Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Food Technology

(Applicable from the academic session 2018-2019)

Name of the Course: Food Process Technology – I (Cereals, pulses, fruits, vegetables, spices, tea, coffee & beverages)	
Course Code: PC – FT 501	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.: 15 Marks
Tutorial: 1 hr./ week	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points: 4	End Semester Exam: 70 Marks

Objective:	
1	To understand and identify the specific processing technologies used for different foods and the various products derived from these materials.
2	To understand the application of scientific principles in the processing technologies specific to the materials.
Pre-Requisite:	
1	Elementary chemistry
2	Elementary physics
3	Plant biology

Details of Syllabus:

Unit	**Content**	**Hrs/ Unit**	**Marks / Unit**
1	Structure and chemical composition of cereals, pulses and anti-nutritional facts wherever applicable.	3	
2	Storage of cereals, Infestation control; Drying of grains	4	
3	Processing of rice and rice products: Conventional milling, modern milling Milling operations, milling machines, milling efficiency. Quality characteristics influencing final milled product. Parboiling	5	
4	Milling of wheat, corn, barley, oat	2	
5	Production of wheat products, including flour and semolina. Puffed cereals from broken rice	3	
6	Functionality of wheat flour components and bakery ingredients, Quality testing of wheat flour and bakery products, Processing and quality testing bread, Biscuits, cakes. Production and extraction of starch: modified starch, resistant starch	5	
7	Storage and handling of fresh fruits and vegetables	2	
8	Equipments, cleaning methods, sorting, grading, peeling and blanching of fruits and vegetables before processing, methods of precooling, minimal processing of fruits and vegetables.	2	
9	Potato processing (potato chips, flakes, powder) and storage	4	

10	Production of fruits and vegetable juices, Preparation of jam, jelly, marmalade, and tomato products (sauce and ketchup), candied peel. Criterion of selection for fruit and vegetables freezing, Various methods of freezing, frozen fruits, changes during freezing. Dehydration of vegetables, fruits, juice powder, soup powder, nuggets, flakes, raisins preparation, Osmo dehydrated products. FPO Standards, By product utilization, Standards for processed products.	12	
11	Proximate composition of tea, coffee & cocoa; different grades of tea and coffee; tea & coffee processing, different tea & coffee products	3	
12	Non-alcoholic non carbonated beverages, preparation of health drinks.	2	
13	Importance of spices, classification of spices, Technology of spices powder production Different types of condiment and herb products, preservation and packaging of spice powder.	3	

Text and Reference Books:

TEXT
1. Food Science by Potter
2. Fruit and Vegetable Preservation by Srivastava and Sanjeev Kumar
3. Principles of Food Science, Vol-I by Fennma Karrel
4. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

REFERENCE
1. Post Harvest Technology of cereal pulse and oil seeds by Chakraborty, AC
2. Food Science by Mudambi

Course Outcome:

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

CO1: Understand the concept of processing and products manufactured from various cereal grains.
CO2: Understand the concepts of physiological characteristics of fruits and vegetables.
CO3: Have better insight about fruit losses during storage and ways to prevent it.
CO4: Understand the characteristics and processing of various raw materials used for beverage manufacturing.
CO5: Understand the role of spices in the diet.
CO6: Understandings of the application of scientific principles in the processing technologies specific to the materials.

Special Remarks (If any): Nil

Name of the Course: Food Process Technology – II (Fish, Meat, Poultry)	
Course Code: PC-FT 502	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.: 15 Marks
Tutorial: Nil	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points:3	End Semester Exam: 70 Marks

Objective:	
1	To develop the knowledge of students about the composition of seafood, meat and eggs
2	To enable the students to understand handling, processing and storage of seafood, meat, eggs and related products
3	To enable the students to explain the potential of by-products arising from seafood, meat, eggs' industry
Pre-Requisite:	
1	Basic biology, food microbiology, food preservation

Details of Syllabus:

Unit	Content	Hrs/ Unit	Marks / Unit
1	Marine and fresh water fish, shell fish - composition and nutrition; commercially important fish and shell fish; World production status of seafood, effect of method of catching and handling on the quality of fish; handling fish from catching to transportation, storage; post mortem changes, freshness criteria and quality assessment of fish; contaminants and toxicants in fish- both endogenous and exogenous, spoilage of fish; methods of preservation of fish: canning, freezing, drying, salting, smoking, fermentation, marinating and pickling, irradiation; effect of processing and storage on nutritive value; packaging;	12	
2	Traditional fish based products of India; surimi (meat analogues); fish byproducts - production of fish meal, fish protein concentrate, isolate, hydrolysate, fish liver oil, fish silage; production of non-food items from fish processing wastes and application; Indian and global companies dealing with seafood; food laws governing processing and sale of seafood.	5	
3	Common and commercially important animals reared for meat (including poultry), World production status of meat; abattoir design, ante-mortem inspection, pre-slaughter/ante-mortem handling and inspection, scientific and	10	

	modern methods of slaughtering of animals: small and large scale; post-slaughter/post-mortem handling and inspection, grading of meat; animal welfare and safety in slaughter plants; meat cuts and portions of meat; post mortem changes: conversion of muscle to meat, ageing; color of meat: under different conditions; by-products from meat industries and their utilization;		
4	Structure and composition of muscle; comparative nutritional value of different meats; contaminants and toxicants in meat - both endogenous and exogenous; spoilage of meat; storage of fresh meat - modified atmosphere packaging, packaging of retail cuts; Processing and preservation - artificial tenderizing, chilling, freezing, curing, smoking, fermentation, canning, irradiation; meat products (comminuted meat products, meat analogues, sausages- fermented and non-fermented: types, manufacturing process), ready-to-eat products; effect of processing on nutritive value; Indian and global companies dealing with meat; food laws governing processing and sale of meat.	10	
5	Eggs - structure, composition; nutritional value; quality factors and grading; storage; egg processing, cleaning, pasteurization, freezing and drying; functional properties and application, utilization of egg-derived products as food ingredients; Effect of processing on nutritive value; additives used in poultry products; by-product utilization; egg substitutes; Indian and global companies dealing with eggs and egg based products.; food laws governing processing and sale of egg and egg based products.	8	

Text and Reference Books:

Text books

1. Seafood Processing: Technology, Quality and Safety, Ioannis S. Boziaris (Editor). The Atrium, Chichester, West Sussex, United Kingdom. Wiley-Blackwell, John Wiley and Sons, 2014. ISBN: 978-1-118-34621-1.
2. Advances in Fish Processing Technology, Sen, D.P. (2005), Allied Publishers Pvt. Ltd.
3. Fish Processing Technology , Rogestein & Rogestein
4. Processed Meats; Pearson AM & Gillett TA; 1996, CBS Publishers.
5. Developments in Meat Science – I & II, Lawrie R; Applied Science Pub. Ltd.
6. Egg Science & Technology; Stadelman WJ & Cotterill OJ; 1973, AVI Pub.

Reference

1. Fish as Food; Vol 1 & 2; Bremner HA; 2002, CRC Press.
2. Fish & Fisheries of India; Jhingram VG; 1983, Hindustan Pub Corp
3. Fish as Food, Vol. I-IV; George Borgstrom, Academic Press
4. Meat; Cole DJA & Lawrie RA; 1975, AVI Pub.
5. Egg and poultry meat processing; Stadelman WJ, Olson VM, Shemwell GA & Pasch S; 1988, Elliswood Ltd.

Course Outcome:

After completion of the course the students will be able to

CO1: Recalling the basic concepts of biology, define the basic structure and biochemical composition of muscle foods and eggs and how these may undergo changes during ante & post mortem handling, processing and storage.

CO2: Understand the spoilage mechanisms in freshly harvested fish, meat and egg and explain how to estimate their quality using apposite qualitative and quantitative biochemical, physical or organoleptic parameters.

CO3: Explain the principle and applicability of different preservation technologies and apply this knowledge to prescribe suitable preservation methods for freshly harvested fish, animal and eggs.

CO4: Analyze ante mortem handling techniques and stunning methods to minimize pain and struggle of animals and frame a hygienic slaughtering process to yield high quality muscle food.

CO5: Evaluate the possibilities of value addition of fish; meat, poultry to design processing and manufacture of value added products and specialty foods

CO6: Identify potential in the by-products originating from fish, meat and poultry industries and propose the manufacture of various food, feed and non-food products

Special Remarks (If any): Nil

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Syllabus for B. Tech in Food Technology

(Applicable from the academic session 2018-2019)

Name of the Course: Food Process Engineering	
Course Code: PC-FT 503	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.:15 Marks
Tutorial: Nil	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1	To develop the knowledge in the area of food processing and technology
2	To enable students to appreciate the application of scientific principles in the processing of these materials.
Pre-Requisite:	
1	Elementary Physics, Mathematics
2	Knowledge of Unit Operations

Details of Syllabus:

Unit	**Content**	**Hrs/ Unit**	**Marks / Unit**
1	Basic unit operations used in food industry	1	
2	Evaporators (basic principle and Single Effect Evaporator). Different types of evaporators: Open pan, Vacuum and boiling-film evaporators.	3	
3	Heat Exchanger (HE): counter and co-current flow. Application of LMTD concept in HE. Different types of HE: Tubular, Shell and Tube, Plate HE, Scrap surface HE,	4	
4	Freezing: concept of freezing, freezing curve, freezing rate, zone of ice crystallization, freezing vs. thawing. Freezing time: Planck's equation. IIR modification of Planck's equation.	5	
5	Different type of freezers: Plate contact freezer, Air blast freezer, cryogenic freezers (use LN_2 and LCO_2; their advantages and disadvantages). Transportation of frozen foods. Cold chain.	3	
6	Cold storage: Introduction and importance of cold store. Types of cold store. Construction of cold store. Refrigeration load calculation of cold store. Air flow pattern, evaporators use, duct and damper arrangement. Pre-fabrication in cold store. Idea of vapor barrier. Different problems and faults found in cold storage and solutions.	3	
7	Drying: Various type of dryers (basic principle and drying time): Solar dryer, Tray dryer, Drum dryer, Spray dryer, Fluidized bed dryer, Freeze-dryer.	6	
8	Engineering aspect of Homogenizer and Pasteurizer (HTST).	3	
9	Thermal processing: Introduction. D-value, K- value, Z- value, TDT, Sterilization value. Graphical representation of D-value and Z-value calculation. Lethality. Process time. Retorting: vertical retort-- its different parts and their functions. Process time.	6	

10	Kneader: Different types of kneaders used in industry. Oil expeller. Seaming machine: Double seaming, Different parts and their functions. Operational stages of double seaming machine	5	
11	Extruder: Introduction. Functions and advantages of extrusion process. Single screw extruder (SSE): different parts present and their functions. Three zones in SSE and their functions. Screw compression ratio (SCR), L/D ratio, Expansion ratio (ER). Screw pitch. Bulk density of product. Double screw extruder (DSE): counter and co-current, intermeshing and non-intermeshing. Advantages of DSE over SSE.	6	

Text and Reference Books:

TEXT
1. Fundamentals of Food Process Engineering; Toledo RT; 2nd edition, 2000, CBS Publishers.
2. Engineering Properties of Foods; Rao MA & Rizvi SSH; 1986, Marcel Dekker Inc.
3. Food process engineering, D. R. Heldman and R.P.Singh
4. Berk, Zeki "Food Process Engineering and Technology" Academic Press, 2009

REFERENCES
1. Bakery Technology & Engineering; Matz SA; 1960, AVI Pub.
2. The Fundamentals of Food Engineering; Charm SE; 1963, AVI Pub.
3. The Technology of Extrusion Cooking by N.D.Frame, Blackie Academic and Professional, Madras.

Course Outcome:

At the end of this course, the incumbent will be able to:

CO1: Understand the basics of various food processing operations.

CO2: Solve different numerical problems on process Engineering.

CO3: Obtain knowledge in application of scientific principles in the processing technologies specific to the materials.

CO4: Understand different line or flow diagrams for different food processing operations.

CO5: Better knowing the changes in the composition of foods with respect to the type of processing technology used
CO6: Develop solutions for practical engineering problems related to industries.

Special Remarks (If any): Nil

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Syllabus for B. Tech in Food Technology

(Applicable from the academic session 2018-2019)

Name of the Course: Fermentation Technology & Biochemical Engineering	
Course Code PE-FT 501A	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.: 15 Marks
Tutorial: Nil	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Atleast 45 hrs/Sem

Objective:

1	Knowledge of this paper helps them competent to analyse problems in fermentation plant and to rectify defects.
2	It also help them to develop bankable project report for development of Biochemical plants
3	To understand different Biochemical pathway different fermentation process.
4	Students can make use of these knowledge in any fermentation industry

Pre-Requisite: The following modules (or equivalents) should be preferably completed prior to, this module:

1	Basic of Food Microbiology
2	Basic of Biochemical pathway of microbial fermentation
3	Basic of mass transfer and heat transfer operation
4.	Knowledge of separation Technology
5	Knowledge of project Engineering

Detailed Syllabus

Unit	**Content**	**Hrs/ Unit**	**Marks / Unit**
1	Development; Production of organic acids (vinegar, lactic acid), alcoholic beverages (beer, wine, and distilled alcoholic beverages such as whiskey, rum, vodka), glycerol	8	
2	Propagation of baker's yeasts; Microbial production of vitamins (B_2 and B_{12}), antibiotics (penicillin, streptomycin,)	8	
3	Bioreactor design: Mechanisms and kinetics (Monod model), Fermentation - types of fermenters, chemostat, chemostat with recycle, turbidostat, PFR, fluidized bed reactor, air lift fermenter, Mass transfer in microbial reactors; scale-up and scale down of bioprocess	12	
4	Bio product recovery: Downstream processing - separation process for cell	9	

	mass and product, filtration, centrifuging, membrane processes (reverse osmosis, ultrafiltration, chromatographic separation)		
5	Bioprocess economics, Cost analysis of alcohol production plant, Fermentation plant design project, Bio-product regulation	8	

Text and reference books:

1. Biochemical Engineering Fundamentals: J.E Bailey, D F Olli, MGH

2. Biochemical Engineering: Aiba S; Academia press, NY

3. Bioprocess Engineering: Basic Concepts, 2nd Edition- Michael L. Shulur and Fikret Kargi

4. Biochemical Engineering: A Textbook for Engineers, Chemists and Biologists- Shigeo Katoh and Fumitake Yoshida

5. Principles of Fermentation Technology- Allan Whitaker, Peter F. Stanbury, and Stephen J. Hall

Course Outcome:

CO1: Define and relate basic principles of industrial microbiology, fermentation techniques and biochemical engineering to food processing sector

CO2: Outline and review research literature in relation to production and downstream techniques for ethanol, antibiotics, organic acids and allied biochemicals through fermentation considering techno-economic feasibility

CO3: Design and develop processes to address problems and find solutions for various fermentation plants to optimize production of high value biochemicals

CO3: Interpret and validate different modeling and simulation strategies for upstream and downstream processing through analysis of data, and synthesis of information for final product stability and functionality, scale-up and sustainability

CO5: Determine modern techniques like immobilizations, recombinant technologies to formulate fermentative products for food and allied industries in compliance to legal, ethical and environmental guideline

CO6: Design, modify and adopt changes relating nature, structure, function and activity of different commercial biochemicals for future market meeting the societal and cultural needs through effective process economics and communication with in multi-disciplinary setting

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Syllabus for B. Tech in Food Technology

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Name of the Course: Instrumental Methods of Food Analysis	
Course Code: PE-FT 501 B	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.: 15 Marks
Tutorial: Nil	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points:3	End Semester Exam: 70 Marks

Objective:	
1	To develop the knowledge of fundamentals of instrument's working principle
2	To enable the students to learn about the instrument's applications in food analysis
Pre-Requisite:	
1	Basic physics, chemistry, biology, mathematics

Details of Syllabus:

Unit	Content	Hrs/ Unit	Marks / Unit
1	**Chromatographic techniques:** General principles. Partition and adsorption chromatography, Paper, thin layer, Gel filtration, ion exchange and affinity chromatography, Liquid chromatography, High Pressure Liquid Chromatography (HPLC), Gas chromatography (GC)	15	
2	**Electrophoretic Techniques:** General principles, Paper and gel electrophoresis. Polyacrylamide gel electrophoresis (Native and SDS)	5	
3	**Spectroscopy:** Beers and Lambert's Law; Extinction coefficient; General principles of colorimeters and spectrophotometers; Ultraviolet, Visible, and Fluorescence Spectroscopy; Infrared Spectroscopy; Atomic Absorption Spectroscopy; Atomic Emission Spectroscopy, Nuclear Magnetic Resonance Spectroscopy, IR Spectroscopy, NIR Spectroscopy, FTIR Spectroscopy	12	
4	**Spectrometry:**, Principle and applications, Mass Spectrometry, Inductively Coupled Plasma-Mass Spectrometry (ICP-MS), Inductively coupled plasma optical emission spectrometry (ICP-OES), MALDI- TOF, ESI	8	
5	**Physical Properties:** Rheological principles of food analysis, Texture Analysis, Thermal Analysis and Color Analysis	5	

Text and Reference Books:

1. Skoog, D.A. et al., "Principles of Instrumental Analysis". 6th Edition, Thomson/Brooks/ Cole, 2007.
2. Willard, Hobart H. et al., "Instrumental Methods of Analysis".7th Edition, CBS Publishers, 2008.
3. Braun, R.D. "Introduction to Instrumental Analysis". McGraw-Hill, 1987.
4. A First Course in Food Analysis, V. Sathe, New Age International Pvt. Ltd., 1st Edition, 1999.
5. Food Analysis, S. S. Nielsen, Kluwer Academic Publishers, 3rd Edition, 2003.
6. Food Analysis Laboratory Manual, S. S. Nielsen, Springer, 2nd Edition, 2010.

Course Outcome:

After completion of the course the students will be able to

CO1: To be able to recall, the structure and working principle of various instruments used in food analysis

CO2: To be able to understand the advantages and shortcomings of the various instruments.

CO3: To be able to apply the various instruments to analyze different components of food matrices.

CO4: To be able to analyze the sensitivity and reproducibility of analytical results produced by the various instruments

CO5: To be able to evaluate the specificity in applications of the various instruments.

CO6: To be able to design and develop methods of food analysis using various instruments.

Special Remarks (If any): Nil

Name of the Course: Engineering Properties of Food Materials	
Course Code: PE-FT 501C	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.: 15 Marks
Tutorial: Nil	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points:3	End Semester Exam: 70 Marks
Atleast 45 hrs/Sem	

Objective:	
1	To impart knowledge and understanding on different types food properties and its relevance to ensure food processing and quality
Pre-Requisite:	
1	Basic understanding of physics, physical chemistry, mechanics, thermodynamics and bioenergetics

Details of Syllabus:

Unit	Content	Hrs/ Unit	Marks / Unit
1	Physical characteristics of different seeds, grain and other food products- shape and size – description of shape and size - volume and density, porosity, surface area	10	
2	Rheology: ASTM standard, terms - physical states of materials - classical ideal material – rheological models and equations - visco elasticity - creep stress relaxation - Non Newtonian fluid and viscometry -rheological properties - force - deformation, stress - strain, elastic - plastic behaviour		
3	Contact stresses between bodies: Hertz problems - firmness and hardness - mechanical damage -impact damage and dead load damage - vibration damage - friction - effect of load, sliding velocity, temperature, water film and surface roughness - friction in agricultural materials - rolling resistance -angle of internal friction, angle of repose - flow of bulk granular materials - aero dynamics of agricultural materials and food products - drag coefficients - terminal velocity.	12	
4	Thermal properties: specific heat - thermal conductivity thermal diffusivity - methods of determination- steady state and transient heat flow.	12	
5	Electrical properties: dielectric loss factor, loss tangent, A.C. Conductivity and dielectric constant -method of determination - energy absorption from high-frequency electric field. Electro-magnetic field effects.	5	

Textbooks:

1. Rao, M. A., Rizvi, S. S. H. and Datta. A. K. Engineering Properties of Foods, (CRC Press, 2005)
2. Sahin S. and Sumnu, S. G. Physical Properties of Foods, (CRC Press, 2006)
3. Mohesenin, N. N. Thermal Properties of Foods and Agricultural Materials, (Gordon and Breach Science Publishers, 1980)
4. Mohesenin, N. N. Physical Properties of Plant and Animal Materials, (Gordon and Breach Science Publishers, 1980)

References:

1. Peleg, M. and Bagelay, E. B. Physical Properties of Foods, (AVI publishing Co., 1983)
2. Jowitt, R., Escher, F., Hallstrom, B., Meffert, H. F., Walter, T., Spices, E. C. and Vox, G. Physical Properties of Foods, (Applied Science Publishers, 1983)
3. Figura L, O. and Teixeira A, A. Food Physics: Physical Properties- Measurement and applications (2007)

Course Outcome:

After completion of the course the students will be able to

CO1: Ability to outline physical properties of food play a key role in all fields where modern technological processes are applied for the generation of raw materials and the production of food

CO2: Ability to understand the problems arising in physical properties of food, food ingredients and their measurement.

CO3: Ability to apply and analyse the molecular interplay and fundamental (multiscale) macroscopic/micro-structural behavior between the basic components of foods like water, oil/fat, proteins and carbohydrates.

CO4: Ability to determination the physical properties of food and related products for Process planning, engineering and automation in today's food industries

CO5: Ability to evaluate and interpret data and apply resources to reach a sustainable solution for effective quality control activities of food industries.

Special Remarks (If any): Nil

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Syllabus for B. Tech in Food Technology

(Applicable from the academic session 2018-2019)

Name of the Course: Process Instrumentation and Control			
Course Code: OE-FT 501A		**Semester: V**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs./ week		Mid Semester Exam.: 15 Marks	
Tutorial: NIL		Assignment & Quiz: 10 Marks	
Practical: Nil		Attendance: 5 Marks	
Credit Points:3		End Semester Exam: 70 Marks	
Atleast 45 hrs/Sem			
Objective:			
1	Understand the operations of different instrument and controlling systems		
2	Provide fundamental knowledge on instruments and their applications in food processing		
3	Understand the function of instruments in food product development		
4	Build the concept of application of process control in respective food manufacturing and safety		
5.	Assess the importance of various operations in processing plants instrumentation		
Pre-Requisite:			
1	To have basic concept of the scientific and technological aspects of instrumentation		
2	Basic concept of physics and electronics		

Details of Syllabus:

Unit	**Content**	**Hrs/ Unit**	**Marks / Unit**
1	Operational aspect of instrument system, control and requisites; Analytical balance and spring balance, load cell, moisture measurement cells for granular material, infrared, transmission measurement of moisture	8	
2	Low pressure measurement by McLeod Gage and Pirani Gage; Temperature measurement by bi-metal thermometers – resistance thermometers, thermistors and thermocouples. Radiation and optical pyrometers; Flow measurement by magnetic flow meters Module	10	
3	Control system, Open and closed loop system, transfer function of open loop and closed loop control systems; Block diagrams; Laplace transform; Response of a control system; Stability; Feedback; PID mode of controller Digital Controller: Position and Velocity control.	10	
4	Controller mode, Root locus plot, Modulation, Final control, Controllers, Control valve, Application of control in heat exchangers, distillation column Text and reference books: 1. Instrumentation, Measurement and Analysis; Nakra BC & Chaudhury KK; TMH 2. Process System Analysis & Control; Coughanowr DR; MGH 3. Chemical Process Control; Stephanopoulis G; PHI	10	

5	Principles of measurement -Calibrations application in food industry. Practical considerations for implementing online measurements. Radiation thermometers		
6	Introduction to automation in food processing industries. Sensors technologies –equipments–e nose, e-tongue, e vision, NIR.	7	

Text and Reference Books:

1. Erika Kress-Rogers and Christopher J. B. Brimelow, Instrumentation and sensors for the food industry, Wood head publishing, 2001.
2. D. Patranabis, Sensors and Transducers, Prentice Hall India Pvt. Ltd, 2007.
3. E. O. Doeblin, Measurement Systems: Applications and Design, Tata McGraw-Hill Book Co., 2008.
4. D. Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd., New Delhi, 2011.
5. Donald P. Eckman, Industrial Instrumentation, Wiley Eastern Limited, 2006.
6. Peter Harriott, Process Control, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 30 Threprint, 2008.

Course Outcome:

After completion of the course the students will be able to

CO1: Recall the parts of instrumentation and their working in food industry.

CO2: Analyze the basic principles of sensors and their applications

CO3: Analyze the Modeling of physical process, controller characteristics, selection of controller mode and control schemes

CO4: Examine the concepts of system representation, time and frequency responses of systems.

CO5: Design and develop instruments for food product development.

Special Remarks (If any): Nil

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Syllabus for B. Tech in Food Technology

(Applicable from the academic session 2018-2019)

Name of the Course: Renewable Energy Technology	
Course Code OE-FT 501B	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.: 15 Marks
Tutorial: Nil	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points:3	End Semester Exam: 70 Marks
Atleast 45 hrs/Sem	

Objective:	
1	Understand the types of renewable energy sources
2	Provide fundamental knowledge on energy sources and their applications in food processing industry
3	Understand the function of renewable energy sources for food product development
4	Build the concept of application of renewable energy source in respective food industry
5.	Assess the importance of food industry waste management by coverting them to renewable energy sources
Pre-Requisite:	
1	To have basic scientific and technical knowledge of renewable sources of energy and their use

Details of Syllabus:

Unit	**Content**	**Hrs/ Unit**	**Marks / Unit**
1	Biological fuel generation; Biomass as a renewable energy source; Types of biomass: forest, agricultural and animal residues; Industrial and domestic organic wastes; Conversion of biomass to clean fuels and petrochemical substitutes by physicochemical and/or fermentation processes.	10	
2	Biogas from anaerobic digestion; Thermal energy from biomass combustion; Ethanol/Biofuel from biomass	8	
3	Hydrogen production by photosynthetic bacteria, biophotolysis of water and by fermentation; Microbial recovery of petroleum by biopolymers (Xanthum gum), biosurfactants.	9	
4	Solar energy; Solar collectors, solar pond, photovoltaic cells, chemical storage; Geothermal energy and wind energy; Use of geothermal energy; Operating principles of different types of wind energy mills; Nuclear energy; Nuclear reactions and power generation; Tidal wave energy.	10	
5	Project	8	

Text and Reference Books:

1. O.P. Gupta, Energy Technology, Khanna Publishing House (AICTE Recommended Textbook – 2018

2. J.E.Smith – Biotechnology, 3rd edn. Cambridge Univ Press.

3. S.Sarkar – fuels and combustion, 2nd edn., University Press.

4. O.P. Gupta, Elements of Fuels and Combustion Technology (ISBN: 978-93-86173-324), Khanna Book Publishing Company, New Delhi

Course Outcome:

After completion of the course the students will be able to

CO1: Recall the parts renewable energy sources
CO2: Analyze the basic cause of development of renewable energy source for food industry
CO3: Analyze the different methods of development and use of renewable energy source
CO4: Examine the concepts of development of renewable energy source from food industry waste
CO5: Design and develop and apply the concepts of renewable energy development for food waste management.

Special Remarks (If any): Nil

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Syllabus for B. Tech in Food Technology

(Applicable from the academic session 2018-2019)

Name of the Course: Mechatronics	
Course Code: OE-FT 501C	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.: 15 Marks
Tutorial: Nil	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points: 3	End Semester Exam: 70 Marks
Atleast 45 hrs/Sem	

Objective:

The implementation of robotics and automation in the food sector offers great potential for improved safety, quality and profitability by optimizing process monitoring and control. Automatic process control and robotics in the food industry, sensors for automated quality and safety control, and the development of machine vision systems have become vital. Hence equipping the students with the latest is essential.

Pre-Requisite:

1	Basics of electronics, mechanical equipment design
2	Conceptual knowledge of food industry processes and flow measuring devices

Details of Syllabus:

Unit	**Content**	**Hrs/ Unit**	**Marks / Unit**
1	Introduction: Definition of mechatronics. Mechatronics in manufacturing, products and design. Review of fundamentals of electronics.	3	
2	Mechatronics elements: Data conversion devices, sensors, microsensors, transducers, signal processing devices, relays, contactors and timers.	7	
3	Processors /controllers Microprocessors, microcontrollers, PID controllers and PLCs.	6	
4	Drives and mechanisms of an automated system Drives: stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, and transfer systems	6	
5	Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, and pumps. Design of hydraulic circuits.	9	
6	Pneumatics: Pneumatic system production, distribution and conditioning of compressed air, system components and graphic representations, design of systems.	8	
7	Industrial Robotics and Automation and their applications in food industries; CNC machines and part programming.	6	

	Components of Industrial Robotics		

Text and Reference Books:

Textbooks:

1. Boucher, T. O., Computer automation in manufacturing - an Introduction, Chapman andHall, 1996.
2. HMT ltd. Mechatronics, Tata Mcgraw-Hill, New Delhi, 1988

References:

1. Deb, S. R., Robotics technology and flexible automation, Tata McGraw-Hill, New Delhi, 1994.
2. Boltan, W., Mechatronics: electronic control systems in mechanical and electrical engineering, Longman, Singapore, 1999

Course Outcome:

After completion of the course the students will be able to

CO1: Explain the fundamentals and relevance of electronics and mechatronics in food industries

CO2: Elucidate the role of mechatronics elements

CO3: Illustrate the function of PIDS and PLCs

CO4: Recognize the drives and mechanisms of an automated systems

CO5: Cite the relevance of industrial automation and robotics in food industries

Special Remarks (If any):

Name of the Course: Engineering Economics	
Course Code: HM-FT 501	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.: 15 Marks
Tutorial: Nil	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points:3	End Semester Exam: 70 Marks

Objective:	
1	To develop the knowledge of students regarding project management, targets and cash flow in an industry
2	To enable the students to analyse the various economic aspects of a project and optimise investment
3	To enable the students to understand depreciation and assess the financial health of the company
Pre-Requisite:	
1	Basic mathematics and book keeping

Details of Syllabus:

Unit	Content	Hrs/ Unit	Marks / Unit
1	Economic Decisions Making – Overview, Problems, Role, Decision making process. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.	9	
2	Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value Of Money, Debt repayment, Nominal & Effective Interest. Present Worth Analysis: End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives. Cash Flow & Rate Of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate Of Return, Calculating Rate Of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis. Economic Analysis In The Public Sector -	15	

	Quantifying And Valuing Benefits & drawbacks.		
3	Uncertainty In Future Events - Estimates And Their Use In Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic Decision Trees, Risk, Risk vs Return, Simulation, Real Options. Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances.	8	
4	Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life Of A New Asset, Marginal Cost, Minimum Cost Life Problems. Inflation And Price Change – Definition, Effects, Causes, Price Change With Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates.	8	
5	Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.	5	

Text and Reference Books:

1. James L.Riggs, David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , Tata McGraw-Hill
2. Donald Newnan, Ted Eschembach, Jerome Lavelle : Engineering Economics Analysis, OUP
3. John A. White, Kenneth E.Case,David B.Pratt : Principle of Engineering Economic Analysis, John Wiley
4. Sullivan and Wicks: Engineering Economy, Pearson
5. R.Paneer Seelvan: Engineering Economics, PHI
6. Michael R Lindeburg : Engineering Economics Analysis, Professional Pub
7. Premvir Kapoor, Sociology & Economics for Engineers, Khanna Publishing House, New Delhi.

Course Outcome:

After completion of the course the students will be able to
CO1: Encounter different problem issues in engineering related to system design, system deployment, project management, etc. and approach towards optimal solution.
CO2: Prepare estimation for short term targets in an industry and compare the actual costs incurred for the same to determine the efficiency of the system.
CO3: Prepare estimation of supply, installation and commissioning in live projects and take necessary measures of cost control.
CO4: Take long term investment decision; select the most profitable project, take decision related to replacement of assets.

CO5: Identify the assets that are subject to depreciation, maintain depreciation account to access the benefit as per tax regulations.
CO6. Can prepare and analyze the financial statements of the company, and determine its financial health.

Name of the Course: Mandatory Course (Constitution of India)	
Course Code: MC 501	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./ week	Mid Semester Exam.: 15 Marks
Tutorial: Nil	Assignment & Quiz: 10 Marks
Practical: Nil	Attendance: 5 Marks
Credit Points: 0	End Semester Exam: 70 Marks

Special Remarks (If any): Nil

Details of Syllabus

Unit	**Content**	**Hrs/ Unit**	**Marks / Unit**
1	Meaning of the constitution law and constitutionalism		
2	Historical perspective of the Constitution of India		
3	Salient features and characteristics of the Constitution of India		
4	Scheme of the fundamental rights		
5	The scheme of the Fundamental Duties and its legal status		
6	The Directive Principles of State Policy – Its importance and implementation		
7	Federal structure and distribution of legislative and financial powers between the Union and the States		
8	Parliamentary Form of Government in India – The constitution powers and status of the President of India		
9	Amendment of the Constitutional Powers and Procedure		
10	The historical perspectives of the constitutional amendments in India		
11	Emergency Provisions: National Emergency, Financial Emergency, President Rule		
12	Local Self Government – Constitutional Scheme in India		
13	Scheme of the Fundamental Right to Equality		

14	Scheme of the Fundamental Right to certain Freedom under Article 19		
15	Scope of the Right to Life and Personal Liberty under Article 21.		

Name of the Course: Food Engineering Lab	
Course Code: PC-FT 591	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 3 hrs./ week	External Assessment: 60 Marks
Credit Points: 1.5	Distribution of marks: Experiments - 40 Marks Viva – 20 Marks

Course Outcomes:	
1	Understand the basics of various food processingoperations.
2	Understand the principles of Process calculations.
3	Understand different line or flow diagrams for different food processing operations
4	Knowledge in application of scientific principles in the processing technologies specific to the materials.
5	Better knowledge about the changes in the composition of foods with respect to the type of processing technology used
6	Develop solutions for practical engineering problems related to industries.
Pre-Requisite:	
1	Elementary Physics, Mathematics
2	Knowledge of Unit Operations
Practical:	
	1) Intellectual skills-
	2) Motor skills-Autoclave/ Canning Unit, Spray Drier/ Tray Drier/ Drum Drier/ Freeze Drier,Plate Freezer, Vacuum Evaporator, Oil Extractor, Extruder

Laboratory Experiments:	
1	Determination of thermal destruction parameters during canning of fruits/ vegetables – F value, D value, z value
2	Study of dehydration characteristics of food materials and drying efficiency calculation during drying of food products in spray drier, tray drier, drum drier, freeze drier
3	Freezing efficiency and freezing time calculation of selected food materials
4	Fruit juice concentration using vacuum evaporator/ other suitable techniques
5	Oil extraction from oils seeds

6	Crude oil refining
7	Study the working principle, operation and yield estimation of an extruder
8	Freeze concentration of alcohol beverage
9	Kinetic study of osmotic dehydration of fruits or vegetables

Text and Reference Books:

1. Fundamentals of Food Process Engineering; Toledo RT; 2nd edition, 2000, CBS Publishers.
2. Berk, Zeki "Food Process Engineering and Technology" Academic Press, 2009
3. Engineering Properties of Foods; Rao MA & Rizvi SSH; 1986, Marcel Dekker Inc.

Special Remarks (If any):

Name of the Course: Food Analysis & Quality Control Lab – I	
Course Code: PC-FT 592	**Semester: V**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory: Nil	Maximum marks: 100 Marks
Tutorial: Nil	Continuous Internal Assessment: 40 Marks
Practical: 3 hrs./ week	External Assessment: 60 Marks
Credit Points: 1.5	Distribution of marks: Experiments - 40 Marks Viva – 20 Marks

Course Outcomes:	
1	To know the methods of selecting appropriate techniques for analysis of food products.
2	To apply knowledge in identifying and determining the relative amounts of components in food sample.
3	To gain knowledge on food standards, regulations and quality control
4	To obtain knowledge of adulterants in foods.
5	To appreciate the role of Food Analysis in food standards and regulation for the manufacture and the sale of food products and food quality control in food industries.
6	To familiarize with the current state of Knowledge in food analysis.

Pre-Requisite:	
1	Basic analytical techniques
2	Handling of glasswares, chemicals and equipments
3	Basic knowledge of solution preparation, chemical reactions
4	Spectrophotometric , titrimetric, gravimetric, volumetric and chromatographic principles
5.	Basic knowledge of Food Chemistry, Food Microbiology and Food preservation

Practical:	
	1) Intellectual skills-
	2) Motor skills- Spetrophotometer, pH meter, Hot Air Oven/ Moisture Analyzer, Soxhlet Apparatus, Kjeldhal Unit, Viscometer, Turbidity Meter, Muffle Furnace, Laminar Air Chamber, Autoclave, Incubator, Colony Counter
	Glasswares, chemicals & consumables

Laboratory Experiments:	
1	Analysis of potable water
2	Analysis of jam, jelly & pickles

3	Analysis of spices
4	Analysis of tea and coffee including antioxidant(s) / polyphenol(s)
5	Analysis of non-alcoholic beverages
6	Estimation of crude fiber in food sample
7	Analysis of lysine content in animal /vegetable sources

Text and Reference Books:

1. FSSAI Manuals
2. Raghuramulu, N. et al., "A Manual of Laboratory Techniques". 2nd Edition. NIN, 2003.
3. Nielson, S. Suzanne. "Food Analysis" 3rd Edition. Springer, 2003.
4. Pomeranz, Yeshajahu and Clifton E. Meloan "Food Analysis : Theory and Practice". 3rd Edition. Springer, 2000.

Special Remarks (If any):