JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF FOOD PROCESSING TECHNOLOGY

COURSE STRUCTURE & SYLLABUS M.Tech
FOOD PROCESSING TECHNOLOGY Programme

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

OVERALL OBJECTIVE

To study the advances in Food Engineering, Food Technology, Food Packaging, Food Standards/Regulations and Food Business Management with elective subjects in emerging areas.

SEMESTER I

S.No	Course No	Category	Course Name	L	T	P	C	Marks
1		Core1	Advances in Food Process Engineering	3	0	--	3	100
2		Core2	Advances in Food Technology	3	0	--	3	100
3		Elective I		3	0	--	3	100
			a) Technology for RTE/RTC Food Products					
			b) Confectionery Technology					
			c) Technology of Food Emulsions, Foams & Gels					
4		Elective II		3	0	--	3	100
			a) Novel Separation Processes					
			b) Food Nanotechnology					
			c) Non Thermal Processing					
5			Research Methodology and IPR	2	0	0	2	100
6		Laboratory 1	Food Technology Lab	-	--	4	2	100
7		Laboratory 2	Food Analysis Lab	-	--	4	2	100
8		Audit Course –1	Plant Design and Economics	2	0	0	0	100
			Total Credits /Marks				**18**	**800**

SEMESTER II

S.No	Course No	Category	Course Name	L	T	P	C	Marks
1		Core 3	Novel Food Packaging	3	0	--	3	100
2		Core 4	Food Safety Standards and Regulations	3	0	--	3	100
3		Elective III		3	0	--	3	100
			a) Lipid Technology					
			b) Protein Technology					
			c) Carbohydrate Technology					
4		Elective IV		3	0	--	3	100
			a) Frozen Food Technology					
			b) Flavor Technology					
			c) Brewing Technology					
5		Laboratory 3	Food Processing Operations Lab	-	-	4	2	100
6		Laboratory 4	Virtual Lab	-	-	4	2	100
7		Core	Mini Project with Seminar	0	0	4	2	100
8		Audit Course -2	Food Business Management	2	0	0	0	100
			Total Credits /Marks				**18**	**800**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

SEMESTER III **

S.No	Course No	Category	Course Name	L	T	P	C	Marks
1		Elective-V	Elective /MOOCS	3	0	--	3	100
		MOOCS	a) Novel technologies for food processing & shelf-life extension (IIT Kharagpur)					
			b) Thermal processing of Foods (IIT Guwahati)					
			c) Dairy and Food Process and products technology (IIT Kharagpur)					
		Electives	a) Advanced Drying Technology					
			b) Industrial Fermentation					
			c) Thermal Processing					
2		Open Elective	Open Elective / MOOCS	3	0	--	3	100
		MOOCS	a) Fundamentals of Artificial Intelligence (IIT Guwahati)					
			b) Statistics for Experiments (IIT Madras)					
			c) Introduction to Internet of Things (IIT Kharagpur)					
		Open Elective: Suitable courses offered by Civil, Mechanical, CSE & ECE departments						
3	DISSERTATION	Core	Dissertation Phase-I / Industrial Project (To be continued and Evaluated next Semester)*	--	--	20	10	--
			Total Credits/Marks				**16**	**200**

*** Evaluated and displayed in 4th Semester marks list**
**** Students Going for Industrial Project / Thesis will complete these courses through MOOCS**

SEMESTER IV

S No.	Course No	Category	Course Name	L	T	P	C	Marks
1	DISSERTATION	Core	Dissertation Phase II (Continued from III Semester)	0	0	32	16	100
			Total Credits /Marks				**16**	**100**

OUTCOME

Basic abilities to prepare feasibility report, setup, operate and manage a food industry.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - I Semester		L	T	P	C
		3	0	0	3

ADVANCES IN FOOD PROCESS ENGINEERING

OBJECTIVE

To study on recent trends, advances and future challenges in Food Process Engineering

SYLLABUS

UNIT-I Thermal Operations: Emerging Technologies like infrared, microwave heating, ohmic heating, radiofrequency, dielectric, instant and high heat infusion and their current status. Recent trends in retort technology & continuous heat processing. Advances in evaporation – multi effect evaporation (DSE, MVR & TVR), recent trends and design calculations, centrifugal evaporation, freeze concentration.

UNIT-II Non Thermal Operations: Recent trends in High pressure processing, high voltage pulsed electric field, high intensity pulsed light technology, oscillating magnetic field, cold plasma, ozone and ultrasonic technology, Osmotic dehydration. Membrane concentration – mechanisms of membrane transport, transport models, equipment – fluid & membrane movement modules.

UNIT-III Mass Transfer Operations Novel drying technologies like microwave drying, radio frequency drying, infrared drying, airless drying, heat pump assisted drying and pulse combustion drying. Extraction – Different types of commercial extraction systems used in processing (tea & coffee extraction, solvent extraction) – Super critical fluid extractions and its application. Recent trends in distillation, absorption and crystallization

UNIT-IV Mechanical Operations: Filtration – Membrane filtration and other recent trends. Grinding – cryogenic grinding. Extrusion – Newtonian and non Newtonian models of single screw extruder performance, multiple screw extruders, heat transfer in extruders, extruder residence time calculations. Mixing of Non Newtonian fluids – power consumption in agitation, scale up considerations for mixing vessels. Coating/enrobing – coating materials and equipments – battering and breading, seasoning

UNIT-V Material Handling and Storage Operations: Transportation of Non Newtonian Liquids – Calculation of frictional losses & power requirements. Storage of solids – solid storage bins, design of storage bins, silos. Recent advances in Conveying systems. Pneumatic conveying (lean & dense phase) and its applications. Advances in Grading Systems.

OUTCOME

Capability to apply advanced technologies in Food Processing Operations

TEXT BOOKS

1. Dennis R. Heldman & Daryl B. Lund, Handbook of Food Engineering, 2nd Edition, CRC Press, Taylor & Francis Group, 2007
2. Philip Richardson, Thermal Technologies in Food Processing, CRC Press, Woodhead Publishing Limited, 2001.
3. D.G. Rao, Fundamentals of Food Engineering, Prentice-Hall of India, New Delhi, 2010
4. R. Paul Singh and Dennis R. Heldman, Introduction to Food Engineering, 4th Edition, Academic Press, 2009.
5. Howard Q. Zhang, Gustavo V. Barbosa-canovas, V.M. Balasubramaniam, C. Patrick Dunne, Daniel F. Faraks, James T. C. Yuan, Non Thermal Processing Technologies for Food, Wiley online Library, 2010.
6. Kudra,T. and A. S. Mujumdar. 2009. Advanced drying technologies. Marcel Dekker, Inc.New York
7. Gustavo V. Barbosa-Cánovas, María S. Tapia and M. Pilar Cano, 2005. Novel Food Processing Technologies, CRC Press. ISBN: 0-8247-5333-X
8. Fellows, P. 2000. Food Processing Technology. CRC Press

REFERENCE BOOKS

1. C. J. Geankoplis, Transport Processes and Separation Process Principles, 4th Edition, PHI learning private limited, New Delhi, 2012.
2. P.G. Smith, Introduction to Food Process Engineering, 2nd Edition, Lincoln, UK, June 2010.
3. Romeo T. Toledo, Fundamentals of Food Process Engineering, 3rd Edition, 2007.
4. Bird R. Byron, Warren E. Stewart and Edwin N. Lightfoot. 2006. Transport Phenomena. Wiley India Pvt. Ltd., New Delhi.
5. Gould,G.W. (Ed).1996. New methods of food preservation. First Edition. Blackie Academic and and Professional, London.
6. Gustavo V. Barbosa- Canovas, Usha R. Pothakamury, Enrique Palou & Barry G. Swanson. 1998. Nonthermal Preservation of Foods. Marcel Dekker Inc. New York.
7. Cullen, P.J., Tiwari, B.K. and Valdramidis V.P. 2012. Novel thermal and non thermal technologies for fluid foods. Academic press, 32 Jamestown Road, London NW1 7BY, UK.

I Year - I Semester		L	T	P	C
		3	0	0	3

ADVANCES IN FOOD TECHNOLOGY

OBJECTIVE

To study on recent trends, advances and challenges in Food Technology

SYLLABUS

UNIT I Cereals, Millets, Pulses & Oilseeds: Advances in Milling like Turbo milling & Extractive milling of wheat – dehusking of millets – Lye peeling of rice. New value added products like agglomerated wheat flour, fortified rice, diabetic rice, cured rice, brown rice. New trends in processing of pulses & oilseeds like preparation of protein concentrates and isolates and their use in high protein foods.

UNIT II Fruit and Vegetable Products– New processing methods like vapor treatment, super critical fluid extraction, aseptic filling, retort processing, IQF, Hurdle technology, minimal processing, non thermal technologies like high pressure processing and pulse electric field processing of fruit juices, cloud juices, fresh cut fruits. **Spices & plantation crops:** Advanced methods in spice processing like Cryogenic grinding, Super critical fluid extraction. **Herbs –** Use of herbs and herbal extracts in formulation of therapeutic foods

UNIT III Meat, Poultry and Marine Products: Current trends and prospects of meat industry - Abattoir Layout, designing - equipments, operation and maintenance, automation of slaughter houses. Advances in poultry dressing, meat yield, preservation, microbiology and quality control methods. Automation in broiler farming, control of shrinkage. Development of convenient egg based products -egg powder, liquid eggs, thermo-stabilized egg. Advanced processing methods like HPP, IQF, Radiation, new products in meat and marine products.

UNIT IV Milk and Milk Products: New Methods of sterilization like UHT, ESL, ISI. New methods like Bactofugation for separation of microbes, recent trends in whey utilization, membrane concentration, Special Milks - Soft curd milk – Flavored milk - Vitaminized milk – sterilized milk - irradiated milk - milk processing methods and products.

UNIT V Future Foods: Specialty foods - organic foods, ethnic foods, fast foods, diet foods; Nutraceuticals, Functional foods - low fat, gluten free, nondairy sugar free, cholesterol free foods. Genetically Modified Foods (GMF) and their health implications, safety concerns of genetically modified foods; Nutrigenomics - interaction between gene-diet-disease, future perspectives of Nutrigenomics foods - benefits and risk; Nanotechnology in foods.

OUTCOME

Capability to apply advanced methods in Food Technology

TEXT BOOKS

1. Srilakshmi, B 2005. Food Science, New Age international (P) Ltd., Publishers New Delhi
2. Samuel Matz The Chemistry and Technology of Cereals as Food & Feed, 2nd Edition N. L. Kent and A. D. Evers, "Kent's Technology of Cereals: An Introduction for students of Food Science and Agriculture", 4th E., Woodhead Pub. Ltd., Cambridge, UK, 1994.
3. Diane M. Barrett Laszlo Somogyi, Processing of Fruits Science and Technology, CRC Press, 2015. R.P. Srivastava & Sanjeev Kumar., and Vegetable Preservation, 3rd revised & enlarged edition, IBDC, 2010.
4. Lawrie, R.S.1985. Developments in meat Science - Vol.III. Applied Science Publishers, London.
5. Ahmed Tufail.1999. Dairy Plant Engineering and management. Kitab Mahal, Allahabad.
6. Sukumar De, Outlines of Dairy Technology, Oxford University Press, 2013.

REFERENCE BOOKS

1. Potter, N. 2005. Food Science, CBS publishers and distributors, New Delhi.
2. Y. H. Hui and Others: Hand Book of Vegetable Preservation and Processing, Mercel Dekker New York 2004
3. Hall,G.M. 1997. Fish processing Technology. Blackie Academic and Professional, London
4. Panda, P.C. 1998. Text Book on Egg and Poultry Technology, Vikas Publishing House Pvt. Ltd., New Delhi.
5. B.D.Sharma, Meat and Meat Products Technology, 1st Edition, Jaypee Brothers, New Delhi, 1999.
6. National Institute of Industrial Research, Modern Technology of Milk processing and Dairy products, II Edition, NIIR Publications, India, 2004

I Year - I Semester		L	T	P	C
		3	0	0	3

TECHNOLOGY FOR RTE/RTC FOOD PRODUCTS

OBJECTIVE

To understand the various aspects of RTE/RTC Foods and their manufacturing technology.

SYLLABUS

UNIT-I Overview of grain-based snacks: whole grains – roasted, toasted, puffed, popped and flakes; Coated grains-salted, spiced and sweetened; Flour based snack– batter and dough based products; savoury and farsans; formulated chips and wafers, papads.

UNIT-II Technology for fruit and vegetable based snacks: chips, wafers, papads etc. Technology for coated nuts – salted, spiced and sweetened products - chikkis, Sing bhujia Technology of ready to eat fruits and vegetable based food products like sauces, fruit bars, glazed candy etc. Technology of ready to eat canned value added fruits/vegetables and mixes and ready to serve beverages etc.

UNIT-III Technology of ready- to- eat baked food products, drying, toasting, roasting and flaking, coating, chipping; Extruded snack foods: Formulation and processing technology, coloring, flavoring and packaging.

UNIT-IV Technology for ready-to-cook food products - different puddings and curried vegetables etc. Technology for ready-to-cook and ready to eat meat and meat food products. Technology for preparation of instant cooked rice, carrot and other cereals based food products.

UNIT-V Technology of ready to eat instant premixes based on cereals, pulses etc. Technology for RTE puffed snack- sand puffing, hot air puffing, explosion puffing, gun puffing etc. Technology for preparation of traditional Indian dairy products

OUTCOME

Expertise in processing/manufacturing of RTE/RTC food products.

TEXT BOOKS

1. Edmund WL. Snack Foods Processing. AVI Publ.
2. Frame ND .1994. Technology of Extrusion Cooking. Blackie Academic.
3. Gordon BR.1997 Snack Food.AVI Publ
4. Samuel AM.1976. Snack Food Technology. AVI Publ.

REFERENCE BOOKS

1. Kamaliya M.K and Kamaliya K.B. 2001.Baking science and Industries, Vol.1 and 2, M.K.Kamaliya Publisher,Anand.
2. Lal Girdhari, Siddappaa.G.S, and TandonG.L. 1998. Preservation of fruits and vegetables. Indian Council of Agricultural Research, New Delhi.
3. Chavan U.D. and Patil J.V. 2013. Industrial Processing of Fruits and Vegetables. Daya Publishing House New Delhi.
4. Duncan Manley.2000. Technology of Biscuits, Crackers and Cookies. CRC Press .Woodhead Publishing Limited, Cambridge, England.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - I Semester		L	T	P	C
		3	0	0	3

CONFECTIONERY TECHNOLOGY

OBJECTIVE

To understand the technologies and recent advances in confectionary.

SYLLABUS

UNIT-I Introduction: History and evolution of confectionery. Comprehensive understanding of raw materials used in the confectionery (cocoa, Sugar, Dried milk products, Special fats, Emulsifiers, Nut kernels, Alcoholic ingredients) and their effect on quality control methods.

UNIT-II Cocoa processing- Cleaning, Breaking, Winnowing, Sterilization, Alkalization, Roasting, Nib grinding, kibbling etc., Byproducts. **Chocolate Processing Technology-** Tempering and fat crystallization effects on chocolate quality, fat bloom formation and development in chocolate process. Enrobing technology, Compound Coatings and Presentation. The production of Dark, milk and white chocolate.

UNIT-III Sugar Confectionery: General technical aspects of industrial sugar confectionery manufacture, Sugar substitutes, Manufacture of high boiled sweets– Ingredients, Methods of manufacture–Types–Center–filled, lollipops, coextruded products. Manufacture of gums and jellies–Quality aspects.

UNIT-IV Flour confectionery: Ingredients and flour specification-Types of dough– Developed dough, short dough, semi-sweet, enzyme modified dough, frozen dough and batters- importance of the consistency of the` dough. Indian flour confections manufacture–Flour specification–ingredients–manufacturing process–types of chemically aerated goods.

UNIT-V Miscellaneous Products: Caramel, Toffee and fudge– Liquorice paste and Aerated confectionery, Lozenges, Sugar panning and Chewing gum, Count Lines Quality aspects, Fruit confections.

OUTCOME

Competence in confectionery processes and products.

TEXT BOOKS

1. Emmanuel Ohene Afoakwa, Chocolate Science and Technology 1st Edition. John Wiley & Sons, 2011.
2. Steve T. Beckett, Industrial Chocolate manufacture and use 4th Edition. John Wiley & Sons, 2011.
3. Bent A, Bennion EB & Bamford GST, The Technology of Cake Making. 6th Ed. Blackie, 1997.
4. Jackson EB, Sugar Confectionery Manufacture. 2nd Edn. Aspen Publ., 1999.

REFERENCE BOOKS

1. Junk WR & Pancost HM, Hand Book of Sugars for Processors. Chemists and Technologists. AVI Publ., 1973.

2. Manley DJR, Technology of Biscuits, Crackers, and Cookies. Ellis Horwood, 1983.

3. Matz SA, Bakery Technology and Engineering. 3rd Ed. Chapman & Hall, 1992.

4. Pomeranz Y, Modern Cereal Science and Technology. MVCH Publ., 1987.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - I Semester		L	T	P	C
		3	0	0	3

TECHNOLOGY OF FOOD EMULSIONS, FOAMS AND GELS

OBJECTIVE

To get familiarize with chemistry and role of Emulsions, Foams and Gels in Food processing.

SYLLABUS

UNIT-I Food dispersions, their characteristics and factors affecting food dispersions. Role in Food Industry.

UNIT-II Food emulsions- conventional and Nano emulsions; emulsifiers and their functions in foods; HLB concept in food emulsifiers; Emulsion formation and stability; Examples of emulsions in food- mayonnaise, sauce, beverages Polymers and surfactants.

UNIT-III Foam morphology- dry and wet, Structure of foams- ordered and disordered, foam formation and stability, Foam ripening and coalesce, Advantage and disadvantages of foam in food processing, Foam generation, Foaming agents, antifoaming agents Egg foams and uses, milk foams and their applications.

UNIT-IV Theory of gel formation; pectic substances and jellies; fruit pectin gels; fruit jellies. Structure of foods representing emulsions, foams and gels; Physical structure of fat rich, concentrated, fermented, coagulated and dried products.

UNIT-V Techniques for evaluation of structure for food emulsions, foams and gels. Application of foams in other food processing application; Case study foam mat drying.

OUTCOME

Accomplished knowledge on emulsion, gel systems and their applications in foods.

TEXT BOOKS

1. Blanshard JMV & Lillford P. 1987. Food Structure and Behaviour. Academic Press.
2. McClement DJ.1999. Food Emulsions - Principles, Practice and Techniques. CRC Press.

REFERENCE BOOKS

1. Haseuhuetti GL.1977. Food Emulsifiers and their Application. Chapman & Hall.
2. Srinivas D & Alain P.1977. Food Proteins and their Applications. Marcel Dekker.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - I Semester		L	T	P	C
		3	0	0	3

NOVEL SEPARATION PROCESSES

OBJECTIVE

To develop familiarity with major Food Process separations.

SYLLABUS

UNIT-I Introduction Separation process in Food processing, Categorization of separation process, equilibrium and rate governed processes. Introduction to various new separation techniques- Membrane separation, Ion-exchange, foam separation, supercritical extraction, liquid membrane, PSA & Freeze drying.

UNIT –II Membrane based separation technique (MBSTs): Historical background, physical and chemical properties of membranes, Techniques of membrane preparation, membrane characterization, various types of membranes and modules.

UNIY –III Osmosis and osmotic pressure. Working principle, operation and design of reverse osmosis, ultrafiltration, microfiltration, electrodialysis and pervaporation. Gaseous separation by membrances.

UNIT –IV Ion Exchange History, basic principle and mechanism of separation, Ion exchange resins, regeneration and exchange capacity. Exchange equilibrium, affinity, selectivity and kinetics of ion exchange. Design of ion exchange systems and their uses in removal of ionic impurities from effluents.

UNIT –V New Separation Techniques Foam separation, micellar separation, supercritical fluid extraction, liquid membrane permeation and chromatographic separation.

OUTCOME

Knowledge on various separation aspects.

TEXT BOOKS

1. King, C. J. Separation Processes, (Tata McGraw-Hill, 1980)
2. Sourirajan, S. and Matsura, T. Reverse Osmosis and Ultra-filtration – Process Principles, (NRC Publication, 1985)
3. Porter, M. C. Handbook of Industrial Membrane Technology, (Noyes Publication, 1990)

REFERENCE BOOKS

1. Henry, J. D. and Li, N. N. New Separation Techniques, (AICHE, 1975)
2. Hatton, T. A., Scamehorn, J. F. and Harvell, J. H. Surfactant Based Separation Processes, (Marcel Dekker Inc., 1989)

I Year - I Semester		L	T	P	C
		3	0	0	3

FOOD NANOTECHNOLOGY

OBJECTIVE

To understand functional materials in food nanotechnology, Nano-nutraceuticals and Nano functional foods

SYLLABUS

UNIT I Introduction: Definition of nanotechnology, potential applications related to food, functional materials in food nanotechnology, Nano-nutraceuticals and Nano functional foods, nanotechnology and risk assessment-regulatory approaches to nanotechnology in food industries. Unit Outcomes:

UNIT II Nanomaterials and manufacture: Nanomaterials technology- Nano powder production-Nano particles manufacture nanotechnology devices- analytical methods for nanotechnology

UNIT III Nanoparticles: Nanofilters, nanotubes, Nano-clay, Nano-films, Nano-membranes, Nano-emulsions, nanocomposite and Nano laminates, nanoscale food additives – Nano-lycopene

UNIT IV Nanoscale delivery systems for food functionalization: Liposom**es-** Nano cochleates- hydrogels based nanoparticles- dendrimers- lipid nanoparticles- polymeric Nano particles- anno crystalline particles – delivery systems – mode of action.

UNIT V Nanotech for food industries: Nanotechnology in food industry- Food quality monitoring- Nano-sensors nanotechnology in food microbiology-bacterial identification-antimicrobial packaging-improved food storage- green packaging-tracking-tracing and brand products-nanotechnology research in food industry.

OUTCOME

Knowledge on nanotechnology and risk assessment-regulatory approaches to nanotechnology in food industries

TEXT BOOKS

1. Pandua W., "Nanotech research methods for foods and bio-products", Wiley publications 2012.
2. FulekarM.H., "Nanotechnology-Implications and applications", International Publishing House (P) ltd 2010.

REFERENCE BOOKS

1. Lestie prey, "Nanotech in food products", Wiley publications 2010.
2. James A Schwarz, "Dekker encyclopedia of nanoscience and nanotechnology". Marcel From instrumentation to nanotechnology. J. Gardner. Taylor and Francis 2004.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - I Semester		L	T	P	C
		3	0	0	3

NON THERMAL PROCESSING

OBJECTIVE

To acquire knowledge of emerging and alternative technologies applied to food processing.

SYLLABUS

UNIT–I Emerging technologies in food processing - Active and intelligent packaging, membrane technology, HPP, PEF, Ultra sound. Supercritical fluid extraction: Concept, property of near critical fluids NCF and extraction methods. Application of SCFE in food processing

UNIT-II Microwave and radio frequency, IR drying - Definition, Advantages, mechanism of heat generation, inductive heating in food processing and preservation. Application in food processing: microwave blanching, sterilization and finish drying. Hurdle technology: Types of preservation techniques and their principles, concept of hurdle technology and its application.

UNIT-III High pressure processing - Types of equipment, mechanism of microbial inactivation Effect of HPP on -fruit juices, meat products, jam. Ultrasonic processing: Properties of ultrasonic, types of equipment, effect of ultrasonic treatment on microbial inactivation, oil yield etc.

UNIT-IV High intensity light generation system - Application of high intensity light in food processing, Pulse electric field-mechanism of inactivation, PEF generation system, PEF treatment chambers,

UNIT-V Mechanism of ohmic heating - Application of ohmic heating in liquid food processing, Principle of cold plasma technology and its generation systems and its application Nanotechnology: Principles and its applications in foods. Cryogenic grinding- Properties of cryogens, systems, and their different Applications.

OUTCOME

Knowledge on high pressure processing, pulsed electric processing, irradiation and hurdle technology in various food industries.

TEXT BOOKS

1. Barbosa-Canovas 2002. *Novel Food Processing Technologies*. CRC.
2. Dutta AK & Anantheswaran RC.1999. *Hand Book of Microwave Technology for Food Applications*.

REFERENCE BOOKS

1. Frame ND. (Ed.). 1994. *The Technology of Extrusion Cooking*. Blackie.
2. Gould GW. 2000. *New Methods of Food Preservation*. CRC.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - I Semester		L	T	P	C
		2	0	0	2

RESEARCH METHODOLOGY AND IPR

UNIT 1:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT 2:

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT 3:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 4:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT 5:

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES:

(1) Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
(2) Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
(3) Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
(4) Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
(5) Mayall, "Industrial Design", McGraw Hill, 1992.
(6) Niebel, "Product Design", McGraw Hill, 1974.
(7) Asimov, "Introduction to Design", Prentice Hall, 1962.
(8) (8) Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
(9) T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - I Semester		L	T	P	C
		0	0	4	2
FOOD TECHNOLOGY LAB					

OBJECTIVE

To refresh/update the practical knowledge on manufacture of basic food products and understand the effect of processing parameters and ingredients on Quality.

SYLLABUS

Following are some of the typical products prepared:

1. **Fruits and vegetables**
   Jam/Jellies/Spreads/Marmalades
   Pickles
   Preserve/Candy/Crystallized fruits
   Fruit Cheese
   Soup mixes
   Squash/Beverages/Juices/Nectars
   Tomato Paste/Ketchup/Puree
   Dehydrated Vegetables
   Instant Soup mixes
2. **Bakery and confectionery**
   Biscuits, Cookies & Crackers
   Cakes & Pastries
   Bread- Sponge & Straight Dough
   Marsh Mallows
   Toffee
3. **Dairy Products** Ice
   cream
   Curd/Cheese/Yoghurt
   Panner
   Khoa
4. **Spice products**
   Spice powders/Masala powders

OUTCOME

Knowledge on factors effecting quality & cost in the manufacture of basic food products.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - I Semester		L	T	P	C
		0	0	4	2
FOOD ANALYSIS LAB					

OBJECTIVE

To refresh/update the practical knowledge on analysis of food materials/products

SYLLABUS

Analysis of following parameters:

1. Moisture by hot air oven method, toluene, vacuum oven
2. Ash, acid insoluble ash
3. Crude fat
4. Crude fibre
5. Protein
6. Carbohydrate
7. Gluten content
8. pH
9. Acid value/Peroxide value
10. Titratable acidity
11. Saponification value
12. Water extract
13. Total dissolved solids
14. Alkalinity
15. Calcium
16. Sulphur dioxide
17. Carotenoid
18. Adulterations in foods

OUTCOME

Ability to carry out food analysis in different food matrixes

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - I Semester		L	T	P	C
		3	0	0	3

PLANT DESIGN & ECONOMICS (Audit Course-I)

OBJECTIVE

To teach various aspects of plant design and its feasibility.

SYLLABUS

UNIT-I Introduction: Important and special features of food processing plants. **Plant location:** Site selection criteria, factors influencing plant location, locational analysis and techniques, General design considerations for location of food plants. **Basics of layouts:** Basic concepts of plant layout, types of layout and its applicability, factors influencing plant layout, understanding of equipment layout.

UNIT-II Design: Selection of process, flow sheet-Basic flowchart, Food processing steps flowchart, Process equipment flowchart, material & energy balance, selection of equipment, process schedule, GANTT chart, PERT and CPM methods in brief, equipment design & design of auxiliary equipment.

UNIT-III Layout: Broad classification of food layouts and their peculiarities. Typical layouts for important products-Rice/Wheat milling, IQF, Beverages, Bakery, Breweries, Extraction plants, Confectionery, Abattoirs, Instant coffee and Tea, Dairy. Other aspects- Boiler Act, Factories Act, Pollution Act, Labour Act and other relevant Acts, Effluent treatment, Waste disposal.

UNIT-IV Project cost: Cost of land, building, equipment and utilities. Fixed capital cost, working capital cost, pre-operative expenses, total capital investment. **Cost of manufacture & Profitability:** Raw material cost, packaging material cost, manpower cost, utilities, administrative expenses, maintenance cost, depreciation cost, interest, taxes, estimation of total manufacturing cost, profitability, breakeven analysis and payback period.

UNIT-V Plant maintenance: Role of maintenance staff and plant operator's, Types of maintenance-Preventive and condition based maintenance; Guidelines for good maintenance & safety precautions; Lubrication & lubricants; Work place improvement through '5S', Six sigma concept. **Sanitation:** Hygiene and sanitation requirement in food processing; CIP methods-single use, multi-use, Compact Systems and Foam-Cleaning Systems, sanitizing & disinfestation, pest control in food processing; storage and service areas.

OUTCOME

Competence to prepare a product feasibility report.

TEXT BOOKS

1. Antonio Lopez-Gomez, Gustavo V. Barbosa-Canovas, Food plant Design, CRC Press, 2005.
2. George D. Saravacos and Zacharias B. Maroulis, Food Plant Economics, CRC Press, 2007.
3. Greg A. Baker, Orlen Grunewald, William D. Gorman, Introduction to Food and Agribusiness Management, 1st Edition, Prentice Hall, 2002.

REFERENCE BOOKS

1. Charley H., Food science, 2nd Edition, John Willey and Sons, New York, 1982.
2. James M Moore, Plant Layout and Design, 1st Edition, Macmillan, 1962.

Peters and Timmerhaus, Plant Design and Economics for Chemical Engineers, 4th Edition, McGraw- Hill, Inc., 1991.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - II Semester		L	T	P	C
		3	0	0	3

NOVEL FOOD PACKAGING

OBJECTIVE

To familiarize with novel, recent advances and innovative food packaging.

UNIT- I Active and Intelligent Packaging Techniques: Active packaging techniques, Active packaging in practice: Fish, meat; Active packaging and colour control: the case study of meat, fruit and vegetables; intelligent packaging techniques, Current use of novel packaging techniques, Consumers and novel packaging. Legislative issues relating to active and intelligent packaging. **Oxygen, ethylene and other scavengers:** Oxygen scavenging technology, selecting the right type of oxygen scavenger, Ethylene scavenging technology, Carbon dioxide and other scavengers.

UNIT-II Antimicrobial food packaging: Antimicrobial agents, constructing an antimicrobial packaging system, Factors affecting the effectiveness of antimicrobial packaging. **Non-Migrating Bioactive Polymers (NMBP) in Food Packaging:** Advantages of NMBP, Inherently Bioactive synthetic polymers: types and application, Polymers with immobilized bioactive compounds, Applications of polymers with immobilized bioactive compounds. **Moisture regulation:** Silica gel, Clay, Molecular sieve, Humectant salts, Irreversible adsorption.

UNIT-III Time-Temperature Indicators (TTIs): Defining and classifying TTIs, Requirements for TTIs, The development of TTIs, Maximizing the effectiveness of TTIs, Using TTIs to monitor shelf-life during distribution. **The use of freshness indicators in packaging:** Compounds indicating the quality of packaged food products, Freshness indicators, Pathogen indicators other methods for spoilage detection. **Packaging-Flavor Interactions:** Factors affecting flavor absorption, the role of the food matrix, the role of differing packaging materials, Flavor modification and sensory quality.

UNIT-IV Developments in Modified Atmosphere Packaging (MAP): Novel MAP gases, testing novel MAP applications, applying high O_2 MAP. MAP, product safety and nutritional quality; Reducing pathogen risks in MAP-prepared produce; Detecting leaks in modified atmosphere packaging; Combining MAP with other preservation techniques; Integrating MAP with new germicidal techniques; Improving MAP through conceptual models. **Recycling Packaging Materials:** The recyclability of packaging plastics, improving the recyclability of plastics packaging, Testing the safety and quality of recycled material, using recycled plastics in packaging.

UNIT-V Green Plastics for Food Packaging: The problem of plastic packaging waste, the range of biopolymers, developing novel biodegradable materials. **Integrated Intelligent Packaging, storage and distribution:** The supply chain for perishable foods, role of packaging in the supply chain, creating integrated packaging, storage and distribution: alarm systems and TTIs. **Testing consumer responses towards new packaging concepts**: New packaging techniques, Methods for testing consumer responses, Consumer attitudes towards active and intelligent packaging. **Optimizing Packaging**.

OUTCOME

Skills to select and design packaging for foods.

TEXT BOOKS

1. Aaron L. Brody, Eugene R. Strupinsky, Lauri R. Kline, Active Packaging for Food Applications, CRC Press, 2002.
2. F A Paine and H Y Paine, A Handbook of Food Packaging, 2nd Edition, Blackie & Sons Ltd., Glasgow, UK, 1983.
3. R. Ahvenainen., Novel Food Packaging Techniques, CRC Press, 2003.
4. Jung H. Han, Packaging for Non Thermal Processing of Food, 1st Edition, IFT Press, 2007.
5. Richard Coles, Derek McDowell, Mark J. Kirwan, Food Packaging Technology, 1st Edition, Blackwell Publishing, CRC Press, 2003.

REFERENCE BOOKS

1. H.B Ajmera & M.R Subramanian, Plastics in packaging, A.P. Vaidya, Secretary IIP, E2, MIDC, 1988.
2. Modern Food Packaging, Published by Indian Institute of Packaging, Mumbai, 1998.
3. Vijaya Khader A, Textbook of Food Science and Technology, ICAR, New Delhi, 2001.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - II Semester		L	T	P	C
		3	0	0	3

FOOD SAFETY, STANDARDS & REGULATIONS

OBJECTIVE

To understand food safety, standards & regulations and implementation.

SYLLABUS

UNIT-I Concepts and Trends in Food Legislation: Evolution of Food Regulations: History of food adulteration and evolution of standards. Food Regulations in India. Need for food laws and regulations, consumer protection. **GATT, WTO, TBT, SPS, FAO:** Overview of Organizational structure, Objectives and Functions.

UNIT-II International Standards: ISO-Origin, Members, Governance, Committees, Procedure employed in development and issue of standards. ISO/TC 34, ISO 9000 series, ISO 22000:2005, Comparison of ISO 9001:2008 vs. ISO 22000:2005, ISO/IEC 17025:2017. **Codex Alimentarius:** Origin & meaning, Membership, Procedure employed in development and issue of standards, Role of CAC and its committees, Codex guidelines in labelling. **Pre-requisites:** Role of GMP, GLP, GAP and GHP-implementation and maintenance in the food industry. **HACCP**- Terminology, Principles, Identification of CCPs, Application of HACCP System and the logic sequence involved.

UNIT-III Indian Food Laws: Brief Review - PFA Act, FPO, MMPO and MFPO. **FSSAI:** Food Safety and Standards Act-2006: Scope; Definitions; Food Safety Standards Rules, Food Safety Standards Regulations, Food Safety & Standards Authority of India– Organizational chart– Committees and Panels, Enforcement of the act, Powers of Food Safety Officer, Responsibilities of Food Business Operator, Food Analyst, Sampling and analysis, Offences and penalties – Adjudication and Food safety appellate tribunal, Food recall procedures, Product Approval, Licensing for food businesses, Packaging and Labelling Regulations. New initiatives taken by FSSAI.

UNIT-IV Indian Food Laws: AGMARK: AGMARK Act & Rules: Scope, Definitions, Certification policy & Procedure, laboratory approvals, Action on noncompliance. **BIS:** Evolution of BIS, Scope, Definitions, Power & Functions of BIS, Licensing procedure, mandatory certification for foods, National Standards Body of India. **APEDA, MPEDA, EIC** and their role in exports. Legal Metrology Act for Packaged commodities.

UNIT-V Legislation in Europe/US and other countries: Evolution, Treaties, Members-Benefits; Risk Analysis, Farm to Fork management of Food Chain, Introduction to EU General Food law (EC 178/2002), EU Legislations (Meaning and nature of each type of legislation), EFSA, Approval Process for Food Additives; Nutritional Labeling (Claims allowed & requirements), Enforcement of Food Laws. Food legislation in UK: Food Safety Act 1990

(Imports & Exports, Safety, Traceability, Labeling, Product withdrawal & recall), National Control Plan for UK. **US Food Regulations:** Introduction to Food Regulation in the United States, CFR Title 21, Federal Meat Inspection Act (1906), Federal Food Drug and Cosmetic Act (1938), Fair Packaging and Labeling Act (1966), Food labelling. USFDA, USDA, FSIS-Inspection and Enforcement. **Legislations in other countries:** Other Regulatory bodies around
the world: (FSANZ) Australia and New Zealand, CFIA, KFDA. Differences in food and nutritional labelling around the world. Case studies on regulations in various countries. Risk analysis paradigm for framing the standards for food safety.

OUTCOME

Knowledge on various food safety and regulatory aspects.

TEXT BOOKS

1. Cynthia A. Roberts, The Food Safety information Handbook, Oryx Press, 2001.
2. Ronald H. Schmidt, Gary E. Rodrick, Food Safety Handbook, John Wiley & Sons, 2005.
3. The Food Safety Standards Act, 2006, Commercial Law Publishers (India) Pvt. Ltd., 2014.
4. Neal D. Fortin, JD, Food Regulation Law, Science, Policy & Practice, 2009.
5. Suresh Chandra Babu, Economic Reforms and Food Security: The Impact of Trade and Technology in South Asia, Haworth Press, 2005.
6. F. H. Erbisch, K. M. Maredia, Intellectual property rights in Agricultural Biotechnology, CABI, 2010.
7. R. W. O'Donnell, John J. O'Malley, Randolph J. Huis, Gerald B. Halt, Intellectual Property in the Food Technology Industry, Springer, 2008.

REFERENCE BOOKS

1. S. K. Chakraborty, Values and Ethics in Organization, OUP, 2001.
2. N. Tripathi, Human Values, New Age International, 2011.
3. Santaniello, Evenson, Ziberman, Carlson, Agriculture and Intellectual Property Rights, Univ. Press, 1998.
4. Tamara K. Hervey, Jean V. McHale, European Union Health Law: Themes and Implications, 2015.

I Year - II Semester		L	T	P	C
		3	0	0	3

LIPID TECHNOLOGY

OBJECTIVE

To learn the chemistry of lipids and technology of manufacturing various lipid based products.

SYLLABUS

UNIT-I Sources of Lipid: Plant, Animal, Microbial, Marine Structured lipids and fats. Structure function relation to food, polymorphism of fats; plasticity of edible oil and fat, lipid- protein and lipid-saccharide interactions.

UNIT-II Oil and fat processing- Extraction/ rendering, refining, degumming, Bleaching, filtration, hydrogenation, inter-esterification, winterization, Dewaxing, fractionation, blending, deodorization, packaging and handling finished fat.

UNIT-III Bakery Fat- functions of fat in cake, pastry and biscuit; Quality parameters for shortening; Liquid shortening and powdered fat. Salad dressing- types and categories- pourable, spoon able etc., Ingredients and manufacturing process of mayonnaise, salad cream, French dressing.

UNIT-IV Fat for chocolate and sugar confectionery- Properties and processing of cocoa butter; fat bloom in confectionery- causes and control. Spreadable fats- types- margarine, sweet and savoury spreads; Ingredients and process technology.

UNIT-V Culinary fats and speciality oils- selection criteria of a frying fat Process Technology for powdered or beaded fat; Fat flakes; Quality analysis of fats and oils Food reformulation to reduce saturated fats- biscuits, savoury snacks, pastry and confectionery.

OUTCOME

Knowledge in the area of oil extraction, refining and manufacturing of various fat based products.

TEXT BOOKS

1. Food Chemistry, O.R. Fennema, Ed., 2008. Marcel and Dekker, Inc., New York, NY.
2. Bailey's Industrial Oil & Fats Products, Ed. by Y.H. Hui, John Wiley & Sons, Inc Akoh, C. C. and Min, D. B. 2002.
3. Food Lipids: Chemistry, Nutrition, and Biotechnology. Marcel Dekker, Inc. Newyork. Gunstone, F. D. 2006.

REFERENCE BOOKS

1. Modifying lipids for use in food. Woodhead Publishing Limited, Gunstone, F. D. 2008.
2. Oils and fats in the food industry. Wiley-Blackwell Talbot, G. 2011.
3. Reducing saturated fats in foods. Woodhead Publishing Limited, Rajah, K.K. 2002.
4. Fats in Food Technology. Sheffield Academic Press Ltd

I Year - II Semester		L	T	P	C
		3	0	0	3

PROTEIN TECHNOLOGY

OBJECTIVE

To teach the importance of Protein and its role in food processing.

SYLLABUS

UNIT-I Survey of protein availability and world's protein need. Present status of proteins in food industry Classification of proteins by structure or function; Chemical and functional properties of proteins in food systems.

UNIT-II Modification of chemical and functional properties of food proteins, Protein interactions with other food constituents. Rheological properties of protein- solubility, viscosity, gelling, and surfactants Proteins functionality test- Model foods for testing- foam, gelation, emulsification (Whipped topping, Angel cake).

UNIT-III Milk proteins- casein: Structure and properties, manufacture of casein based ingredients, Use and application of casein based ingredients, interaction with other ingredients. **Cereal protein**- Gluten: formation, properties and modification and food applications (bread, biscuit, pasta), Gluten manufacturing process, use and application of gluten.

UNIT-IV Soy protein- structures and functional properties of β-conglycinin and glycinin, production technology for soy protein isolate; Application of soy proteins as food ingredients, improving soy protein functionality. **Textured vegetable proteins** and spun fiber technology, types of textured vegetable proteins, Processing of raw materials for texturization, Application of textured vegetable proteins.

UNIT-V Gelatin: Introduction, manufacturing process, regulations and standard quality test methods, chemical composition and physical properties, Gelatin derivatives, application of gelatin. **Single cell protein**- significance, historical evolution in production, harvesting and commercialization, functional properties, utilization. **Protein as antifreeze agent**- evolution and structures, mechanism of action, application Taste modifying proteins- types, methods of extraction and purification.

OUTCOME

Proficiency in various food proteins and their application in Food industry.

TEXT BOOKS

1. Yada, R. Y. 2004. Proteins in food processing. Woodhead Publishing Limited and CRC Press LLC
2. Gennadios, A. 2002. Protein-Based Films and Coatings. CRC Press LLC
3. G.O and Williams.P.A. 2011. Handbook of food proteins, Woodhead Publishing Limited, New Delhi.

REFERENCE BOOKS

1. Fennema OR. 1985. Food Chemistry.
2. Thompson. Abby, Boland, Mike and Harjinder Singh. 2009. Milk Proteins from Expression to Food. Academic Press is an imprint of Elsevier.

I Year - II Semester		L	T	P	C
		3	0	0	3

CARBOHYDRATE TECHNOLOGY

OBJECTIVE

To understand the importance of Polysaccharides and gums in Food product technology.

UNIT-I Carbohydrates: introduction, classification Carbohydrate structure, functions, chemical, physical and rheological properties. Use of carbohydrates in food industries: role of sugar, liquid sugar, starches, starch hydrolysates, pectin, invert sugar Role of Carbohydrates in confectionery, beverage industry; Role of Carbohydrates in frozen foods, meat processing, role of sweeteners in food flavors, sugar in human nutrition.

UNIT-II Dietary fibers and their role in human health. The role of dietary fiber in the prevention of lipid metabolism disorders; Polydextrose as soluble fiber and complex carbohydrate to reduce calorie intake. Complex carbohydrates as fat mimetics. Carbohydrates as prebiotics.

UNIT-III Important polysaccharides – Structures, properties and utilization: Agar, Alginates, Carrageenan, Furcellaran, Gum Arabic, Karaya Gum, Guar Gum, Locust Bean Gum, Tamarind Flour, Pectin, Dextrin, Inulin and Oligo fructose. Role of Carbohydrates as food additives, (bulking agents, emulsifiers, stabilizers, sweeteners, gelling and textural agent, carriers of flavor, hydrocolloids).

UNIT-IV Industrial production of plant carbohydrates and the impact on human health & nutrition, Functional food ingredients, Pectin, carrageenan and other hydrocolloids; Glucans and arabino-xylans, Fibre function, resistant starch and health. Starch-lipid composites, starch-protein blend and its applications, Thermo-reversible gels from grain; Heart-healthy foods from modified carbohydrate, Carbohydrate arrays (Glycan array).

UNIT-V Analysis of carbohydrates using various analytical methods- HPLC and others: Methods for the analysis of dietary fiber and complex Carbohydrates, resistant starch; NIR Analysis of dietary fiber.

OUTCOME

Competence in different classes of Carbohydrates and their role in Food industry.

TEXT BOOKS

1. Damodaran, S., Parkin, K. L., and Fennema, O.R. (2008) Fennema's Food Chemistry 4th Edition, CRC Press
2. Belitz, H-D., Grosch, W. & Schieberle, P. (2004) Food Chemistry 3rd Ed. (translation of fifth German edition)

REFERENCE BOOKS

1. Food Chemistry, O.R. Fennema, Ed., 2008. Marcel and Dekker, Inc., New York, NY.
2. Springer Atkins, P. (1997) The Elements of Physical Chemistry, W.H. Freeman & Co.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - II Semester		L	T	P	C
		3	0	0	3

FROZEN FOOD TECHNOLOGY

OBJECTIVE

To understand the importance of freezing in the preservation of foods.

SYLLABUS

UNIT-I Fundamentals of Freezing: Physical chemical principles in freezing, glass transition in frozen food systems, refrigeration cycles, microbiology of frozen foods, thermo physical properties of frozen foods, mathematical modeling of freezing process

UNIT-II Facilities for the cold chain: Freezing methods and equipment, cold store design and maintenance, transportation of frozen foods, retail display equipment and management, monitoring and control of cold chain.

UNIT-III Freezing Technology: The freezing process, freezing capacity, mechanical refrigeration, cryogenic refrigeration systems, freezing time calculations, freezer selection, economics of freezing, freezing equipment, belt freezers, fluidized bed freezers, contact freezers, cryogenic freezers, liquid carbon dioxide freezers, form freezing, physical storage and distribution of frozen foods, frozen food supply chain.

UNIT-IV Emerging technologies of food freezing: Ultra sound accelerated freezing, high pressure shift freezing, electro static field assisted food freezing, antifreeze proteins.

UNIT-V Packaging of frozen foods: Introduction to frozen food packaging, plastic packaging of frozen foods, packaging of frozen foods with other materials, active and intelligent packaging, vacuum packaging, edible coatings and films and their applications on frozen foods.

OUTCOME

Knowledge on the various processes, Advances and product manufacturing is gained.

TEXT BOOKS

1. De wan sun, Handbook of Frozen food processing and packaging 2nd Edition, CRC Press, 2012.
2. Judith A. Evans, Frozen Food Science and Technology, Blackwell publishing ltd, 2008.

REFERENCE BOOKS

1. Mallett. C. P., Frozen Food Technology, Blackie Academic and Professional, 1993.
2. Pruthi. J. S., Quick Freezing Preservation of Foods, Volume II, ISBN, 1999.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - II Semester		L	T	P	C
		3	0	0	3

FLAVOR TECHNOLOGY

OBJECTIVE

To understand the importance of Flavors in Foods and their chemistry.

SYLLABUS

UNIT – I Food flavor and its importance to consumers and food processors. Flavor and nutrition. Sources, extraction, delivery systems, and analyses (chemical, instrumental, and sensory) of flavours and flavorings in foods.

UNIT – II Sensory perception of flavor: Senses of taste and smell, tasting versus sniffing, astringency, pungency, interaction of senses in flavor perception; taste, odour and acceptance of flavor stimuli. Chemistry of substances responsible for taste and flavor-taste sensations, flavour enhancers, flavour potentiators or modifiers. Methodology of sensory evaluation and determination of threshold levels as specified by BIS.

UNIT – III Flavoring constituents of various foods like meat, fish, milk, vegetables, fruits, fats & oils, spices & herbs, cereals and pulses. Flavor changes during processing, preservation, packaging, and storage of foods. Roles as sulphur compounds, fatty acids, amino acids, terpenoids, lactic acid ethanol in food flavours. Process and reaction flavours/volatiles in foods.

UNIT – IV Spices and herbs as food flavorings: Processing of basil, mint, saffron, cloves, tamarind, ginger, cardamom, chill, pepper etc. for essential oils, extracts and/or oleoresins.

UNIT – V Determination of hygroscopic nature and shelf life/acceptance of foods. Natural, Nature identical and Synthetic flavors: Definitions, chemical composition/constituents, extraction and preparation of flavors, Stability and utility of flavor preparations. Methods used in flavor evaluation. BIS Specifications/FSSAI restrictions for use of certain constituents in flavoring materials.

OUTCOME

Adequate knowledge on Flavor types, stability, and role in Food industry.

TEXT BOOKS

1. Flavor Chemistry and Technology. G. Reineccius, Taylor & Francis Publishers, 2nd Edition, 2006.
2. Food Chemistry. O.R. Fennema, Food Science & Technology series, CRC press, New York, 4th Edition, 2007.

REFERENCE BOOKS

1. Spices and Flavor Technology. J.S. Pruthi, ICAR Publications, 2nd Edition, 1998.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - II Semester		L	T	P	C
		3	0	0	3

BREWING TECHNOLOGY

OBJECTIVE

To understand the Beer manufacturing, ingredients and their roles.

UNIT-I Introduction of brewing, history of brewing; Raw materials: barley, hops, water, yeast; Adjuncts for beer production: Maize, rice, millet, wheat, sugar etc.

UNIT-II Malt production, role of enzymes for malting; Barley storage, steeping, germination, kilning, cooling, storage; Malt from other cereals, caramel malt, roasted malt, smoked malt, malt extract; Malt quality evaluation.

UNIT-III Wort production, malt milling, Mashing, Mashing vessels; Wort boiling, clarification, cooling and aeration Enzyme properties, starch degradation, b-glucan degradation; Conversion of fatty matter, Biological acidification.

UNIT-IV Beer production methods, fermentation technology, changes during fermentation; Filtration procedure and equipment, beer stabilization conditions and durations, beer carbonation process; Packaging equipment and packaging materials, storage conditions and distribution process. Brewing Equipments. Grain mill, kettles, siphons, carboys, fermentation equipment, wort chillers, pumps beer bottles, cans, labels, bottle caps, sanitation equipments.

UNIT-V Preventive Production of beer against technology, ling phenomenon of beer, possible measures against staling reactions, oxidation. Recent advances: Immobilized Cell Technology in Beer Production, immobilized yeast cell technology. Energy management in the brewery and malting; waste water treatment Automation and plant planning.

OUTCOME

Proficiency in beer making and understanding Brewery.

TEXT BOOKS

1. Dennis E. Briggs, Chris A. Boulton, Peter A. 2004.
2. Brewing: science and practice, Brookes and Roger Stevens, Woodhead publishing limited Wolfgang Kunze, 2010.
3. Technology of Brewing and malting, Bibliographic information published by Die Deutsche Bibliothek Hans Michael Eßlinger, 2009.

REFERENCE BOOKS

1. Handbook of Brewing: Process, Technology, Markets, Wiley-VCH Verlag GmbH & Co.KgaA Charles W. Bamforth. 2006.
2. Brewing: New Technologies, Woodhead Pub.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - II Semester		L	T	P	C
		0	0	4	2
FOOD PROCESSING OPERATIONS LAB					

OBJECTIVE

To refresh/update the practical knowledge on Food processing operations.

SYLLABUS

Following are some of the typical unit operations:

1. Drying
2. Centrifugation
3. Sedimentation
4. Grinding
5. Screening
6. Grading
7. Filtration
8. Leaching
9. Liquid-liquid Extraction
10. Solvent extraction
11. Evaporation
12. Mixing
13. Extrusion
14. Crystallization
15. Distillation
16. Baking
17. Frying
18. Roasting

OUTCOME

Practical knowledge on effect of operating parameters in food processing operations.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - II Semester		L	T	P	C
		0	0	4	2
VIRTUAL LABS					

OBJECTIVE

To refresh/update the knowledge on Food processing operations through virtual labs

FLUID FLOW

1. Flow through Pipes
2. Flow through Fittings
3. Flow through Orifice meter
4. Flow through Venturi meter
5. Flow through packed bed
6. Flow through Fluidized bed
7. Friction in Pipes

HEAT TRANSFER

1. Parallel flow heat exchanger
2. Heat flow by conduction
3. Heat transfer by natural convection
4. Heat transfer by forced convection
5. Heat transfer by radiation

MASS TRANSFER (IIT Guwahati)

1. ASTM distillation
2. Column tray efficiency
3. Rotary Dryer
4. Forced draft tray dryer
5. Vapor in air diffusion
6. Mass transfer with or without chemical reaction
7. Binary vapor liquid equilibrium
8. Design of binary distillation column
9. Water cooling tower

PROCESS DYNAMICS (IIT Kharagpur)

1. Stirred tank heater
2. Heat Exchanger
3. Continuous Stirred Tank Reactor
4. Adsorption
5. Feed batch Fermentor
6. Membrane separation

OUTCOME

Knowledge on effect of operating parameters in Food processing operations

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

I Year - II Semester		L	T	P	C
		3	0	0	3
MINI PROJECT WITH SEMINAR ON NEW PRODUCT DEVELOPMENT/PROCESS/METHOD					

OBJECTIVE

To develop new product/process/method or improve the existing product/process/method and establish its feasibility

SYLLABUS

The following is the Plan of work:

1. Identification of product/process/method for development
2. Literature survey
3. Design of experiments
4. Product preparation
5. Results and conclusion
6. Preparation of Report/Publication
7. Preparation of preliminary feasibility report:
    i. Raw material availability
    ii. Demand for Product
    iii. Selection of location
    iv. Process details
    v. List of equipment with complete specifications and suppliers
    vi. Layout
    vii. Project cost
    viii. Cost of production
    ix. Profitability (with breakeven point, payback period etc.)

OUTCOME

Abilities to develop new product/process/method and prepare a project feasibility report

I Year - II Semester		L	T	P	C
		3	0	0	3

FOOD BUSINESS MANAGEMENT

OBJECTIVE

To enlighten the student about the various functional areas of management and to enable them to manage any successful organization.

SYLLABUS

UNIT-I Management: Definitions, scope and importance, Managerial roles and functions, Management - Science or Art? Internal and External environment, managing for competitive advantage-the challenges of management in cross- cultural environment, Corporate Social Responsibility, Managerial ethics.

UNIT-II Financial Management: Nature of capital budgeting, decisions-techniques of capital budgeting: pay back method, average rate of return and Time adjusted methods: IRR and NPV, profitability index, and excess present value index. Advanced problems and cases in capital budgeting. Statement of Changes in Working Capital, Funds flow and cash flow statement.

UNIT-III Human Resource Management: Definition and functions of HRM, Significance of HRM, Evolution of HRM, Role of HRM to increase firm performance, Role and position of HR department, HRM at global perspective, Changing dynamics of HRM in globalized scenario. Importance of recruitment and selection, Nature and Significance of Human Resource Development, human resource accounting practices and standards-problems- HR audit-process-HRIS Process and its significance.

UNIT-IV Marketing Management: Introduction to marketing: needs, wants, demands, products, exchange, transactions, market, marketing, Evolution of marketing concepts, Indian marketing environment, role and functions of marketing department, Marketing mix and significance of 4Ps, product life cycle stages, skimming and penetration pricing strategies, Market segmentation and targeting- factors affecting effective segmentation, essentials of effective segmentation, Identification of market segments-marketing strategies. Positioning strategies, Need for international marketing, nature and significance of international trade, Balance of payments-nature-causes for disequilibrium in balance of payments, Trends in international business.

UNIT-V Company laws: Company Act, 1956: Nature and Types of companies-formation-memorandum of association-articles of association-kinds of shares-duties of directors-winding up.

OUTCOME

Skills to manage a food industry.

TEXT BOOKS

1. Greg A.Baker, Orlen Grunewald, William D. Gorman, Introduction to Food and Agribusiness Management: Prentice Hall, 2002.
2. K.Aswathappa, Human Resource and Personnel Management, Tata McGraw Hill, 2002.
3. M.Y.Khan, P.K.Jain, Financial Management – Text and problems, Tata McGraw Hill, 2010.
4. P.Subba Rao, International Business- Text and cases, Himalaya publishing house, 2012.
5. Rajan Saxena, Marketing Management, Tata McGraw Hill, 2011.
6. S.S Gulshan, G.K. Kapoor, Business law including company law, New age Publishers, 2008.
7. Weihrich and Aryasri, Principles of Management: Koontz, Tata McGraw Hill, 2004.

REFERENCE BOOKS

1. Biswanth Ghosh, Human Resource Development and Management, Vikas Publishing, 2010.
2. Gary Dessler, Human Resource Management, PHI Private Limited, New Delhi, 2007.
3. Jawaharlal, Advanced Management Accounting, S.Chand and Company Limited, New Delhi, 2010.
4. K. Aswathappa, Essentials of business environment, Himalaya publishing, 2000.
5. Philip Kotler, Marketing Management, Prentice Hall/ Pearson Education, 2011.
6. Sundaram and Black, International Business Environment, Text and cases, PHI Private Limited, 2012.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

II Year - I Semester		L	T	P	C
		3	0	0	3

ADVANCED DRYING TECHNOLOGY

OBJECTIVE

To understand mechanism of drying and advanced application of drying in food processing

UNIT-I Drying fundamentals: Theories of drying, drying rate characteristic curve, heat and mass transfer mechanisms in drying, models for prediction of sorption isotherms, thermodynamics of sorption isotherms. Need for advanced drying technologies, classification and selection criteria- conventional versus novel technologies.

UNIT –II Innovation and trends in drying technologies: Impinging steam drying: basic features, hydrodynamics and heat transfer Pulsed fluid bed drying: principles and examples Low pressure superheated steam drying: Basic principle of LPSSD, LPSSD of food and biomaterials.

UNIT –III Airless drying: Drying in mobilized beds, vacuum jet drying, Refractance window drying, Acoustic drying, RF vacuum drying, Contact sorption drying: mechanism, characteristics of sorbents/carriers, technology of contact sorption drying

UNIT –IV Heat pump assisted drying: Classification of heat pump dryers, fundamentals of heat pump dryers, heat and mass transfer mechanisms, optimum use of heat pump in drying systems, innovative heat pump design systems. Sonic drying: basic characteristics of sound, sound generation, mechanism of sonic drying, drying kinetics, sound assisted dryers.

UNIT-V Pulse combustion drying: Principle, combustors design and construction, types of combustors, Hybrid drying technologies: microwave-convective drying with cogeneration, microwave vacuum drying, filter mat drying, spray fluid bed vibrated fluid bed dryer, Food dryer process controls: need of process control, control parameters, control strategy, control philosophy, fundamental control methods, and advanced control.

OUTCOME

Knowledge of innovative drying technology in food processing.

TEXT BOOKS

1. Advanced Drying Technologies, Kudra T & Mujumdar AS, CRC Press, 2009
2. Dehydration of foods, Barbosa-Canovas GV, Vega-Mercado HV, International Thomson publishing, 1996.

REFERENCE BOOKS

1. Ratti, C. (Ed.). (2008). Advances in food dehydration. CRC Press.
2. Kudra, T. (2009). Energy aspects in food dehydration. Advances in food dehydration, 423-445.

II Year -I Semester		L	T	P	C
		3	0	0	3

INDUSTRIAL FERMENTATION

OBJECTIVE

To acquaint with importance of food fermentation and its application.

UNIT-I Industrial Fermentation: Fundamentals involved in the production of industrial Microbial products such as details of the fermenters/Bioreactors, types of fermenters, Types of fermentation – solid state and submerged; Design and working of batch, fed-batch and continuous fermenters; Scale up of Bioreactors; Sterilization methods.

UNIT-II Media for Fermentation: Importance of media components for production of industrial products by fermentation; use of different sources of carbon, nitrogen, minerals and activators for commercial fermentation; importance of pH, temperature and aeration in fermentation; optimization of fermentation media. **Enzyme kinetics:** Michaelis-Menten Constant, Competitive, Non-competitive inhibitions, Lineweaver- Burke Plot, Regulation of enzymes. Growth Kinetics: Modeling and optimization techniques.

UNIT-III Downstream processing: Importance, need for downstream processing, unit operations for downstream processing (Cell Harvesting and Disruption, Filtration, Centrifugation, Extraction, Adsorption, Chromatography, Electrophoresis, Membrane separation & Drying) and their importance.

UNIT-IV Alcoholic and Non-Alcoholic Beverages: Production of Alcoholic Beverages based on fruit juices (wines), cereals (whisky, beer, vodka etc.), sugar cane (rum) etc. Process description, quality of raw materials, fermentation process controls etc. Production of non-alcoholic beverages like tea, coffee and cocoa. A detailed study of 'Ethanol' production by fermentation using black strap molasses, starchy substances and cellulose substrates like waste sulphate liquor and purification methods for production of absolute ethyl alcohol.

UNIT-V Food Products: Processes for preparing milk based fermented products including Cheese, Yoghurt (curd) and other Traditional Indian Products like Idli, Dosa, Dhokla, Shrikhand, etc., Soya based products like Soya sauce, Natto, etc., control of quality in such products. **Other products for food industry applications:** Fermentative production of Organic acids like (Citric Acid, Lactic Acid, Acetic Acid), Amino Acids (Glutamic acid, Lysine), Vitamins, Antibiotics (Erythromycin, Penicillin), Oligosaccharides (GOS, FOS) and Polysaccharides (Dextran, Xanthan) etc.; flavor components and industrial enzyme production by micro-organisms; process descriptions and key controls for optimal production.

OUTCOME

Knowledge in fermentation processes & Products.

TEXT BOOKS

1. A. H. Patel, Industrial Microbiology, Macmillan Publishers India, 2000.
2. J. E. Bailey and D. F. Ollis, Biochemical engineering fundamentals, McGraw Hill Book Co., 1986.
3. Paul A. Belter, E. L. Cussler & Nei Shou Hu, Bio-separation – Downstream processing for biotechnology, A wiley interscience Publication, 1988.
4. Wulf Creuger & Anneliese Creuger., A Textbook of Industrial Microbiology, Sinauer Associates, 2005.

REFERENCE BOOKS

1. Conn, J. M and Schick W.A, Food Processing on Industrial Power House in Transition, John Willey and Sons, New York, 1997.
2. H.J. Peppler and D. Pulman, Microbial Technology Volume 1 & 2, Academic Press, 1979.
3. Vine R.P., Commercial wine making process and controls, Chapman & Hall, London, New York, 1978.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

II Year - I Semester		L	T	P	C
		3	0	0	3

THERMAL PROCESSING

OBJECTIVE

To understand advances in thermal processing.

UNIT-I Introduction: Thermo-physical properties of foods, Heat and mass transfer in Thermal food processing, processing systems: In pack processing- Retort system, Inline processing- Heat exchangers. **Quality and Safety of Thermally Processed Foods:** Thermal processing of: Meat products, Poultry products, Fishery products, Dairy products, canned foods, Ready meals, Vegetables, UHT thermal processing of milk.

UNIT-II Thermal Processing Design and Optimization: Basic principles in thermal destruction of microorganisms - D, Z, F_o values; Thermal processing, sterilization classification U.H.T. systems, recent advances design of thermal processes. Survival curves, thermal death curves, analysis of thermal resistance data, process time evaluation. Regulatory considerations, Critical factors related to the design of thermal treatments for the products packaged prior to treatment.

UNIT-III Measurement and Validation of Thermal Processes: Setting the target process value, Validation methods: Objectives and Principles, Temperature measurement approaches, Process establishment methods, Process calculation methods. **Online control and automation:** Online control and strategies- batch processing, plant automation for automatic batch retort systems.

UNIT-IV Developments in Packaging Formats for Retort Processing: Introduction: requirements for low and high acid foods, Developments in packaging formats: the metal can, plastic can, pot and bottle, retort pouches: construction, sealing, processing and packaging, methods for improving glass packaging, Future trends.

UNIT-V Innovations in Thermal Food Processes: Ohmic heating in Food processes, radio frequency dielectric heating, infrared heating, and pressure assisted thermal processing, pH assisted thermal processing, time-temperature integrators for thermal process evaluation, and laser based packaging sterilization in aseptic processing.

OUTCOME

Technical know-how on foods manufactured by thermal processing.

TEXT BOOKS

1. Sandeep. K. P., Thermal Processing of Foods, Blackwell publishing, 2011.
2. Tucker. G & Susan. F., Essentials of Thermal Processing, 1st Edition, Wiley-Blackwell, 2011.

REFERENCE BOOKS

1. Da-Wen Sun, Thermal Food Processing, CRC Press, 1st Edition, 2006.
2. Philip Richardson, Improving the Thermal Processing of Foods, 1st Edition, CRC Wood head publishing limited, 2004.
3. Ricardo Simpson, Engineering Aspects of Thermal Food Processing, CRC Press, 2009.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

II Year - I Semester		L	T	P	C
		3	0	0	3

NOVEL TECHNOLOGIES AND FOOD PROCESSING AND SHELF-LIFE EXTENSION

COURSE OUTLINE:

Food processing which includes both fresh and packaged food involves handling of foods, preparation and storage through the subsequent stages so that the pathogens and toxic components present in food are destroyed and deactivated making the food safer and hygienic. It is the capability of the food processing sector to develop novel food processing and preservation technologies to manufacture and preserve food in an elective manner with a view to enhance their shelf life, improve quality as well as make them functionally more useful.

Syllabus:

Introduction to food processing, preservation, and quality. Basic principles & methods, water activity vs. food stability, structure-function relationship.

Chemical changes in food during processing. Browning reactions (enzymatic and non-enzymatic),

protein interactions, carbohydrate interactions, Rancidity & reversion.

High pressure processing and Membrane technologies in food processing.

Food irradiation, RF & microwave heating; Super critical -fluid extraction and ultrasonication.

Food extrusion technology, RTE snack foods, Textured vegetable protein, Rice and dal analogues.

Hurdle technology concept, Natural antimicrobials & bacteriocin; Freeze drying.

Controlled atmosphere storage of food grains; ozone, microwave treatment for disinfestation of grains. Detection of spoilage in grains.

Modified atmosphere packaging, Active packaging, and Edible coating of fruits & vegetables

Extraction and processing of oil, Mechanical expellers, solvent extraction, refining, hydrogenation,

winterization

Shelf-life extension of oils using natural antioxidants. Concept and, measurement of rancidity.

Microencapsulation of bioactive and Technology of oil powder.

Functional foods and Nutraceuticals. Ready to eat therapeutic food, micronutrient fortified high energy bar, gluten free bread, lactose free milk, carbonated cereal beverage.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

II Year - I Semester		L	T	P	C
		3	0	0	3

THERMAL PROCESSING OF FOODS

The Food and Agriculture Organization (FAO) of the United Nations (UN) issued a report on the importance and complexities associated with feeding the projected 9.1 billion world population in 2050. Sustainable production of safe and nutritious foods, development of foods that have a long shelf life and foods that are either ready-to-eat or easy to are of greater importance towards meeting this goal. Understanding "Food Engineering" and "Thermal Processing of Foods" serves as basic requirement means of meeting this goal.

Syllabus:

Food microbiology: microbial growth and concerns in various foods, Blanching, Pasteurization, Ultra-pasteurization, Hot fill and UHT.

Thermal processing equipment, Milk pasteurization, Canning operations.

Temperature distribution and heat penetration, Kinetics of reactions, F value and process requirements.

Quality considerations and process optimization, Shelf-life studies, Validation of heat processes.

Fundamentals of aseptic processing, Aseptic equipment design, Aseptic process design.

Microwave and radio frequency heating,Ohmic heating, Overview of non-thermal processing Technologies.

Advanced separation processes high pressure, dialysis ultrafiltration and reverse osmosis nanofiltration, electro dialysis and membrane separation.

Various types of heat exchangers for food process engineering Various types of driers for food process engineering.

Importance and applications of extrusion technology in food processing Changes of properties and functional components of extruded foods.

Food biosensors Types of functional foods: Probiotics and nutraceuticals.

Packaging considerations: Barrier and mechanical properties of different food packaging materials biocomposite/bionanocomposite materials for food packaging applications.

Sanitary components and requirements, Regulatory considerations.

II Year - I Semester		L	T	P	C
		3	0	0	3

DAIRY AND FOOD PROCESS ANDPRODUCTS TECHNOLOGY

This course will cover basics of dairy (liquid food) food processing and preservation technologies required in any dairy and food processing industries. The basic knowledge on dairy food processing is intermingled with most of the unit operations at some or other stage of processing. Since, this basic aspect of food processing and preservations not taught in most of the Agricultural engineering institutions elaborately, a comprehension of these aspects of processing and preservation will enrich the knowledge base of the students in general.

Syllabus:

Basic principles and methods of food processing and preservation. Emerging Technologies in food
processing. Food additives and preservatives.

Food laws and standards. Effect of processing on acceptability and nutritive value of food.

Physico-chemical properties and structure of milk and milk constituents.

Chemical and microbial spoilage of milk and milk products; Fluid milk Processing, packaging and
distribution.

Common dairy processes – cream separation (standardization), pasteurization, sterilization and Homogenization.

Process technology for manufacture of evaporated milk, condensed milk, dried milk, malted milk,
infant and baby foods, ice-cream, cheese, butter, fermented milk and indigenous dairy products.

Methods and procedures for sampling and testing of milk and milk products. Laws and standards for
milk and milk products.

Technological processes for industrially manufactured foods of commercial importance, from plant
and animal origin.

Cereals, vegetables, fruits, meats, poultry, and egg products; Bakery, pasta and confectionary products, ready to eat foods, fermented foods, alcoholic and non- alcoholic Beverages, tea, coffee
and cocoa, fabricated foods.

Packaging materials; Characteristics, properties, and their design. Packaging requirement for different processed and unprocessed foods.

Working Principles of various type of fillers: form-fill- seal machine.

Gas packaging and modified atmosphere Package design. Shelf-life prediction of foods in packages.

Quality control in Food packaging. Product safety and packaging regulations.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

II Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE

There are complex real-world problems like speech recognition and machine translations that span across various practices of engineering. Aim of artificial intelligence (AI) is to tackle these problems with rigorous mathematical tools. The objective of this course is to present an principles and practices of AI to address such complex real-world problems. The course is designed to develop a basic understanding of problem solving, knowledge representation, reasoning and learning methods of AI.

Syllabus:

Artificial intelligence: History, Trends and Future
Problem Solving by search
Problem Solving by search
Knowledge Representation and Reasoning
Reasoning under uncertainty
Planning
Planning, Decision Making
Decision Making
Machine Learning

II Year - I Semester		L	T	P	C
		3	0	0	3
STATISTICS FOR EXPERIMENTALISTS					

INTRODUCTION TO INTERNET OF THINGS

This course is addressed towards students, researchers and engineers carrying out experiments in their fields of study and work. In depth knowledge of probability and statistics, though helpful, is not a pre-requisite to understand the contents of this course. The first part of the course deals with random variables, typical probability distributions, random sampling, confidence intervals on population parameters and hypothesis testing. These form the basic background of statistical analyses. In the second part of this course, design of experiments and regression analysis are introduced. The factorial design of experiments involving two or more factors is discussed in detail. Properties of orthogonal designs and other popular design strategies such as the Central Composite Design and Box Behnken design are also discussed. The characteristic features of experimental design strategies are defined and compared. Linear regression model building concepts are explained using which empirical models may be fitted to experimental data. The methods to assess the quality of the models fitted are discussed. Identification of optimum performance of the process through experimental investigations is demonstrated through the response surface methodology approach. After understanding this course material, the experimentalist will develop the confidence to identify an appropriate design strategy suited for his work. He will also be able to interpret the results of the experiments in a scientific manner and communicate them unambiguously.

Syllabus:

A. Random Variables

Introduction to discrete and continuous random variables, quantify spread andcentral tendencies of discrete and continuous random variables

B. Important Statistical Distributions

Properties and applications of Normal, log-normal and t-distributions, Chi-Square andF distributions

C. Point and interval estimates of population parameters

Point Estimation of the population mean, distribution of the sample means, centralLimit theorem, confidence Intervals on the population mean, optimal sample size toobtain precision and confidence in interval estimates of mean, maximum likelihoodparameter estimation

D. Hypothesis Testing

Formulation of null and alternate hypotheses, errors in hypothesis Tests, power ofhypothesis tests, hypothesis tests on population means, variances and ratios ofvariances

E. Analyze single factor experiments

Introduction to Analysis of Variance (ANOVA), blocking and randomization

F. Factorial Design of Experiments

Need for planned experimentation, factorial design experiments involving twofactors, effect of interactions,ANOVA in factorial design, general factorial design,partial factorial designs

G. Linear Regression Analysis

Matrix approach to linear regression, Variance-Covariance matrix, ANOVA in regression analysis, quantifying regression fits of experimental data, Extra sum of squares approach, confidence intervals on regression coefficients, lack of fit analysis

H. Comparison of different experimental design strategies

Properties of orthogonal designs, implications of different factorial design models, importance of center runs, scaled prediction variance, central composite design, Box Behnken design, moments of experimental designs, rotatable of experimental designs, face centered cuboidal designs, comparison of experimental designs

I. Response Surface Methodology

Method of steepest ascent, first and second order models, identification of optimal process conditions

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

II Year - I Semester		L	T	P	C
		3	0	0	3

INTRODUCTION TO INTERNET OF THINGS

Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defence sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different IoT solutions. IoT-based applications such as innovative shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT based systems. Therefore, it is very important to learn the fundamentals of this emerging technology.

Syllabus:

Introduction to IoT: Part I, Part II, Sensing, Actuation, Basics of Networking: Part-I
Basics of Networking: Part-II, Part III, Part IV, Communication Protocols: Part I, Part II
Communication Protocols: Part III, Part IV, Part V, Sensor Networks: Part I, Part II
Sensor Networks: Part III, Part IV, Part V, Part VI, Machine-to-Machine Communications
Interoperability in IoT, Introduction to Arduino Programming: Part I, Part II, Integration ofSensors and Actuators with Arduino: Part I, Part II
Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT withRaspberry Pi
Implementation of IoT with Raspberry Pi, Introduction to SDN, SDN for IoT
SDN for IoT, Data Handling and Analytics, Cloud Computing
Cloud Computing, Sensor-Cloud
Fog Computing, Smart Cities and Smart Homes
Connected Vehicles, Smart Grid, Industrial IoT
Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring