables-general classification-overview of principles of preservation-Drying –dehydration-freezing-concentration-canning-chemical preservation-Hurdle technology-intermediate moisture foods-irradiation –application in fruit and vegetable industry	6	15%
II	Processing technology of fruits and vegetables: Technology of Jam, jelly, marmalade-method -flow chart-equipments-Tests for end point determination-pectin-commercial pectin manufacturing-Theories of gel formation-	7	15%

	fruit preserves-fruit cheese/butter-fruit candies-crystallized fruit-glazed fruit-fruit toffee		
FIRST INTERNAL EXAMINATION			
III	Processing technology of fruit beverages: Unit operations involved-equipments-pulper-screw type juice extractor-burning machines-rollers-Taglith press by CFTRI- Basket press-Rack and cloth press-Hydraulic press-Deaerator-Sietz Filters-flash pasteurizer-Types of beverages-Juice-RTS-Nectar-Squash-syrups-concentrates- cordials-specifications	5	15%
IV	Processing technology of vegetable products: Minimal processing of vegetables-processing and packaging of fresh cut fruits and vegetables-processing technology of vegetable wafers, vegetable soup powder-sauces and ketchups-differences –types- tomato and soy sauce-problems in sauce making- preparation of chutney-pickles-types of pickling-dry salting-brining-vinegar pickling-Sauerkraut technology-spoilage in sauerkraut.	10	15%
SECOND INTERNAL EXAMINATION			
V	Fermented products from fruits and vegetables: Technology of Vinegar fermentation—types of vinegar-methods-slow and quick process- Technology of fermented fruit wines-champagne-cider-fortified wines-sherry-vermouth-orange wine-Perry-Tokay-Port-Feni-Neera-Toddy.	10	20%
VI	Hygiene and sanitation in Fruit and vegetable processing industry- Quality evaluation –Rules and regulations related to fruit and vegetable products-FSSAI specifications for fruit and vegetable products	4	20%
END SEMESTER EXAM			

Course No.	Course Name	L-T-P - Credits	Year of Introduction
FT312	Spices and Plantation Crop Processing	3-0-0-3	2016
Course Objectives To study about processing of spices, equipments used and value addition and to enrich the knowledge about processing of plantation crops			
Syllabus Processing of tea Processing of coffee Processing of nuts and oil seeds Processing of spice and herbs Spice processing and product analysis			
Expected outcome. Student will get knowledge about the different methods of processing and value added products made from spices and plantation crops			
Text Book: <ol style="list-style-type: none"> 1. Kenji Hirasa and Mitsno Takemasa (1998) <i>Spice Science and Technology</i>, Marcel Dekker, Inc. 2. Kenneth T Farrel (1985) <i>Spices, condiments and seasonings</i>. The AVI Pub. Company 			
Data Book (Approved for use in the examination):			
References: <ol style="list-style-type: none"> 1. J.W .Purseglove, E.G Brown ,C.L Green and S.R.J Robbins (1981) <i>Vol I and II Spices</i> Longman Publications. 2. Berger, <i>Flavours and fragrances chemistry bioprocessing</i>, springer, 2007. 3. <i>Hand book of spices and condiments</i> National Institute of Industrial Research, 2010. 4. <i>Introduction to spices plantation crops and aromatic plants</i>, Kumar Rangaswami South Asian Books, 1997. 			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Processing of tea: Various types of tea, chemistry of constituents, harvesting, fermentation, tea concentrates, decaffeination process, evaluation and grading of tea	7	15%
II	Processing of coffee: types of coffee, drying, fermentation, roasting and browning processes and their importance, chicory, chemistry and technology, analysis of tea and coffee quality, standards and	7	15%

	specification for tea/coffee		
FIRST INTERNAL EXAMINATION			
III	Processing of Nuts and Oil seeds: processing of cashew nut, cocco bean ,oil palm,coconut,at, arecanut, cashew, cocoa, , oil palm, , chicory.	7	15%
IV	Spices and herbs: Introduction, Types ,spices role in food processing, properties of spices, scope of spice processing in India, Spice qualities and specifications, Antioxidant and antimicrobial qualities, medicinal values of spices, Important spices and herbs added in food products	7	15%
SECOND INTERNAL EXAMINATION			
V	Spice processing: Processing and manufacture of Indian spices and herbs, pepper, cinnamon, cardamom, nutmeg, saffron, turmeric, ginger, vanilla, cloves, oregano, tulsi, mint, thyme, lemongrass	7	20%
VI	Spice products and Analysis : condiments and spice products, spice blends and extractives, encapsulated oil, essential oil, oleoresins, salad dressings and seasonings, spice processing machinerries, analysis, packing of spices	7	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT332	Food Processing and Preservation Lab I	0-0-3-1	2016

Course Objectives

To study about various food processing operations and preservation techniques.

List of Exercises/Experiments :

1. To study the effect of different temperatures on the keeping quality of milk
2. To study the sensory and other quality parameters of the milk
3. Preparation, packaging and storage of various milk products- yoghurt, khoa, paneer, chhana, curd, rasgolla, gulabjamun, peda, milk powder
4. Determination of time required for blanching of different vegetables
5. Dehydration of vegetable / fruits using different dryers
6. Minimal processing of vegetables
7. Preparation, packaging and storage of Jam, Jelly, Marmalade, Squash, RTS, Fruit bar, candies
8. Preparation of tomato ketchup, sauce, puree, paste
9. Intermediate moisture food
10. Study of stages of sugar cookery
11. Process of inversion, melting, caramelization in sucrose
12. Processing of hard boiled candies, toffee
13. Chocolate processing
14. Processing , packaging and storage of mayonnaise, margarine, peanut butter
15. Sensory evaluation of food products by triangle test
16. Sensory evaluation of food products by Duo-trio test
17. Sensory evaluation of food products by Ranking test
18. Sensory evaluation of food products by Hedonic Test

Expected outcome .

Students will get knowledge about various food processing operations and preservation techniques.

Text Book:

1. *Laboratory Manual on Food Processing and Preservation*

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT334	Food Analysis and Quality Evaluation Lab II	0-0-3-1	2016
<p>Course Objectives To study about estimation of food constituents and food quality evaluation techniques.</p>			
<p>List of Exercises/Experiments :</p> <ol style="list-style-type: none"> 1. Determination of Water activity 2. Determination of Titratable acidity 3. Estimation of Benzoic acid in food 4. Estimation of free and total SO₂ in food 5. Characterization of oil by acid number 6. Estimation of iodine number of oil 7. Estimation of Saponification number of oil 8. Separation and analysis of fat by TLC 9. Tests for oxidation of fat: Peroxide value/TBA test 10. Estimation of salinity of brined products/salt content of processed food 11. Quality analysis of tea/coffee 12. Quality Analysis of Honey 13. Quality analysis of condensed milk/skimmed milk/dairy products 14. Quality analysis of Jam/Jellies/Squash/Fruit juices 15. Quality analysis of fish and fish products 16. Quality analysis of Alcoholic beverages 17. Quality analysis of spices 18. Sodium determination using Ion Sensitive electrode /Mohr titration 			
<p>Expected outcome . Students will get knowledge about estimation of food constituents and food quality evaluation techniques.</p>			
<p>Text Book:</p> <ol style="list-style-type: none"> 1. <i>Manual of methods of Analysis of fruit and vegetable products, food safety and standard authority of India, 2012.</i> 2. <i>Manual of methods of Analysis of milk and milk products, food safety and standard authority of India, 2012.</i> 3. <i>Manual of methods of Analysis of Beverages, food safety and standard authority of India, 2012.</i> 4. <i>Manual of methods of Analysis of Oil, food safety and standard authority of India, 2012</i> 			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT362	Fermentation and Enzyme Technology	3-0-0-3	2016
Course Objectives To study about fermentation process and enzyme technologies.			
Syllabus Classification of enzymes; mechanism of action Kinetic of enzyme action Enzyme immobilization Overview of fermentation process Industrial microbiology Fermenter functions and maintenance			
Expected outcome. Students will be able to understand the fermentation process, concept of enzyme immobilization techniques and the application of enzymes in food industries			
Text Book: 1. Bailey, J.E. and Ollis, D.F. "Biochemical Engineering Fundamentals", 2nd Edition, McGraw-Hill, 1986. 2. Blanch, H.W. and D.S. Clark "Biochemical Engineering", Marcal Dekker, Inc., 1997. 3. Lee, James M. "Biochemical Engineering", Prentice – Hall, 1992.			
Data Book (Approved for use in the examination):			
References: 1. Palmer, Trevor "Enzymes : Biochemistry, Biotechnology, Clinical Chemistry", Affiliated East-West Press Pvt. Ltd., 2004. 2. Stanbury, P.F., A. Whitaker and S.J. Hall "Principles of Fermentation Technology", 2nd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995. 3. Wiseman, Alan "Handbook of Enzyme Biotechnology", 3rd Edition, Ellis Harwood Publications, 1999. 4. Hartmeier, Winfried "Immobilized Biocatalysts : An Introduction", Springer – Verlag, 1986			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks

I	<p>INTRODUCTION TO ENZYMES</p> <p>Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis – collision theory, transition state theory</p>	7	15%
II	<p>KINETICS OF ENZYME ACTION</p> <p>Kinetics of single substrate reactions; estimation of Michelis – Menten parameters, multisubstrate reactions- mechanisms and kinetics; turnover number; types of inhibition & models –substrate, product. Allosteric regulation of enzymes, Monod changeux wyman model, ph and temperature effect on enzymes & deactivation kinetics.</p>	7	15%
FIRST INTERNAL EXAMINATION			
III	<p>ENZYME IMMOBILIZATION</p> <p>Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages.</p>	6	15%
IV	<p>OVERVIEW OF FERMENTATION PROCESSES</p> <p>Overview of fermentation industry, general requirements of fermentation processes, main parameters to be monitored and controlled in fermentation processes, microbial changes in fermented foods - micro organism - proteolytic, lipolytic and fermentative bacteria.</p>	8	15%
SECOND INTERNAL EXAMINATION			
V	<p>Industrial Importance:</p> <p>Selection of industrial importance microorganism. Media for industrial fermentation - Medium Composition - Energy, CO₂, nitrogen and other growth factors, buffering and foam agents. Types of fermentation - Ethanol fermentation - mixed alcoholic and acid fermentation - Lactic acid fermentation.</p>	7	20%
VI	<p>Fermenter:</p>	7	20%

	Basic functions of fermentor - Design of fermentor - types of fermentor - different parts - agitator, impellers, aerator, baffles, process control, function and maintenance of various parts of fermentor- fermentor accessories. Recovery and purifications of food products		
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT364	Food Additives and Flavourings	3-0-0-3	2016

Course Objectives

To study about the role, activity of chemical and natural food additives theoretically.

Syllabus

Food additives and their permissible limits

Additives used for colouring preservation, antioxidants

Additives for emulsification, stabilization

Acidulants sweeteners

Flavouring agents

Sensory valuation

Expected outcome.

Students will get knowlwdge of food additives and their permissible limits

Text Book:

1. *Food Additives, Branen, Davidson, Salmines, 2nd edition Marecl Delker Publishers, 2002*
2. *Food Chemistry by Fennema, 4th edition CRC Press, 1996*

Data Book (Approved for use in the examination):

References:

1. *Alexander, R.J. 1998. Sweeteners: Nutritive. St. Paul, MN: Eagan Press.*
2. *Cremer, M.L. 1998. Quality Food in Quantity. Management and science. Berkely C.A: McCutchan Publishing Company*
3. *Ensminger, AH., ME. Ensminger, J.E. Konlande and J.R. Robson, 1983. Foods and Nutrition Encyclopaedia 2 Vols. Clovis, C.A: Pegasus Press*
4. *Francis F.J. 1998, Colorants. St. Paul, MN: Eagan Press*
5. *Stauffer C.E. 1999. Emulsifiers. St. Paul, MN.: Eagan Press.*
6. *Thomas O.J. and WA Atwell. 1999 Starches. St. Paul, MN.: Eagan Press*
7. *Spices & Flavor Technology by Pruthi, J.s.*
8. *Flavour chemistry and technology Reinecius, 2nd edition Taylor & Francis, 2006.*

Course Plan

Module	Contents	Hours	Sem. Exam Marks
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I	<p>Introduction:</p> <p>Food Additives- definition, intentional and incidental additives, evaluation of additives, maximum permissible limit, methods for finding tolerance limits, approval of food additive, Risk assessment, levels of toxicity, acute and chronic studies, government regulations with respect to additives</p>	6	15%
II	<p>Additives used in food preservation and processing</p> <p>Additives used in food preservation and processing preservative, antioxidants, colouring agents: functions, chemistry, mode of action ,uses in food formulations</p>	7	15%
FIRST INTERNAL EXAMINATION			
III	<p>Emulsifiers, Stabilizers:</p> <p>Emulsifiers, Stabilizers, Ant caking agents, Enzymes, Gases,: Function and Applications, mode of action,chemistry,physical and chemical properties, permissible level in foods</p>	7	15%
IV	<p>Acidulants, Sweetness:</p> <p>Acidulants, Sequestrants, , Sweeteners ,Nutritive additives: Function and Applications, Safety issues, mode of action, chemistry, physical and chemical properties, permissible level in foods</p>	7	15%
SECOND INTERNAL EXAMINATION			
V	<p>Sensory instruments</p> <p>Food Flavour, its importance ,substances responsible for flavour, flavour isolation methods, essential oi,oleoresins,spray dried products, different flavour products,extracts,essences,flavour emulsions, flavour analysis(GC, Electronic Nose),scoville unit</p>	8	20%
VI	<p>Flavouring agents</p> <p>Flavouring agents used in food industry,natural,natural identical and artificial flavouring agents, process flavour, flavour enhancer/modifier, commonly used flavouring agents in food</p>	7	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT366	Food Toxicology	3-0-0-3	2016
Course Objectives To Familiarize with hazards, and toxicity associated with food and their implications for health.			
Syllabus Toxicology, factor affecting Natural Food toxicants Derived food toxicants Additives and their toxicology Determination of toxins and risk assessment Food allergens			
Expected outcome. Student will be able to identify food toxins and allergens and their effect.			
Text Book: <ol style="list-style-type: none"> 1. Concon JM.1988. <i>Food Toxicology - Principles & Concepts.</i> Marcel Dekker. 2. Steven T. 1989. <i>Food Toxicology: A Perspective on Relative Risks</i> 3. Helferich, William and Carl K.Winter “<i>Food Toxicology</i>” CRC Press, 2001 4. Shibamoto, Taka yuki and Leonard F.Bjeldanzes “<i>Introduction to Food Toxicology</i>” 2nd Edition.Academic Press, 2009. 			
Data Book (Approved for use in the examination):			
References: <ol style="list-style-type: none"> 1. Labbe, Ronald G. and Santos Garcia “<i>Guide to Food Borne Pathogens</i>” John Wiley & Sons, 2001. 2. Cliver, Dean O. and Hans P.Riemann “<i>Food Borne Diseases</i>” 2ndEdition., Academic Press/Elsevier, 2002. 3. Riemann, Hans P. and Dean O. Cliver “<i>Food Borne Infections and Intoxications</i>” 3rdEdition., Academic Press/Elsevier, 2006 			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Introduction: Definition, scope, need for understanding food toxicology.	7	15%

	Hazards- microbial, nutritional, environmental. Classification of food toxicants, factors affecting toxicity of compounds. Toxin absorption in body and effects		
II	Natural Food toxicants: Toxicants and allergens derived from plants, animals, marine algae, mushrooms etc. Microbial toxins, food poisoning , food born diseases and infestation	7	15%
FIRST INTERNAL EXAMINATION			
III	Derived food toxicants: Toxicants generated during food processing and packaging such as nitrosamines, acrylamide, benzene, dioxins, furans etc. , persistent organic pollutants, food carcinogen and mutagens	7	15%
IV	Toxicology and additives: Toxicants from intentional direct and indirect additives, preservatives, nitrite, nitrate and nitroso compounds, flavour enhancers, food colours, nutritional supplements. Chemicals from fumigation, chlorinated solvent use, heavy metals etc.	7	15%
SECOND INTERNAL EXAMINATION			
V	Determination of toxins and risk assessment: Quantitative and qualitative analysis of toxicants in foods; Biological determination of toxicants Assessment of food safety – Risk assessment and risk benefit indices of human exposure, acute toxicity, mutagen city and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioural effect, immunotoxicity.	8	20%
VI	Food allergens: Types, Chemistry of food allergens, celiac disease, food disorders associated with metabolism, lactose intolerance, and asthma	6	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT368	Biologically Active Phytochemicals in Food	3-0-0-3	2016
<p>Course Objectives</p> <p>To study about biologically active phytochemicals, antioxidant assay assessment techniques</p>			
<p>Syllabus</p> <p>Biosynthesis and significance Analysis of phytochemicals Antioxidant activity assessment Carotenoids Optimising phytochemicals</p>			
<p>Expected outcome.</p> <p>Student will get knowledge about various phytochemicals in food and antioxidant assessment.</p>			
<p>Text Book:</p> <p>1. Gilbert, John and H. Z. Senyuva "Bioactive Compounds in Food". Blackwell Publishing, 2008.</p> <p>2. Meskin, Mark S., W.R. Bidlack and R.K. Randolph. "Phytochemicals : Nutrient-Gene Interactions". CRC / Taylor & Francis, 2006.</p>			
<p>Data Book (Approved for use in the examination):</p>			
<p>References:</p> <p>1. Premier, Robert. "Phytochemicals in Food". Blackwell, 2010.</p> <p>2. Johnson, Ian and Gary Williams. "Phytochemical Functional Foods". CRC Press, 2003.</p>			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	BIOSYNTHESIS AND SIGNIFICANCE Phytochemicals in food, the plants as chemical factories, synthesis of isotopically Labeled Phytoestrogens	7	15%
II	ANALYSIS OF PHYTOCHEMICALS Qualitative and quantitative methods: phytoestrogens in plants; isoflavones; falavnols, polyphenols, tannins, saponins,	7	15%

	lignans . Multiresidue method for penicillins and cephalosporins in Bovine muscl		
FIRST INTERNAL EXAMINATION			
III	ANTIOXIDANT ACTIVITY In vitro and In vivo methods for the assessment of antioxidant activity, Comparison of different methods to evaluate the antioxidant ,	6	15%
IV	ASSESSMENT OF ANTIOXIDANT ACTIVITY Prediction of the antioxidant activity of natural phenolics from electrotopological state indices. Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources	7	15%
SECOND INTERNAL EXAMINATION			
V	CARATENOIDS Factors affecting bioavailability , chemical and characterisation of cell histochemical wall polysaccharides in almond seed in relation to lipid bioavailability.	8	20%
VI	OPTIMISING PHYTOCHEMICAL Optimising phytochemical release by process technology, Variation of Antioxidant Activity during technological treatments , new food grade peptidases from plant sources .	7	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT372	Post-Harvest Physiology and Spoilage in Food	3-0-0-3	2016
<p>Course Objectives</p> <p>To study about physiological changes occurring in fruits and vegetables after harvest and spoilage of them</p>			
<p>Syllabus</p> <p>Basic physiology, respiration, gas exchange</p> <p>Factors affecting post-harvest physiology</p> <p>Changes during handling and storage</p> <p>Factors involved with spoilage</p> <p>Quality improvement</p> <p>Storage Characteristics</p>			
<p>Expected outcome.</p> <p>Students will be able to identify the physiology changes and their reasons occurring after fruit and vegetable harvest and methods for quality improvement.</p>			
<p>Text Book:</p> <ol style="list-style-type: none"> <i>1. Post harvest physiology and pathology of vegetables, by Jerry A Bartz, Jeffrey K Brecht, 2nd edition, Marcel Dekker Inc. NY</i> <i>2. Post Harvest Technology of Horticulture crops, by Sudheer K P and Indira V, New India Publishing Agency</i> 			
<p>Data Book (Approved for use in the examination):</p>			
<p>References:</p> <ol style="list-style-type: none"> <i>1. R.H.H. Wills et.al. An introduction to the Post-harvest physiology and handling of fruits and vegetables</i> <i>2. Kadar AA.1992. Post-harvest Technology of Horticultural Crops. 2nd Ed. University of California.</i> <i>3. Lal G, Siddapa GS & Tandon GL.1986. Preservation of Fruits and Vegetables. ICAR.</i> <i>4. Pantastico B. 1975. Post Harvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables. AVI Publ.</i> <i>5. Salunkhe DK, Bolia HR & Reddy NR. 1991. Storage, Processing and Nutritional Quality of Fruits and Vegetables. Vol. I. Fruits and Vegetables. CRC.</i> <i>6. Thompson AK. 1995. Post Harvest Technology of Fruits and Vegetables. Blackwell Sci.</i> <i>7. Verma LR. & Joshi VK. 2000. Post Harvest Technology of Fruits and Vegetables. Indus Publ.</i> 			
<p>Course Plan</p>			

Module	Contents	Hours	Sem. Exam Marks
I	Introduction Basic post harvest physiology, definition, respiration and gas exchange, hormonal changes during post harvest, physical and chemical changes, transpiration, water stress	7	15%
II	Factors affecting post-harvest physiology,: Pre-harvest nutritional factors, harvesting and handling injuries, storage conditions; temperature, RH, composition and its modification, ethylene biosynthesis and action	7	15%
FIRST INTERNAL EXAMINATION			
III	Changes during handling and storage: Changes during ripening, hormones, enzymes associated, change in colour, texture, flavour during storage, role of vitamins and carbohydrates. Maturity and maturity indices, storage types, post- harvest treatments, bio regulators	7	15%
IV	Factors involved with spoilage: Biotic, abiotic factors; temperature, insects, microbes; fungi, bacteria etc. quality and safety factors,	7	15%
SECOND INTERNAL EXAMINATION			
V	Quality Improvement techniques: Improve quality; harvesting, handling techniques, coatings and treatments, insect control and microbial control, quality control measures, GAP, GMP, HACCP	7	20%
VI	Storage characteristics Storage characteristics of different fruits and vegetables, measurement of product quality methods; destructive and non-destructive tests; physical chemical, biological, visual methods	7	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P – Credits	Year of Introduction
FT401	Food Process Equipment and Design	4-0-0-4	2016
Course Objectives To study various food process equipment and their design			
Syllabus General equipment design procedure Design of storage vessels Design of evaporator, agitation vessels Design of material handling equipment Design of cold storage and freezers			
Expected outcome. Student will get knowledge and be able to design various food process equipment.			
Text Book: <ol style="list-style-type: none"> 1. Joshi, M.V and V.V.Mahajani. 2004 <i>Process Equipment Design (3 rd edition)</i>. New India Publishing Agency, New Delhi. 2. Phirke, P.S. 2004. <i>Processing and conveying equipment design</i>. Jain Brothers, New Delhi. 3. Bhattacharjee, B.C. "<i>Chemical Equipment Design</i>", 1990 			
Data Book (Approved for use in the examination):			
References: <ol style="list-style-type: none"> 1. George D.Saravacos and Athanasios E.Kostaropoulos. 2002. <i>Hand Book of Food Processing Equipment</i>. Kluwer Academic/Plenum Publishers, 233 Spring Street, New York. 2. Hall, C.W and T.J. Hedrick. 1971. <i>Drying of milk and milk products</i>. AVI Publishing Co., West Port, Connecticut. 3. Jowitt, R.(Ed.), 1980. <i>Hygienic Design and operation of food plant</i>. Ellis Horwood, Chichester. 4. Leniger and Beverloo. 1975. <i>Food process engineering</i>. Reidal Publishing Co. Holland. 5. Perry, R.H and C.H.Chilton.1998. <i>Chemical engineering handbook</i>. McGraw Hill, Tokyo. 			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Basic considerations in process equipment design, nature of equipments, general design procedure, equipment classification, properties of materials, stress analysis, hook's	8	15%

	law, materials of construction, corrosion, load, theories of failure, economic considerations. safety measures in equipment design.		
II	<p>Design of Vessels:</p> <p>Codes and regulations, Materials of construction, Design for pressures, Design pressure and temperature loadings, allowable stresses, minimum thickness after forming, corrosion mechanism, corrosion control, Design for internal and external pressure, cylindrical and spherical shell, formed heads, re-enforcement openings.</p>	10	15%
FIRST INTERNAL EXAMINATION			
III	<p>Design of food storage tank,</p> <p>horizontal and vertical silos, insulated and un-insulated, process plant piping: codes and regulations, testing, fabrication requirements, overall economic and safety considerations, heat exchangers: shell and tube heat exchangers, construction codes, general design considerations, clad tube sheet, plate type exchangers, air cooled heat exchangers, heat exchanger cost economics.</p>	10	15%
IV	<p>Design of other equipments</p> <p>Design of Evaporator; Agitation Vessels and centrifugal separator. Design of dryers – cabinet / tray dryer, fluidized bed dryer, vacuum dryer, spray dryer, heat pump dryer, foam mat dryer and freeze dryer – design considerations, installation, operation and maintenance - design considerations of food extruders – single and twin screw extruders – installation, operation and maintenance of food extruders..</p>	9	15%
SECOND INTERNAL EXAMINATION			
V	<p>Design of material handling equipment:</p> <p>Belt conveyor, bucket elevator, screw conveyor, chain conveyor, pneumatic conveyor. Air screen cleaner, rotary cleaner, graders based on size shape and surface produce handled, esign of filters</p>	10	20%
VI	<p>Design of Cold storage and freezers</p> <p>Design of cold storage – factors to be considered – estimation of cooling load – construction and operation-construction,</p>	9	20%

	installation and maintenance of cold storage -design consideration for controlled atmospheric storage and modified atmospheric storage of perishables-design of freezers – types of freezers – design considerations – construction and operation-design of frozen storage – installation and operation.		
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END SEMESTER EXAM

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT403	Bye-Product Utilization in Food Industry	3-0-0-3	2016
<p>Course Objectives</p> <p>To study about By-products obtained from various food process operation and their utilization.</p>			
<p>Syllabus</p> <p>Bye- product utilization from cereals</p> <p>Bye- product utilization from vegetable and fruits</p> <p>Bye- product utilization from fish, meat and poultry</p> <p>Food waste recycling</p>			
<p>Expected outcome.</p> <p>Student will know how to utilize bye-product obtained during food processing.</p>			
<p>Text Book:</p> <ol style="list-style-type: none"> <i>Bor S. Luli (ed), "Rice Production and Utilisation"</i> <i>Chakravarthy & De, "Agricultural Waste and By Product Utilisation"..</i> 			
<p>Data Book (Approved for use in the examination):</p>			
<p>References:</p> <ol style="list-style-type: none"> <i>Food processing waste management by green and Kramer (AVI)</i> <i>By- products from food industries: utilization and disposal by AFSI (I)</i> <i>Handbook of advanced wastewater treatment by Culp and Wisner.</i> 			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	<p>Bye-product utilization from Cereals:</p> <p>Importance of bye-product utilization. Different sources of wastes from food industries and their availability in India- nature of different waste - Waste utilisation from rice mill - Thermal and biotechnological uses of rice husk - pyrolysis and gasification of rice husk -cement preparation and different thermal applications - utilisation of rice bran - - stabilization - defatted bran utilisation.</p>	7	15%

II	<p>Fruit and vegetable Bye-products</p> <p>Processes for Waste utilization from fruit and vegetable industries- Distillation for production of alcohol - oil extraction from waste - waste management in sugar mills - citric acid production from fruit waste.</p>	8	15%
FIRST INTERNAL EXAMINATION			
III	<p>From Fish, Meat And Poultry</p> <p>Fish industry by products and waste utilisation - Fish byproducts - production of fish meal, fish protein concentrate, fish protein hydrolyzate fish liver oil and fish silage; Production of chitin, chitosan; Production of non-food items from fish processing wastes. meat and poultry waste recycling.</p>	6	15%
IV	<p>Utilization Of Wheat And Pulse Mill</p> <p>By products of wheat milling – germs and bran – by products of pulse milling –husk, germs and broken. Coconut processing – by- product utilization – fuel briquette.</p>	7	15%
SECOND INTERNAL EXAMINATION			
V	<p>From Other crops</p> <p>like tuber crops, plantation crops, plantain, jackfruit, co etc.</p>	6	20%
VI	<p>Waste water Recycling:</p> <p>Effluent safe disposal- effluent treatment plant- waste water treatment- physical and chemical methods, sludge disposal</p>	8	20%
END SEMESTER EXAM			

Course No.	Course Name	L-T-P - Credits	Year of Introduction
FT405	Meat and Poultry Processing	3-0-0-3	2016
<p>Course Objectives</p> <p>To study about treatment of the concepts involved in the production, processing and acceptance of meat and poultry. To study products derived from meat and poultry.</p>			
<p>Syllabus</p> <p>Meat composition and characteristics</p> <p>Beef, mutton processing</p> <p>Poultry and egg processing</p> <p>Chilling and freezing of meat and poultry</p> <p>Safety and sanitation in meat processing industry</p>			
<p>Expected outcome.</p> <p>Course will prepare the students for a position in the meat and poultry processing industry.</p>			
<p>Text Book:</p> <ol style="list-style-type: none"> 1. Lawrie, R.A. —<i>Meat Science , Second Edition. Pergamon Press, Oxford, UK. 1975.</i> 2. <i>G.J.Mountney Poultry Products Technology</i> 3. <i>Stadelmen, W.J. and Cotterill, O.J., —Egg Science and Technology , Second Edition, AVI, Westport, 1977.</i> 			
<p>Data Book (Approved for use in the examination):</p>			
<p>References:</p> <ol style="list-style-type: none"> 1. <i>Joseph Kerry, John Kerry and David Ledwood. —Meat Processing , Woodhead Publishing Limited, England (CRC Press), 2002.</i> 2. <i>Mead, G. —Poultry Meat Processing and Quality , Woodhead Publishing, England, 2004.</i> 			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	<p>Introduction;</p> <p>Current level of production, consumption and export of meat products. Meat composition from different sources; muscle structure and compositions; Effect of feed, breed and management on production and quality, post-mortem muscle chemistry; meat colour and flavours; meat microbiology and</p>	7	15%

	safety.		
II	<p>Beef, mutton, hog</p> <p>Beef, mutton pork as human foods. Modern abattoirs, typical layout and features, Ante-mortem handling and design of handling facilities; Hoisting rail and traveling pulley system; stunning methods; steps in slaughtering and dressing; offal handling and inspection; inedible by-products; operational factors affecting meat quality; effects of processing on meat tenderization; abattoir equipment and utilities</p>	7	15%
FIRST INTERNAL EXAMINATION			
III	<p>Chilling and freezing process</p> <p>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; radiation processing, canning of meat.</p>	7	15%
IV	<p>Poultry meat</p> <p>Poultry industry in India, measuring the yields and quality characteristics of poultry products, microbiology of poultry meat, spoilage factors; Lay-out and design of poultry processing plants, Plant sanitation; Poultry meat processing operations, equipment used – Defeathering, bleeding, scalding etc.; Packaging of poultry products, refrigerated storage of poultry meat</p>	8	15%
SECOND INTERNAL EXAMINATION			
V	<p>Egg:</p> <p>Structure, composition, nutritional and functional characteristics of eggs. Grading, spoilage, storage and transportation of whole eggs. Processing of eggs for liquid products (White, yolk and whole egg) and solid products (albumin, whole egg powder) for preservation through freezing & drying. Egg powder processing. Factor affecting egg quality and measures of egg quality. Byproduct Utilization – commercial processing of lecithin and other egg solids</p>	6	20%
VI	<p>Safety and Sanitation:</p> <p>Meat plant sanitation and safety. Regulations and procedures;</p>	7	20%

	GMP, HACCP, MFPO. Regulatory bodies. Bye-product utilization of meat and poultry processing, waste management.		
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT407	Food Quality, Safety and Regulations	3-0-0-3	2016
Course Objectives To study about Food quality, safety and regulations			
Syllabus Safety Food contaminants Quality characteristics Quality control Quality assurance, quality management systems Food standards and specifications			
Expected outcome. Student will get knowledge about safety and quality aspects in food industry and their control systems			
Text Book: <ol style="list-style-type: none"> <i>Krammer, A. and Twigg, B.A, "Quality control for the food industry". 3 rd Ed.,AVI. Westport 1970.</i> <i>Ranganna, S, "Hand book of analysis and Quality control for fruits and vegetable products". Tata Mc Graw hill. New Delhi 1986.</i> 			
Data Book (Approved for use in the examination):			
References: <ol style="list-style-type: none"> <i>Amerine MA, Pangborn RM & Rosslos EB. 1965. Principles of Sensory Evaluation of Food. Academic Press.</i> <i>Early R.1995.Guide to Quality Management Systems for Food Industries. Blackie Academic.</i> <i>Furia TE.1980. Regulatory status of Direct Food Additives. CRC Press.</i> <i>Jellinek G. 1985. Sensory Evaluation of Food - Theory and Practice. Ellis Horwood.</i> <i>Krammer A & Twigg BA.1973. Quality Control in Food Industry. Vol. I, II. AVI Publ.</i> 			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Safety Principles of food safety - Historical developments Food safety testing. , Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials.Control of	7	15%

	rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection - indicators of risk - risk analysis - risk management - causes of major failure - clothing and personal hygiene - source of contamination -test for food safety.		
II	Food Contaminants (Microbial, Chemical, Physical), Types of adulterants - test to detect adulterants in foods - Antinutritional factors in food. Undesirable constituents developing in Process and storage of food. Food Additives; antioxidants, sweeteners flavours, colours, vitamins, stabilizers - pesticidal residue (functional role, safety issues), Food Packaging & labeling. .	7	15%
FIRST INTERNAL EXAMINATION			
III	Quality Ways of describing food quality: Composition, appearance, kinethetic and flavour attributes Nutritional quality of foods and its assessment (content and quality of nutrients):. Food proteins (Digestibility, Biological value, NPU, PER), Modifications of foods constituents due to processing and storage and their nutritional implications.	7	15%
IV	Quality control – definition. Aspects of quality - Quality control tools. Quality control chart - Methods of food quality evaluation - Reference and standard methods for chemical and microbiological analysis, Comparison of newer and rapid methods A review of the methods available for authentication of meats, dairy products and culinary oils. Sensory quality and its evaluation, instrumental measurement of sensory attributes such as colourr, viscosity, texture specific gravity, Rheological and textural characteristics .Texture profile analysis. Correlation between instrumental and Sensory analysis of food quality attributes.	7	15%
SECOND INTERNAL EXAMINATION			
V	Quality assurance. Quality management systems, total quality management-Hazard analysis, critical control points (HACCP) and its developments- HACCP - History definition - preliminary task - principles - hazard analysis - record keeping - HACCP implementation and maintenance. General principle of microbial risk - assessment - hazard determination - HACCP worksheet. Critical Control Point -	7	20%

	identification of critical points in the process - Methods by which obstacles can be overcome.		
VI	<p>Food standards and Specifications:</p> <p>Compulsory and voluntary trade and Company standards. Consumer, company, In-process and finished product specifications. Relevant Food laws : PFA, FPO, SWMA, MPO, AgMark, and BIS Standards.</p> <p>The role of IUPAC, ISO, IDF, etc.- The EFSIS Standard for Companies Supplying Food Products- The British Retail Consortium (BRC) Technical Standard for Companies Supplying Retailer Branded Food Products- The British Meat Manufacturers' Association (BMMA) Standard for Meat Manufacture.</p> <p>Indian and global regulations: FAO in India,</p> <p>Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.</p>	7	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT409	Food Packaging Technology	3-0-0-3	2016
Course Objectives To acquaint the students with packaging methods, packaging materials, packaging machineries, modern packaging techniques etc.			
Syllabus Types of packaging material ; functions Paper,paper boards, plastic films Glass, Metal packaging material Packaging systems Properties of packaging materials Printing and labelling in packaging			
Expected outcome. Students will get perspective for understanding about modern food packaging materials and methods used in food industries.			
Text Book: <ol style="list-style-type: none"> Robertson, G.L. "Food Packaging : Principles and Practice". 2nd Edition. Taylor & Francis, 2006. S. Saclarow and R.C. Griffin Principles of Food Packaging 			
Data Book (Approved for use in the examination):			
References: <ol style="list-style-type: none"> Han, Jung H. "Innovations in Food Packaging". Elsevier, 2005. Ahvenainen, Raija. "Novel Food Packaging Techniques". Wood Head Publishing, 2003 M. Mahadeviah and R.V. Gowramma Food Packaging Materials Paine E.A, "Fundamentals of packaging 			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Introduction: Definitions, objectives and types of packaging materials; functions of package. Cushioning materials, packaging requirements, different packaging material and systems for fruits, vegetables, dairy, meat, fish etc.	6	15%

II	<p>Paper, plastics</p> <p>Paper as food packaging material - corrugated paper board manufacturing process, machine - plastics - properties of - different types of polyethylene, polypropylene, polyvinyl, biaxially oriented polypropylene, polyethylene terephthalate, polyester materials - co-extruded, laminated plastic films, heat sealing - adhesive tapes.</p>	7	15%
FIRST INTERNAL EXAMINATION			
III	<p>Glass, Metal</p> <p>Glass; properties, advantages and disadvantages. Use Metal- tin and aluminium, can types; manufacturing process three piece, two piece cans, double seaming, protective coatings</p>	7	15%
IV	<p>Packaging systems:</p> <p>Filling and bottling systems, aseptic packaging, tetrapak shrink packaging, stretch packaging, retorting, vacuum, CA, MA packaging systems, cook in / ship in packaging, bag in box system, microwave ovenable and retortable packages .</p>	8	15%
SECOND INTERNAL EXAMINATION			
V	<p>Properties of materials</p> <p>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, selection and design of packaging material for different foods.</p>	8	20%
VI	<p>Package printing,</p> <p>Coding and marking including bar coding. Packaging Laws and Regulations, Evaluation of food packaging materials and package performance. Environmental, ecological & Economic issues, recycling and waste disposal.</p>	6	20%
END SEMESTER EXAM			

Course code.	Course Name	L-T-P - Credits	Year of Introduction
FT431	Food Processing and Preservation Lab II	0-0-3-1	2016

Course Objectives

To study about various food processing operations and preservation techniques.

List of Exercises/Experiments :

1. Study on cooking qualities of egg
2. Egg white foam formation and factors affecting its stability
3. Egg foam products- omelettes/meringues/soufflé
4. Spray drying of egg to egg powder
5. Drying of fish
6. Processing of fish balls, meat pickle, fish pickle
7. Canning of fish
8. Preparation of different types of pickle
9. Processing and storage of saurkrat
10. Processing of wine, beer
11. Processing of tofu,tempeh,ske,souti,cider,feni
12. Vinegar processing
13. Experiments on ohmic heating, osmotic dehydration, freeze drying, reverse osmosis
14. Value addition and fortification in coconut chips
15. Value addition and fortification in cassava products
16. Value addition and fortification in sweet potato products
17. Value addition and fortification in Extruded products
18. Preparation of new product and organizing an exhibition cum sale

Expected outcome .

Students will get knowledge about various food processing operations and preservation techniques

Text Book:

1. *Laboratory Manual on Food Processing and Preservation*

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT461	Neutraceuticals and Functional Foods	3-0-0-3	2016

Course Objectives

To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.

Syllabus

Characteristics of neutraceuticals
 Neutraceuticals from plant origin
 Neutraceuticals from animal
 Probiotics and Prebiotics
 Physiochemical Characterisation
 Harmful effects

Expected outcome.

Students will get knowledge of the newly emerging area of nutraceuticals with respect to the types, mechanisms of action, manufacture of selected nutraceuticals, product development, clinical testing and toxicity aspects

Text Book:

1. *Kramer, Hoppe and Packer, "Nutraceuticals in Health and Disease Prevention", Marcel Dekker, Inc., NY 2001.*
2. *Bao and Fenwick, "Phytochemicals in Health and Disease", Marcel Decker, Inc. NY 2004.*

Data Book (Approved for use in the examination):

References:

1. *Yashwant Pathak, "Handbook of Nutraceuticals and Functional Foods. Vol. 1. (Ingredients, formulations, and applications)" CRC Press 2005.*
2. *Robert Wildman, "Handbook of Nutraceuticals and Functional Foods". 2 nd edition. CRC Press 2001.*
3. *Shi J. (Ed.). 2006. Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC Press.*

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	INTRODUCTION Introduction, definition, Modification in the definition of nutraceuticals. Classification of nutraceuticals, Nutraceuticals	6	15%

	market scenario, formulation considerations.Challenges for Nutraceuticals.		
II	Potentialnutraceutical Ingredients From Plant Origin Nutraceuticals value of spices and seasoning – Turmeric, mustard, chilli, cumin, fenugreek, garlic, ginger, onion, clove, cardamom etc.,Nutraceuticals from fruits and vegetables- mango, apple, grapes, banana, broccoli, tomato, bitter melon, bitter organge.etc.	8	15%
FIRST INTERNAL EXAMINATION			
III	-Nutraceuticalsfrom Animal And Mineral Omega -3 fatty acids from fish- Typical properties, structural formula, functional category. CLA- typical properties, structural formula, functional category. Application in Nutraceuticals. Calcium, chromium, copper, iodine, iron, magnesium, Zn- mechanism of action, bioavailability, uses and deficiency, dietary sources.	7	15%
IV	Probioticsand Prebiotics As Nutraceutical Definition, classification – Type of classification (Probiotics, probiotics and synbiotics: Health effects of probiotics including mechanism of action. Probiotics in various foods: fermented milk products, non-milk products etc. 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 following: Non-digestible carbohydrates/oligosaccharides: Dietary fibre, Resistant starch, Gums.	8	15%
SECOND INTERNAL EXAMINATION			
V	Physiochemicalcharacterization Of Nutraceuticals And Thier Antioxidant Activity Phytosterol, fatty acids, carotenoids, anthocyanins, carotenoids, amino acids, water soluble vitamins, Free radical biology and antioxidant activity of nutraceuticals.	6	20%
VI	Harmful effects: Clinical testing of nutraceuticals and health foods; interactions of prescription drugs and nutraceuticals;	7	20%

	adverse effects and toxicity of nutraceuticals; nutrigenomics – an introduction and its relation to nutraceuticals.		
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END SEMESTER EXAM

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT463	Cane Sugar Technology	3-0-0-3	2016

Course Objectives

To study technology of extracting sugarcane juice and operations involved in the production of sugar

Syllabus

Pre-processing operations

Juice Extraction

Cane juice Clarification

Evaporation

Sugar production

Crystallization

Expected outcome.

Students will get to know the technology of producing and refining sugars

Text Book:

1. Ram Behari Lal and Mathur. 1972. *Hand book of cane sugar technology*. Oxford and IBH publishing company New Delhi
2. Earle, R.L. *Unit Operations in Food Processing*. Pergamon press

Data Book (Approved for use in the examination):

References:

1. Baikow, V.E. 1967. *Manufacturing and refining of raw cane sugar*. Elsevier Publishing Company, New York
2. McCabe, W.L. and J.e. Smith 1976. *Unit operations in chemical engineering*. McGraw Hill Kogakusha Ltd., Tokyo

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Preprocessing Operations Sugarcane – Constituents – Harvesting indices – Cane cutting – Manual, Mechanical – Transportation – loading – Unloading – Cane conveyor – Washing – Shredders – Types.	6	15%
II	Juice extraction	8	15%

	Crushing – Crushers – Types, Crushing efficiency – Extraction of juice – methods, Accumulators – types – Maceration – Theory of cane diffusivity – different diffuser – ring diffuser – weighing of juice.		
FIRST INTERNAL EXAMINATION			
III	Cane juice Clarification Clarification – methods – clarifying agent – bleaching agent - Role of pH, non-sugars, colloids and gums in cane juice clarification. Liming of cane juice – CO ₂ , P ₂ O ₅ and its importance.	8	15%
IV	Filtration Process Filtration of mud – Filter types – filter press, rotary vacuum filter – Rapi – Floc process. Filter cake washing.	6	15%
SECOND INTERNAL EXAMINATION			
V	Evaporation – Evaporation rate – types of evaporators used in cane sugar industry – Cleaning of evaporators – Entrainment separator – methods – Boiling in Vacuum pan – Footing magma – Masecuite A,B,C – Mother liquor, Molasses A,B,C Molasses exhaustibility.	7	20%
VI	-Sugar Production From Cane Juice Crystallization – Super saturation – Crystallizers type – batch and continuous. Centrifuge – types. Drying of sugar – conveyors for sugar – by-product from sugar mills – utilization.	7	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT465	Beverage Processing	3-0-0-3	2016
<p>Course Objectives</p> <p>To understand various concepts, principles and procedures involved in processing of beverages and unit operations involved in their manufacturing, quality control steps in beverage preparation.</p>			
<p>Syllabus</p> <p>Basic Ingredients</p> <p>Beer and wine manufacture</p> <p>Manufacture of distilled fermented beverages</p> <p>Carbonated Beverages and Non - Carbonated Beverages</p> <p>Quality control of Beverages</p>			
<p>Expected outcome.</p> <p>Students will be imparted knowledge and skills of process techniques and equipment used for the production of beverages</p>			
<p>Text Book:</p> <ol style="list-style-type: none"> 1. Ashurst,P.R , "Chemistry and Technology of Soft Drinks and Fruit Juices", 2nd Edition, Blackwell Publishing, 2005. 2. Steen,D.P and Ashurst,P.R, "Carbonated soft drinks-Formulation and Manufacture", Blackwell Publishing, 2000. 3. Shahkunthala Manay,V and Shadakdharaswamy,M, "Food-Facts and Principles", New Age International Pvt. Ltd, 3rd Revised Edition,2000. 4. Charles,W, Bamforth, "Food, Fermentation and Microorganisms," Blackwell Science Publishing Ltd.2005 5. Inge Russel, Graham Stewart and Charlie Bamforth, "Whisky-Technology, production and marketing", Elsevier.2003. 			
<p>Data Book (Approved for use in the examination):</p>			
<p>References:</p> <ol style="list-style-type: none"> 1. Amalendu Chakraverty et al, "Handbook of post harvest technology", Ed: Marcel Dekker Inc, (Special Indian Edition), 2000. 2. Robert W Hukins, "Microbiology and Technology of fermented Foods", IFT Press, Blackwell Publishing Ltd. 2006. 			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks

I	<p>Basic Ingredients in Beverages</p> <p>Beverage definition-why we drink beverages-ingredients-water,CO₂,Bulk and Intense Sweeteners, Water Miscible and Water dispersible flavouring Agents, Colours-natural and artificial ,micro and nano emulsions of flavours and colours in beverages, Preservatives, Emulsifiers and Stabilizers</p>	6	15%
II	<p>Beer and Wine Manufacture</p> <p>Ingredients-Malt, Hops-adjuncts-water, yeast. Beer manufacturing process-malting, preparation of sweet wort, brewing, fermentation, pasteurization and packaging. Beer defects and spoilage. Wine fermentation-types-red and white. Wine defects and spoilage</p>	8	15%
FIRST INTERNAL EXAMINATION			
III	<p>Manufacture of Distilled Fermented Beverages</p> <p>Malt and Grain Whisky-types, raw materials and processing. Design-wash still operation-spirit still operation-continuous distillation-design and operation of grain whisky stills-maturation and blending- co products. Whiskies of the world and their regulations.</p>	7	15%
IV	<p>Carbonated Beverages</p> <p>Procedures- Carbonation equipment-ingredients, preparation of syrups-filling systems-packaging-containers and closures.</p>	7	15%
SECOND INTERNAL EXAMINATION			
V	<p>Non Carbonated Beverages</p> <p>Coffee bean preparation-processing-brewing-decaffeination-Instant Coffee-Tea-types-Black, Green and oolong. Dairy based beverages</p> <p>Fruit juices, Nectar, Squash, RTS beverages and Isotonic Beverages. Flash Pasteurization, Canning and Aseptic packaging of beverages</p>	7	20%
VI	<p>Quality Control</p> <p>Packaged drinking water- definition, types, manufacturing processes, Effective application of quality controls-Sanitation and hygiene in beverage Industry-quality of water used in beverages-threshold limits of various ingredients –Food safety</p>	7	20%

	regulations-Requirements of Soluble Solids and Titrable Acidity in Beverages		
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT467	Fish Preservation and Processing Technology	3-0-0-3	2016
Course Objectives To study about unit operation in fish preservation techniques and products.			
Syllabus Types of fish, characteristics Care in Handling and Transportation Chilling and freezing Cured and smoked fish Drying of fish Other fish processed products			
Expected outcome. Students get knowledge to work in fish processing industry.			
Text Book: <ol style="list-style-type: none"> Govindan, T.K. "Fish Processing Technology". Oxford and IBH, 1985. Wheaton, F.W. and Lawson, T.R "Processing of Aquatic Food Products". John Wiley and Sons, 1985. Hall, G.M. "Fish Processing Technology". London Blackie Academic and Professional Publication, 1992. 			
Data Book (Approved for use in the examination):			
References: <ol style="list-style-type: none"> Gerasimov, G.V. and Antonova, MT. "Techno-Chemical Control of fish Processing Industry". Amerind Publishing Co. Pvt. Ltd., 1979. Borgess, G.H.O., Cutting, C.L., Lovern, J.A. and Waterman, U. "Fish Handling and Processing". Chemical Publishing Co., 1967. Fish & Fisheries of India; Jhingram VG; 1983, Hindustan Pub Corp Fish as Food, Vol. I-IV; George Borgstrom, Academic Press Fish Processing Technology , Rogestein & Rogestein 			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Introduction: Types of fish, Types of fish, Fishing resources - Inland, marine, Brackish water fisheries, harvesting methods crafts -	7	15%

	gears composition, structure, and spoilage factors of fish. Post-mortem changes in fish. Consumption, production, export scenario, roles of MPEDA, CMFRI		
II	Handling and transportation Care in Handling and transportation of fish at sea; Handling and transportation on land; Ship board refrigeration equipments; Cold chain. design of refrigerated and insulated trucks;	7	15%
FIRST INTERNAL EXAMINATION			
III	Chilling and freezing Products of chilled fish; Freezing of fish; Use of additives for freezing; IQF method; Packaging, storage and distribution of frozen fish; Thawing and drip losses; Freezing of tropical fish; Quality of frozen fish.	7	15%
IV	Cured and Smoked Fish Salt curing of fish; Storage of salted fish; Quality of finished products; Production of cold smoke fish; Hot smoked fish and light salted and light smoked fish; smoked fish using curing liquid.	7	15%
SECOND INTERNAL EXAMINATION			
V	Drying of Fish ; Sun drying offish; Dehydration offish; Production of Balyk preparations; Freeze drying. Thermal Processing of Fish; Types of canned fish; Canning offish; Spoilage of canned fish products and quality control. Irradiation of Fish	7	20%
VI	Other Fish Products; Marinated and spiced fish; Caviar; Fish preserves; Fried fish; Soups; Baked fish; Jellied preparations from fishes. By Products; production of fish meal, fish protein concentrate, fish protein hydrolyzate fish liver oil and fish silage; Production of chitin, chitosan; Production of non-food items from fish processing wastes	7	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT469	Snack Food Technology	3-0-0-3	2016
Course Objectives To provide knowledge of principles and characteristics of snack foods processing technology.			
Syllabus Snack food industry Flour based snack foods Fruit and vegetable snack foods Equipments for snack food preparation Evaluation of snackfood quality			
Expected outcome. Student will know process and techniques of snack food technology processing and quakity evaluation.			
Text Book: 1. <i>Edmund WL. Snack Foods Processing. AVI Publ</i> 2. <i>Gordon BR.1997 Snack Food.AVI Publ</i>			
Data Book (Approved for use in the examination):			
References: 1. <i>Frame ND .1994.The Technology of Extrusion Cooking. Blackie Academic</i> 2. <i>Samuel AM.1976. Snack Food Technology. AVI Publ</i>			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Introduction Overview, snack industry, Technology for grain-based snacks: whole grains – roasted, toasted, puffed, popped and flakes, coated grains-salted, spiced and sweetened, Snackfood industry, major players	7	15%
II	Flour based – batter and dough based products; savoury and farsans; formulated chips and wafers, papads, instant premixes of	7	15%

	traditional Indian snack foods. Popcorn,tortillas		
FIRST INTERNAL EXAMINATION			
III	Fruit and vegetable based Technology for fruit and vegetable based snacks: Chips, wafers; Technology for coated nuts – salted, spiced and sweetened; chikkis . potato chips, cassava chips	7	15%
IV	Extruded snack foods: Formulation and processing technology, colouring, flavouring and packaging	7	15%
SECOND INTERNAL EXAMINATION			
V	Equipments Equipments for frying, Baking and drying, toasting, roasting and flaking, popping, blending, Coating, chipping, Ovens	7	20%
VI	Evaluation: Sensory evaluation, snack foods filling and packaging, evaluation methods and quality controls	7	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT402	Food Plant Layout and Design	3-0-0-3	2016
<p>Course Objectives</p> <p>To educate the students regarding selection parameters for the location of food processing industry and design layout.</p>			
<p>Syllabus</p> <p>Manufacturing process, Selection of Plant Location Development of layout Baking plant types Dairy plant layout Evaporation plant layout</p>			
<p>Expected outcome.</p> <p>Students will get knowledge about food plant layouts and design of layouts.</p>			
<p>Text Book:</p> <p>1. James M Moore, "Plant Layout and Design", Mcmillan & Co.,</p>			
<p>Data Book (Approved for use in the examination):</p>			
<p>References:</p> <p>1. J M Apple, " Plant layout and Material Handling", John Willey & Sons, 2. Slade, F.H, "Food processing plant". Leonardhill Books, London 1967 3. Hall, H.S and Y. Rosen, "Milk plant layout" (F.A.O. Publication) 1976</p>			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	<p>Introduction:</p> <p>Basic concepts of plant layout and design with special reference to food process industries. -Manufacturing processes-concept -types Application of HACCP concept, ISO, FPO & MPO requirements in food plant layout and design.</p>	6	15%
II	<p>Selection Of Plant Location</p> <p>Plant location, location theory and models, Plant location factors-plant site selection-estimation of series- peak and</p>	8	15%

	critical load-Economic plant size-plant layout objectives-classical and practical layout. Characteristics of an efficient layout		
FIRST INTERNAL EXAMINATION			
III	<p>Development of The Layout</p> <p>Development and presentation of the layout, selection of site and Location of plant, General points of considerations for designing food plant, floor plant types of layouts Food building planning, Basic understanding of equipment layout and ventilation in food process plants. Preparation of flow sheets for material movement and utility consumption in food plants</p>	7	15%
IV	<p>Baking oven and frying plant-types,</p> <p>Baking oven and frying plant-types, concepts and layout. Plant layout and design of fruits and vegetables processing industries including beverages. Filling closing and labeling plant layout. Organization and trends in plant layout - sample layout, installation procedure for food processing plant</p>	7	15%
SECOND INTERNAL EXAMINATION			
V	<p>Dairy Plant Layout</p> <p>Plant layout and design of milk and milk products. Miscellaneous aspects of plant layout and design like provision for waste disposal, safety arrangements etc.</p>	7	20%
VI	<p>Evaporation plant layout-</p> <p>single, multiple, vacuum and film evaporators-types and concepts, drying plant layout, drying process, drier types, selection of driers.</p>	7	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT404	Food Laws and Legislation	3-0-0-3	2016
Course Objectives To study about basic food standards, laws and legislative bodies			
Syllabus Food safety standards and rules Food hazards and contamination Safety regulations Food Acts Risk assessment Food standardization			
Expected outcome. Student will know about safety regulations and food acts for food standardization.			
Text Book: <ol style="list-style-type: none"> 1. Singal RS (1997). <i>Handbook of indices of food quality and authenticity</i>. Woodhead Publ. Cambridge, UK. 2. Shapton DA (1994). <i>Principles and practices of safe processing of foods</i>. Butterworth Publication, London. Winton AL (1999) <i>Techniques of food analysis</i>, Allied Science Publications New Delhi. 3. Pomeranze Y (2004). <i>Food analysis - Theory and Practice</i> CBS Publications, New Delhi. 4. Jacob MB (1999). <i>The chemical analysis of foods and food products</i>. CBS Publ. New Delhi 5. Rees, Naomi and David Watson —<i>International Standards for Food Safety</i>, Aspen Publication, 2000. 6. Schmidt, Ronald H. and Rodrick, G.E. —<i>Food Safety Handbooks</i>, Wiley Interscience, UK, 2005. 			
Data Book (Approved for use in the examination):			
References: <ol style="list-style-type: none"> 1. Mehta, Rajesh and J. George —<i>Food Safety Regulations, Concerns and Trade : The Developing Country Perspective</i>^, Macmillan, 2005. 2. <i>The Prevention of Food Adulteration Act, 1954D</i>, Commercial Law Publishers India) Pvt. Ltd. 			

Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	<p>Introduction:</p> <p>Introduction, concept of food safety and standards, food safety strategies. Establishment of US Pure Food Law in early 1900s and of Food & Drug Administration to enforce safety of food products Prevention of Food Adulteration Act 1954 & Rules 1955 established in India to enforce safety and purity of food products; Various aspects of defining adulteration, taking samples of food for analysis by public analyst, prosecution for adulteration and punishment; Standards of various food products; FPO; Infant Milk Substitute Act; Laws relating to vegetable oils; Use of permitted additives like colours, preservatives, emulsifiers, stabilisers, antioxidants etc.</p>	7	15%
II	<p>Food hazards and contaminations</p> <p>Food hazards and contaminations - biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution / chemicals) and physical factors. Preventive food safety systems - monitoring of safety, wholesomeness and nutritional quality of food. Prevention and control of microbiological and chemical hazards. Food safety aspects of novel methods of food processing such as PEF, high pressure processing, thermal and non thermal processing, irradiation of foods</p>	7	15%
FIRST INTERNAL EXAMINATION			
III	<p>Food Safety Regulation</p> <p>Indian and Food Regulatory Regime (Existing and new), PFA Act and Rules, Food Safety and Standards Act, 2006, Essential Commodities Act, 1955, Global Scenario, Codex Alimentarius, WHO/FAO Expert Bodies (JECFA/JEMRA/JMPR) WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR). Food safety inspection services (FSIS) and their utilization.</p>	7	15%
IV	<p>Food Acts:</p> <p>Introduction to OIE & IPPC, Other International Food</p>	7	15%

	Standards (e.g. European Commission, USFDA etc). WTO: Introduction to WTO Agreements: SPS and TBT Agreement, Export & Import Laws and Regulations, Export (Quality Control and Inspection) Act, 1963. Customs Act and Import Control Regulations, Other Voluntary and mandatory product specific regulations, Other Voluntary National Food Standards: BIS Other product specific standards; AGMARK. Nutritional Labeling, Health claims.		
SECOND INTERNAL EXAMINATION			
V	Risk Assessment: Risk assessment studies: Risk management, risk characterization and communication. Voluntary Quality Standards and Certification GMP, GHP, HACCP, GAP, Good Animal Husbandry Practices, Good Aquaculture Practices	6	20%
VI	Food Standardization: Trends in Food Standardization, An Overview and structure of 9001:2000/2008, ISO 9001:2000, An overview and Structure of 22000:2005, ISO 9000, ISO 22000, ISO 14000, ISO 17025, PAS 22000, FSSC 22000, BRC, BRC IOP, IFS, SQF 1000, SQF 2000. Role of NABL .	7	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT462	Food Plant Utilities, Maintenance, Safety and Sanitation	3-0-0-3	2016
Course Objectives To study about food plant utilities, maintenance, safety and sanitation.			
Syllabus Food plant utilities Steam Generation Food Safety Quality control Sanitization Waste management			
Expected outcome. Students will get knowledge of food plant utilitie, steam generation techniques, safety and quality control in industry.			
Text Book: 1. Ballaney, P.L. "Thermal Engineering". Khanna publishers, New Delhi, 1995. 2. Belan, F.I. "Water Treatment". Meer publishers. Moscow.			
Data Book (Approved for use in the examination):			
References: 1. Finley, J., Robinson, S. and Armstrong, D. (Eds.). 1992. Food Safety Assessment. American Chemical Society, Washington D.C. 2. Jones, J. 1992. Food Safety. Eagen Press, St. Paul Minnesota 3. Bhatnagar, D. and Cleveland, T. (Eds.). 1992. Molecular Approaches to Improving Food 4. Quality and Safety. Van Nostrand Reinhold, New York			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Introduction: Foot plant utilities and their importance; Estimation of utilities	7	15%

	and utility load diagram; Plant maintenance program, role of maintenance staff and plant operators Preventive maintenance, Guidelines for good maintenance and safety precautions, Importance of food plant sanitation; Sanitation standards and their implementation.		
II	Steam Generation: Properties of steam and steam generation process: steam generation equipment (boiler); Boiler type and their characteristics: Boiler accessories; Selection of boiler for food processing operations; Performance of boilers and its evaluation; Energy conservation in boiler operation; Treatment of boiler feed water.	7	15%
FIRST INTERNAL EXAMINATION			
III	Food Safety Principles of food safety, indicators of risk analysis, risk management, clothing and personal hygiene , hygienic and sanitation requirement in different food processing units, pest control in food processing ,storage and service area source of contamination -test for food safety.	7	15%
IV	Quality Control Indian factories act on safety, HACCP, GMP, GHP, GAP, Personal protective equipment, accident investigation report, safety promotion activity, environmental pollution and its control Introduction to quality control - definition. Aspects of quality - Quality control tools. Quality control chart - Quality factors in food - Nutritional labeling - Specification	7	15%
SECOND INTERNAL EXAMINATION			
V	Sanitization: Sanitary design of food process equipment, for cleaning, packaging sanitation, food storage sanitation, transport sanitation and water sanitation.The need for cleaning; Frequency of cleaning: Methods of cleaning and cleaning equipment: Standards for clean surfaces; Sanitizing agents and agents and sanitization processes.	7	20%
VI	Waste management:	7	20%

	Characterization of food industry wastes e.g., BOD, COD and total organic content, floatable and suspended solids in water, pretreatment, secondary treatments of solid waste, sludge volume index, advanced techniques activated bio-filtration, Flow process chart of food plant Waste utilization processes, various treatment for waste disposal analysis of cleaners & sanitizers, CIP Cleaning.		
END SEMESTER EXAM			

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT464	Entrepreneurship Development for Food Technology	3-0-0-3	2016
Course Objectives			
To understand entrepreneurship development for food technology students			
Syllabus			
Introduction			
Entrepreneur flair			
Marketing principles			
Analysis			
Monitoring decisionmaking			
Reports			
Expected outcome.			
Students will be encouraged to become entrepreneur in food processing sector			
Text Book:			
1. <i>Entrepreneurial Development by Sarwate (Everest Publication)</i>			
Data Book (Approved for use in the examination):			
References:			
1. <i>Philip Kotler, 1985, Marketing management, Prentice Hall of India</i>			
2. <i>Brigham, Eugene, F. 1989. Fundamentals of financial management, The Dryden press</i>			
3. <i>Sherilaker. 1985. Marketing management, Himalaya Publishing Company.</i>			
3. <i>Mehtha., P.L. Managerial Economics- Analysis, problems and cases, Sultan Chand and Sons, New Delhi</i>			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Introduction: Indian Economy and contribution of various sub-sectors in the economy. Structural base of Indian economic Life. Contribution of MSME sectors in the national economy. Impact of globalizanon and liberalization on MSME	6	15%

	sectors. Agricultural sector and food processing industry problems and opportunity.		
II	Entrepreneur & entrepreneurial flair; Classification of small, medium and large scale manufacturing industries; Opportunities of food processing industries in Kerala compared to other states Agencies for promotion of food processing industries; Source of machine and equipment. Entrepreneurship Development Training and Other Support Organisational Services - Central and State Government Industrial Policies and Regulations -	8	15%
FIRST INTERNAL EXAMINATION			
III	Marketing Principles: Fundamentals of marketing principles and marketing mix, Sales and distribution management, Costing and cost management, pricing methods, fundamentals of operations and supply chain management, organization structure and human resource management , Trade license and registration marks; capital structure and methods of raising fund; Selection of land and factory sheds.	8	15%
IV	Analysis: Opportunity identification and feasibility studies, financial analysis, technical entrepreneurship .Project sizing , fund management and enterprise management issues.	6	15%
SECOND INTERNAL EXAMINATION			
V	Monitoring and decision making: Problem solving, decision making processes and tools, conflict and change management in a new industrial enterprise, Systems approach and consideration in an entrepreneurial venture. Management reporting and information system for monitoring and control of the new enterprise, managing Innovation. Marketing challenges and approaches for new products and services sustaining in a competitive environment	8	20%
VI	Reports: Preparation of project report; Market feasibility reports; Techno-economic feasibility report on an identified	6	20%

	opportunity-any food processing; bakery and confectionary etc.		
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END SEMESTER EXAM

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT466	Automation in Food Processing	3-0-0-3	2016
Course Objectives To study automation technique and parameters in food processing			
Syllabus Process control Automation and robotics Data acquisition Modelling systems Automation in fruit, vegetable process			
Expected outcome. Student will be able to automate many unit operation in food process			
Text Book: <ol style="list-style-type: none"> 1. <i>Robotics and Automation in the Food Industry</i> by D Caldwell, Elsevier Science, Woodhead Publishing 2. <i>Eackman DP. 1972. Automatic Process Control. Wiley Eastern.</i> 			
Data Book (Approved for use in the examination):			
References: <ol style="list-style-type: none"> 1. <i>George Stephanopolous, "Chemical Process Control", Prentice Hall of India, 1990</i> 2. <i>Luyben, W. L, Process Modeling, Simulation and Control for Chemical Engineers, McGraw hill, 1973.</i> 3. <i>Considine DM. 1974. Process Instruments and Controls. Mc-Graw-Hill</i> 4. <i>Thermal Processing of Foods: Control and Automation</i> by K. P. Sandeep March 2011, Wiley-Blackwell 5. <i>Gouri S Mittal, "Computerized control system in the food industry", Marcel Decker Inc. 1997.</i> 			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Process control: Introduction to process control, identification, variables,	7	15%

	strategies, laws Block and physical diagram of control systems, open and closed loop, feedback and forward controls pneumatic and lectronic controllers. Measuring element controller and final control elements; P, PI, PID controls. Mode of control actions. PLC system; ladder diagram		
II	Automation and robotics: Automatic process control in food industry. Process control methods in food industry, current, future trends. Robotics in food industry, specification of food sector robot.	7	15%
FIRST INTERNAL EXAMINATION			
III	Data acquisition: Instrumentation in food processing, sensors for automation, measurement methods, applications, machine vision, optical sensors and spectroscopic techniques. SCADA; standards, application and implementation	7	15%
IV	Modelling systems: Modelling strategy, ANN, null hypothesis, Intelligent control system using fuzzy logic, design of PID controller, real time optimization	7	15%
SECOND INTERNAL EXAMINATION			
V	Automation in fruit, vegetables process Automation in sorting, thermal processing, fresh produce: Automation in bulk sorting; principles, requirements. Automation in food chilling and freezing; in storage, transport, retail systems Automation in fruit vegetable processing; cleaning, grading, canning etc.	7	20%
VI	Automation in meat and poultry process Automation in packaging and meat, poultry, fish processing: Automation in meat processing, carcass production, separation; before and after chilling Automation in poultry industry; hanging, conveying, processing, packing Automation in sea food processing, in unit operations associated.	7	20%

	Automation in packaging of food products.		
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END SEMESTER EXAM

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT468	Food Informatics	3-0-0-3	2016
Course Objectives To study information acquiring through instrumentation analysis in food.			
Syllabus Data measurement system, devices Instrument systems Chromotography and spectrometry Electromagnetic spectrum Other analytical equipment Role of computer			
Expected outcome. Students will get knowledge about food informatics and instrumental method of acquiring.			
Text Book: <ol style="list-style-type: none"> Sharma, B.K, "Instrumental Methods of Chemical Analysis". Goel Publishing House, New Delhi 2004. Eckman, D.P., Industrial Instrumentation, Wiley Eastern Ltd., New York 1990. Jain, R.K., Mechanical and Industrial Measurements, Khanna Publishers. 			
Data Book (Approved for use in the examination):			
References: <ol style="list-style-type: none"> Doebelin, D.O. "Measurement Systems; Application and Design". McGraw Hill, 1984. Fribance, A.E. "Industrial Instrumentation Fundamentals", McGraw Hill, 1962 Patranabis. D. "Principles of Industrial Instrumentation", Tata McGraw Hill, 1995 Liptak, V.G. "Instrumentation in the Processing Industry", Chilton Book Company, 1973. Nielsen, S.S, "Introduction to the chemical analysis of foods". Jones and Bartlett Publishers, Boston, London 2004. Instrumentation, Measurement and Analysis; Nakra BC & Chaudhury KK; TM 			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Introduction Informatics; definition, Basic concepts of measurement system configuration. Concept of accuracy precision error, resolution	7	15%

	repeatability bias, calibration, range. Error analysis, Instrument types; Indicating and recording type instruments, digital displays, transmitting and telemetering devices. , static and dynamic characteristics		
II	<p>Basic instrument systems</p> <p>Zero, first and second order instrument systems and their response to different input signals (step, ramp etc) Specification and testing of dynamic response. Different types of measuring instruments, their working principles, construction features, measurement of level, flow, temperature, pressure, vacuum, force, torque, power, displacement, vibration, acceleration, pH, colour, viscosity, surface tension and composition.</p>	7	15%
FIRST INTERNAL EXAMINATION			
III	<p>Chromatography and spectrometry</p> <p>Paper chromatography, thin layer chromatography, HPLC (High performance liquid chromatography), Gaschromatography -Application in food analysis. Spectrophotometry- Atomic absorption spectroscopy - Introduction to AAS – Components of an AA spectrometer – Overview, Light sources, Nebuliser / Atomiser assemblies, Nebulisers, flames, optics, detectors, support gases, AAS measurements- Application in food analysis.</p>	7	15%
IV	<p>Electromagnetic spectrum –</p> <p>The NMR Phenomenon – Types of information provided by NMR spectra – Instrumental and Experimental Considerations – Solid state NMR –application of NMR to Food analysis. – Application of GC/MS, LC/MS / FAB/MS / MS/MS and Linked scan techniques.</p>	7	15%
SECOND INTERNAL EXAMINATION			
V	<p>Other analytical equipments</p> <p>FTIR, XRF, Differential Scanning Calorimeter, XRD, SEM, TEM, water activity meter, textural analyser, e – sensors, biosensors, Nitrogen analyzers -instrumentation, operating procedure and application in analysis of foods.</p>	7	20%

VI	Role of Computer Role of Computer in Data Optimization: Developing predictive model between independent and dependent parameters by using Artificial neural network – Neural network architecture, weights and bias values of neurons, least square method for NN parameters optimization matrix representation and computation of the values of NN parameters.	7	20%
END SEMESTER EXAM			

Course code.	Course Name	L-T-P - Credits	Year of Introduction
FT472	Extension and Transfer of Technology In Food Processing	3-0-0-3	2016
Course Objectives To study extension and technology transferring techniques in respect to food processing.			
Syllabus Introduction Strategy Positioning Prototype Evaluation of technology Role of institutions			
Expected outcome. Students will be able to know the principles of technology transfer and intellectual property legislations			
Text Book: <ol style="list-style-type: none"> <i>The Art and Science of Technology Transfer by Phillis L Speser, John Wiley & Sons (19 May 2006)</i> <i>Watton, Harry B. "New Product Planning", Prentice Hall Inc. 1992</i> 			
Data Book (Approved for use in the examination):			
References: <ol style="list-style-type: none"> <i>Sherilaker, "Marketing management". Himalaya Publishing Company 1985.</i> <i>Metha, P.L, "Managerial Economics"- Analysis, Problems and cases, Sultan Chand and Sons, New Delhi 1999.</i> <i>The Technology Transfer Law Handbook by Elizabeth R and Sean S, American Bar Association (August 7, 2015)</i> <i>Models and Methods of University Technology Transfer (Foundations and Trends(r) in Entrepreneurship) 5th ed. Edition by Samantha R B, Christopher S H, Albert N L, Now Publishers Inc; 5th ed. edition (April 26, 2013)</i> 			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Introduction:	7	15%

	Study of human behaviour, current technologies and practices, product process service, study of market, channel, supply chain, stakeholders. Market size barriers, share. Functionality of technology to be transferred. Competing technology present.		
II	Strategy: Strategy- nash equilibrium. Social, environmental, legal obligation for technology, Intellectual properties, patenting process, trademarks, copyrights etc.	7	15%
FIRST INTERNAL EXAMINATION			
III	Positioning: Positioning the technology for end user, test hypothesis, launching tactics, pick the position, determine strength weakness, opportunities and threats	7	15%
IV	Proto type Design of proto type, testing – quality standards Finding the target, market alignment, technology alignment, risk analysis, revenue expense valuation.	7	15%
SECOND INTERNAL EXAMINATION			
V	Evaluation of technology Inventory management, EOQ, EBQ, ABC and VED analysis, CPM and PERT network analysis	7	20%
VI	Role of institutions in technology transfer Research, science and technology parks; role in technology transfer. Role of government and non-government bodies in TOT. Major transfer of technologies in food industry (like tetrapak) Suggestion for a problem in nearby food processing industry	7	20%
END SEMESTER EXAM			