

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(Established by Govt. of A.P., Act. No. 30 of 2008)
ANANTHAPURAMU – 515 002 (A.P.) INDIA.

Course Structure for B.Tech-R15 Regulations**Food Technology****II YEAR I SEMESTER**

S.No.	Code	Subject	L	T	P	C
1	15A27301	Principles of Food Engineering-I	3	1	-	3
2	15A27302	Food Microbiology	3	1	-	3
3	15A27303	Post Harvest Engineering	3	1	-	3
4	15A27304	Food Biochemistry & Nutrition	3	1	-	3
5	15A27305	Principles of Food Processing & Preservation	3	1	-	3
6	15A27306	Cereals, Pulses & Oilseeds Processing Technology	3	1	-	3
7	15A27307	Food Microbiology Lab	-	-	4	2
8	15A27308	Food Product Lab-I (Cereals, Pulses & Oilseeds)	-	-	4	2
Total			18	6	8	22

II YEAR II SEMESTER

S.No.	Code	Subject	L	T	P	C
1	15A27401	Principles of Food Engineering-II	3	1	-	3
2	15A54401	Probability & Statistics	3	1	-	3
3	15A27402	Fluid Mechanics in Food Process Engineering	3	1	-	3
4	15A27403	Food Chemistry	3	1	-	3
5	15A27404	Fruit and Vegetable Processing	3	1	-	3
6	15A27405	Mechanical Operations & Material Handling	3	1	-	3
7	15A27406	Fluid Mechanics Lab	-	-	4	2
8	15A27407	Mechanical Operations & Milling Lab	-	-	4	2
9	15A27408	Comprehensive Online Examination-I	-	-	-	1
Total			18	6	8	23

III YEAR I SEMESTER

S.No.	Code	Subject	L	T	P	C
1	15A27501	Heat Transfer Operations	3	1	-	3
2	15A27502	Dairy & Dairy Products	3	1	-	3
3	15A27503	Processing of Spices & Plantation Crops	3	1	-	3
4	15A27504	Industrial Microbiology	3	1	-	3
5	15A27505	Food Analysis	3	1	-	3
6	15A27506	MOOCS-I Food Business Management	3	1	-	3
7	15A27507	Heat Transfer Operations Lab	-	-	4	2
8	15A27508	Food Product Lab-II (Fruits and Vegetables)	-	-	4	2
9	15A99501	Audit course – Social Values & Ethics	2	0	2	0
Total			20	6	10	22

III YEAR II SEMESTER

S.No.	Code	Subject	L	T	P	C
1	15A27601	Food Quality & Sensory Evaluation of Food Products	3	1	-	3
2	15A27602	Instrumentation and Process Control	3	1	-	3
3	15A27603	Mass Transfer	3	1	-	3
4	15A27604	Meat & Poultry products	3	1	-	3
5	15A27605	Fish and Marine Products	3	1	-	3
6		Elective-I	3	1	-	3
	15A27606	Food Refrigeration & Cold Chain				
	15A27607	Thermal Operations				
	15A27608	Frozen food Technology				
7	15A27609	Mass Transfer Lab	-	-	4	2
8	15A27610	Food Product Lab-III (Meat, Poultry & Fish)	-	-	4	2
9	15A52602	Advanced English Language Communication Skills (AELCS) Laboratory (Audit Course)			2	-
10	15A27611	Comprehensive Online Examination - II	-	-	-	1
Total			18	6	10	23

IV YEAR I SEMESTER

S.No.	Code	Subject	L	T	P	C
1	15A27701	Food Safety and Standards	3	1	-	3
2	15A27702	Byproduct Utilization and Waste Management in Food Industries	3	1	-	3
3	15A27703	Food Plant Utilities & Energy Conservation	3	1	-	3
4	15A27704	Food Packaging Technology	3	1	-	3
5		Elective -II	3	1	-	3
	15A27705	Food Extrusion Technology				
	15A27706	Bakery, Confectionery & Snack products				
	15A27707	Technology of Traditional foods				
6		Elective -III	3	1	-	3
	15A27708	Technology of Beverages				
	15A27709	Flavor Technology				
	15A27710	Specialty Foods: Nutraceuticals and Functional Foods				
7	15A27711	Food Analysis Lab	-	-	4	2
8	15A27712	Packaging Lab	-	-	4	2
Total			18	6	8	22

IV YEAR II SEMESTER

S.No.	Code	Subject	L	T	P	C
1	15A27801	MOOCS-II	3	1	0	3
		Plant Design and Process Economics				
2	15A27802	MOOCS -III	3	1	0	3
		Food Plant Sanitation & Hygiene				
3	15A27803	Comprehensive Viva Voce	0	0	4	2
4	15A27804	Technical Seminar	0	0	4	2
5	15A27805	Project work	0	0	24	12
Total			6	2	32	22

L – Theory T- Tutorial P – Practical/Drawing C – Credits

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech II-I Sem. (FT)

L	T	P	C
3	1	0	3

(15A27301) PRINCIPLES OF FOOD ENGINEERING – I

Preamble:

The text prescribed for detailed study focuses on basic concepts like units and its conversion, fundamental laws and principles are useful to understand the subject.

Objectives:

- To familiarize the importance and usage of units.
- To understand the fundamental laws and principles and its application

UNIT – I

Introduction to Food Engineering: Definition of terms, System of measurements, The S.I System, Conversion of Units

UNIT – II

Steam Generation & Utilization: Concept of normal boiling point, Properties of Steam: Wet, dry saturated, superheated steam. Pressure-Enthalpy diagram, Steam Tables and their application, Problems; Boilers: Classification, Types, Criteria for selection, Maintenance & Applications

UNIT – III

Basic principles of Physics & Chemistry: Ideal Gas law and PVT relationships
Gases and Vapors: Behavior of Gases – Kinetic Theory of gases – Perfect Gas – Gas laws – Ideal gas laws – Real gas- Van der Waal's equation -pure component vapour pressure- partial pressure Dalton's law. Pure component volume-Amagat's law; Problems

UNIT – IV

Thermodynamics: Thermodynamic variables, Heat Capacity, Entropy, Laws of Thermodynamics, Various Thermodynamic processes (Adiabatic, Isothermal, Isobaric, Isocratic)

Basic concepts: definitions, approaches, thermodynamic systems, thermodynamic properties and equilibrium, state of a system, state diagram, path and process, different modes of work

Zeroth law of thermodynamics: concept of temperature, heat

First law of thermodynamics: Energy, enthalpy, specific heats, applications of first law, steady and unsteady flow analysis

Second law of thermodynamics: Kelvin-Planck and Clausius statements, reversible and irreversible processes, thermodynamic temperature scale, availability and irreversibility

Refrigeration: Basic concepts, Joule-Thomson effect, Refrigerants-Classification, Refrigeration Load, Problems, Refrigeration types (VCR, Absorption), Applications

UNIT – V

Measurement & Control of Process Parameters: Various Process Parameters, On-line & Off-line parameters, Critical & non-critical parameters, Measurement of various parameters, controlling methods (Manual, Automatic & Computer control)

Text Books

1. R.K. Rajput. 2007. Engineering Thermodynamics, 3rd Ed. Laxmi Publications (P) Ltd., Bangalore.
2. P.G. Smith, Introduction to Food Process Engineering, 2nd Edition, Lincoln, UK, 2010.
3. Warren L. McCabe, Julian Smith, Peter Harriott. 2004. Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA.
4. Christie John Geankoplis. 2003. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.

References

1. J.M. Smith, H.C. Van Ness and M.M. Abbott. 2005. Introduction to Chemical Engineering Thermodynamics, 7th Ed. McGraw-Hill, Inc., NY, USA.
2. R. Paul Singh and Dennis R. Heldman, Introduction to Food Engineering, 4th Edition, Academic Press, 2009.
3. Z. Berk, Food Process Engineering and Technology, Food Science and Technology, 1st Edition, International Series, Elsevier, 2009.
4. D. G. Rao, Fundamentals of food engineering, Prentice-Hall of India, New Delhi, 2010

Outcomes:

- Students will learn the importance of units.
- Students will understand the basic laws and principles and its application in food engineering

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech II-I Sem. (F.T.)

L	T	P	C
3	1	0	3

(15A27302) FOOD MICROBIOLOGY

Preamble:

To make the student to understand the causes of food spoilage and predict the micro organism that can spoil a given food, when prepared, processed and stored under given condition and take corrective measures to control the spoilage and pathogenic micro organism in food. To help the students to understand the machines and their components so as to enable them manage the machineries in the food industries

Objectives:

- To understand the role of beneficial micro organisms in food processing and preservation.
- To list the major food spoilage microorganisms.
- To analyze methods used to control or destroy micro organism commonly found in food.

UNIT I

Introduction: Development and scope of Microbiology - Classification and Identification of Microorganisms –Bacteria, fungi, viruses, protozoa and bacteriophage Morphology, cultivation- Growth curve – microscopy – types- importance of micro organisms in food.

UNIT II

Isolation of Microorganisms:Methods of isolation and purification – preparation of media – types of nutritional media – staining techniques – Simple, differential and structural staining – preservation of the microbial culture- primary sources of micro organisms in food- Factors affecting the growth of microorganisms

UNIT III

Microbial spoilage in Foods: Types of micro organisms in food via meat, poultry, sea foods, vegetables, dairy products, fruits and vegetables. Assessing microbial population in food- meat, poultry, fish and dairy products- microbial spoilage of fruits, vegetables, cereal and bakery products, meat products and egg.

UNIT IV

Food Preservation:Preservation by Moist Heat-Heat Resistance of microorganisms and spores. Decimal reduction time (Dvalues), 12D concept, Thermal Death Time curves. Unitof lethality, determination of process lethality requirements, effective F values.Preservation by low temperature.The behaviour of microorganisms under freezing and refrigeration environment.Growth and lethal effects of low temperature treatments on microorganisms in raw and processed foods.

UNIT V

Harmful Micro-organism and Beneficial Micro-organism: Food borne diseases – food infection and food intoxication, toxins – symptoms, causes and control measures. Micro organisms as food- Single Cell Protein Fermented food- pickles, sauerkraut- vinegar and lactic acid.

Text Books

1. Pelczar, M.J., E.C.S. Chan and N.R. Krieg. "Microbiology". McGraw-Hill New York 1993.
2. Frazier, W.C. and Westhoff, D.C. "Food Microbiology". Fourth Edition. Tata McGraw Hill Publishing Co. Ltd., New Delhi 2008.

References

1. Banwart, G.J, "Basic Food Microbiology" Van No Strand Reinhold Publishers, New York 1989.
2. Jay, J.M., "Modern Food Microbiology". CBS Publishers & Distributors, New Delhi 2000.

Outcomes:

- The students become familiar with identification and its activity of microorganisms in various foods.
- The students would understand the spoilage of foods due to harmful microorganisms.
- The students also get to know the various methods to eliminate/inactivate the growth of microorganisms in different foods

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech II-I Sem. (F.T)

L	T	P	C
3	1	0	3

(15A27303) POST HARVEST ENGINEERING

Preamble: The subject gives broad idea about importance of post harvest operations and equipment used for each operation.

Objective:

1. To explore the post harvest technology
2. To acquire the knowledge on reduction post harvest losses
3. To understand the working principles of equipment used for processing

UNIT – I

Overview of post harvest technology: Concept and science, production and post harvest losses, reasons for losses, importance of loss reduction; Water activity, water binding and its effect on enzymatic and non-enzymatic reactions and food texture, control of water activity and moisture, intermediate moisture foods.

UNIT – II

Post Harvest Handling operations; Cleaning: Cleaning of grains, washing of fruits and vegetables, types of cleaners, screens, types of screens, rotary screens, vibrating screens, machinery for cleaning of fruits and vegetables (air cleaners, washers), cleaning efficiency, care and maintenance; Sorting and grading: Sorting, grading, methods of grading; Grading- Size grading, colour grading, specific gravity grading; screening, equipment for grading of fruits and vegetables, grading efficiency, care and maintenance.

UNIT– III

Separation: Magnetic separator, destoners, electrostatic separators, pneumatic separator; Decorticating and shelling: Principles of working, design and constructional details, operating parameters, maintenance, etc. of various decorticators/dehullers/shellers, description of groundnut decorticators, maize shellers, etc.

UNIT – IV

Field Drying: Grain drying theory, grain dryers; Liquid dryers; Parboiling: process, changes during parboiling, parboiling methods, advantages and disadvantages of parboiling with respect to milling, nutritional and cooking quality of grain, significance of glass transition temperature.

UNIT – V

Milling: milling, polishing, grinding, milling equipment, dehuskers, polishers (abrasion, friction, water jet), flour milling machines, pulse milling machines, grinders, cutting machines, oil expellers, calculation of machine efficiency and power requirement.

Text Books

1. AmalenduChakraverty and R. Paul Singh. 2014. Post Harvest Technology and Food Process Engineering. CRC Press, Boca Raton, FL, USA.
2. A. Chakraverty. 2008. Post Harvest Technology of Cereals, Pulses and Oilseeds, 3rd Ed. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Don W. Green and Robert H. Perry. 2008. Perry's Chemical Engineers' Handbook. McGrawHill Co., Inc., NY, USA.
4. James G. Brennan. 2006. Food Processing Handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.

References

1. K.M. Sahay and K.K. Singh. 2001. Unit Operations of Agricultural Processing. Vikas Publishing House Pvt. Ltd., Noida, UP.
2. G. Boumans. 1985. Grain Handling and Storage. Elsevier Science Publishers, Amsterdam, The Netherlands.
3. R.L. Earle. 1983. Unit operations in Food Processing. Pergamon Press, New York, USA.
4. Carl W. Hall and Denny C. Davis. 1979. Processing Equipment for Agricultural Products. The AVI Publishing Company, Inc., Connecticut, MA, USA.
5. S.M. Henderson and R.L. Perry. 1966. Agricultural Process Engineering, 2nd Ed. The AVI Publishing Company, Inc., Connecticut, MA, USA.

Outcome:

- The student will learn the importance of post-harvest technology, production and losses
- The students will understand the types and different equipment used for operation

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B. Tech II-I Sem. (F.T)

L	T	P	C
3	1	0	3

(15A27304) FOOD BIOCHEMISTRY & NUTRITION

Preamble:

This is an introductory course which gives the necessary details and information to get acquainted with the biochemistry of foods and classification of nutrients as well as nutritional importance.

Objectives:

At the end of this course, the student will have an idea about the various constituents of foods, sources, energy and nutritional requirements and their functions.

UNIT – I

Concepts of food and nutrition: Definition of terms – nutrition, malnutrition (undernutrition, overweight, obesity), health and nutritional status, functions of food, basic food groups – energy yielding, body building and protective, nutrients supplied by food, nutritional needs – requirements and recommended allowances of foods under normal conditions for all age groups. Nutrients: Sources, functions, digestion, absorption, assimilation and transport of carbohydrates, proteins and fats in human beings.

UNIT – II

Mechanism of enzyme action Introduction to enzymes, coenzymes, regulation of enzymatic activity, enzyme kinetics, inhibition effects of pH, allosteric enzymes, derivation of Michaelis-Menten Equation. Nucleic acids Definition and composition of RNA and DNA, structure of various components, viz, bases and sugars, hydrolysis of nucleic acids, structure of RNA and double helical structure of DNA

UNIT – III

Metabolism of carbohydrates Biological role of carbohydrates, glycolysis and respiration (TCA cycle), production of ATP- a brief description of electron transport chain, oxidative and substrate phosphorylation. Metabolism of lipids Biological role of lipids, breakdown of triglycerides and phospholipids, β -oxidation of long chain fatty acids, ketosis, biosynthesis of fatty acids, triglycerides and phospholipids.

UNIT – IV

Metabolism of proteins Breakdown of proteins, transamination, deamination, decarboxylation, nitrogen fixation, urea cycle. Minerals Functions, sources, factors affecting absorption of minerals, absorption promoters – Vit C for Fe, absorption inhibitors – phytates, tannins, oxalates, effect of deficiency – Calcium, phosphorus, iron, zinc, iodine, fluorine and copper.

UNIT – V

Vitamins and hormones Classification, functions, sources, effects of deficiency, fat soluble vit (A,D,E,K), water soluble vitamin (thiamine, riboflavin, niacin, cyanocobalamin, folic acid, and ascorbic acid), relationship between vitamins and hormones in terms of their biological role. Physico chemical and nutritional changes during processing Changes during food processing treatment – drying and dehydration, irradiation, freezing, fermentation, canning, restoration, enrichment, fortification and supplementation of foods

Text Books:

1. Gaile Moe, Danita Kelley, Jacqueline Berning and Carol Byrd-Bredbenner. 2013. Wardlaw's Perspectives in Nutrition: A Functional Approach. McGraw-Hill, Inc., NY, USA.
2. David L. Nelson and Michael M. Cox. 2012. Lehninger Principles of Biochemistry, 6th Ed. Macmillan Learning, NY, USA.
3. Donald Voet and Judith G. Voet. 2011. Biochemistry, 4th Ed. John Wiley and Sons, Inc., NY, USA.

References:

1. Carolyn D. Berdanier, Elaine B. Feldman and Johanna Dwyer. 2008. Handbook of Nutrition and Food, 2nd Ed. CRC Press, Boca Raton, FL, USA.
2. Bob B. Buchanan, Wilhelm Gruissem and Russell L. Jones. 2002. Biochemistry & Molecular Biology of Plants. John Wiley and Sons, Inc., NY, USA.
3. Jeremy M. Berg, John L. Tymoczko, Lubert Stryer and Gregory J. Gatto, Jr. 2002. Biochemistry, 7th Ed. W.H. Freeman and Company, NY, USA.

Outcome:

- Students will be able to learn the usefulness of cells and organisms
- Students will understand the metabolic pathways
- Students will get information on types and importance of nutrients

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B. Tech II-I Sem. (F.T)

L	T	P	C
3	1	0	3

(15A27305) PRINCIPLES OF FOOD PROCESSING & PRESERVATION

Preamble:

This course helps the students to apply basic food science knowledge and get to know biochemical changes occurring during various processing and preservation techniques.

Objective:

1. Emphasis on importance of food technology into reduce the spoilage and improve the quality
2. To explore the various preservation methods

UNIT – I

Definition and scope of Food Science and Technology, Historical development of food processing and preservation, general principles of food preservation. Degree of perishability of unmodified foods, Causes of quality deterioration and spoilage of perishable foods, intermediate moisture foods, wastage of foods.

UNIT – II

Preservation of foods by low temperatures: (A) Chilling temperatures: Consideration relating to storage of foods at chilling temperatures, Chilling injury, Applications and procedures, Controlled and Modified atmospheric storage of foods, Post storage Handling of foods.

(B) Freezing temperatures: Freezing process, Slow and quick freezing of foods; effect on foods, other occurrences associated with freezing of foods. Technological aspects of pre freezing, Actual freezing, Frozen storage and thawing of foods, Individual Quick Freezing.

UNIT – III

Preservation of foods by high temperatures: Basic concepts in thermal destruction of microorganisms D, Z and F values. Heat resistance and thermophilic microorganisms. Cooking, blanching, pasteurization and sterilization of foods. Extrusion, baking, roasting, frying, dielectric heating, ohmic, microwave and infrared heating. Assessing efficacy of thermal processing of foods, General process of canning of foods, Spoilage in canned foods.

Unit-IV

Preservation by water removal: (a) Principles, Technological aspects and application of evaporative concentration process; Freeze concentration and membrane process for food concentrations. (b) Principles, Technological aspects and application of drying and dehydration of foods, Cabinet, tunnel, belt, bin, drum, spray, vacuum, foam mat, fluidized-bed and freeze drying of foods.

UNIT – V

Chemical & Natural Preservatives: Classification, Principles, Radiations: Sources of radiations, units and dosages, effect on microorganisms and different nutrients; dose requirements for radiation preservation of foods., safe limits, irradiation mechanism and survival curve, technological aspects; applications of sugar and salt, antimicrobial agents, biological agents, Hurdle technology. Effects of various food processing operations on the nutritive value of foods.

Text Books:

1. Food Science, Norman N. Potter and J.H. Hotchkiss, Chapman and Hall, 5th Edition., 1998.
2. Food processing technology: principles and practice, P. J. Fellows, Taylor and Francis, 3rd Edition 2009.

References:

1. Principles of Food Science-Part-II: Physical Method of Food Preservation, M. Karel, O.R. Fennema and D.B. Lund, Marcel Dekkar Inc., 2nd Edition, 2001.
2. Principles of Food Preservation, V. Kyzlink, Elsevier Press, 2nd Edition, 2003.
3. Modern Food Microbiology, J. M. Jay, D. Van Nostrand, 7th Edition, 2005.

Outcomes:

Upon completion of this course students should be able to understand

1. The changes occurring during various food processing techniques
2. The changes during storage and preservation
3. The effect of enzymes on spoilage reactions of foods

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech II-I Sem. (F.T)

L	T	P	C
3	1	0	3

(15A27306) CEREALS, PULSES & OILSEEDS PROCESSING TECHNOLOGY

Preamble:

This course covers fundamentals of cereals and pulses processing, equipments, products and storage requirements.

Objectives:

1. To learn about the processing of major cereals and pulses.
2. To gain knowledge about grain storage structure and handling devices.

UNIT – I

Importance of Cereals Pulses and Oilseeds, Composition, Structure and processing characteristics of Cereal grains, Legumes and Oilseeds, Post-harvest technology, Post processing practices for safe storage. Rice: Structure, types, composition, quality characteristics and physicochemical properties of Rice. Milling and parboiling of paddy, Curing and ageing of paddy and rice. Criteria and assessment of milling, cooking, nutritional and storage qualities of raw & parboiled rice. Processed rice products (flaked, expanded and puffed rice). By-products.

UNIT – II

Wheat-Structure, Composition, Types, quality characteristics for milling into flour and Semolina. Flour milling, Turbo grinding and air classification, Blending of flours, Flour grades and their suitability for baking purposes, Milling equipment and milled products (Dalia, Atta, Semolina and flour). Assessment of flour quality and characteristics, Macaroni products. Dough rheology- influence of flour constituents in dough rheology. Baked products-Ingredients Technology and quality parameters: Bread, Biscuits and Cakes, Crackers.

UNIT – III

Other Cereals: Corn- Structure, types and composition. Dry and wet milling of Corn. Starch and conversion products. Processed corn products (popped corn, corn flakes etc.) Structure and composition of Barley, Malting of barley, Bajra, Jowar and other cereal grains and millets. Pearling of millets. Parched and snack products. Cereal Malts: Basic malting process, malting plant, malt storage, malt characteristics, malt extract, uses; Breakfast cereals.

UNIT – IV

Pulses: Pulses production, types, chemical composition, anti-nutritional factors, milling of pulses, milling equipment, factors affecting quality, secondary processing of pulses,

processed products, fermented products, traditional products, Value addition; effect of processing on nutritive value. Milling of legume-pulses by traditional and improved processes.

UNIT – V

Processing of oil seeds for direct use and consumption, Oil extraction methods- mechanical (Ghani and Expellers) and chemical methods (solvent extraction), Processing of extracted oil: Refining, Hydrogenation, Interesterification. Processing of deoiled cake into protein concentrates and isolates, Texturized vegetable protein, Functional protein preparations. Peanut butter, Margarine and Spread.

Text Books:

1. Hand Book of Cereal Science and Technology, K. Kulp and J. G. Ponte. Jr., CRC, 2nd Edition, 2000.
2. Cereals Processing Technology, G. Owens, Woodhead Publishing, 2nd Edition, 2001.
3. Baking Technology and Engineering, Samuel A Matz, Springer, 1991.
4. Legumes: Chemistry, Technology and Human Nutrition, R.H. Mathews, Marcel Dekker, 1st Edition, 1989.
5. Bailey's Industrial Oil & Fat Products, D. Swer, John Wiley & Sons, 5th Edition, 2005.

References:

1. Cereals and Cereal products: Chemistry and Technology, Vol. 4, D.A.V. Dendy and B.J.Dobraszczyk, Springer, 1st Edition, 2001.
2. Rice: Chemistry and Technology, B.O.Juliano, AACCC, 2nd Edition, 1985.
3. Wheat: Chemistry and Technology, Y.Pomeranz, AACCC, 3rd Edition, 1988.
4. Malts and Malting, D. E. Briggs, Kluwer Academic Publication, 1st Edition, 1997.
5. Oils and Fats manual, A. Karleskind, Lavoisier Publisher, Paris, 1st Edition, 1996.

Outcome:

1. Students will get information about the classification of various grains
2. Students also exposed to various processing methods and machinery used
3. Students will learn value added products from all grains

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech II-I Sem. (F.T)

L	T	P	C
0	0	4	2

(15A27307) FOOD MICROBIOLOGY LAB

Objectives:

This lab gives idea about counting microorganisms by various techniques in selected foods and identification of specific microorganisms in different foods

Laboratory Experiments:

1. Familiarization with common techniques for handling pure culture serial dilution, Inoculation, slide preparation incubation, counting etc.
2. Direct total, viable, and non-viable count of microorganisms in milk.
3. Preparation and sterilization of media and glass ware for microbial counts.
- 4-6. Determination of Standard Plate Count (SPC) in natural and/or processed foods like cereal and cereal products, vegetable and fruits, meat and meat products, fish and other sea foods, Eggs and poultry, milk and milk products; sugar, salts and spices.
- 7-9. Microbiological examination of some selected natural and processed foods like cereal and cereal products, vegetable and fruits, meat and meat products, fish and other sea foods, Eggs and poultry, milk and milk products; sugar, salts and spices.
- 10-12 Microbiological examination of potable water: Total and coliform count.
- 13-15. Enumeration of coliform organism in some selected processed foods like cereal and cereal products, vegetable and fruits, meat and meat products, fish and other sea foods, Eggs and poultry, milk and milk products; sugar, salts and spices.

Outcome:

- Students will learn the different techniques for growth of microorganisms and colony counting
- Students will be able to identify the specific microorganism present in food by specific procedure.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech II-I Sem. (F.T)

L	T	P	C
0	0	4	2

(15A27308) FOOD TECHNOLOGY LAB – I (CEREALS, PULSES AND OILSEEDS)

Objective:

- Determination of parameters by qualitative and quantitative methods
- Study on some important unit operations used for some grains
- Preparation of standard food products

Laboratory Experiments:

1. Determination of physical properties (Bulk Density, Porosity, Sphericity, Angle of repose, Test weight, Particle size, Sieve analysis) of different grains.
2. Determination of Gluten content, sedimentation value, alcoholic acidity, water absorption capacity and Polenske value of wheat flour.
3. Determination of adulterant (NaHCO_3) in wheat flour/ Maida.
4. Determination of alkali score and gelatinization temperature of rice.
5. Traditional and improved pre-treatments and their effect on dehusking of some legumes.
6. Removal of anti-nutritional compounds from selected pulses and oilseeds.
7. Study of cooking quality of Dhal.
8. Pearling of some millets.
9. Determination of yeast activity.
10. Determination of different quality parameters of oils.
11. Determination of efficiency of oil extraction techniques (mechanical expelling and solvent extraction).
12. Preparation of Bread.
13. Preparation of Biscuits.
14. Preparation of Cookies.
15. Preparation of Cake.
16. Preparation of Rusk.
17. Preparation of Crackers.
18. Visit to a Bakery, Confectionery Unit
19. Visit to a working modern roller flour mill and FCI godowns.
20. Visit to working rice mill.

Outcome:

1. Students are exposed to learn various parameters determination and quantification
2. Students will be able to prepare and understand the technology involved in foods from grains
3. Students will acquire more knowledge by visiting industries

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech II-II Sem. (FT)

L	T	P	C
3	1	0	3

(15A27401) PRINCIPLES OF FOOD ENGINEERING II

Preamble: The subject covers the all basic concepts related to engineering and also these fundamentals are useful for selection, design of equipment and in food industries.

Objectives:

To impart knowledge to the students on basic concepts and applications of Psychrometric chart, humidifiers and dehumidifiers. Problems on material and energy balance, importance of dimensional analysis and engineering properties of foods.

UNIT – I

Humidity & Humidification: Humidity & Relative Humidity, Saturation Humidity, Percentage Humidity, Humid Heat, Humid volume, Dew point, Enthalpy of Humid air, Dry bulb temperature, Wet bulb temperature, Problems, Psychrometric chart-Utilization, problems; Humidifiers & Dehumidifiers, Applications

Water activity – concepts and importance. sorption isotherms, three stages of water, phase diagram for water, vapour pressure-temperature curve for water, heat requirement for vaporization, measurement of humidity

UNIT – II

Material balance: Law of Conservation of mass- Process flow diagram-system boundaries - overall mass balance – component mass balance –basis and tie material- Continuous vs. Batch-Recycle and by pass-unsteady state -mass balance problems on concentration, dehydration, evaporation, crystallization, mixing –solvent extraction –multi stage process. Problems

UNIT – III

Energy balance and evaluation of Heat requirements: Heat capacity – gases – solids – liquids -Latent heat – sensible heat -energy balance for a closed system and open system - total energy balances. Energy balance problems in heat exchangers –Drying. Problems

UNIT – IV

Dimensional Analysis Dimensional Consistency, Fundamental -derived units. Definitions of some basic physical quantities – Force, momentum, pressure, work and energy, power, heat and enthalpy. Mole – atomical molar mass, Conversion of Dimensional equations – Uses, Methods (Rayleigh's & Buckingham's) Examples: Nusselts Number, Reynolds number, Prandtl's number, Froude's number.

UNIT – V

Engineering properties of Food Materials: Mass- volume- area related properties of foods, rheological properties of fluid foods & solid foods, thermal properties of frozen & unfrozen foods, electrical conductivity of foods, dielectric properties of foods, colorimetric properties of foods, surface properties, ultrasound properties.

Text Books

1. M.A.Rao, Syed S.H. Rizvi, Ashim K. Datta 2005. Engineering Properties of Foods, 3rd Edition, Taylor & Francis Group, CRC Press.
2. R.K. Rajput. 2007. Engineering Thermodynamics, 3rd Ed. Laxmi Publications (P) Ltd., Bangalore.
3. P.G. Smith, Introduction to Food Process Engineering, 2nd Edition, Lincoln, UK, 2010.
4. Warren L. McCabe, Julian Smith, Peter Harriott. 2004. Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA.
5. Christie John Geankoplis. 2003. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.

References

1. J.M. Smith, H.C. Van Ness and M.M. Abbott. 2005. Introduction to Chemical Engineering Thermodynamics, 7th Ed. McGraw-Hill, Inc., NY, USA.
2. R. Paul Singh and Dennis R. Heldman, Introduction to Food Engineering, 4th Edition, Academic Press, 2009.
3. Z. Berk, Food Process Engineering and Technology, Food Science and Technology, 1st Edition, International Series, Elsevier, 2009.
4. D. G. Rao, Fundamentals of food engineering, Prentice-Hall of India, New Delhi, 2010

Outcomes:

- Understand the fundamental concepts of psychrometry
- Learn about the material and energy balances for equipment sizing
- Gain knowledge on properties of foods and its applicability

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech II-II Sem. (F.T.)

L	T	P	C
3	1	0	3

(15A54401) PROBABILITY AND STATISTICS

(Common to CSE, IT, Civil, Mech.)

Objectives: To help the students in getting a thorough understanding of the fundamentals of probability and usage of statistical techniques like testing of hypothesis, Statistical Quality Control and Queuing theory

UNIT – I

Basic concepts of Probability – Random variables – Expectation – Discrete and continuous Distributions – Distribution functions. Binomial and poisson distributions Normal distribution – Related properties.

UNIT – II

Test of Hypothesis: Population and Sample - Confidence interval of mean from Normal distribution - Statistical hypothesis - Null and Alternative hypothesis - Level of significance. Test of significance - Test based on normal distribution - Z test for means and proportions.

UNIT – III

Small samples - t- test for one sample and two sample problem and paired t-test, F-test and Chi-square test (testing of goodness of fit and independence).

UNIT – IV

Statistical Quality Control: Concept of quality of a manufactured product -Defects and Defectives - Causes of variations - Random and assignable - The principle of Shewhart Control Chart-Charts for attribute and variable quality characteristics- Constructions and operation of \bar{X} - Chart, R-Chart, p - Chart and C-Chart.

UNIT – V

Queuing Theory: Pure Birth and Death process, M/M/1 & M/M/S & their related simple problems.

TEXT BOOKS:

1. Probability & Statistics by E. Rukmangadachari & E. Keshava Reddy, Pearson Publisher.
2. Probability & Statistics for engineers by Dr. J. Ravichandran WILEY-INDIA publishers.

REFERENCES:

1. Probability & Statistics by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad, S.Chand publications.
2. Statistical methods by S.P. Gupta, S.Chand publications.
3. Probability & Statistics for Science and Engineering by G.Shanker Rao, Universities Press.
4. Probability and Statistics for Engineering and Sciences by Jay L.Devore, CENGAGE.
5. Probability and Statistics by R.A. Jhonson and Gupta C.B.

Outcomes: The student will be able to analyze the problems of engineering & industry using the techniques of testing of hypothesis, Statistical Quality Control and Queuing theory and draw appropriate inferences.

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B. Tech II-II Sem. (F.T)

L	T	P	C
3	1	0	3

(15A27402) FLUID MECHANICS IN FOOD PROCESS ENGINEERING

Preamble:

The subject covers properties of fluids and its flow characteristics, flow through pipes. Importance of dimensional analysis and its applicability. Types and Selection of pumps.

Objectives:

1. The basic concepts and fluid-flow phenomena and the kinematics of flow
2. To enable the students to design efficient water conveyance systems like canals, channels and pipes from places of origin to delivery points by acquiring knowledge on the principles of mechanics of fluids, water measurement and regulation

UNIT – I

Introduction and Properties of Fluids Properties of Fluids: Concept of fluid mechanics, definition of fluid, fluid continuum, density, specific weight Viscosity: Newtonian and Non-Newtonian fluids, kinematic viscosity, dynamic viscosity, variation of temperature with viscosity Surface tension, vapour pressure, incompressible and compressible fluids, ideal and real fluids

UNIT – II

Fluid Mechanics Pressure Measurement: Static pressure of liquids, absolute and gauge pressures, mechanical pressure gauges, pressure measurement by manometers Forces on plane surfaces, forces on curved surfaces, Buoyant forces (Archimedes' Principle). Dynamics of Fluid Flow Euler's equation of motion, application of Euler's equation Bernoulli's equation, applications of Bernoulli's equation, cavitation, momentum

UNIT – III

Kinematics of Fluid Motion Classification of Flow: Method of describing fluid motion, classification of flow: steady and unsteady; uniform and non-uniform; one, two and three dimensional flow Laminar and turbulent flows, streamline, pathline and streakline Acceleration equations, continuity equations, circulation and vorticity, flownet

UNIT – IV

Analysis of Flow Through Pipes Energy losses in pipe lines, minor losses in pipe lines due to enlargement, contraction, bends and pipe fitting Equivalent Length and Equivalent Pipes, Concept of equivalent length and equivalent pipes Problems in Pipe Flow, Determination of pipe diameter, determination of discharge, determination of head loss Flow Measurements Measurement of Flow in Pipes, Venturimeter, flow nozzle, sharp edged concentric orifice

meter, bend meter, rotameter. Measurement of Velocity, Pitot tube, hot wire anemometer, current meter.

UNIT – V

Fluid Machines Pumps: classification, centrifugal pumps, submersible pumps, reciprocating pumps, positive displacement pump. Centrifugal pumps: Pumps in series and parallel, basic equations applied to centrifugal pump, loss of head due to changed discharge, static head, total head, manometric head, manometer efficiency, operating characteristics of centrifugal pumps. Submersible pumps: Reciprocating pumps: working of reciprocating pump, double acting pump, instantaneous rate of discharge, acceleration of piston and water, gear pump.

Text Books

1. P.G. Smith, Introduction to Food Process Engineering, 2nd Edition, Lincoln, UK, 2010.
2. R. Paul Singh and Dennis R. Heldman, Introduction to Food Engineering, 4th Edition, Academic Press, 2009.
3. Christie John Geankoplis. 2003. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.

References

1. Modi, P. M. and Seth, S.M. 1973. Hydraulics and Fluid Mechanics, Standard Book House, Delhi
2. Chow, V. T. 1983. Open Channel Hydraulics, Mc Graw Hill Book Co., New Delhi
3. Jagdish Lal, 1985. Fluid Mechanics and Hydraulics. Metropolitan Book Co. Private Limited., New Delhi

Outcome:

By the end of the course the students will be able to

1. gain knowledge on Bernoullies theory, Buckingham's Pi theorem, Hagen-Poiseuille equation
2. gain the knowledge on mechanical gauges, flow of fluids in the pumps, and Archimedes principles and theory
3. understand flow through mouth pieces, flow through orifices and pumps

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech II-II Sem. (F.T)

L	T	P	C
3	1	0	3

(15A27403) FOOD CHEMISTRY

Preamble:

This subject covers each and every macro, micro nutrients. The classification, changes during processing of foods.

Objective:

- To impart knowledge to the students on the chemistry of macronutrients and its application in food industry.
- To understand different chemical and enzymatic chemical reactions occurring in foods.

UNIT- I

Food Science: Food requirements - Consumer safety – Objectives of food science – Constituents of food – Food as a source of energy – Energy requirement in human body – Food health and disease. Water – Role of water – Dietary requirements and sources – Important physical properties of water – concept of water activity – Water binding in foods – water activity and activity of microorganisms – Controlling of water activity in foods – Experimental determination of water activity in foods.

UNIT - II

Carbohydrates: Chemistry of carbohydrates – composition and structure- Definition, classification, importance, monosaccharides -structure and properties disaccharides-maltose, lactose, sucrose. Oligo saccharides- raffinose. Polysaccharides-starch, cellulose, pectins, seed gum, sea weed and algal polysaccharides. Dietary sources – Functional properties of dietary carbohydrates- Biological role of Dietary fibre– Nutrition - Flavor and colour development Sweetness – Texturing characteristics of carbohydrates – Plasticizing action and Humectancy of carbohydrates; Non-nutritive sweeteners.

UNIT - III

Fats and Oils: Definition and classification –biological role and uses of lipids – Fat group classification – Dietary sources – Fatty acids in foods nomenclature – Triglycerides – composition and structure – Physical properties of triglycerides – Polymorphism of triglycerides – Plasticizing properties of fats – Enrobing fats – Emulsifying properties of fats – Rancidity and reversion of fats.

UNIT - IV

Proteins and Enzymes: Classification, structure and functions – Role of proteins and requirements – Aminoacids-Definition, classification, properties, Functions of proteins in foods – physical and chemical properties of proteins, Important protein sources– Milk, Meat,

Fish, Egg and Cereal proteins – Enzymes – Endogenous enzymes in foods and their activity – Enzymes as food processing aids.

UNIT -V

Vitamins and Minerals: Definition –Classification, general sources, structure, properties, functions and dietary requirements – deficiency symptoms and toxicity of fat soluble and water soluble vitamins. Role of minerals – Food colours and flavors – Food additives – classification and purpose – Role of thickeners, sweeteners, stabilizers, emulsifiers, leaveners, colours, flavoring agents, preservatives – examples.

Food Pigments &Flavouring Agents: Importance, types and sources of pigments — their changes during processing & storages.

Text Books

1. Sivasankar, B, “Food processing and preservation” Prentice – Hall of India Pvt. Ltd. New Delhi 2002.
2. Fox, B. A. and Cameron, A.G., “Food Science, Nutrition and Health”, 5th Edition, Edward Arnold, London 2005.

References:

1. Srinivasan Damodaran, Kirk L. Parkin, and O.R. Fennema, E, “Food Chemistry” 4th Edition, CRC Press, New York2007.

Outcome:

By the end of the course, the students will be able

- i. to gain knowledge on different chemical & enzymatic reactions occurring in foods
- ii. understand Industrial application of different macronutrients
- iii. apply their knowledge of biomolecules to understand the changes that occur in foods during processing.

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B. Tech II-II Sem. (F.T)

L	T	P	C
3	1	0	3

(15A27404) FRUIT AND VEGETABLE PROCESSING

Preamble:

This course enables the students to gain a sound knowledge about the processing and preservation technologies of fruits and vegetables.

Objective:

At the end of this course the students get a detailed background about

1. Various methods used for preserving fruits and vegetables.
2. Different operations involved in processing fruits and vegetables
3. Technology behind intermediate moisture and minimally processed fruit and vegetable.

UNIT – I

Production and processing scenario of fruits and vegetables in India and world; Scope of fruit and vegetable processing industry in India; Overview of principles and preservation methods of fruits and vegetables; Supply chain of fresh fruits and vegetables;

UNIT – II

Primary processing and pack house handling of fruits and vegetables; Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables; Storage of Fresh Fruits and Vegetables: Containers: Tin, glass and other packaging materials used in fruits and vegetables preservations. Canning and bottling, effect of canning and bottling on nutritive value, spoilage of canned foods, spoilage organisms, detection and control.

UNIT – III

Preparation and preservation of Juice, Squash, Syrup, Sherbet, Nectar, Cordial, Crush etc.;FSSAI specifications,Processing and equipment for above products; Preparation, preservation and equipment for manufacture of crystallized fruits and preserves, Jam, Jelly and Marmalades, defects in making, Candies; FSSAI specifications.

UNIT – IV

Preparation, preservation and equipment for manufacture of Chutney, Pickles, Sauce, Puree, Paste, Ketchup; Toffee, Cheese, Lather. Production of Pectin and Vinegar; Commercial processing technology of selected fruits and vegetables for production of various value added processed products;FSSAI specifications.

UNIT – V

Minimally processed Fruits and Vegetables: Factors affecting shelf life and the quality of minimally processed fruits and vegetables, physiology and biochemistry of fresh cut fruits.

Dehydration of Fruits and Vegetables:Methods; packaging, storage, quality control. Products: Dehydrated, Wafers and Papads, Soup powders; Food additives: Use in fruit and vegetable preservation; Restructured fruits & Vegetables; FSSAI specifications.

Text Books:

1. Giridharlal, Siddappa andTandon. Preservation of fruits and vegetables.ICAR, New Delhi.
2. Sudhir Gupta (Compiled). Fruits and Vegetables Processing Hand Book.EIRI, Delhi.
3. Srivastava.P.R. and Sanjeev Kumar. Fruit and vegetable preservation - 3rd Edition. International Publishers, Delhi.

References:

1. Norman Potter.Food Science.CBS publishers and distributors,New Delhi.
2. Joshi and Pandey.Biotechnology: Food Fermentation, Volume-II. Educational Publishing and Distributing Co
3. EIRI Board of Consultants and Engineers. Manufacture of Snacks, Namkeen, Papads and Potato products-EIRI.

Outcomes:

By the end of the course, the students will be able to

- train the students in the field of Fruit and Vegetable Processing.
- enable the students learn different preservation techniques to curb post-harvest losses in the field of agriculture.
- learn processing of fruits & vegetables - different preservation techniques to improve the shelf life of seasonal fruits.
- understand the importance of FSSAI Specifications

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B. Tech II-II Sem. (F.T)

L	T	P	C
3	1	0	3

(15A27405) MECHANICAL OPERATIONS AND MATERIAL HANDLING

Preamble: The broad idea of this subject mentions about each individual operation and its applicability in food processing.

Objective:

To impart knowledge to the students on principles, operation and maintenance of various food processing equipment namely mixing, forming, size reduction, cutting and grinding equipment. centrifugation, filtration material handling equipment like belt, screw and pneumatic conveyors, bucket elevator.

UNIT – I

Geometrical, physical, functional and growth property of foods. Cleaning, sorting and grading of foods. Peeling, decortications, deseeding of fruits, dehulling of grains, blanching of vegetables. Size Reduction: Principles and types of size reduction equipment, disintegration of fibrous materials. Principles of comminution, Types of comminuting equipment. Energy and power requirement, Crushers, Grinders, Mechanical expression of edible oil.

UNIT – II

Sedimentation: Theory and principles of sedimentation, minimum area for continuous sedimentation, applications in food industry. Filtration: Principle of Constant pressure and constant rate filtration and types of filtration equipment, Settling classifiers and Flotation Screening, types of screen. Centrifugation: Principle of settling and centrifugation, devices for centrifugal separation. Membrane separation processes: Reverse osmosis, nano-filtration, ultrafiltration, microfiltration, dialysis and pervaporation.

UNIT – III

Mixing: Mixing of liquids and solids (powder), mixing equipment, mixing index and mixing time, Agitation and blending, types of agitators, power consumption in mixing. Scope and importance of material handling devices; Study of different material handling systems: Classification, principles of operation, conveyor system selection/design; Separation/Grading: Theory and principles: Types of separators – Disk, Indent cylinder, spiral and specific gravity, stone, inclined belt, pneumatic and aspirator separators- separation based on fluidization techniques – magnetic, cyclone and colour separator.

UNIT – IV

Belt conveyor: Principle, characteristics, design, relationship between belt speed and width, capacity, inclined belt conveyors, idler spacing, belt tension, drive tension, belt tripper; Chain conveyor: Principle of operation, advantages, disadvantages, capacity and speed, conveying chain; Screw conveyor: Principle of operation, capacity, power, troughs, loading and discharge, inclined and vertical screw conveyors;

UNIT – V

Bucket elevator: Principle, classification, operation, advantages, disadvantages, capacity, speed, bucket pickup, bucket discharge, relationship between belt speed, pickup and bucket discharge, buckets types; Pneumatic conveying system: Capacity and power requirement, types, air/product separators; Gravity conveyor design considerations, capacity and power requirement. Storage: Methods of storage, silos and bins, hoppers.

Text Books:

1. Earle R.L. Unit operations in Food Engineering.
2. Fellows P.J. Food Processing Technology, Principles and Practice. Wood Head Publishing Ltd., Cambridge, England.
3. HSE (Health and Safety Executive) information sheet no.24
4. Singh R. P and Heldman D.R. Introduction to Food Engineering. 3rdEdn.
5. Smith P.G. Introduction to Food Process Engineering.

References:

1. Cabe Mc., Smith J.C and Harriot P. Unit operations of Chemical Engineering. McGraw Hill Publishers. New Delhi.
2. Mohesinin N. N. Physical properties of Plant and Animal materials.
3. Stanley E.C. Fundamentals of Food Engineering. AVI Publishers. Westport. USA.
4. Sahay K.M and Singh K.K. Unit operations of Agricultural Processing. Vikas Publishing House Pvt. Ltd. New Delhi.
5. Chakraverty A. Post-Harvest Technology of Cereals, Pulses and Oilseeds. Oxford & IBH Publishers. New Delhi.

Outcome:

By the end of the course, the students will be able to

- i) understand different food processing equipment that are being used in food industries
- ii) study about the principles, operation and maintenance of food processing equipment viz., material handling, cleaning, grading, mixing, forming, size reduction, cutting, grinding, centrifugation, filtration, evaporation and drying

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B. Tech II-II Sem. (F.T)

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(15A27406) FLUID MECHANICS LAB

Objective:

To impart knowledge on coefficient of discharge, friction factor, pressure drop on different fluids. Importance of pipe fittings and application of various pumps in food industry.

Laboratory Experiments:

1. To determine the coefficient of discharge of an orifice (or a mouth piece) of a given shape.
2. To calibrate an orifice meter and study the variation of the coefficient of discharge with the Reynolds number.
3. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
4. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
5. To study the variation of friction factor, 'f' for turbulent flow in smooth and rough commercial pipes.
6. To determine the loss coefficients for the pipe fittings.
7. To verify Bernoulli's equation experimentally.
8. To determine the flow rate and coefficient of discharge using Venturimeter.
9. To measure discharge through Rotameter.
10. To determine the Reynolds number and types of flow (Laminar or Turbulent), the flow rate and coefficient of discharge using Orifice meter.
11. To determine losses due to pipe fitting, sudden enlargement and contraction.
12. Measurement of viscosity and surface tension of liquids.
13. To determine the characteristics of centrifugal pump and to find out total head, pump efficiency and overall efficiency of pump.
14. Study of various types of pipes and pipe fittings.
15. Study of different types of valves.
16. Study of reciprocating pump.
17. Determination of frictional coefficient of given pipe.

Outcome:

By the end of the course the students will be able to

- i. know the measurement of fluid pressure, measurement of discharge and measurement of time
- ii. know how to determine the Coefficient of discharge from the pitot tube experiment
- iii. know how to measure the water level from 'U' tube manometer

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B. Tech II-II Sem. (F.T)

L	T	P	C
0	0	4	2

(15A27407) MECHANICAL OPERATIONS & MILLING LAB

Objectives:

To impart practical orientation of usage of different mills, concept of terminal and settling velocity. Calculation of filter cake resistances.

Laboratory Experiments:

1. Particle size distribution using sieve shaker.
2. To find out the screen effectiveness of a given sample by vibratory screen/destoner
3. Estimation of work index of material using Ball Mill
4. Mixing experimentation and determination of mixing index.
5. Determination of power consumption in mixing/agitation.
6. Determination of equivalent and specific cake resistance.
7. Determine the terminal velocity of Cyclone separator.
8. Separation by gravity separator
9. Studies on membranes separation processes.
10. Settling velocity of a particle by sedimentation.
11. Determination of 'g' by using disc bowl centrifuge

Outcome:

By the end of the course, the students will be able to

- i. determine the Screen efficiency
- ii. size reduction by various mills
- iii. power requirement for mixing
- iv. importance of terminal and settling velocity for designing cyclone separator and settling tanks.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech III-I Sem. (FT)

L	T	P	C
3	1	0	3

(15A27501) HEAT TRANSFER OPERATIONS

Preamble:

This subject deals with fundamentals of heat transfer mechanisms, emphasis on heat transfer equipment like heat exchangers and evaporators and their selection and applications in food industry.

Objectives:

To impart knowledge to students on different modes of heat transfer through extended surfaces, study of heat exchanges and evaporators.

UNIT I

Introduction to heat transfer and general concepts of heat transfer by conduction, convection and radiation. Conduction: Basic concepts of conduction in solids, liquids and gases, steady state temperature fields and one dimensional conduction without heat generation, e.g., through plane walls, cylindrical and spherical surfaces, composite layers, etc. Insulation materials, critical and optimum insulation thickness. Extended surfaces, fins and their practical applications. Introduction to unsteady state heat transfer.

UNIT II

Convection: Fundamentals of convection, Basic concepts and definitions, natural and forced convection, hydrodynamic and thermal boundary layers, laminar and turbulent heat transfer inside and outside tubes, Dimensional analysis, determination of individual and overall heat transfer coefficients and their temperature dependence, heat transfer in molten metals.

UNIT III

Radiation: Basic laws of heat transfer by radiation, black body and gray body concepts, view factors, Kirchoff's law, solar radiations, combined heat transfer coefficients by convection and radiation.

UNIT IV

Heat Transfer with Phase Change: Condensation of pure and mixed vapors, film wise and drop wise condensation, loading in condensers and basic calculation on condensers, heat transfer in boiling liquids, boiling heat transfer coefficients. Heat Transfer Equipment: Classification, principles and design criteria, types of exchangers, viz., double pipe, shell and tube, plate type, extended surface, Furnaces and their classification and application.

UNIT V

Evaporation: Elementary principles, parts of evaporator, types of evaporators. Single and multiple effect evaporators and their area calculations, boiling point elevation, selection, types of energy use, thermovapour recompression, mechanical vapor recompression. Fouling prevention, cleaning and hygiene. Applications in food processing.

Text Books:

1. Coulson, J.M. & Richardson, J.F. "Chemical Engineering: Vol-1", 6th ed. Butterworth-Heinemann(1999)
2. Holman, J.P.: "Heat Transfer" 9 th ed. McGraw Hill (1989).

References:

1. McAdams W.H. "Heat Transmission", 3rd ed., McGraw-Hill, (1954)
2. Kern D.Q. "Process Heat Transfer" McGraw Hill Book (1950)
3. Badger W.L. & Bancharo J.T., "Introduction to chemical engineering" Tata McGraw Hill

Outcomes:

- Students acquire knowledge from different modes of heat transfer, extended surfaces, boiling and condensation process and principles of heat exchangers which are very essential in dairy and food industries

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B. Tech III-I Sem. (F.T.)

L	T	P	C
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(15A27502) DAIRY AND DAIRY PRODUCTS

Preamble:

This text focuses on physico-chemical properties of milk, equipment used in processing of milk and milk products. Study of different milk products processing and its storage.

Objectives:

To impart knowledge to the students on milk and milk products processing, manufacturing of indigenous milk products, packaging and storage of milk and milk products

UNIT-I

Fluid Milk: Composition of milk and factors affecting it. Physico-chemical characteristics of milk and milk constituents. Production and collection, cooling and transportation of milk. Tests for milk quality and Adulteration. Pasteurization and Sterilization: Process and equipment for milk pasteurization, direct and indirect sterilization; Ultra - High - Temperature (UHT) sterilization. Fouling of pasteurizers and sterilizers. Aseptic packaging.

UNIT-II

Homogenizers: principle of operation, design calculation for laminar and turbulent regimes, technology of homogenized milk production. Technology and standards of commercial liquid milk products: Toned, Double Toned Products, Reconstituted, Recombined, Standardized and Fermented Milks etc, FSSAI Specifications. Dairy Chemistry & Microbiology: Roles of lipids, proteins, carbohydrates, minerals, vitamins and enzymes, importance of psychrophilic, mesophilic and thermophilic spoilage organisms in storage.

UNIT – III

Dairy Products Manufacturing: Process Technology and standards of manufacturing of Fermented Products like dahi, shrikhand; lassi; mattha/Chhas and Other Milk Products (Casein, Whey Proteins, Lactose Etc.). Manufacturing of Indigenous dairy products like milk based puddings/ desserts- kheer; payasam; gajar-ka-halwa, FSSAI Specifications.

UNIT – IV

Definition, Classification, Composition and physico-chemical properties of Cream. Production processes and quality control. Butter: Definition, Classification, Composition and methods of manufacture, Packaging and storage. Butter oil/Ghee. Ice cream: Definition, Classification and Composition, Constituents and their role. Preparation of mixes and

freezing of Ice cream, Overrun, Judging, Grading, and defects of Ice cream, FSSAI Specifications.

UNIT – V

Evaporated and Condensed milk: Method of manufacture, Packaging and storage. Defects, Causes, and prevention. Roller and Spray Drying of milk solids. Instantization. Flow ability, Dustiness, Reconstituability, Dispersability, Wettability, Sinkability and appearance of milk powders. Manufacture of Casein, Whey protein, Lactose from milk or use in formulated foods, FSSAI Specifications.

Text Books:

1. Applied Dairy Microbiology, E. H. Marth and J. L. Eteele, Marcel Dekker, 2nd Edition, 2001.
2. Dairy Science Technology, P. Walstra, J.T.M.Wouters and T.J. Geurts, CRC press, 2nd Edition, 2006.
3. Dairy Technology: Principles of Milk Properties and Processing, P. Walstra, T.J. Geurts, A. Noomen, and J.S. Van Boekel, Marcel Dekker, Illustrated Edition, 1999.

References:

1. Milk and Dairy Product Technology, E. Spreer, Marcel Dekker, 2nd Edition, 1998.
2. Modern Dairy Technology, Vol. 1: Advances in Milk Processing, R.K.Robinson, Aspen Publishers, 2nd Edition, 1999.
3. Modern Dairy Technology, Vol. 2: Advances in Milk Products, R. K. Robinson, Aspen Publishers, 2nd Edition, 1996.
4. Outlines of Dairy Technology, Sukumar De, Oxford University Press, 3rd Edition, 2006.
5. Milk and Milk Products, C. Eckles, W. Combs, and H. Macy, Tata McGraw Hill, 3rd Edition, 2003.

Outcomes:

By the end of the course, the students will be able to

- i. Know about milk, its constituents, nutritive value, collection and its hygienic handling practices
- ii. Study about Pasteurization, Homogenization and Sterilization of milk
- iii. Learn about manufacture of cream, butter, ghee, yoghurt, cheese, ice-cream, indigenous milk products and milk confectionery

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B. Tech III-I Sem. (F.T)

L	T	P	C
3	1	0	3

(15A27503) PROCESSING OF SPICES AND PLANTATION CROPS

Preamble:

The subject covers the importance of spices and processing of major and minor spices, plantation crops and medicinal crops and secondary and tertiary processing.

Objective:

To impart knowledge about spice processing and their marketable standards, plantation crops and their importance in Indian economy, post-harvest technology of spices, value added products of spices, packaging of processed spices, food, medicinal and pharmaceutical uses of different spices.

UNIT – I

Importance and Processing of Spices: Classification, chemical composition and principal constituents, History of usage & Spice trade in India and the world.

Spices – production and importance – stage of harvesting and harvesting methods – processing of major and minor spices – Ginger, Chilli, Turmeric, Onion and Garlic, Pepper, Cardamom. Herbs, leaves and Spartan seasonings and their processing and utilization – Unit operations involved – equipment used- value addition of spices.

UNIT – II

Processing of minor Spices: Herbs, leaves and Spartan seasonings and their processing and utilization – All spice, Annie seed, Sweet basil; Caraway seed, Cassia, Cinnamon; Clove, Coriander, Cumin, Dill seed; Fennel seed, Nutmeg, Mace, Mint, Marjoram. Rosemary, saffron, sage; Savory, thyme, ajowan; Asafetida, curry leaves – Unit operations involved – equipment used- value addition of spices.

UNIT – III

Processing of Plantation Crops: Tea Processing Composition and production of tea leaves; processing of tea leaves; CTC tea, black tea, green tea and Oolong tea, grading and packaging; processing of instant tea Coffee Processing Production and processing of coffee cherries by wet and dry method; processing technology for coffee; preparation of brew; processing technology for instant coffee and decaffeinated coffee.

UNIT – IV

Processing of Plantation Crops: Cocoa processing Cocoa bean- introduction, history and composition; processing of cocoa bean; processed products of cocoa. Coconut, Arecanut, Vanilla and Cashew nut– production and importance – harvesting and stages of harvest – drying, cleaning and grading, processing methods, process and equipment – value added products – grading and types – packaging and storage

Unit – V Processing of Medicinal Crops:Importance of medicinal crops – production and export status – processing of medicinal crops – equipment used – principles and operations – active components in various medicinal plants – application and uses – extraction methods
Extraction of Principal Constituents in Spices
Spice Oils & Oleoresins:Flavour extraction from Spices by different methods.

Text books

1. Pandey, P. H, “Post-Harvest Engineering of Horticultural Crops through Objectives”. SarojPrakasam, Allahabad 2002.
2. Pruthi, J.S, “Major Spices of India – Crop Management and Post-Harvest Technology”. Indian Council of Agricultural Research, KrishiAnusandhanBhavan, Pusa, New Delhi. PP. 514, (1998)
3. ASTA, “Official analytical methods of the American Spice Trade Association”, Fourth Edition 1997.

References

1. Purseglove, J.W., E.G.Brown, G.L.Green and S.R.J.Robbins, “Cardamom – Chemistry. Spices, Vol. I, Tropical Agricultural Series”, Longman, London, 1: 605. (1981)
2. Quality Assurance in Spices and Spice Products – Modern Methods of Analysis by J S Pruthi, Allied Publishers Limited, New Delhi.

Outcome:

By the end of the course, the students will be able to

- i. know History of spices, uses of spices, classification of processed spices according to marketing standards, packaging and different grades
- ii. learn about flavor development during processing, classification of spices according to economic importance, post-harvest technology and treatments, specifications for marketed products

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech III-I Sem. (F.T)

L	T	P	C
3	1	0	3

(15A27504) INDUSTRIAL MICROBIOLOGY

Preamble:

This subject emphasis on basic concepts of bio processing, fermentation technology, kinetics of microbial growth, up and downstream processing and production of useful enzymes.

Objective:

To impart the knowledge to students about

- a) Fermentation technology and its application in Food industry
- b) Industrially important Microorganisms and their application in food industry

UNIT – I

Basic concepts: Historical development of bioprocess technology, an overview of traditional and modern applications of biotech process, Outline of integrated bioprocess and various (upstream and downstream)unit operations involved in biochemical engineering, generalized process flow sheets.

UNIT – II

Kinetics of microbial growth and product formation. Phases of cell growth in batch cultures, Simple unstructured kinetic models for microbial growth, Monod model, Growth of filamentous organisms. Growth associated (primary) and non-growth associated (secondary) product formation kinetics.

UNIT – III

Fermentation process: Basic design and construction of fermenter and ancillaries, main parameters to be monitored and controlled in fermentation processes. Overview of aerobic and anaerobic fermentation processes and their application in biotech industry, Solid substrate and submerged fermentation and its application. Fermenter types; Modeling of batch, fed batch and continuous Fermenters.

UNIT – IV

Down stream processing operations; Cell disruption, Solid- Liquid and Liquid- Liquid Separation processes, Extraction, Micro Filtration membrane filtration and centrifugal separation techniques, Chromatographic techniques for separation, drying of products; Biochemical process control and instrumentation. Immobilized enzyme technology: enzyme immobilization, industrial processes, utilization and regeneration of cofactors. Immobilized enzyme kinetics: effect of external mass transfer resistance, analysis of intraparticle diffusion and reaction.

UNIT – V

Industrial production of important products; Production of pectic Enzymes- submerged fermentation and semisolid fermentation Techniques: Industrial production of Glucose transforming enzymes; Organisms involved, production, purification and immobilization of (a) Glucose isomerase and (b) Glucose Oxidase. Industrial scale production of Bakers' yeast and Brewer's yeast; Microbial oil production and Bio pesticides.

Text Books:

1. Biochemical Engineering Fundamentals, J. E. Bailey, F. Oilis, Tata Mc Graw Hill, 2nd Edition, 2010.
2. Bioprocess Engineering- Basic Concepts, M. L. Shuller, F. Kargi, PHI, 2nd Edition, 2002.
3. Principles of Fermentation Technology, P.F. Stanbary, A. Whitaker, Hall, 2nd Edition, Aditya Books Pvt. Ltd., 2008.

References:

1. Industrial microbiology, S.C. Prescott and C.G. Dunn, Agrobios (India), 1st Edition, 2007.
2. Industrial Microbiology, A. H. Patel, McMillan India Ltd., 2nd Edition, 2009.
3. Biosensors for Food Analysis, A. Scott, Royal Society of Chemistry, UK, 1st Edition, 1998.
4. Biochemical Engineering: A Textbook for Engineers, Chemists and Biologists, Shigeo Katoh and Fumitake Yoshida, Wiley VCH, 1st Edition, 2009.

Outcome:

By the end of the course, the students will be able to

- i) know about Industrial fermentation techniques
- ii) know about different Industrially important micro organisms
- iii) know about different growth regulators (Hormones)
- iv) know about different products produced by Industrial fermentation process

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B. Tech III-I Sem. (F.T)

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(15A27505) FOOD ANALYSIS

Preamble:

The subject deals with the basic concepts of food analysis, principles of analytical techniques, separation techniques and rapid result methods.

Objective:

To impart knowledge to the students on the Techniques in food analysis

To ready them with the Analytical techniques in Quality control laboratory.

UNIT – I

Sampling and sampling techniques. Proximate analysis- Moisture, ash, crude fat, crude fibre, crude protein and carbohydrates by difference. Principles and methods of food analysis.

UNIT – II

Basic principles: Refractometry, polarimetry, densitometry, HPLC, GLC, spectrophotometry, electrophoresis, automatic amino acid analyzer.

UNIT – III

Determination of starch. Test for unsaturation of fats, rancidity of fats. Quantitative analysis of protein by Biuret method, Ninhydrin method, Lowry's method and Dye-binding method Bioassays for protein quality of grains.

UNIT – IV

Chemical, microbiological, flurometric and colorimetric methods of analysis of fat soluble and water soluble vitamins.

UNIT – V

Principles and methods for estimation of minerals: Atomic absorption spectroscopy, colorimetric, titrimetric and gravimetric methods Methods for determining physical and rheological properties of food.

Text Books:

1. S.S. Nilson, Food Analysis, Aspen Publishers, Gaithery Berg, Mary Land. AOAC methods For Food Analysis.
2. Y. Pomeranz and C.E. Meloan, Food Analysis, Theory and practice, A.V.I Publishing Company, INC West Port, Connecticut, U.S.A.,
3. Jayaraman, J. 1980. Laboratory Manual in Biochemistry. Wiley Eastern Publishers, New Delhi.

References:

1. Plummer, D.T. 1979. An introduction to Practical Biochemistry. Tata Mc Graw-Hill Publishing Co., New Delhi.
2. Sadasivam, S. and Manickam, A. 1996. Biochemical methods for Agricultural Sciences. New Age International Publisher, New Delhi.
3. ManoRanjanKalia First Edition 2002, Food Analysis and Quality Control. Kalyani Publishers, New Delhi, Hyderabad.

Outcomes:

- understand the concepts of Techniques in food analysis,
- understand proximate analysis of foods
- understand Biochemical methods and approaches used in Food analysis

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B. Tech III-I Sem. (F.T)

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**(15A27506) FOOD BUSINESS MANAGEMENT
(MOOC I)**

Preamble:

The subject describes the concept of business and its functions, various management strategies useful in food industry.

Objective:

To impart knowledge to the students on different managements and their functions and activities.

UNIT – I

Business - meaning - characteristics of business - divisions of business - industry – commerce. Management: Theories of Management, Functions of management - Planning - nature of planning - importance of planning - kinds of enterprise plans - planning premises - forecasting - steps in forecasting

UNIT – II

Organization - Meaning - importance - features of all organization structures - views of organization - process of organization - principles of organization. Staffing and directing - nature of direction - principles of direction- communication - Motivation. Controlling - nature of controlling- requirements of good control system. Co-ordination - features of co-ordination-techniques of co-ordination.Fixed capital - factors determining fixed capital requirements - sources of fixed capital working capital - gross and net classification-determinants and sources

UNIT – III

Human resource development - man power planning - manpower utilization - current man power assessment - future man power demand - employment trends. Career planning - elements of career planning - criteria in developing career planning organization plans for career planning. Personnel Management - importance - objectives - scope of Personal Management

UNIT – IV

Marketing Management - Definition - Meaning - Importance - Marketing mix - 4Ps of Marketing - Product - Place - Price - Promotion - 4 c's of marketing mix. Different Process of Marketing- Market Segmentation - Methods of market Segmentation Target marketing - Market Penetration- Market positioning. Product life cycle - Introduction stage - Growth - Maturity - Saturation - Decline - why Products fail - Extending the life cycle of a product.

UNIT – V

Materials management - meaning - scope - material control - purchase management functions of purchase department. Objectives of purchase department- steps in purchasing - store keeping - objectives and functions of store keeping. 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.

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. Wehrich and Aryasri, Principles of Management: Koontz, Tata McGraw Hill, 2004.

References:

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.

Outcome:

By the end of the course, the students will be able to

- i. gain knowledge on different managements like resource management, organization management, marketing management and in addition to emphasis on food business management.

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B. Tech III-I Sem. (F.T)

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(15A27507) HEAT TRANSFER OPERATIONS LAB

Objectives:

To determine the thermal conductivity of different materials and heat transfer coefficient of heat exchangers.

Laboratory Experiments:

1. To find the thermal conductivity of metallic rod at different temperature and draw the temperature profile for steady and unsteady state conduction.
2. To find out the thermal conductivity of insulating powder.
3. To find the thermal conductivity of liquid / gases.
4. To find the emissivity of grey plate with respect to black plate
5. To study the critical heat flux behaviour of a liquid
6. To find the heat transfer coefficient for parallel and counter current flow condition for a Double pipe heat exchanger
7. To study the shell & Tube heat exchanger and find the heat duty and Overall heat transfer coefficient for parallel flow condition.
8. To study the shell & Tube heat exchanger and find the heat duty and Overall heat transfer coefficient for counter flow condition.
9. Compare the heat duty for parallel & Counter flow and find the energy saving.
10. To study the Plate heat exchanger and find the Overall heat transfer coefficient
11. To study the performance of heat pipe.
12. To find the heat transfer coefficient for open pan evaporator for steady and unsteady state condition.
13. To study Single/Double/Trippl effect Evaporator and find its Steam economy.

Outcome:

learn efficient design of heat exchangers on the basis of overall heat transfer coefficient and LMTD

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L	T	P	C
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(15A27508) FOOD TECHNOLOGY LAB – II (FRUITS AND VEGETABLES)

Objectives:

Estimation of preservatives like benzoic acid and SO₂, different processed products from fruit and vegetables and each operation importance.

Laboratory Experiments:

1. Estimation of benzoic acid & SO₂
2. Pectin determination in fruits and vegetable products.
3. Preparation fruit juices e.g. carambola, orange, pineapple, mango etc.
4. Canning of fruits and vegetables
5. Extraction of Pectin (identification pectin rich foods, chemistry and interaction of pectin with other components)
6. Preparation of jams and jellies, marmalade, crystallized & glazed fruit, preserves and candies (knowledge on selection of fruits)
7. Preparation of Syrup, Squash, Crush
8. Preparation of tuti-fruti
9. Preparation of pickles, chutneys
10. Preparation of tomato products
11. Preparation of Papain
12. Drying of fruit and vegetables (Soup powders, dried products)
13. Visit to a Canning Plant
14. Visit to Fruits and Vegetable processing industries; processing of Mushrooms.

Outcome:

The students will learn the all processing methodology of fruit and vegetable products and significance of each unit operation.

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(15A99501) SOCIAL VALUES & ETHICS (AUDIT COURSE)

(Common to all Branches)

UNIT - I

Introduction and Basic Concepts of Society: Family and Society: Concept of family, community, PRIs and other community based organizations and society, growing up in the family – dynamics and impact, Human values, Gender Justice.

Channels of Youth Moments for National Building: NSS & NCC: History, philosophy, aims & objectives; Emblems, flags, mottos, songs, badge etc.; Organizational structure, roles and responsibilities of various NSS functionaries. **Nehru Yuva Kendra (NYK):** Activities – Socio Cultural and Sports.

UNIT – II

Activities of NSS, NCC, NYK:

Citizenship: Basic Features Constitution of India, Fundamental Rights and Fundamental Duties, Human Rights, Consumer awareness and the legal rights of the consumer, RTI.

Youth and Crime: Sociological and psychological Factors influencing youth crime, Peer Mentoring in preventing crimes, Awareness about Anti-Ragging, Cyber Crime and its prevention, Juvenile Justice

Social Harmony and National Integration: Indian history and culture, Role of youth in peace-building and conflict resolution, Role of youth in Nation building.

UNIT – III

Environment Issues: Environment conservation, enrichment and Sustainability, Climate change, Waste management, Natural resource management (Rain water harvesting, energy conservation, waste land development, soil conservations and afforestation).

Health, Hygiene & Sanitation: Definition, needs and scope of health education, Food and Nutrition, Safe drinking water, Sanitation, Swachh Bharat Abhiyan.

Disaster Management: Introduction to Disaster Management, classification of disasters, Role of youth in Disaster Management. Home Nursing, First Aid.

Civil/ Self Defense: Civil defense services, aims and objectives of civil defense, Need for self defense training – Teakwondo, Judo, karate etc.,

UNIT – IV

Gender Sensitization: Understanding Gender – Gender inequality – Role of Family, Society and State; Challenges – Declining Sex Ratio – Sexual Harassment – Domestic Violence; Gender Equality – Initiatives of Government – Schemes, Law; Initiates of NGOs – Awareness, Movements;

UNIT - V

Physical Education : Games & Sports: Health and Recreation – Biological basis of Physical activity – benefits of exercise – Physical, Psychological, Social; Physiology of Muscular Activity, Respiration, Blood Circulation.

Yoga: Basics of Yoga – Yoga Protocol, Postures, Asanas, Pranayama: Introduction of Kriyas, Bandhas and Mudras.

TEXT BOOKS:

1. NSS MANUAL
2. SOCIETY AND ENVIRONMENT: A.S.Chauha, Jain Brothers Publications, 6th Edition, 2006
3. INDIAN SOCIAL PROBLEM: G.R.Madan, Asian Publisher House
4. INDIAN SOCIAL PROBLEM: Ram Ahuja, Rawat Publications
5. HUMAN SOCIETY: Kingsley Davis, Macmillan
6. SOCIETY: Mac Iver D Page, Macmillan
7. SOCIOLOGY – THEMES AND PERSPECTIVES: Michael Honalambos, Oxford University Press
8. CONSTITUTION OF INDIA: D.D.Basu, Lexis Nexis Butterworth Publishers
9. National Youth Policy 2014 (available on www.yas.nic.in)
10. TOWARDS A WORLD OF EQUALS: A.Suneetha, Uma Bhrugudanda, Duggirala Vasantha, Rama Melkote, Vasudha Nagraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu
11. LIGHT ON YOGA : B.K.S.Iyengar, Penguin Random House Publishers
www.un.org www.india.gov.in www.yas.nic.in
<http://www.who.int/countries/ind/en/>
<http://www.ndma.gov.in>
<http://ayush.gov.in/event/common-yoga-protocol-2016-0>

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech III-II Sem. (FT)

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(15A27601) FOOD QUALITY & SENSORY EVALUATION OF FOOD PRODUCTS

Preamble:

The text prescribed for detailed study focuses on food quality and its functions, principles, statistical approach, standards and sensory evaluation tests and instrumental measurements.

Objectives:

To enhance the knowledge on quality of foods and safety concerns in all stages of food distribution system, evaluation of sensory attributes by different qualitative and quantitative tests.

UNIT – I

Quality and Assurance: Definition, scope, importance and difference, Total quality control and (TQC) Total quality management (TQM), Statistical quality control. Definition, importance, scope and difference between food quality and food safety. Food quality and quality attributes - Classification of quality attributes and their role in food quality, objectives, importance and functions of quality control, principles of quality assurance.

UNIT – II

Raw materials & Finished product quality: Quality parameters and evaluation procedures: Appearance, Color, Texture, Viscosity, Consistency, Flavour etc. International standards, food additives, introduction and importance, classification of preservatives, colouring agents, emulsifying and stabilizing agents, antioxidants. Various methods/ techniques for the assessment of quality of different foods, instrumental analysis of quality control.

UNIT – III

Different ways of testing texture of different foods, grading and marking standards and specification for finished products, food adulteration- introduction and various ways of adulteration, consumer studies and different types of consumer studies, introduction to HACCP, implementation in food industry. Food safety and quality control Food grade standards for different processed products

UNIT – IV

Introduction to sensory analysis, Factors influencing sensory measurements, Sensory quality parameters –Size, shape, texture, aroma, taste, color and gloss, threshold and dilution tests, different tests for sensory evaluation– discrimination, descriptive, affective, flavour profile and tests, ranking tests.

Laboratory quality measurements; Types of tests, panel selection and testing environment, serving procedures, instruction to judges, difference tests, directional difference tests, classification of difference tests, two sample and three sample tests, multisampling tests, ranking, scoring, hedonic scaling, dilution procedures, descriptive sensory analysis, contour method.

UNIT – V

Instrumental measurements of sensory attribute of foods, sensory characteristics of foods, types of tests, methods of sensory evaluation of their food products, Electronic noses and tongues: Sensors for food flavour and freshness, electronic noses, tongues and testers; Introduction to flavour assessment, modelling the human nose, electronic nose, electronic tongue. Texture profile analysis. Correlation between instrumental and Sensory analysis of food quality attributes. Computer-aided sensory evaluation of food and beverage, statistical analysis of sensory and objective analysis data.

Text Books:

1. Imteaz Ali. Food Quality Assurance – Principles and Practices. CHIPS, Texas.
2. Multon. J.L. Quality Control for Food and Agricultural Products. CHIPS, Texas.
3. Amerine, Pangborn. M.A. and Roseiur. Principles of Sensory Evaluation of Food.
4. Birk, G.G. Berman and Parker. K.J. Sensory Properties of Food. Applied Science, London.

References:

1. Pattee. Evaluation of Food quality of fruits and vegetables. AVI publishers, Westport.
2. Ranganna. S. Handbook of Analysis and Quality Control – Fruits and Vegetable Products. Tata Mc Graw Hill, New Delhi
3. BIS standards on Sensory Evaluation

Outcomes:

Student explored on need of quality and safety in food products, maintenance of quality product to consumer with increasing sensory parameters of food.

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B. Tech III-II Sem. (F.T.)

L	T	P	C
3	1	0	3

(15A27602) INSTRUMENTATION AND PROCESS CONTROL

Preamble:

To impart knowledge to the students on instrumentation and process controls used in food industry.

Objectives:

- 1) understand the different instruments used in different operations of food industries
- 2) know about working principles of different instruments used in different operations

UNIT – I

Introduction, definitions, characteristics of instruments, functional elements, performance characteristics of instrumentation systems-static and dynamic characteristics; Temperature and temperature scales; Various types of thermometers; thermocouples, resistance thermometers and pyrometers;

UNIT – II

Pressure and pressure scales, manometers, pressure elements differential pressure; Liquid level measurement, different methods of liquid level measurement; Flow measurement: Kinds of flow, rate of flow, total flow differential pressure meters, variable area meters, food flow metering; Weight measurement: Mechanical scale, electronic tank scale, conveyor scale;

UNIT – III

Measurement of moisture content, specific gravity, measurement of humidity, measurement of viscosity, turbidity, color, measurement of density, brix, pH, enzyme sensors, automatic valves; Transmission: Pneumatic and electrical; Control elements, control actions, pneumatic and electrical control systems;

UNIT – IV

Process control: Definition, simple system analysis, dynamic behaviour of simple process, Laplace transform, process control hardware; Frequency response analysis, frequency response characteristics, Bode diagram and Nyquist plots and stability analysis; Transducers: Classification, self-generating transducers, variable parameter type, digital, actuating and controlling devices;

UNIT – V

Controllers and indicators: Temperature control, electronic controllers, flow ratio control, atmosphere control, timers and indicators, food sorting and grading control, discrete

controllers, adaptive and intelligent controllers; Computer-based monitoring and control: Importance, hardware features of data acquisition and control computer, signal interfacing, examples in food processing.

Text Books

1. Measurement Systems: Applications and Design. E O Doebelin and D N Manik, Tata McGraw Hill, 5th Edition, 2003.
2. Bela G. Liptak. 2003. Instrument Engineer's Handbook, Vol. I and II, 4th Ed. CRC Press, Boca Raton, FL, USA.
3. Curtis D. Johnson. 2003. Process Control Instrumentation Technology, 7th Ed. Prentice Hall of India Pvt. Ltd., New Delhi.
4. D.V.S. Murty. 2004. Transducers and Instrumentation. Prentice-Hall of India Pvt. Ltd. New Delhi.

References

1. Process Control. Peter Harriot, Tata McGraw Hill.
2. Industrial Instrumentation, D. Patranabis, McGraw Hill, 2nd Edition, 2001.
3. Automatic Control Systems. B C Kuo, Prentice Hall, 7th Edition, 2002.
4. Process system Analysis & Control, D.R. Coughanoowr, McGraw Hill Publication

Outcomes:

- The students become familiar with the identification of different instruments and controls used in various operations
- solutions to tackle the problems encountered in use and operation of different instruments

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B. Tech III-II Sem. (F.T)

L	T	P	C
3	1	0	3

(15A27603) MASS TRANSFER

Preamble:

This course deals with principles of mass transfer and momentum transfer and their respective applications in the food industry

Objectives:

Basic concepts of mass transfer and mechanism of mass transfer operations like distillation, extraction, leaching, crystallization and drying.

UNIT – I

Mass Transfer Laws: Review of Fick's 1st law for molecular diffusion, molecular diffusion in biological solutions and gels, molecular diffusion in solids, diffusion coefficients in gas, liquid and solid, numerical solution of steady state diffusion, Fick's 2nd law and unsteady state operation, mass transfer coefficients, interphase mass transfer, diffusion of gases in porous solids and capillaries.

UNIT – II

Physical Chemistry of Mass Transfer Operations in Food Processing: fugacity, activity, water Relation to foods: roles of water and activity in foods; control of water activity by addition of solute and moisture removal; measurement of water activity; different models of sorption isotherms, their limitations and applicability, prediction and moderation of water activity of foods. Drying: types of drying, constant and falling rate, equilibrium moisture content, drying curve and drying time, types of dryers.

UNIT – III

Gas Absorption: Equilibrium solubility of gases in liquids, ideal and non-ideal solutions. Equipment: Gas dispersed- bubble columns, tray towers, liquid dispersed-venturi scrubbers, wetted wall towers, spray tower, packed towers. Concept of NTU, HTU and HEPT. Ideal stage and stage efficiency. Adsorption and Ion Exchange: Types of Adsorption, nature of adsorbents, adsorption equilibrium, adsorption of a single component from a gas mixture/liquid solution. Multistage cross current and counter current adsorption, continuous contact adsorption. Principle of ion exchange, equilibria and rate of ion-exchange.

UNIT – IV

Distillation: Vapour liquid equilibria, boiling point diagram, relative volatility, enthalpy concentration diagram, flash vapourization, differential distillation, steam distillation, azeotropic distillation and extractive distillation for binary system. Continuous rectification,

McCabe Thiele method, bubble cap distillation column. Crystallization-rate of crystallization, crystallization equilibrium. Super saturation – Crystallizers type – batch and continuous. Centrifuge – types.

UNIT – V

Solid-liquid extraction: Countercurrent, co-current, multistage continuous contact operations. Liquid-liquid extraction: Ternary liquid–liquid equilibrium and tie line data, choice of solvents, extraction equipment. Leaching principle and equipment.

Outcome:

Students are exposed to mass transfer laws and concerning unit operations and their principles, equipment used.

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B. Tech III-II Sem. (F.T)

L	T	P	C
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(15A27604) MEAT AND POULTRY PRODUCTS

Preamble:

This subject covers the scope and importance of meat and poultry processing, and their value added products, various preservation methods, equipment used.

Objectives:

To enable the students to learn about national and international prospects of Meat industry along with processing and preservation technology of Meat, Egg and Poultry Products.

UNIT – I

Sources and importance of meat and poultry; Status of Meat and poultry industry in India; World production of meat and poultry, consumption pattern and nutritive value; characteristics and structure of meat and poultry muscle. Abattoir design and layout. Preslaughter operations and slaughtering operations for animals; stunning, methods of stunning –bleeding-skinning of animals. Ante-mortem inspection, Evaluation of animal carcasses.

UNIT – II

Post slaughter care-post mortem and Biochemical changes in meat-rigour mortis – Factors affecting post-mortem changes, properties and shelf life of meat; meat tenderization-artificial tenderization-muscle stretching-mechanical disruption by artificial enzymes.Mechanical deboning, grading and aging; Preservation of meat by chilling, freezing, pickling, curing, cooking and smoking, dehydration, radiation, chemical and biological preservatives; Meat emulsions; Eating and cooking quality of meat.

UNIT – III

Meat cutting and handling; Preparation, preservation and equipment for manufacture of smoked meat and its quality evaluation; Preparation, packaging and equipment for manufacture of dehydrated meat products and their quality evaluation; Preparation, preservation and equipment for manufacture of meat sausages and their quality evaluation; comminuted meat products: ham, bacon, meat analogues; effect of processing on nutritive value; hygiene in meat processing, spoilage of meat, contaminants and naturally occurring toxicants;

UNIT – IV

Poultry: Pre-slaughter care and consideration; Operations in preparation of dressed poultry, its storage and marketing, processing of poultry. Egg: structure, composition, nutritive value,

egg products, dehydrated egg powder. Effect of processing on nutritive value; additives used in poultry products;

UNIT – V

Meat plant sanitation and safety; By-products of meat, poultry and eggs and their utilization; Safety standards in meat industry: HACCP/ISO/FSSAI/Kosher/Halal.

Text Books

1. Vikas Nanda. 2014. Meat, Egg and Poultry Science & Technology. I.K. International Publishing House Pvt. Ltd., New Delhi.
2. B.D. Sharma and Kinshuki Sharma. 2011. Outlines of Meat Science and Technology. Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.
3. Howard J. Swatland. 2004. Meat Cuts and Muscle Foods, 2nd Ed. Nottingham Univ. Press, Nottingham.
4. B.D. Sharma. 2003. Modern Abattoir Practices and Animal Byproducts Technology. Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.

References

1. B.D. Sharma. 1999. Meat and Meat Products Technology Including Poultry Products Technology. Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi.
2. Alan H. Varnam and Jane P. Sutherland. 1995. Meat and Meat Products: Technology, Chemistry and Microbiology. Chapman & Hall, London.
3. William J. Stadelman and Owen J. Cotterill. 1995. Egg Science and Technology, 4th Ed. Food Products Press, NY, USA.
4. R.A. Lawrie. 1985. Meat Science, 4th Ed. Pergamon Press, Oxford, UK.

Outcome:

Composition and structure of Meat, Egg, Poultry & effective preservation techniques along with concepts of value addition & quality assessment of Meat and sanitary measures in meat industry.

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B. Tech III-II Sem. (F.T)

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(15A27605) FISH AND MARINE PRODUCTS

Preamble:

This subject focus on scope and status of marine industry, various processed products with different preservation techniques, novel methods.

Objectives:

To impart knowledge on fisheries and other marine foods, their nutritional composition and processing technologies

UNIT – I

Fisheries resources, global and Indian scenario; Types of fish and other marine products; Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish and quality assessment, spoilage of fish- microbiological, physiological, biochemical; Relationship between chilling and storage life.

UNIT – II

Methods of Preservation of fish: Drying, Salting, Smoking and Curing. General aspects of fish freezing, changes in quality during chilled and frozen storage; Principles of canning, effect of heat processing on fish, storage of canned fish, preprocess operations, post-process operations, cannery operations for specific canned products;

UNIT – III

Fish products: Introduction, fish muscle proteins, surimi process, traditional and modern surimi production lines, quality of surimi products, comparison of surimi and fish mince products; Preparation protocols of indigenous products: Fish sauce and paste.

UNIT – IV

Novel methods; Low dose irradiation; High pressure treatment, MAP, vacuum packaging, gas packaging; Oxygen absorbents and CO₂ generators, ethanol vapour generation, hurdle barrier concept, value added fish products, packaging; Sea food quality assurance, HACCP, EU hygienic regulations and ISO 9000 standards; New kinds of quality and safety problems emerging in sea food processing and preservation.

UNIT – V

Fish by products - production of fish meal, fish protein extracts, fish protein hydrolysates, fish protein concentrate, fish liver oil and fish sauce and other important byproducts; Quality control of processed fish; Fish processing industries in India.

Text books

1. D.P. Sen. 2005. Advances in Fish Processing Technology. Allied Publishers Pvt. Ltd., Delhi.
2. Brigitte Maas-van Berkel, Brigiet van den Boogaard and CorlienHeijnen. 2004. Preservation of Fish and Meat. Agromisa Foundation, Wageningen.
3. FAO. 2003. Code of Practices of Canned Fishery products. FAO, UN, Rome.
4. Brend W. Rautenstrauss and Thomas Liehr. 2002. Fish Technology. Springer-Verlag, US.
5. G.M. Hall. 1997. Fish Processing Technology, 2nd Ed. Chapman & Hall, London, UK.

References

1. C.O. Chichester and H.D. Graham. 1973. Microbial safety of Fishery products. Academic Press, New York.
2. American Public Health Association. 1970. Recommended Procedures for the Bacteriological examination of Seawater and shell fish. APHA, USA.
3. George Borstorm. 1961. Fish as Food - Vol. I, II, III and IV. Academic Press, New York.
4. K. Gopakumar. View Larger ImageTextbook of Fish Processing Technology. ICAR, New Delhi. y Charles L. Cutting. Processing and Preservation of Fish. Agro Bios, New Delhi.

Outcomes:

By the end of the course, the students will be able to

- gain knowledge in the areas of fish and other marine food preservation and processing technology

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech III-II Sem. (F.T)

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**(15A27606) FOOD REFRIGERATION AND COLD CHAIN
ELECTIVE – I**

Preamble:

This subject emphasis on principles of refrigeration, role of equipment in refrigeration system, cycles, refrigeration load calculations and commercial applications in food industry.

Objectives:

- i. To know the equipment available to store perishable items for a long time
- ii. To understand to increase the storage life of food items

UNIT – I

Principles of refrigeration: Definition, background with second law of thermodynamics, unit of refrigerating capacity, coefficient of performance; Production of low temperatures: Expansion of a liquid with flashing, reversible/ irreversible adiabatic expansion of a gas/ real gas, thermoelectric cooling, adiabatic demagnetization; Air refrigerators working on reverse Carnot cycle: Carnot cycle, reversed Carnot cycle, selection of operating temperatures;

UNIT – II

Air refrigerators working on Bell Coleman cycle: Reversed Brayton or Joule or Bell Coleman cycle, analysis of gas cycle, polytropic and multistage compression; Vapour refrigeration: Vapor as a refrigerant in reversed Carnot cycle with p-V and T-s diagrams, limitations of reversed Carnot cycle; Vapour compression system: Modifications in reverse Carnot cycle with vapour as a refrigerant (dry Vs wet compression, throttling Vs isentropic expansion), representation of vapor compression cycle on pressure- enthalpy diagram, super heating, sub cooling;

UNIT – III

Liquid-vapour regenerative heat exchanger for vapour compression system, effect of suction vapour super heat and liquid sub cooling, actual vapour compression cycle; Vapour-absorption refrigeration system: Process, calculations, maximum coefficient of performance of a heat operated refrigerating machine, Common refrigerants and their properties: classification, nomenclature, desirable properties of refrigerants- physical, chemical, safety, thermodynamic and economical; Azeotropes; Components of vapour compression refrigeration system, evaporator, compressor, condenser and expansion valve;

UNIT – IV

Ice manufacture, principles and systems of ice production, Treatment of water for making ice, brines, freezing tanks, ice cans, air agitation, quality of ice; Cold storage: Cold store, design of cold storage for different categories of food resources, size and shape, construction and material, insulation, vapour barriers, floors, frost-heave, interior finish and fitting, evaporators, automated cold stores, security of operations; Refrigerated transport: Handling and distribution, cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display;

UNIT – V

Air-conditioning: Meaning, factors affecting comfort air-conditioning, classification, sensible heat factor, industrial air-conditioning, problems on sensible heat factor; Winter/summer/year round air-conditioning, unitary air-conditioning systems, central air-conditioning, physiological principles in air-conditioning, air distribution and duct design methods; design of complete air-conditioning systems; humidifiers and dehumidifiers; Cooling load calculations: Load sources, product cooling, conducted heat, convected heat, internal heat sources, heat of respiration, peak load; etc.

Text Books:

1. Arora, C. P. 1993. Refrigeration and Air Conditioning. Tata MC Graw Hill Publishing Co.Ltd., New Delhi.

References:

1. Adithan, M. and Laroiya, S. C. 1991. Practical Refrigeration and Air Conditioning. Wiley Estern Ltd., New Delhi

Outcome:

By the end of the course, the students will

- i. understand the different equipment useful to store the food items for a long period.
- ii. understand to increase the storage life of food items

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech III-II Sem. (F.T)

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(15A27607) THERMAL OPERATIONS

ELECTIVE – I

Preamble:

This subject covers all the aspects of thermal properties and pasteurization, sterilization and UHT processing, newer technologies like ohmic, radio frequency and etc.

Objectives:

To impart the knowledge on thermal operations and advances in thermal processing.

UNIT – I

Thermal properties of food constituents and foods. Overview of thermal operations carried out in dairy and food processing.

UNIT – II

Pasteurization and Sterilization: microbial destruction in batch and continuous sterilization; kinetics of loss of nutrients in sterilization; batch and continuous pasteurization, Indirect and direct methods of UHT processing; aseptic packaging; Steam generation and culinary steam production.

UNIT – III

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.

UNIT – IV

Modelling and Simulation: Direct calculation of survival ratio and iso thermal time equivalent in heat preservation processes, computational fluid dynamics in thermal processing. Optimization, Control of Thermal processes for Shelf-Stable Products: Regulatory considerations, Critical factors related to the design of thermal treatments for the products packaged prior to treatment, Critical factors related to the design of thermal treatments for the products packaged prior to aseptic packaging, Qualification of heat stabilization equipment, Design and validation of thermal treatments, Heat destruction parameters and sterilization value.

UNIT – V

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.

Text Books

1. Heat Transfer (in SI Units). Holman, J. P., Tata McGraw Hill, 9th Edition (Special Indian Edition), 2008.
2. Fundamentals of Heat and Mass Transfer. F. P. Incropera, and P. W. David, Wiley, 3rd Edition, 1990.

References

1. Fundamentals of Heat and Mass Transfer, R.C. Sachdeva, Wiley Eastern Limited, 3rd Edition, 2001.
2. Fundamental of Food Process Engineering, R.T. Toledo, CBS publishers, 3rd Edition, 1980.
3. Engineering Heat Transfer, C.P. Gupta and R. Prakash Nemchand and Brothers, 4th Edition, 1994.

Outcome:

Students are explored to novel technologies in thermal processing and principles, equipment used, advantages and disadvantages.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech III-II Sem. (F.T)

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(15A27608) FROZEN FOOD TECHNOLOGY

ELECTIVE – I

Preamble:

This subject emphasis on fundamentals of freezing, methods and types of freezers, packaging and latest technologies.

Objectives:

The principles involved in freezing, properties of frozen foods, calculation of freezing time, selection of freezer and emerging technologies for frozen foods.

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, IQF freezing, 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.

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.

References:

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.

Outcome:

Students will get knowledge on

1. Basics in freezing, different freezing methods, advantages and disadvantages
2. New technologies and their scope
3. Packaging for frozen foods
4. Mathematical modelling

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech III-II Sem. (F.T)

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(15A27609) MASS TRANSFER LAB

Objectives:

To learn the separation factor for all mass transfer operations like distillation, absorption, solid-liquid and liquid-liquid extraction.

Laboratory Experiments:

1. Determination of water activity of different foods.
2. Determination of depression of freezing point
3. Determination of Boiling point elevation and solute concentration
4. Studies on Humidification/ Dehumidification columns.
5. Psychrometric chart and psychrometers.
6. Studies on Bubble cap/ tray/ fractional column
7. Studies on extraction column.
8. Separation factors of the experiments with differential distillation.
9. Separation factors of the experiments with flash vaporization.
10. Separation factors of the experiments with vapour liquid equilibrium.
11. Separation factors of the experiments with liquid – liquid extraction.
12. Separation factors of the experiments with solid –liquid extraction.
13. Separation factors of the experiments with ion exchange.
14. Separation factors of the experiments with membrane separation.
15. Studies on Bubble cap/ tray/ fractional column.
16. Studies on Absorption columns.
17. Studies on crystallization and adsorption.

Outcome:

Students will understand the separation techniques, significance of water activity, working principle of various mass transfer equipment.

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B. Tech III-II Sem. (F.T)

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(15A27610) FOOD PRODUCT LAB III (MEAT, POULTRY AND FISH)

Objective:

To learn the different preservation methods for meat, poultry and fish and preparation of value added products.

Laboratory Experiments:

1. Study of post-mortem changes; Meat cutting and handling
2. Preservation of meat by curing and pickling
3. Value added meat products
4. Evaluation of quality and grading of eggs
5. Preservation of shell eggs
6. Preparation of value added poultry meat products
7. Value added egg products
8. Study of anatomy and dressing of fish
9. Study of anatomy and dressing of prawn and other marine products
10. Preservation of fish: Drying, pickling
11. Preparation of value added sea products: Cutlets, bullets, wafers
12. Preparation and evaluation of meat sausages
13. Preparation and evaluation of meat/ chicken patties
14. Estimation of TVB and TMA
15. Visit to Abattoir
16. Visit to fish and prawn processing industry

Outcome:

By the end of the course, the students will

- learn different methods of slaughter, Postmortem changes, preservation techniques and methods of value addition to meat
- develop practical skills in preservation and processing technology of fish and marine products

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech III-II Sem. (F.T)

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(15A52602) ADVANCED ENGLISH LANGUAGE COMMUNICATION SKILLS (AELCS) LAB (Audit Course)

1. INTRODUCTION

With increased globalization and rapidly changing industry expectations, employers are looking for the wide cluster of skills to cater to the changing demand. The introduction of the Advanced Communication Skills Lab is considered essential at 3rd year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.

The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

- Gathering ideas and information and to organise ideas relevantly and coherently.
- Engaging in debates.
- Participating in group discussions.
- Facing interviews.
- Writing project/research reports/technical reports.
- Making oral presentations.
- Taking part in social and professional communication.

1. OBJECTIVES:

This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.
- To prepare all the students for their placements.

3. SYLLABUS:

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

UNIT-I: COMMUNICATION SKILLS

1. Reading Comprehension
2. Listening comprehension
3. Vocabulary Development

4. Common Errors

UNIT-II: WRITING SKILLS

1. Report writing
2. Resume Preparation
3. E-mail Writing

UNIT-III: PRESENTATION SKILLS

1. Oral presentation
2. Power point presentation
3. Poster presentation

UNIT-IV: GETTING READY FOR JOB

1. Debates
2. Group discussions
3. Job Interviews

UNIT-V: INTERPERSONAL SKILLS

1. Time Management
2. Problem Solving & Decision Making
3. Etiquettes

4. LEARNING OUTCOMES:

- Accomplishment of sound vocabulary and its proper use contextually
- Flair in Writing and felicity in written expression.
- Enhanced job prospects.
- Effective Speaking Abilities

5. MINIMUM REQUIREMENT:

The Advanced English Communication Skills (AECS) Laboratory shall have the following infra-structural facilities to accommodate at least 60 students in the lab:

- Spacious room with appropriate acoustics.
- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system
- P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ
- T. V, a digital stereo & Camcorder
- Headphones of High quality

6. SUGGESTED SOFTWARE:

The software consisting of the prescribed topics elaborated above should be procured and G

1. **Walden Infotech: Advanced English Communication Skills Lab**
2. **K-VAN SOLUTIONS-Advanced English Language Communication Skills lab**
3. **DELTA's key to the Next Generation TOEFL Test: Advanced Skills Practice.**
4. **TOEFL & GRE(KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)**
5. **Train2success.com**

7. BOOKS RECOMMENDED:

1. **Objective English for Competitive Exams**, Hari Mohana Prasad, 4th edition, Tata Mc Graw Hill.
2. **Technical Communication** by Meenakshi Raman & Sangeeta Sharma, O U Press 3rd Edn. 2015.
3. **Essay Writing for Exams, Audrone Raskauskiene, Irena Ragaisiene & Ramute Zemaitiene,OUP, 2016**
4. **Soft Skills for Everyone**, Butterfield Jeff, Cengage Publications, 2011.
5. **Management Shapers Series** by Universities Press (India) Pvt Ltd., Himayatnagar, Hyderabad 2008.
6. **Campus to Corporate**, Gangadhar Joshi, Sage Publications, 2015
7. **Communicative English**,E Suresh Kumar & P.Sreehari, Orient Blackswan, 2009.
8. **English for Success in Competitive Exams**, Philip Sunil Solomon OUP, 2015

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech IV-I Sem. (FT)

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(15A27701) FOOD SAFETY STANDARDS

Preamble:

This course deals about the laws and regulations concerning food safety in India and rest of the world.

Objectives:

To impart the knowledge to students about

- a) Importance of Food safety and standards
- b) Various laws and regulations in India and rest of the world
- c) Implementation Protocol

UNIT – I

Definition, Importance, Scope and Factors affecting Food Safety. Principles of food safety – Establishment: design and facilities - emergency preparedness – Maintenance cleaning and sanitation – personal hygienic – packaging and labelling – transportation – traceability – recall procedure. GATT, WTO, TBT, SPS, FAO: Overview of Organizational structure, Objectives and Functions.

UNIT – II

Codex Alimentarius – PRP – GMP – GHP – GAP - GRAS- SSOP, Types of hazards - Biological, Chemical, Physical hazards. Management of hazards - Need. Control of parameters. Temperature control. Food storage.HACCP - principles – Hazard analysis – determine CCP – establish critical limit – establish monitoring procedure – establish corrective action – record keeping – verification – AOQL (Average Outgoing Quality Limit) – HACCP plan chart.Risk Analysis.

UNIT – III

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

History of food adulteration and evolution of standards. Intentional and unintentional - Preservatives - antioxidants, sweeteners, flavours, colours, vitamins, stabilizers - indirect additives - organic residues - inorganic residues and contaminants.

UNIT – IV

FSSAI, Essential Commodities Act, BIS, organizational chart – prohibition and regulation of sales – Laboratory and sampling analysis – scope and objective of industry – food safety policy – environmental policy – glass policy – jewellery policy – visitor policy.

UNIT – V

Implementation of food safety for a desired food processing industry. Newer approaches to food safety. Recent Outbreaks. Indian and International Standards for food products.

Text books

1. Food safety and standards regulations, 2010.
2. General requirements (Food Hygiene) of the Codex Alimentarius, Volume II. Food and Agriculture organization of the United Nations.

References

1. The ministry of health and family welfare, The Gazette of India: Extraordinary, Part- III, section

Outcomes:

The students get knowledge on

1. Need of food safety
2. Scope and importance of all food laws & regulations
3. ISO, CODEX and FSSAI
4. Implementation of food laws by governing authorities

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech IV-I Sem. (F.T.)

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(15A27702) BY PRODUCT UTILIZATION AND WASTE MANAGEMENT IN FOOD INDUSTRIES

Preamble:

Utilization of wastage from food products into useful products, these products can be used as vital food ingredient, packaging material and raw material to other industries.

Objectives:

To impart knowledge to the student on the food industry byproducts like Fruits and vegetables by-products, Cereal byproducts utilization, byproducts from Sugar industry, byproducts from alcoholic beverages, byproducts from dairy industry.

UNIT – I

Introduction to Industrial by - products and waste –facts and figures in India and world- Potentials and prospects of developing by-products Industry in India. Agricultural wastes and agro based industries - Types of By-products in agro - based industries - commercial compounds obtained from by-products.

UNIT – II

By-products of Cereals - by-products of cereals processing - Rice and corn milling byproducts, Husk Utilization. By-product utilization of Legume seeds. By-products of oilseed Industry - Oil seed cake utilization.

UNIT – III

By- products of vegetable and fruit processing Industry - various wastes obtained in different fruit processing industries - pectin extraction from apple pomace - tartaric acid extraction, oxalic acid. Fruit pits- kernel oil production, Citrus oil production, Value added products from culled fruit, peels and rinds.

UNIT – IV

By-products of fruit and vegetable fermentation - wine and vinegar. By-products of meat, poultry and egg processing Industry - Abattoir By-products. By-products of meat, poultry and egg processing Industry - By-products of fish processing units.

UNIT – V

By-products of spices and plantation crops. By-products of Alcoholic Fermentation Industries. By-products of Sugar Industry. By-products of Bakery Industry. By-products of

dairy industry, Classification, Principle and method of utilization - Whey utilization - demineralization of whey - Lactose preparation, Casein preparation - Utilization of Ghee residue - protein hydrolysates.

Text books

1. A Chakraverty, Post-Harvest Technology of Cereals, Pulses and Oil Seeds. Oxford and IBH Publishing Co. Ltd., Calcutta
2. Giridharlal, Siddappa and GL Tandon, ICAR. Preservation of fruits and vegetables, New Delhi.
3. Sudheer Gupta (Compiled), EIRI Fruits & Vegetables Processing Hand Book, Delhi.
4. R.P. Srivastava, Sanjeev Kumar, Fruit and vegetable preservation-3rd Edition, International Publishers, Delhi.
5. Norman N. Potter. Food Science.

References

1. Sukumar De, Outlines of Dairy Technology. Oxford University Press. New Delhi.
2. Ervan. Food from Wastes.
3. Sharma, B.D. Modern Abattoir Practices and Animal by Products Technology, Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi
4. P. Chereminst. Food Protein sources - Fire Energy from Solid Waste
5. B.H. Webb and E.O. Whittier, By-Products from Milk - AVI Publishers Co., West port, Connecticut, USA.

Outcomes:

By the end of the course, the students will be able to

- i. understand the concepts of Agricultural wastes and agro based industries
- ii. understand the industrial application of Food Industry By-Products like Oil seed cake utilization

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech IV-I Sem. (F.T)

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(15A27703) FOOD PLANT UTILITIES & ENERGY CONSERVATION

Preamble:

This subject focuses on different utilities like water, steam, electricity and its properties, production of consumption of these sources in the food plant.

Objective:

To give brief idea about the utilities that are required/used in food industry and their sources and importance.

UNIT – I

Introduction Classification of various utilities and services in food industry. Water use in Food Processing Industry Water supply system: Pumps of different types, operational aspects, piping system for fresh water, chilled water etc., fittings and control, water requirement for cleaning and processing, water quality, water purification and softening Water use in food processing: Different types of water requirements in food processing plants, types of water use, waste water sources, water wastage minimization, water loadings per unit mass of raw material. Water conservation: Water and waste water management, economic use of water, water filtration and recirculation.

UNIT – II

Steam uses in Food Industry Steam uses in food industry: Food processing operations in which steam is used, temperature, pressure and quantity of steam required in various food processing operations Steam generation system: Components of a boiler system, fuels used in boilers, energy analysis for a steam generation system, heat loss from boiler system, boiler design consideration. Energy conservation technologies for steam generation system, Energy saving through optimal design and operation of boiler, energy recovery from flue gas, energy recovery from blow down water, maintenance of boiler. Steam distribution system: Components of steam distribution, heat loss and energy efficiency of a steam distribution system. Energy conservation technologies for steam distribution system: Steam trap maintenance, condensate recovery, repairing of steam leaks, insulation improvements. Economical analysis of energy efficiency improvement, cogeneration.

UNIT – III

Electric Energy uses in Food Industry Power and Electrical System: Types of electrical loads, electric loads, sources of energy losses in power and electrical systems, low power factor, improper motor load, poor control. Power management for demand control, power factor improvement, replacement with high efficiency motors, replacement with electronic

adjustable motors. Energy conservation in heat exchangers: Energy conservation through heat transfer enhancement techniques, energy conservation through cleaning of fouling layer, energy conservation through optimization of heat exchanger design, energy conservation through heat exchanger network retrofit.

UNIT – IV

Waste-Heat Recovery in Food Processing Facilities Quantity and quality of waste heat in food processing facilities, waste heat utilization, heat exchangers for waste heat recovery, heat pumps for waste heat recovery. Waste Disposal and its Utilization Industrial waste, sewage, influent, effluent, sludge, dissolved oxygen, biological oxygen demand, chemical oxygen demand.

UNIT – V

Planning and Design of Service Facilities in Food Industry Estimation of utilities requirements: Lighting, ventilation, drainage, CIP system, dust removal, fire protection etc. Maintenance of facilities: Design and installation of piping system, codes for building, electricity, boiler room, plumbing and pipe colouring, maintenance of the service facilities. Services required in offices, laboratories, locker and toilet facilities, canteen, parking lots and roads, loading docks, garage, repair and maintenance shop, ware houses etc.

Text Books

1. Energy Efficiency and Management in Food Processing Facilities, by Lijun Wang. Published by CRC Press, 2008
2. Energy-saving Techniques for the Food Industry by M. E. Casper. Published by Noyes Data Corp., 1977
3. Chilton's Food Engineering. Published by Chilton Co., 1979 Reference book

References

1. Thermal Engineering in SI Units, P.L. Ballaney, 23rd Edition, Khanna Publishers, Delhi., 2003.
2. Refrigeration and Air conditioning, C.P. Arora, Tata McGraw Hill Publishing Co. Ltd. 3rd Edition, New Delhi. 2008.
1. A Survey of Water Use in the Food Industry by W. E. Whitman, S. D. Holdsworth. Published by British Food Manufacturing Industries Research Association.

Outcome:

Students will understand the importance of plant utilities, and resources and utilization in food plant.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech IV-I Sem. (F.T)

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(15A27704) FOOD PACKAGING TECHNOLOGY

Preamble:

This course was designed to know about the importance of packaging for foods, different food packaging materials, interactions between food and packaging materials and also novel food packaging techniques.

Objectives:

- a) The need for Optimum Packaging of foods, and
- b) About different packaging materials, and machinery used to protect food products and increase their shelf life

UNIT – I

Introduction: Importance and Functions of Food Packaging, Type of packaging materials; Selection of packaging material for different foods: Cereals, Meat, Poultry, Fish, Milk, Vegetables, Fruits, Spices and Carbonated Beverages. Selective properties of packaging film; Tests on packaging materials - Mechanical strength (Tension, notch and tearing strengths), Gas and water vapour transmission rates; Methods of packaging and packaging equipment.

UNIT – II

Cellulosic and Polymeric packaging materials and forms: Food grade polymeric packaging materials, Rigid plastic packages. Films: Oriented, Co-extruded, Laminates and Metallised; Cellophane, Olefins, Polyamides, Polyesters, PVC, PVDC, PVA, Inomers, Copolymers, Polycarbonates, Phenoxy, Acrylic and Polyurethane. Their mechanical sealing and barrier properties.

UNIT – III

Glass and Metal containers: Glass: Composition, Properties, Bottle making and Closures for glass containers. Metal: Bulk containers, Tin-plate containers, Tin free steel containers, Aluminium containers, Latest development in metal cans and protective lacquers. Testing of Packaging Material: Destructive & Non destructive test, testing of rigid, semi rigid and flexible packaging material, Shelf life study etc. Corrosion and toxicity of packaging material.

UNIT – IV

Food product characteristics and package requirement, Interactions between packaging material and foods. Selection of materials, Forms, Machinery and methods for fresh produce

UNIT – V

Advances in Food Packaging: Smart packaging, Intelligent Packaging, Active Packaging and Antimicrobial packaging, Retortable pouches, biodegradable and edibles packaging materials and films. Package printing, Barcodes & Labelling; Packaging Laws and Regulations, Evaluation of food packaging materials and package performance.

Textbooks

1. Food Packaging Principles and Practices. G. L. Robertson, Marcell Decker, 2nd Edition, 2006.
2. Innovation in Food Packaging. J.H. Han (Ed), Elsevier Publications, 1stEdition, 2005.
3. Food Packaging: Principles and Practices. G. L. Robertson, CRC Press, 2nd Edition, 2005.
4. M. Mahadeviah and R.V. Gowramma Food Packaging Materials

References

1. Food Packaging Technology. R. Coles, D. McDowell and M. J. Kirwan, CRC Press, 1st Edition, 2003.
2. Novel Food Packaging Techniques. R. Ahvenainen (Ed), Woodhead Publishing, 1st Edition, 2003.
3. Food Packaging Science and Technology. K. L. Yam, D.S. Lee and L. Piergiovanni, CRC Press, 1st Edition, 2008.
4. S. Saclarow and R.C. Griffin Principles of Food Packaging Trends in Food Science & Technology Proceedings of IFCON-1988

Outcome:

By the end of the course, the students will be able to know

- i) about different types of paper based packaging material
- ii) about different types of plastic based package material
- iii) about metal and glass based packaging material
- iv) about advanced packaging techniques and packaging machinery

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech IV-I Sem. (F.T)

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(15A27705) FOOD EXTRUSION TECHNOLOGY

ELECTIVE – II

Preamble:

This course deals with the significance of extrusion technology over other technologies. Steps involved in extrusion process. Application of this technology in order to produce various food products.

Objectives:

To impart knowledge to the students about extrusion technology, principle of working, classification of extruders according to process and construction, extruded products and their processing.

UNIT – I

Extrusion definition, introduction to extruders and their principles, types of extruders. Extruders in the food industry: History and uses of extruders in the food industry. Single screw extruder: principle of working, net flow, factors affecting extrusion process, co-kneaders.

UNIT – II

Twin screw extruder: counter rotating and co-rotating twin screw extruder. Process characteristics of the twin screw extruder: feeding, screw design, screw speed, screw configurations, die design. Barrel temperature and heat transfer, adiabatic operation, heat transfer operations and energy balances. Problems associated with twin screw extruder.

UNIT – III

Pre-conditioning of raw materials used in extrusion process, Pre-conditioning operations and benefits of pre-conditioning and devolatilization. Interpreted-flight expanders - extruders, dry extruders. Chemical and nutritional changes in food during extrusion. Practical considerations in extrusion processing: pre-extrusion processes, cooker extruder Profiling.

UNIT – IV

Practical considerations in extrusion processing: Addition and subtraction of materials, shaping and forming at the die, post extrusion processes. Breakfast cereals: introduction, type of cooking - High shear cooking process, steam cookers, low shear, low pressure cookers and continuous steam pre-cooking, available brands.

UNIT – V

Breakfast cereal processes: traditional and extrusion methods, classification of breakfast cereals - flaked cereals, oven puffed cereals, gun puffed cereals, shredded products. Texturized vegetable protein: Definition, processing techniques, and foods. Snack food extrusion: Direct expanded (DX) and third generation (3G) Snacks: types, available brands, co- extruded snacks and indirect-expanded products.

Text books

1. Richardson P. Thermal Technologies in Food Processing. Wood head Publishers, Cambridge
2. Guy R. Extrusion Cooking, Technologies and Applications. Wood head Publishing Limited, Abington, Cambridge.
3. Fast R.B. and Caldwell E.F. Breakfast Cereals and How they are made. (2000) American Association of Cereal Chemists., St. Paul, Minnesota.

References

1. Frame N.D. The Technology of Extrusion Cooking. (1994) Blackie Academic & Professional, New York.
2. Harper J.M. Extrusion of Foods. Vol. 1&2 (1991) CRC Press, Inc; Boca Raton, Florida.
3. O'Connor C. Extrusion Technology for the Food Industry. (1987) Elsevier Applied Science, New York.

Outcomes:

By the end of the course, the students will be able to

- i. learn about use of extrusion technology in food industry
- ii. study about Extrusion cooking, preconditioning of raw material, types of extruders and operating parameters

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B. Tech IV-I Sem. (F.T)

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(15A27706) BAKERY, CONFECTIONERY & SNACK PRODUCTS

ELECTIVE – II

Preamble:

This course was designed to know the status of bakery and confectionery industry. Study of various bakery & confectionery, snack products. Significance of dough rheology.

Objectives:

- i) To train the students in Bakery & Confectionery and to impart knowledge about different raw materials used and their role.
- ii) To impart knowledge on different equipment, processing of different Products and their packaging & Quality maintenance.

UNIT – I

Current status, growth rate, and economic importance of Bakery and Confectionery Industry in India. Raw materials for bakery and confectionery products- Essential and optional. FSSAI Specification of raw materials.

UNIT – II

Bakery Products: Ingredients, assessing quality of ingredients & processes for breads, bread rolls, sweet yeast dough products, biscuits, cookies & crackers, cake specialties, pies and pastries, doughnuts; rusks; other baked products. product quality characteristics, faults and corrective measures for above bakery products. Assessing quality of products, FSSAI Specifications.

UNIT – III

Dough rheology, Bakery machinery and equipment: Weighing Equipment- Manual scale, Automatic weigh, liquid measuring. Mixing blenders, Horizontal and vertical planetary, continuous mixers. Make up equipment- Divider, Rounder, Proofer, moulder. Baking equipment – different oven, slicer.

UNIT – IV

Confectionery and chocolate products: Chocolate, fondant, caramels, fudge, hard-boiled candies, toffees, fruit drops, chewing and bubble gums, cocoa products and other confections: - ingredients, equipment & processes, packaging, storage and quality testing, product quality parameters, faults, causes and corrective measures, FSSAI Specifications.

UNIT – V

Snack foods: Types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing; Snack food seasonings; Breakfast cereals, macaroni products and malts: Specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing, FSSAI Specifications.

Textbooks

1. Bakery Technology and Engineering. S. A. Matz, CBS Publications, 3rd Edition, 2003.
2. Cereals as Food and Feed. S. A. Matz, CBS Publications, 2nd Edition, 2001.
3. Baking Science and Technology. E. J. Pyler, Sosland Publishing Company, 3rd Edition, 2009.
4. Bernard. W. Minifie., PhD “Chocolate, Cocoa, and confectionery” (Science and Technology), 3rd edition, CBS publishers and Distributors, New Delhi 110002.

References

1. Industrial Chocolate Manufacture. T. Beckett, Wiley-Blackwell, 4th Illustrated Edition, 2005.
2. Dough rheology and baked product texture. F. Faubion, CBS Publications, 1st Edition (Indian reprint), 1997.
3. Chocolate, Cocoa and Confectionery. B.W. Minifie, CBS Publications, 3rd Edition, 1997.
4. “The complete Technology book on bakery products” by NIIR Board.

Outcome:

By the end of the course, the students will have

- i. knowledge in the all areas of Bakery and Confectionery and their processing methods, equipment used and operating procedure and etc.

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(15A27707) TECHNOLOGY OF TRADITIONAL INDIAN FOODS

ELECTIVE – II

Preamble:

This course emphasis on importance and significance of traditional foods in all parts of India. Processing and advantages of those foods.

Objective:

- To know the all indigenous foods and their significance
- Various methods of processing
- Standardization of traditional foods and its health benefits

UNIT – I

Processing & Preservation methods of Sweets & Desserts: Kulfi, Falooda, Kheer, khurchan, khoa/mawa, Rabri, jalebi, imarti, Gulabjamun, Pedas, petha, rewdi, gajak, milk cake, balushahi, balmithai, singoni, Ras-malayi, Gulqand, ghevar, rasgolla, chamcham, son halwa, son papri, several varieties of halwa, laddu, barfi & rasgolla.

UNIT – II

Processing & Preservation methods of Snacks: Gujiya, kachauri, samosa, mirchibada, kofta, potato chips, banana-chips, mathri, bhujia, fried dhals, bhujia, shakarpara, pakoda, vada.

UNIT – III

Processing & Preservation methods of Fermented Foods: Idli, dosa, Vada, khammandhokla, Dahi (Curd), Srikhand.

UNIT – IV

Processing & Preservation methods of Baked Products: Biscuits, Toast, Candies, Cookies, Breads, Roti, Naan, Tandoori Roti, parantha, kulcha, puri, bhatura.

UNIT – V

Processing & Preservation methods of Preserves & Beverages: Murabba, sharbat, pana, aampapad, sharbat, coconut water, tea, milk (khas, rose), Alcoholic Beverages (palm wine, fenny, bhang & Indian beer)

Text Books

1. Handbook of Indigenous Fermented Foods. K.H. Steinkrus (Ed), Marcel Dekkar Inc. 2nd Edition, 1998.

2. Outlines of Dairy Technology. Sukumar De, Oxford University Press, 1st Edition (PB), 2009.

References

1. The Food of India. P. Wickramasinghe, and C. Selva Rajah (Eds), Oberoi Group, Periplus, 1st Edition, 2001.

2. Technology of Indian Milk Products. R. P. Aneja, B.N. Mathur, R.C. Chandan, and A.K. Banerjee, (Eds), Dairy India YearBook, 2009.

3. Fundamentals of Indian Cooking. Rakesh Mangal, Subling Publication, 2nd Edition, 2003.

Outcome:

Students acquire knowledge on all Indian ethnic foods, history and scope, processing techniques and its uses.

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(15A27708) TECHNOLOGY OF BEVERAGES ELECTIVE – III

Preamble:

The text describes the various beverages that can be manufactured. Rawmaterials and other ingredients used in beverage processing. Quality parameters for waterand threshold levels.

Objectives:

This subject taught the different types of beverages and its commercial application, processing and quality control in beverage industry. Equipment used and sanitation methods for cleaning equipment.

UNIT – I

Beverage-definition-ingredients- water, carbon dioxide, bulk and intense sweeteners, water miscible and water dispersible flavouring agents, colours – natural and artificial, Micro and nanoemulsions of flavors and colors in beverages, preservatives, emulsifiers and stabilizers.

UNIT – II

Technology for alcoholic beverages: Raw materials Malt, hops, adjuncts, water, yeast quality and handling. Beer manufacturing process malting, preparation of sweet wort, brewing, fermentation, pasteurization and packaging. Beer defects and Spoilage.Wine-fermentation-types –red and white. Wine defects and spoilage.Equipment and machinery for Wine, Beer, Whiskey, Brandy, and Rum. Cereal Fermentation. Packaging and storage of different beverages, FSSAI Specifications.

UNIT – III

Equipment and machinery for carbonated beverages, water treatment, syrup preparation, filling system, packaging containers and closures, handling of empty containers and cleaning, carbonation, filling, inspection and quality control.

UNIT – IV

Technology for non-carbonated beverages: Raw materials quality and handling. Coffee bean preparation-processing-brewing-decaffeination- instant coffee-Teatypes-black, green and oolong- fruit juices, nectars, squash, RTS beverages, isotonic Beverages, FSSAI Specifications. Flash pasteurization, Canning and Aseptic Packaging of beverages. Equipment and machinery used.

UNIT – V

Effective application of quality controls- sanitation and hygiene in beverage industry-Quality of water used in beverages - threshold limits of various ingredients according to FSSAI, EFSA and FDA – Absolute requirements of Soluble solids and titratable acidity in beverages. Water: RO, Mineral water specifications.

Text books

1. Ashurst, P.R, “Chemistry and technology of Soft drink and fruit juices”, 2nd edition, Blackwell Publishing Ltd. 2005.
2. Steen, D.P and Ashurst, P.R, “Carbonated soft drinks – Formulation and manufacture”, Blackwell Publishing Ltd. 2000.
3. ShankunthalaManay, N. and Shadakdharaswamy, M, “Foods – Facts and Principles”, New Age International Pvt. Ltd, 3rd revised edition 2000.
4. Charles, W.Bamforth, “Food, fermentation and microorganisms”, Blackwell Science Publishing Ltd. 2005.

References

1. AmalenduChakraverty et al, “Handbook of Post-Harvest Technology”, Ed: Marcel Dekker Inc. (Special Indian edition) 2000.
2. Robert.W.Hutkins, “Microbiology and Technology of Fermented foods”, IFT Press, Blackwell Publishing Ltd. 2006.
3. “Brewing yeast and fermentation Chris Boulton and David Quain”, Blackwell Science Ltd
4. “Prevention of Food Adulteration Acts and Rules Manual”.

Outcome:

- Students will acquire knowledge on technology of beverages and its scope and comparison of various processing of beverages. Quality standards by FSSAI, EFSA and FDA.

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(15A27709) FLAVOUR TECHNOLOGY ELECTIVE – III

Preamble:

This course mainly focus on significance of flavor, sensory perception of flavor and its interactions with different foods. Uses of flavourings in foods.

Objective:

To expose the students to flavor technology, in that the sources of flavours and methods of extraction. Flavor compound present in different foods and specifications for flavours by BIS/FSSAI.

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, flavourpotentiators 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 sulfur compounds, fatty acids, amino acids, terpenoids, lactic acidethanol 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.

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.

Textbooks:

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.

References:

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

Outcome:

- Students will understand the concept of flavor and its applications in various foods.
- Consumer perception towards flavor resultant to that development of new flavours.

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(15A27710) SPECIALTY FOODS: NUTRACEUTICALS AND FUNCTIONAL FOODS

ELECTIVE – III

Preamble:

This course will cover the classification, brief history and the impact of nutraceuticals and functional foods on health and disease prevention. Nutraceuticals to be covered in the course include isoprenoids, isoflavones, flavanoids, carotenoids, lycopene, garlic, omega 3 fatty acids, sphingolipids, vitamin E and antioxidants, herbal products in foods. Also marketing issues related to functional foods and nutraceuticals as well as stability testing will be reviewed.

Objectives:

1. To understand the interrelationship between nutraceuticals and health maintenance.
2. Cite the evidence supporting the efficacy and safety of nutraceutical and functional food products
3. To explain the metabolic consequences of nutraceuticals and functional foods.
4. Describe the physiologic and biochemical changes associated with consumption of nutraceuticals

UNIT – I

Introduction, definition, Modification in the definition of nutraceuticals. Classification of nutraceuticals, Nutraceuticals market scenario, formulation considerations. Challenges for Nutraceuticals.

UNIT – II

Nutraceuticals value of spices and seasoning – Turmeric, Mustard, Chilli, Cumin, Fenugreek, Black Cumin, Fennel, Asafoetida, Garlic, Ginger, Onion, Clove, Cardamom Etc., Nutraceuticals from Fruits And Vegetables- Mango, Apple, Grapes, Bel, Banana, Broccoli, Tomato, Bitter Melon, Bitter Orange.

UNIT – III

Omega -3 fatty acids from fish- Typical properties, structural formula, functional category. CLA- typical properties, structural formula, functional category. Application in Nutraceuticals. Calcium, chromium, copper, iodine, iron, magnesium, Zn- mechanism of action, bioavailability, uses and deficiency, dietary sources.

UNIT – IV

Definition, classification – Type of classification (Probiotics, probiotics and synbiotics: Taxonomy and important features of probiotic microorganisms. Health effects of probiotics including mechanism of action. Probiotics in various foods: fermented milk products, non-milk products etc. Prebiotics. Definition, chemistry, sources, metabolism and bioavailability, effect of processing, physiological effects, effects on human health and potential applications in risk reduction of diseases, perspective for food applications for the following: Non-digestible carbohydrates/oligosaccharides: Dietary fibre, Resistant starch, Gums.

UNIT – V

Phytosterol, Fatty Acids, Carotenoids, Anthocyanins, Carotenoids, Amino Acids, Water Soluble Vitamins, Free radical biology and antioxidant activity of nutraceuticals. Regulations of Nutraceuticals and Functional Foods in India and rest of the world.

Text Books

1. Yashwant Pathak, “Handbook of Nutraceuticals and Functional Foods. Vol. 1. (Ingredients, formulations, and applications)” CRC Press 2005.
2. Robert Wildman, “Handbook of Nutraceuticals and Functional Foods”. 2nd edition. CRC Press 2001.
3. Human nutrition: A textbook of nutrition in health and disease. B. T. Burton, Mc Graw Hill, 3rd Edition, 2002.
4. Nutrition and Dietetics. S. A. Joshi, Tata Mc Graw Hill Co. Ltd., 2nd Edition, 2003.

References

1. Dietetics. B. Shrilakshmi, New Age International (P) Ltd., New Delhi, 5th Edition, 2005.
2. Nutrition and Dietetic Foods, A. E. Bender, Chem. Pub. Co. New York, 2nd Edition, 2004.
3. Basic Nutrition in Health and Disease. P. S. Howe, W. B. Saunders Company, London, 2nd Edition, 2003.
4. Kramer, Hoppe and Packer, “Nutraceuticals in Health and Disease Prevention”, Marcel Dekker, Inc., NY 2001.
5. Bao and Fenwick, “Phytochemicals in Helath and Disease”, Marcel Decker, Inc. NY 2004.

Outcome:

- Students will get know the nutraceuticals and its active components in different foods, regulations on nutraceuticals in India.

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(15A27711) FOOD ANALYSIS LAB

Objectives:

To expertise the students to analyze the proximate composition and other important constituents present in the food.

Laboratory Experiments:

1. Sampling plan; Sampling requirements, Sample collection and preparation for analysis procedures and methods
2. Determination of pH
3. Determination of moisture content of foods by oven drying and distillation methods
4. Determination of Total and Acid insoluble ash content in foods
5. Determination of crude fat content by solvent extraction methods in foods
6. Determination of crude Protein by Kjeldhal Lowry method & other methods
7. Determination of reducing and total sugar content in foods
8. Determination of crude fibre content in foods
9. Determination of specific mineral contents in foods such as Calcium, Iron, Phosphorus, Chloride etc.
10. Determination of specific vitamin content of food such as ascorbic acid, carotenes etc.
11. Determination of specific Natural and/ or added Colouring Matters in foods
12. Determination of specific added food Preservatives in foods

Outcome:

By the end of the practical exercises, the students will be able to

- i. adapt suitable method for food analysis
- ii. apply the knowledge of Techniques in Food Analysis,
- iii. differentiate between Qualitative identification and Quantitative estimations

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(15A27712) PACKAGING LAB

Objectives:

To learn the identification of various packaging materials and testing of packaging material quality, shelf life related calculations.

Laboratory Experiments:

1. Identification of different types of packaging and packaging materials
2. Measurement of thickness of paper, paper boards and other packaging materials
3. Measurement of basic weight and grammage of paper and paperboards
4. Measurement of water absorption of paper, paper boards
5. Measurement of bursting strength of paper, paper boards
6. Measurement of tear resistance of papers
7. Measurement of puncture resistance of paper and paperboard
8. Measurement of tensile strength of paper, paper boards
9. Measurement of grease resistance of papers
10. Determination of gas and water transmission rate of package films
11. Drop test, Box compression test
12. Identification of plastic films
13. Shelf life calculations for food products
14. Head space analysis of packaged food
15. Determination of tensile strength of given material;
16. Introduction of students with the latest trends in packaging from websites and magazines

Outcome:

By the end of the Practical exercises, the students will be able to

- i) know about measurement of thickness, grammages, Burst strength of different packaging materials
- ii) know about measurement of Tensile strength, water vapour transmission rate (WVTR)
- iii) know about the pre-packing practices for packaging fruit & vegetables

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(15A27801) PLANT DESIGN AND PROCESS ECONOMICS

MOOCS – II

Preamble:

This subject broadly covers the principles and types of plant layout and design, peculiarities of food plant layouts, scale up and pilot plant studies.

Objectives:

To impart knowledge on food plant layout and design of food industries and its considering factors, cost economics and etc.

UNIT – I

Introduction to Plant Design, Peculiarities of food processing industries, Process Development, Process selection, Flow sheet preparation, sketching techniques, Equipment numbering, Stream designation, Material and energy balances.

Plant Design basis, Selection of equipment, specification and design of equipment's, Optimisation of different process equipment, materials of construction, Plant location, Plant layout and installation, Safety, Start up, Shutdown and Operating guidelines.

UNIT – II

Development and presentation of the layout, selection of site and Location of plant, General points of consideration for designing food plant, floor plant types of layouts, Food building planning, preparation of machinery layout for fruit, vegetables and meat-size reduction machinery layout.

UNIT – III

Evaporation plant layout-single, multiple, vacuum and film evaporators-types and concepts, drying plant layout, drying process, dryer types, selection of dryers. Baking oven and frying plant-types, concepts and layout. Filling closing and labelling of plant layout. Organization and trends in plant layout - sample layout, installation procedure for food processing plant.

UNIT – IV

Cost Engineering Time value of money and equivalence, Interest, cost comparisons by present worth, Annual equivalent cost and capitalised cost methods, Uniform gradient and series. Depreciation, Taxes and Insurances, Nature of depreciation, Methods of determining

depreciation, depreciation rates in current Indian situation, Types of taxes and insurances, Procedure for cost comparison after taxes.

UNIT – V

Cost Estimation- Types of cost estimation, capital investment cost, fixed capital cost, working capital cost, start-up costs, process equipment cost estimation, cost index, Equipment costs due to inflation, Battery limit investments, estimation of plant cost, Estimation of total product cost, Manufacturing cost, General expenses. Profitability Criteria of profitability, Payout period, Return on investment, Present value, Cash flow analysis, Alternative investment analysis, Sensitive analysis in project profitability. Preparation of techno-economic 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.

References

1. Peters M., Timmerhaus K. & Ronald W., Plant Design & Economics for Chemical Engineers, McGraw Hill
2. James R Couper, Process Engg. Economics (Chemical Industries) CRC Press 3. Aries & Newton, Chemical Engg. Cost Estimation, McGraw Hill.

Outcomes:

By the end of the course, the students will

- i. acquire knowledge on theoretical aspects to be considered for site selection, layout selection and design considerations for a food plant

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(15A27802) FOOD PLANT SANITATION & HYGIENE

MOOCS – III

Preamble:

This subject deals with importance of food plant sanitation hygiene, principles of sanitation and hygiene.

Objective:

To explore the knowledge on types of sanitizers and methods to eradicate the pests and good hygienic practices by individual and organization.

UNIT – I

Sanitation and food industry Sanitation, importance of sanitation in food plants, sanitation laws and guidelines, establishment of sanitary practices. Food contamination sources, Sources of contamination, contamination of foods, protection against contamination

UNIT – II

Cleaning compounds and sanitizers Classification, selection of cleaning compounds, handling and storage, precautions, sanitizing methods – thermal, steam, hot water, radiation, HHP, Vaccum/Steam/Vaccum, chemical sanitizers – chlorine, iodine, bromine, quaternary ammonium compound, acid sanitizers, detergent formulations, iodophores

UNIT – III

Pest and Rodent Control Insect infestation, cockroaches, rodents, birds, use of pesticides, integrated pest management. Sanitary design and construction for food processing plant Site selection, site preparation, building construction considerations, pest control design, construction materials

UNIT – IV

Water quality and treatment Characteristics of drinking water – physical (temperature, colour, turbidity, taste and odour), chemical (pH, hardness, alkalinity), microbiological (total plate count, E.Coli, Streptococcus faecalis), waste disposal – industrial waste, influent, effluent, biological oxygen demand, chemical oxygen demand, tolerance limits for industrial effluent discharged into surface water, water treatment – primary (screening, sedimentation, floatation), secondary (trickling filters, activated sludge method, lagoons), tertiary (chemical coagulation and flocculation process), utilization of waste from food processing industry

UNIT – V

Personal hygiene and sanitary food handling Personal hygiene, employee hygiene, sanitary food handling, role of employee supervision, employee responsibility. Role of HACCP in sanitation HACCP, HACCP development, interface with GMP and SSOPs, HACCP principles, organization, implementation and maintenance

Textbooks

1. Food Hygiene and Sanitation. S. Roday, Tata McGraw Hill, 1st Edition, 1998.
2. Principles of Food Sanitation. N. G. Marriott, Springer, 5th Edition, 2006.
3. Hobbs Food Poisoning and Food Hygiene. Jim Mclauchlin and Christine Little (Eds), 7th Edition, 2007.

References

1. Food Plant Sanitation, Marcell Dekker Inc by Bernard L Bruinsma, J Richard Gorham
2. Sanitation in Food Processing. John Troller, Academic Press, 2nd Edition, 1993.

Outcome:

Students are exposed to different sanitizers for cleaning the equipment and methods of hygienic practices.