Curricula and Syllabi

B.Tech. (Food Technology)

2019

Placed before the
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KERALA AGRICULTURAL UNIVERSITY

KELAPPAJI COLLEGE OF AGRICULTURAL ENGINEERING & TECHNOLOGY

TAVANUR, KERALA-679573

B.Tech. (Food Technology)

INTRODUCTION

With liberalization of Indian economy, all-round industrial growth has been witnessed in all sectors with improvements in social and economic conditions of our people. This has created demand for more and better quality foods. With advancement in production technology, high yield levels will lead to large amount of marketable surplus of food grains and crop residues, demanding appropriate handling, processing, preservation, storage, marketing and utilization.

Though Kerala has the unique distinction of producing a number of agricultural commodities of commercial importance, the production front is yet to receive a commercial orientation in the real sense. The primary export commodities are cereals, spices, plantation crops, fruits, vegetables and their processed products, and marine products but fast growing speciality products have also penetrated in foreign markets. Considering the contribution of these products in Indian export, it is necessary to have appropriate technology of handling and processing of agricultural produce. Agro processing sector of the state failed to receive due recognition and importance till date and consequently many of the agricultural commodities produced in Kerala are traded in their raw form after some primary processing.

Food Engineering and Technology is a branch of science in which the food science is applied in manufacturing and preservations of food products by eliminating losses and making more balanced and nutritious foods. The B.Tech course in Food Technology is designed to train the best talents of the nation in order to provide a support base for the country's food security. The course deals with diversified aspects of formulation, processing and preservation of foods; it also enables students to effectively design and fabricate food processing machineries. This course aims to give adequate training and knowledge to candidates regarding analyzing the quality of raw materials, packing standards and methodology, processing technologies, storage and food values. The future of the food industries, on a global scale, is in the hand of food technologists. The syllabus of the course is framed to enable the students to comprehend the whole gamut of the fast changing food scenario of the world and it comprises mainly of food technology, microbiology, food preservation techniques, food packaging and food quality.

Food has become a high-profit industry by reason of the scope it offers for value addition, particularly with the food processing industry getting recognized in India as a high-priority area. In order to achieve the expected returns on investment through good quality and right value addition, application of technology has become imperative, leading to an unprecedented demand for scientists, technologists and other professionals who can manage the emerging challenges of the food processing industry effectively.

Degree awarded

B.Tech (Food Technology)

Placement and scope of job opportunities for the scholars

Food processing industry is rapidly growing in India and several employment opportunities are available in various industries. Many of the research institutes in the state as well as country are urgently in need of suitable candidates with specialization in Food Technology. This course offers numerous job opportunities in various areas like food processing industries, research laboratories and institutions, quality control labs, Food safety standards institutes and other food manufacturing facilities as engineers, technologists and managers.

Number of seats

The maximum number of candidates to be admitted in each year will be 30 subject to the manpower requirements and facilities. However the number of candidates to be admitted in an academic year shall be decided by the Academic Council from time to time. The sponsored candidates will be admitted over and above the seats so fixed with the approval of the Academic Council.

Mode of selection and qualifications for admission

The selection of candidates for admission shall be made as per rules in force. The qualifications for this programme shall be as suggested by Government and prescribed by the Academic Council from time to time.

Reservation

Fifteen percent seats are filled by Indian Council of Agricultural Research, New Delhi through a National Level entrance Examination.

Duration of the degree programme

The minimum prescribed duration of this programme shall be eight semesters (four academic years) excluding the period of temporary discontinuance, if any. The maximum time limit permitted to complete the programme shall be fourteen semesters including the period of discontinuance, if any.

Academic Regulations

The academic rules and regulations of the B.Tech (Food Technology) programme would be the Kerala Agricultural University academic rules as approved by the Kerala Agricultural University Academic Council.

B.Tech. (Food Technology) -Semester wise break up of courses

Semester-I			
1	Beas.1101	English Language	2 (1+1)
2	Pafe. 1101	General Microbiology	3 (2+1)
3	Beas.1102	Engineering Mathematics-I	2 (2+0)
4	Pafe.1102	Engineering Drawing	2 (0+2)
5	Fmpe1101	Electrical Engineering	3 (2+1)
6	Pafe.1103	Workshop Technology	3 (1+2)
7	Beas.1103	Crop Production Technology	3 (2+1)
8	Swce.1101	Environmental Sciences & Disaster Management	2 (1+1)
9	Beas.1104	Physical Education	1 (0+1)*
Total			**20 (11+9)**

* Non-Credit Course

Semester-II			
1	Pafe.1204	Food Chemistry of Macronutrients	3 (2+1)
2	Pafe.1205	Food Microbiology	3 (2+1)
3	Pafe.1206	Food Thermodynamics	2 (2+0)
4	Beas.1205	Information Technology and Computer Programming	3 (1+2)
5	Pafe.1207	Fluid Mechanics	3 (2+1)
6	Beas.1206	Basic Electronics Engineering	3 (2+1)
7	Beas.1207	Engineering Mathematics-II	2 (2+0)
8	Pafe.1208	Post Harvest Engineering	3 (2+1)
9	Ncss.1201	NSS	1 (0+1)*
Total			**22 (15+7)**

* Non-Credit Course

Semester-III			
1	Pafe.2109	Food Additives and Preservatives	2 (1+1)
2	Pafe.2110	Processing Technology of Liquid Milk	2 (1+1)
3	Pafe.2111	Processing Technology of Cereals	3 (2+1)
4	Pafe.2112	Industrial Microbiology	3 (2+1)
5	Pafe.2113	Computer Aided Drafting of Food Processing Equipments	2 (1+1)
6	Pafe.2114	Food Chemistry of Micronutrients	3 (2+1)
7	Pafe.2115	Heat and Mass Transfer in Food Processing	3 (2+1)
8	Pafe.2116	Fundamental Unit Operations in Food Processing	3 (2+1)
9	Beas.2108	Statistical Methods and Numerical Analysis	2 (1+1)
Total			**23 (14+9)**

Semester-IV			
1	Pafe.2217	Processing Technology of Dairy Products	3 (2+1)
2	Pafe.2218	Processing Technology of Legumes and Oilseeds	3 (2+1)
3	Pafe.2219	Food Biochemistry and Nutrition	3 (2+1)
4	Pafe.2220	Unit Operations in Food Processing-II	3 (2+1)
5	Pafe.2221	Food Biotechnology	3 (2+1)
6	Pafe.2222	Food Refrigeration and Cold Chain	3 (2+1)
7	Pafe.2223	Processing of Spices and Plantation Crops	3 (2+1)
8	Beas.2209	Business Management and Economics	2 (2+0)
Total			**23 (16+7)**

Semester-V			
1	Pafe.3124	Processing Technology of Fruits and Vegetables	3 (2+1)
2	Pafe.3125	Food Plant Sanitation	2 (1+1)
3	Pafe.3126	Instrumental Techniques in Food Analysis	3 (2+1)
4	Beas.3110	ICT Applications in Food Industry	3 (1+2)
5	Pafe.3127	Food Process Equipment Design	3 (2+1)
6	Pafe.3128	Food Storage Engineering	3 (2+1)
7	Pafe.3129	Bakery, Confectionery and Snack Products	2 (1+1)
8	Beas.3111	Marketing Management and International Trade	2 (2+0)
9.	Pafe.3130	Sensory Evaluation of Food Products	2 (1+1)
Total			**23 (14+9)**

Semester-VI			
1	Pafe.3231	Processing Technology of Beverages	3 (2+1)
2	Pafe.3232	Food Packaging Technology and Equipment	3 (2+1)
3	Pafe.3233	Processing of Meat and Poultry Products	3 (2+1)
4	Pafe.3234	Processing of Fish and Marine Products	3 (2+1)
5	Pafe.3235	Food Quality, Safety Standards and Certification	2 (2+0)
6	Beas.3212	Instrumentation and Process Control in Food Industry	3 (2+1)
7	Beas.3213	Project Preparation and Management	2 (1+1)
8	Pafe.3236	Emerging Methods of Food Preservation	3 (2+1)
Total			**22 (15+7)**

Semester-VII			
1	Beas.4114	Communication Skills and Personality Development	2 (1+1)
2	Beas.4115	Entrepreneurship Development	3 (2+1)
3	Exlp.4101	Student READY-Experiential Learning Programme - I	7 (0+7)
4	Exlp.4102	Student READY- Experiential Learning Programme- II	7 (0+7)

5	Proj.4101	Student READY - Research Project	3 (0+3)
6	Semr.4101	Student READY - Seminar	1 (0+1)
Total			**23 (3+20)**

Semester-VIII			
1	Idtr.4201	Student READY - Industrial Tour	2 (0+2)
2	Iplt.4201	Student READY - In-Plant Training	20 (0+20)
Total			**22 (0+22)**

Grand Total of Credit Hours 178 (88+90)

Semester wise distribution of courses and credits

Sl.No.	Semester	No. of Courses	Credit Hours
1	I	9	**20 (11+9)**
2	II	9	**22 (15+7)**
3	III	9	**23 (14+9)**
4	IV	8	**23 (16+7)**
5	V	9	**23 (14+9)**
6	VI	8	**22 (15+7)**
7	VII	6	**23 (3+20)**
8	VIII	2	**22 (0+22)**
Total			**178 (88+90)**

Department wise distribution of courses		Credit	Page No.
Department of Processing and Food Engineering			
Pafe.1101	General Microbiology	3 (2+1)	
Pafe.1102	Engineering Drawing	2 (1+1)	
Pafe.1103	Workshop Technology	3 (1+2)	
Pafe.1204	Food Chemistry of Macronutrients	3 (2+1)	
Pafe.1205	Food Microbiology	3 (2+1)	
Pafe.1206	Food Thermodynamics	2 (2+0)	
Pafe.1207	Fluid Mechanics	3 (2+1)	
Pafe.1208	Post Harvest Engineering	3 (2+1)	
Pafe.2109	Food Additives and Preservatives	2 (1+1)	
Pafe.2110	Processing Technology of Liquid Milk	2 (1+1)	
Pafe.2111	Processing Technology of Cereals	3 (2+1)	
Pafe.2112	Industrial Microbiology	3 (2+1)	
Pafe.2113	Computer Aided Drafting of Food Processing Equipments	2 (1+1)	
Pafe.2114	Food Chemistry of Micronutrients	3 (2+1)	
Pafe.2115	Heat and Mass Transfer in Food Processing	3 (2+1)	
Pafe.2116	Fundamental Unit Operations in Food Processing	3 (2+1)	
Pafe.2217	Processing Technology of Dairy Products	3 (2+1)	
Pafe.2218	Processing Technology of Legumes and Oilseeds	3 (2+1)	
Pafe.2219	Food Biochemistry and Nutrition	3 (2+1)	
Pafe.2220	Unit Operations in Food Processing-II	3 (2+1)	
Pafe.2221	Food Biotechnology	3 (2+1)	
Pafe.2222	Food Refrigeration and Cold Chain	3 (2+1)	
Pafe.2223	Processing of Spices and Plantation Crops	3 (2+1)	
Pafe.3124	Processing Technology of Fruits and Vegetables	3 (2+1)	
Pafe.3125	Food Plant Sanitation	2 (1+1)	
Pafe.3126	Instrumental Techniques in Food Analysis	3 (2+1)	
Pafe.3127	Food Process Equipment Design	3 (2+1)	
Pafe.3128	Food Storage Engineering	3 (2+1)	
Pafe.3129	Bakery, Confectionery and Snack Products	2 (1+1)	
Pafe.3130	Sensory Evaluation of Food Products	2 (1+1)	
Pafe.3231	Processing Technology of Beverages	3 (2+1)	
Pafe.3232	Food Packaging Technology and Equipment	3 (2+1)	
Pafe.3233	Processing of Meat and Poultry Products	3 (2+1)	
Pafe.3234	Processing of Fish and Marine Products	3 (2+1)	
Pafe.3235	Food Quality, Safety Standards and Certification	2 (2+0)	
Pafe.3236	Emerging Methods of Food Preservation	3 (2+1)	
		Total 99 (63+36)	

Department of Farm Machinery and Power Engineering			
Fmpe.1101	Electrical Engineering	3 (2+1)	
		Total 3 (2+1)	
Department of Soil and Water Conservation Engineering			
Swce.1101	Environmental Sciences & Disaster Management	2 (1+1)	
		Total 2 (1+1)	
Department of Basic Engineering and Applied Sciences			
Beas.1101	English Language	2 (1+1)	
Beas.1102	Engineering Mathematics-I	2 (2+0)	
Beas.1103	Crop Production Technology	3 (2+1)	
Beas.1104	Physical Education	1 (0+1)*	
Beas.1205	Information Technology and Computer Programming	3 (1+2)	
Beas.1206	Basic Electronics Engineering	3 (2+1)	
Beas.1207	Engineering Mathematics-II	2 (2+0)	
Beas.2108	Statistical Methods and Numerical Analysis	2 (1+1)	
Beas.2209	Business Management and Economics	2 (2+0)	
Beas.3110	ICT Applications in Food Industry	3 (1+2)	
Beas.3111	Marketing Management and International Trade	2 (2+0)	
Beas.3212	Instrumentation and Process Control in Food Industry	3 (2+1)	
Beas.3213	Project Preparation and Management	2 (1+1)	
Beas.4114	Communication Skills and Personality Development	2 (1+1)	
Beas.4115	Entrepreneurship Development	3 (2+1)	
* Non-Credit Course		**Total 34 (22+12)**	

SEMESTER-I

Beas. 1101English Language 2 (1+1)

OBJECTIVES

1. To equip the students for excellence in formal writing as well as familiarize them with the basic patterns of English Grammar.
2. To enable them to deconstruct given study material through note-making, references etc.

THEORY

MODULE I (5 Hours)

Basic sentence patterns in English: Agreement between subject and verb; Proper use of pronouns, adjectives and adverbs; Proper use of phrases and clauses.

MODULE II (7 Hours)

Some basic rules of composition; Concept of register; development of vocabulary; Reference skills: Dictionary, thesaurus, indexing, contents, glossary; Reading of selected texts and discussions; Vocabulary building tasks; Note-taking and note-making, linkage, development of paragraphs; Cohesion, coherence and style.

MODULE III (4 Hours)

Importance of language and communication skills in the engineering profession Introduction; Spoken and conversational English: Main features, agreement, disagreement, likes, dislikes and enquiries; Debate and discussion.

PRACTICAL

Grammar tenses; Voice-change; Direct/indirect narration; Prepositions and determiners; Word-formation with parts of speech; Types of sentences; Elementary knowledge of English sound with word-stress, intonation pattern; Composition, letter, application, summary and report writing.

Lecture Schedule

1. Subject, Predicate, verb, object
2. Agreement between subject and verb (Taking into account singular and plural usage; tenses; active voice/passive voice)
3. Agreement between subject and verb (Taking into account singular and plural usage; tenses; active voice/passive voice)
4. Proper use of pronouns, adjectives, verbs.
5. Proper use of phrases and clauses.
6. Concept of register
7. Development of vocabulary (synonyms and antonyms)
8. Reference skills- proper use of Dictionary, thesaurus, indexing, contents, glossary

9. Mid term Examination
10. Reading of selected texts and discussions (comprehension of unseen passages-reading speed, grasping of the content matter and evaluation of the same through short questions.)
11. Reading of selected texts and discussions (comprehension of unseen passages-reading speed, grasping of the content matter and evaluation of the same through short questions.)
12. Note- taking, Note-making
13. Linkage, Development of paragraphs-cohesion, coherence and style.
14. Spoken and conversational English(Formal and colloquial styles)
15. Agreement, disagreement, likes, dislikes
16. Enquiries, Requests, orders, permissions, advice, suggestions
17. Debate and discussion

Practical Schedule

1. Grammar tenses
2. Voice-change
3. Direct/indirect narration
4. Prepositions and determiners
5. Word-formation with parts of speech
6. Word-formation with parts of speech
7. Types of sentences
8. Elementary knowledge of English sound with word-stress
9. Elementary knowledge of English sound with word-stress
10. Intonation pattern
11. Composition
12. Letter
13. Application
14. Summary
15. & 16.Report writing
17. Practical Examination

Suggested Reading

1. Alice Oshima and Ann Hogue. 1998. Writing Academic English. Addison Wesley Longman, White Plains, NY, USA.
2. N. Krishnaswamy and T. Sriraman. 1995. Current English for Colleges. Macmillan India Ltd., Chennai.

Pafe. 1101 General Microbiology 3 (2+1)

OBJECTIVES

Upon completion of this course, students are expected to be able to:

1. Understand the basic rules to be maintained in a microbiology laboratory

2. Identify and differentiate the basic taxonomic groups of microorganisms
3. Handle microscopes, and familiar with different staining methods
4. Know about growth, reproduction and cultivation of microbes
5. Compare and contrast the acquisition of novel genetic information in microbes via mutations and genetic exchange, specifically conjugation, transformation and transduction
6. Understand the basic knowledge about sterilization, chemotherapeutic agents and antibiotics

THEORY

MODULE I (12 Hours)

Evolution and scope of microbiology; History of microbiology; Microbial classification, nomenclature and identification; Taxonomic groups; General methods of classifying bacteria; Microscopy and microscopes: Smears and staining; Morphology and fine structure of bacteria.

MODULE II (8 Hours)

Cultivation of bacteria, nutritional requirements; Nutritional classification of bacteria; Phototrophs, chemotrophs, autotrophs and heterotrophs; Obligate parasites; Bacteriological media, Growth of bacteria, Reproduction of bacteria; Introduction to fungi, algae and protozoa and virus :

MODULE III (8 Hours)

Nutrient transport phenomenon: Passive diffusion, facilitated diffusion; Group translocation, active transport. Microbial genetics; Bacterial recombination; Bacterial conjugation, transduction; Bacterial transformation; Mutations: Types of mutations, mutagenesis; Mutation rate, repair of mutations; Phenotypes of bacterial mutants; Designation of bacterial mutants;

MODULE IV (5 Hours)

Destruction of microorganisms: Physical agents and chemical agents; chemotherapeutic agents and chemotherapy; Characteristics of antibiotics; Mode of action of antibiotics; pure culture: Methods of isolation of pure cultures; Maintenance and preservation of pure cultures; Culture collections.

PRACTICAL

Microscopy; Micrometry; Cleaning and sterilization of glassware and acquainting with equipment used in microbiology; Preparation of nutrient agar media and techniques of inoculation; Staining methods (monochrome staining, gram staining, negative staining, capsule-staining, flagella staining and endospore staining); Pure culture techniques (streak plate/pour plate/spread plate); Identification procedures (morphology and cultural characteristics); Growth characteristics of fungi: Determination of microbial numbers, direct

plate count, generation time; Factors influencing growth: pH, temperature, growth curves for bacteria.

Lecture Schedule

1. Evolution and scope of microbiology
2. History of microbiology: spontaneous generation theory, biogenesis, germ theory diseases
3. History of microbiology: contributions of Anton van Leeuwenhoek, Louis Pasture, Robert Koch, Alexander flaming, Winogradsky, Beijerink
4. Microbial classification: general principle, three kingdom and five kingdom concept, universal phylogenetic tree
5. Nomenclature and identification, Taxonomic groups
6. General methods of classifying bacteria
7. Microscopy and microscopes, parts of microscopes
8. Types of optical microscope
9. Electron microscope and its types, advantages
10. Types of Smears and staining: simple staining, differential staining and structural staining
11. Morphology and fine structure of bacteria
12. Morphology and fine structure of bacteria
13. Cultivation of bacteria, nutritional requirements
14. Nutritional classification of bacteria; Phototrophs, chemotrophs, autotrophs and heterotrophs; Obligate parasites
15. Bacteriological media
16. Growth and reproduction of bacteria, growth curve
17. Introduction to fungi: classification, growth and reproduction
18. Introduction to algae: classification, growth and reproduction
19. Introduction to protozoa: classification, growth and reproduction
20. Introduction to virus
21. Nutrient transport phenomenon: Passive diffusion, facilitated diffusion
22. Group translocation and active transport
23. Mid Semester Examination
24. Microbial genetics; Bacterial recombination
25. Bacterial conjugation
26. Transduction
27. Bacterial transformation
28. Mutations: Types of mutations, mutagenesis
29. Mutation rate, repair of mutations; Phenotypes of bacterial mutants; Designation of bacterial mutants
30. Destruction of microorganisms: Physical agents and chemical agents
31. Chemotherapeutic agents and chemotherapy
32. Antibiotics : Characteristics, mode of action
33. Pure culture: Methods of isolation of pure cultures
34. Maintenance and preservation of pure cultures; Culture collections

Practical Schedule

1. Microscopy and Micrometry
2. Cleaning and sterilization of glassware
3. Equipment used in microbiology
4. Preparation of nutrient agar media and techniques of inoculation
5. Staining methods: simple (monochrome) staining and Negative staining
6. Gram staining
7. Capsule-staining, Endospore staining and Flagella staining
8. Pure culture techniques: streak plate
9. Pure culture techniques: pour plate
10. Pure culture techniques: spread plate
11. Identification procedures for unknown bacteria (morphology and cultural characteristics)
12. Identification procedures for unknown bacteria (morphology and cultural characteristics)
13. Growth characteristics of fungi
14. Determination of microbial numbers, direct plate count, generation time
15. Factors influencing growth: pH, temperature
16. Growth curves for bacteria
17. Practical examination

Suggested Reading

1. Gerard J. Tortora, Berdell R. Funke, Christine L. Case. 2014. Microbiology: An Introduction, 12th Ed. Prentice-Hall, NY, USA.
2. Johanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2013. Prescott's Microbiology, 9th Ed. McGraw-Hill Higher Education, NY, USA.
3. Michael J. Pelczar Jr., E.C.S. Chan and Noel R. Krieg. 1998. Microbiology, 5th Ed. Tata McGraw-Hill Education, New Delhi.

Beas. 1102 Engineering Mathematics-I 2(2+0)

OBJECTIVES

1. To impart analytical ability in solving mathematical problems as applied to the various branches of engineering
2. To understand differential equations which are very useful to obtain unknowns.
3. To understand about divergence and curl of a vector point function and their physical interpretations.

THERORY

MODULE I (12 Hours)

Differential calculus: Taylor's and Maclaurin's expansions, indeterminate form; asymptotes, function of two or more independent variables, partial differentiation,

homogeneous functions and Euler's theorem, composite functions, total derivatives, derivative of an implicit function, change of variables, Jacobians, maxima and minima.

MODULE II (4 Hours)

Ordinary differential equations: Exact and Bernoulli's differential equations, equations reducible to exact form by integrating factors, equations of first order and higher degree, Clairaut's equation.

MODULE III (9 Hours)

Differential equations of higher orders, methods of finding complementary functions and particular integrals, method of variation of parameters, Cauchy's and Legendre's linear equations, simultaneous linear differential equations with constant coefficients, series solution techniques, Bessel's and Legendre's differential equations.

MODULE IV (8 Hours)

Vector calculus: Differentiation of vectors, scalar and vector point functions, vector differential operator Del, Gradient of a scalar point function, Divergence and Curl of a vector point function and their physical interpretations, identities involving Del, second order differential operator; Line, surface and volume integrals, Stoke's, divergence and Green's theorems (without proof.)

Lecture Schedule

1. Taylor's and Maclaurin's expansions
2. Indeterminate forms
3. Asymptotes
4. Tracing of curves, Cartesian curves.
5. Polar curves.
6. Function of two or more variables,Partial differentiation
7. Homogeneous functions and Euler's theorem.
8. Composite functions.
9. Total derivatives.
10. Change of variables.
11. Jacobians.
12. Maxima and minima of functions of more than one variable
13. Linear and Bernoulli's differential equations
14. Equations reducible to exact form by integrating factors
15. Equations reducible to exact form by integrating factors.
16. Clairaut's equation
17. Methods of finding complementary function and particular integrals
18. Methods of finding complementary function and particular integrals
19. Method of variation of parameters
20. Method of variation of parameters
21. Mid Examination
22. Cauchy's and Legendre's linear equations

23. Simultaneous linear differential equations with constant coefficients
24. Bessel's equation, Recurrence formula, value of $J_{\frac{1}{2}}$
25. Legendre's differential equations
26. Rodrigue's formula. recurrence formula.
27. Differentiation of vectors, Scalar and vector point functions.
28. Gradient of a scalar point function
29. Divergence and curl of a vector point function and their physical interpretations
30. Identities involving Del
31. Line integrals, Surface integrals
32. Green's theorem
33. Stocke's theorem for surface integrals.
34. Volume integrals, Gauss divergence theorem, Green's theorems (without proof).

Suggested Reading

1. B.S. Grewal. 2004. Higher Engineering Mathematics. Khanna Publishers Delhi.
2. Shanti Narayan. 2004. Differential Calculus. S. Chand and Co. Ltd., New Delhi.
3. Shanti Narayan. 2004. Integral Calculus. S. Chand and Co. Ltd. New Delhi.
4. Shanti Narayan. 2004. A Textbook of Vector Calculus. S. Chand and Co. Ltd. New Delhi.

Pafe. 1102 Engineering Drawing 2 (0+2)

OBJECTIVES

1. To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions.
2. To enable students to acquire requisite knowledge, techniques and attitude required for advanced study of engineering drawing
3. To understand the fundamental concepts of machine drawing and to generate orthographic and sectional drawing of different machine parts

PRACTICAL

MODULE I (9 Hours)

Drawing Instruments and their uses, Types of lines, lettering and dimensioning. Introduction of drawing scales, First and third angle methods of projection. Principles of orthographic projections; References planes; Points and lines in space and traces of lines and planes; Auxiliary planes and true shapes of oblique plain surface; True length and inclination of lines

MODULE II (9 Hours)

Projections of solids (Change of position method, alteration of ground lines); Section of solids and Interpenetration of solid surfaces; Development of surfaces of geometrical so lids; Isometric projection of geometrical solids. Preparation of working drawing from models and isometric views. Drawing of missing views. Concept of sectioning. Revolved and oblique sections.

Module III (9 Hours)

Introduction to Machine Drawing, Types of lines, Dimensioning, Different methods of dimensioning. Free hand sketching in machine drawing- Machine components, assembly and manufacturing drawing. Sectional drawing of simple machine parts. Types of rivet heads and riveted joints. Processes for producing leak proof joints. Symbols for different types of welded joints.

Module IV (9 Hours)

Threaded fasteners -Nomenclature, Thread profiles, multi start threads, left and right hand threads, representation of threads, ISO metric thread and square thread forms. Square and hexagonal headed nuts and bolts. Different types of lock nuts, studs, machine screws, cap screws and wood screws. Different types of keys-types, taper, rank taper, hollow saddle etc. Types of cotter and pin joints, Socket and spigot joint, sleeve and cotter joint and knuckle joint.

Practical Schedule

1. Acquaintance of drawing instruments, lettering, curves etc.
2. Study of lettering and exercises
3. Different type of scales
4. Projection – orthographic projection views, plane of projection, first and third angle projection
5. Orthographic projections –points
6. Orthographic projections- lines, parallel to and contained by one or both planes, perpendicular to a plane, inclined to one plane and parallel to other
7. Projection of lines – Projection of lines inclined to both plane, True length and Inclination of lines, traces of lines
8. Projection of plane- perpendicular to both plane, perpendicular to one and parallel to other, perpendicular to one and inclined to the other, Traces of planes
9. Auxiliary planes and true shapes of oblique plane surface
10. Auxiliary planes and true shapes of oblique plane surface
11. Projections of solids-simple positions
12. Projection of solid-axis inclined to one plane and parallel to other, axis inclined to both planes
13. Section of solids- concept of sectioning, section plane parallel to one plane, section plane perpendicular to one plane and inclined to other
14. Development of surfaces of geometrical solids
15. Isometric projection of geometrical solids.
16. Preparation of working drawing from models and isometric views. Drawing of missing views.
17. Revolved and oblique sections.
18. Dimensioning, Different Methods of dimensioning
19. Free hand sketching of machine components
20. Sectional drawing of simple machine parts
21. Introduction to riveted joints
22. Forms of rivet heads, leak proof joints
23. Symbols for different types of welded joints
24. Forms of screw threads
25. Drawing of BSW, Square and Metric threads
26. Drawing of square headed and hexagonal headed nuts and bolts.

27. Drawing of Different types of lock nuts
28. Drawing of machine screws, cap screws and wood screws
29. Drawing of Different types of keys
30. Assembly drawing of simple machine parts
31. Introduction to cotter and pin joints
32. Drawing of Socket and spigot joint
33. Drawing sleeve and cotter joint
34. Drawing of knuckle joint
35. Practical Examination

Suggested Reading

1. N.D. Bhatt. 1995. Elementary Engineering Drawing. Charotar Publishing House, Anand.
2. Parkinson, A.C. and J.H. Currie, First year Engineering Drawing, Wheelers Publishers, Allahabad, India.
3. Anil kumar, K. N., 2005, Engineering Graphics, Adhyuth Narayan Publishers, Kottayam
4. Varghese,P.I 2015. Engineering Graphics.VIP publishers, Thrissur.

Fmpe. 1101 Electrical Engineering 3(2+1)

OBJECTIVE

1. To impart basic knowledge in Electrical Engineering by understanding of Fundamental Concepts and develop analytical skills.
2. Conceptual understanding of basic laws and analysis methods in electrical and magnetic circuits.

THEORY

MODULE I (7 Hours)

AC Fundamentals: Definitions of cycle, frequency, time period, amplitude, Peak value, RMS value, Average value, Electro motive force, reluctance etc, laws of magnetic circuits, Phase relations and vector representation, AC through resistance, inductance and capacitance, A.C. series and parallel circuits, Simple RL, RC and RLC circuits.

MODULE II (10 Hours)

3 Phase Systems: Star and Delta connections, Relationship between line and phase voltages and currents in Star and Delta connections. Methods of Single phase and three phase power measurements. Transformer : Principle of working, construction of single phase transformer, emf equation, Phasor diagrams, Ideal transformer, transformer on no load, Transformer under load, Transformer losses, efficiency, Regulation, Open and short circuit test.

MODULE III (13 Hours)

Poly-phase induction motor: Construction, operation, effect of rotor resistance, torque equation, D.C. Machine (generator and motor): Types, Construction and Operation, EMF

equation, armature reaction and commutation of D.C. generator and their characteristics, D.C. Motor speed controls and characteristics.

MODULE IV (3 Hours)

Electrical Wiring, system of wiring, domestic wiring installation, protection devices, Earthing, use of Multimeter, Circuit protection devices, fuses, MCB, ELCB & relays.

PRACTICAL

Study of voltage resonance in RLC circuits at constant frequency: (a) Star connection study of voltage and current relation, Delta connection study of voltage and current relation, Determination of Power factor of single phase AC circuit, Measurement of Power in 3 phase circuit by two-wattmeter method and Measurement of Power in single phase circuit by energy meter, Polarity test on single-phase transformer, Load of single-phase transformer, OC and SC test of single-phase transformer, Load test on 3 phase induction motor-determination of efficiency, line current, speed slip and power factor at various outputs, Determination of relation between the induced armature voltage and speed of separately excited D.C. generator, Magnetization characteristics of D.C. generator, Study of various measuring instruments and circuit protection devices

Lecture Schedule

1. Review of fundamental electrical quantities, definition and units, circuit elements
2. Average and effective values of sinusoidal and periodical waveforms
3. EMF and MMF, fundamentals and laws of magnetic circuits
4. AC through resistance, inductance and capacitance, phase relations and vector representation.
5. A.C through series and parallel circuits, Simple RL, RC and RLC circuits.
6. Sinusoidal response of RL and RC circuits.
7. Sinusoidal response of RLC circuit.
8. 3 Phase Systems: Star and Delta connections.
9. Relationship between line and phase voltages and currents in Star and Delta connections.
10. Methods of Single phase and three phase power measurements
11. Transformer : Principle of working, construction of single phase transformer
12. Emf equation derivation, Phasor diagrams, Ideal transformer, transformer on no load.
13. Transformer under load, Transformer losses, Hysteresis and eddy current losses.
14. Efficiency, condition for maximum efficiency and voltage Regulation.
15. Open circuit and short circuit tests on single phase transformer.
16. Mid term Examination.
17. Single phase induction motor: principle of operation, double field revolving theory.
18. Characteristics of phase split, capacitor start and shaded pole motors.
19. Poly-phase induction motor: Construction and principle of operation.
20. Slip ring and Squirrel cage rotor construction, frequency of rotor currents, Torque developed.
21. Torque at standstill condition, running torque and effect of rotor resistance.

22. D.C. Machine (generator and motor): Types and Constructional details.
23. Armature windings, Lap and wave windings-comparison.
24. Principle of operation, generation of induced emf, emf equation derivation.
25. Armature reaction, demagnetizing and cross-magnetizing effect.
26. Ampere turns calculations, compensating windings, additional field ampere turns.
27. Effect of armature reaction on commutation of DC Generator.
28. Commutation of D.C. generator, Methods of improving commutation.
29. D.C. generator operating characteristics.
30. D.C. Motor, speed controls and characteristics
31. power factor and power factor improvement
32. Electrical Wiring, system of wiring, domestic wiring installation.
33. Protection devices, Earthing, use of Multimeter.
34. Circuit protection devices, fuses, MCB, ELCB & relays.

Practical Schedule

4. Study of voltage resonance in RLC circuits at constant frequency: (a) Star connection study of voltage and current relation.
5. Delta connection study of voltage and current relation.
6. Sinusoidal response of series RLC circuit.
7. Determination of Power factor of single phase AC circuit.
8. Measurement of Power in 3 phase circuit by two-wattmeter method
9. Measurement of Power in single phase circuit by energy meter.
10. Calibration of single phase induction type energy meter.
11. Polarity test on single-phase transformer.
12. Measurement of Coupling Coefficient of Transformer coil.
13. Load of single-phase transformer.
14. OC and SC test of single-phase transformer.
15. Load test on 3 phase induction motor- determination of efficiency, line current, speed, slip and power factor at various outputs.
16. Determination of relation between the induced armature voltage and speed of separately excited D.C. generator.
17. Magnetization characteristics of D.C. generator.
18. Determination of power factor of single phase AC circuit.
19. Study of various measuring instruments and circuit protection devices.
20. Practical Exam.

Suggested Reading

1. B.L. Theraja and A.K. Theraja. 2005. A Textbook of Electrical Technology, Vol I and Vol II. S. Chand & Company Ltd., New Delhi.
2. Dr. P.S.Bimbhra. 2004. Electrical Machinery, Khanna Publications, New Delhi.
3. Vincent Del Toro. 2000. Electrical Engineering Fundamentals. Prentice-Hall India Private Ltd., New Delhi.
4. Robert L Smith and Stephen L Herman. 2011. Electrical Wiring – Industrial

Pafe. 1103 Workshop Technology 3 (1+2)

OBJECTIVE

1. To impart knowledge on various production and manufacturing equipment's and processes.

THEORY

MODULE I (4 Hours)

Introduction to various carpentry tools, materials, types of wood and their characteristics and Processes or operations in wood working. Introduction to Smithy tools and operations.

MODULE II (4 Hours)

Introduction to welding, types of welding, oxyacetylene gas welding, types of flames, welding techniques and equipment. Principle of arc welding, equipment and tools. Casting processes.

MODULE III (4 Hours)

Classification, constructional details of center lathe, Main accessories and attachments. Main operations and tools used on center lathes. Types of shapers, Constructional details of standard shaper. Work holding devices, shaper tools and main operations.

MODULE IV (5 Hours)

Types of drilling machines. Constructional details of pillar types and radial drilling machines. Work holding and tool holding devices. Main operations. Twist drills, drill angles and sizes. Types and classification. Constructional details and principles of operation of column and knee type universal milling machines. Plain milling cutter. Main operations on milling machine.

PRACTICAL

Preparation of simple joints: Cross half Lap joint and T-Halving joint; Preparation of Dovetail joint, Mortise and tenor joint; Jobs on Bending, shaping etc.; Jobs on Drawing, Punching, Rivetting. Introduction to tools and measuring instruments for fitting; Jobs on sawing, filing and right angle fitting of MS Flat; Practical in more complex fitting job; Operations of drilling, reaming, and threading with tap and dies; Introduction to tools and operations in sheet metal work; Making different types of sheet metal joints using G.I. sheets. Introduction to welding equipment, processes tools, their use and precautions; Jobs on ARC welding – Lap joint, butt joint; T-Joint and corner joint in Arc welding; Gas welding Practice – Lab, butt and T-Joints; Introduction to metal casting equipment, tools and their use; Mould making using one-piece pattern and two pieces pattern; Demonstration of mould making using sweep pattern, and match plate patterns; Introduction to machine shop machines and tools; Demonstration on Processes in machining and use of measuring instruments; Practical

jobs on simple turning, step turning; Practical job on taper turning, drilling and threading; Operations on shaper and planer, changing a round MS rod into square section on a shaper; Demonstration of important operations on a milling machine, making a plot, gear tooth forming and indexing; Any additional job.

Lecture Schedule

1. Introduction to various carpentry tools, materials
2. Types of wood and their characteristics. Processes or operations in wood working
3. Introduction to Smithy tools and operations
4. Introduction to welding. Types of welding, oxyacetylene gas welding
5. Types of flames, welding techniques and equipment
6. Principle of arc welding, equipment and tools
7. Casting processes.
8. Lathe- Classification, Constructional details of center lathe
9. Main accessories and attachments
10. Main operations and tools used on center lathes
11. Shaper machine- Types of shapers. Constructional details of standard shaper
12. Work holding devices, shaper tools and main operations.
13. Types of drilling machines. Constructional details of pillar types and radial drilling machines
14. Work holding and tool holding devices
15. Twist drills, drill angles and sizes
16. Constructional details and principles of operation of column and knee type universal milling machines
17. Plain milling cutter. Main operations on milling machine.

Practical Schedule

1. Preparation of simple joints: Cross half Lap joint
2. Preparation of simple joints: T-Halving joint
3. Preparation of Dovetail joint
4. Preparation of Dovetail joint
5. Preparation Mortise and tenor joint
6. Jobs on Bending, shaping etc.
7. Jobs on Drawing, Punching, Rivetting.
8. Introduction to tools and measuring instruments for fitting
9. Jobs on sawing, filing and right angle fitting of MS Flat
10. Practical in more complex fitting job
11. Operations of drilling, reaming, and threading with tap and dies
12. Introduction to tools and operations in sheet metal work
13. Making different types of sheet metal joints using G.I. sheets
14. Introduction to welding equipment, processes tools, their use and precautions
15. Jobs on ARC welding - Lap joint, butt joint,
16. Jobs on ARC welding- T-Joint and corner joint in Arc welding
17. Gas welding Practice – Lab, butt and T-Joints

18. Introduction to metal casting equipment, tools and their use
19. Mould making using one-piece pattern and two pieces pattern
20. Mould making using one-piece pattern and two pieces pattern
21. Demonstration of mould making using sweep pattern, and match plate patterns
22. Introduction to machine shop machines and tools
23. Demonstration on Processes in machining and use of measuring instruments
24. Practical jobs on simple turning
25. Practical jobs on step turning
26. Practical jobs on step turning
27. Practical job on taper turning
28. Practical job on drilling and threading
29. Practical job on drilling and threading
30. Operations on shaper and planer- changing a round MS rod into square section on a shaper
31. Demonstration of important operations on a milling machine
32. Making a plot, gear tooth forming and indexing
33. Making a plot, gear tooth forming and indexing
34. Practical Examination

Suggested Readings

1. Hazra, Choudari S K and Bose S K. 1982. Elements of Workshop technology (Vol. I and II). Media Promoters and Publishers Pvt.Ltd., Mumbai.
2. Chapman W A J. 1989. Workshop Technology (Part I and II). Arnold Publishers (India) Pvt. Ltd., AB/9 Safdarjung Enclave, New Delhi.
3. Raghuwamsi B S. 1996. A Course in Workshop Technology (Vol. I and II). DhanpatRai and Sons, 1682 NaiDarak, New Delhi.

Beas. 1103 Crop Production Technology 3 (2+1)

OBJECTIVE

1. To introduce the production technologies of different crops.

THEORY

MODULE I (8 Hours)

Classification of crops; Effect of different weather parameters on crop growth and development; Principles of tillage; Soil-water-plant relationship, crop rotation, cropping systems, intercropping, relay cropping and mixed cropping; Principles and practices of soil fertility management and weed control.

MODULE II (9 Hours)

Crop production technology for major cereal crops viz., paddy; Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production

etc.; Crop production technology for major oilseed crops viz., coconut, sesame, groundnut etc.; Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production etc.; Crop production technology for major pulse crops viz., cowpea, green gram, black gram, etc.; Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production etc.

MODULE III (10 Hours)

Crop production technology for major spices and cash crops viz., pepper, nutmeg, clove, cardamom, cinnamon, ginger, turmeric, garlic, sugarcane, arecanut, cocoa, etc.; Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production etc.

Horticulture: Scope of horticultural crops. Soil and climatic requirements for fruits and vegetables, nursery raising and management; Crop production technology for major fruit crops viz., mango, banana, sapota, aonla, pomegranate, guava, etc.: Major varieties, time of transplanting, spacing, inter-culturing, fertilizer and water requirement, time and method of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.;

MODULE IV (6 Hours)

Crop production technology for major vegetable crops viz., onion, tomato, chilli, cucurbitaceous vegetables, vegetable cowpea and other green and leafy vegetables; Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.; Crop production technology for tuber crops viz., tapioca, sweet potato, yams, dioscorea, elephant foot yam etc.

PRACTICAL

Examination of soil profile in the field; Introduction to different equipments utilized in a weather observatory; Identification of seeds of different agricultural crops and their varieties; Study of seed viability and germination test; Identification of different weeds and methods of their control; Use of different inter-culturing equipments; Study of water requirement of different crops; Fertilizer application methods and equipments; Judging maturity time for harvesting of crop; Identification and description of important fruit and vegetable crops; Preparation of nursery; Study of different garden tools; Practices of pruning and training in some important fruit crops.

Lecture Schedule

1. Weather parameters-rainfall, temperature, humidity, wind and solar radiation- effect of weather parameters on crop growth and development
2. Principles of tillage-types and benefits
3. Tilth-methods of tillage
4. Soil-water-plant relationship-water requirement of different crops

5. Cropping systems-mono cropping, multiple cropping, intercropping, relay cropping, mixed cropping; crop rotation
6. Principles and practices of soil fertility management
7. Weeds-definition, classification and its control
8. Classification of crops
9. Crop production technology - paddy
10. Major varieties, sowing time, method of sowing, spacing, inter-culturing of paddy
11. Fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production of paddy etc.
12. Crop production technology - coconut
13. Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production etc.
14. Crop production technology -sesame, groundnut etc.
15. Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production etc.
16. Crop production technology - cowpea, green gram, black gram, etc.
17. Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production etc.
18. Mid Semester examination
19. Crop production technology - pepper, nutmeg, clove
20. Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production etc.
21. Crop production technology - cardamom, cinnamon, ginger, turmeric, garlic
22. Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production etc.
23. Crop production technology for sugarcane, arecanut, cocoa, etc.
24. Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production etc.
25. Horticulture: Scope and importance of horticultural crops.
26. Soil and climatic requirements for fruits and vegetables, nursery raising and management
27. Crop production technology - mango, banana, sapota, aonla, pomegranate, guava, etc.
28. Major varieties, time of transplanting, spacing, inter-culturing, fertilizer and water requirement, time and method of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.
29. Crop production technology - onion, tomato, chilli

30. Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.
31. Crop production technology - cucurbitaceous vegetables, vegetable cowpea and other green and leafy vegetables
32. Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.
33. Crop production technology - tapioca, sweet potato, yams, dioscorea, elephant foot yam etc.
34. Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.

Practical Schedule

1. Examination of soil profile in the field
2. Introduction to different equipments utilized in a weather observatory
3. Introduction to different equipments utilized in a weather observatory
4. Introduction to different equipments utilized in a weather observatory
5. Identification of seed of different agricultural crops and their varieties
6. Identification of seed of different agricultural crops and their varieties
7. Study of seed viability and germination test
8. Identification of different weeds and methods of their control
9. Use of different inter-culturing equipments
10. Use of different inter-culturing equipments
11. Study of water requirement of different crops
12. Fertilizer application methods and equipments
13. Judging maturity time for harvesting of crop
14. Identification and description of important fruit and vegetable crops
15. Preparation of nursery; Study of different garden tools
16. Practices of pruning and training in some important fruit crops.
17. Practical Examination.

Suggested Reading

1. K. Alice and K. V. Peter. 2007.Commercial Crops Technology. New India Publishing Agency, Pitampura, Delhi.
2. S. Prasad and U. Kumar. 2010. Principles of Horticulture. Agrobios, New Delhi.
3. S.S. Singh. 1985. Principles and Practices of Agronomy. Kalyani Publishers, Ludhiana.
4. T. R. Gopalakrishnan. 2007. Vegetable Crops. New India Publishing Agency, Pitampura, Delhi.
5. T. Radha and L. Mathew. 2007.Fruit Crops. New India Publishing Agency, Pitampura, Delhi.

Swce. 1101 Environmental Sciences & Disaster Management 2 (1+1)

OBJECTIVE

1. To understand the natural environment and its relationships with human activities and to characterise and analyze human impacts on the environment.
2. Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

THEORY

MODULE I (5 hours)

Environment, ecology and ecosystem: Definition and inter-relationships amongst and between them, components of environment, relationship between different components; Man environment relationship; Impact of technology on the environment; Environmental degradation; Ecology and ecosystems: Introduction; Ecology: Objectives and classification, concepts of an ecosystem structure and function of ecosystem; Components of ecosystem: Producers, consumers, decomposers; Bio-geo-chemical cycles: Hydrological cycle, carbon cycle, oxygen cycle, nitrogen cycle, sulphur cycle; Energy flow in co-system

MODULE II (7 hours)

Food chains: Grazing, detritus, food webs; Ecological pyramids; Major ecosystems: Forest ecosystem, Grassland ecosystem, desert ecosystem, aquatic ecosystem, estuarine ecosystem; Population and natural resources: Development of habitation patterns and environmental factors governing human settlement; Population and pollution, reasons for overpopulation, population growth, demographic projections and population structures, production of food; Renewable and non-renewable resources: Renewable resources, non-renewable resources, destruction versus conservation; Water resources: Water resources, Indian scenario; Water sources: Surface and ground water sources, uses and overuses of water resources, problems due to over exploitation of water resources; Forest resources: Indian scenario; Importance of forests-ecologically and economically, uses of forest products, forest types; Deforestations: Causes and effects, forest degradation in India; Energy resources: Indian scenario, conventional energy sources and its problems; Non-conventional energy sources: Advantages and its limitations, problems due to overexploitation of energy resources.

MODULE III (4 hours)

Environmental pollution - Water pollution: Introduction, water quality standards, sources of water pollution, classification of water pollutants, effects of water pollutants, eutrophication; Air pollution: Composition of air, structure of atmosphere, ambient air quality standards, classification of air pollutants, sources of common air pollutants like SPM, SO2, NOX, natural and anthropogenic sources, effects of common air pollutants; Land and noise pollution: Introduction, lithosphere, land uses, causes of land degradation, sources of noise pollution, effects of noise pollution; Radioactive pollution; Food processing industry waste and its management; Management of urban waste water; Recycling of organic waste; Recycling of factory effluent; Control of environmental pollution through law; Composting of biological waste; Sewage, uses of water disposal effluent treatment; Current environmental global issues: Global warming and green houses effects, acid rain, depletion of ozone layer.

PRACTICAL

Environment and its analysis; Water quality parameters; Collection of sample for pollution study; Determination of pH/acidity/alkalinity from sample; Estimation of dissolved oxygen; Estimation of BOD; Estimation of COD; Estimation of nitrates; Estimation of phosphates; Estimation of pollutant elements; Estimation of heavy/toxic elements; Estimation of lead /mercury; Visit to industrial sewage disposal unit.

Lecture Schedule

1. Environment, ecology and ecosystem: Definition and inter-relationships amongst and between them, components of environment, relationship between different components.
2. Man environment relationship; Impact of technology on the environment; Environmental degradation.
3. Ecology and ecosystems: Introduction. Objectives and classification, concepts of an ecosystem structure and function of ecosystem
4. Components of ecosystem: Producers, consumers, decomposers
5. Bio-geo-chemical cycles: Hydrological cycle, carbon cycle, oxygen cycle, nitrogen cycle, sulphur cycle; Energy flow in co-system
6. Food chains: Grazing, detritus, food webs; Ecological pyramids; Major ecosystems: Forest ecosystem, Grassland ecosystem, desert ecosystem, aquatic ecosystem, estuarine ecosystem
7. Population and natural resources: Development of habitation patterns and environmental factors governing human settlement; Population and pollution, reasons for overpopulation, population growth, demographic projections and population structures, production of food.
8. Renewable and non-renewable resources: Renewable resources, non-renewable resources, destruction versus conservation
9. Mid term Examination
10. Water resources: Water resources, Indian scenario; Water sources: Surface and ground water sources, uses and overuses of water resources, problems due to over exploitation of water resources
11. Forest resources: Indian scenario; Importance of forests-ecologically and economically, uses of forest products, forest types; Deforestations: Causes and effects, forest degradation in India
12. Energy resources: Indian scenario, conventional energy sources and its problems.
13. Non-conventional energy sources: Advantages and its limitations, problems due to overexploitation of energy resources.
14. Environmental pollution - Water pollution: Introduction, water quality standards, sources of water pollution, classification of water pollutants, effects of water pollutants, eutrophication
15. Air pollution: Composition of air, structure of atmosphere, ambient air quality standards, classification of air pollutants, sources of common air pollutants like SPM, SO2, NOX, natural and anthropogenic sources, effects of common air pollutants.
16. Land and noise pollution: Introduction, lithosphere, land uses, causes of land degradation, sources of noise pollution, effects of noise pollution; Radioactive pollution
17. Food processing industry waste and its management; Management of urban waste water; Recycling of organic waste; Recycling of factory effluent; Control of environmental pollution through law

18. Composting of biological waste; Sewage, uses of water disposal effluent treatment; Current environmental global issues: Global warming and green houses effects, acid rain, depletion of ozone layer.

Practical Schedule

1. Determination of Water quality parameters
2. Collection of samples for pollution study
3. Determination of pH/acidity/alkalinity from sample
4. Estimation of dissolved oxygen
5. Estimation of BOD
6. Estimation of COD
7. Estimation of nitrates
8. Estimation of phosphates
9. Estimation of pollutant elements-1
10. Estimation of pollutant elements-2
11. Estimation of heavy/toxic elements
12. Estimation of lead
13. Estimation of mercury
14. Study of composting Process
15. Study of sewage treatment plants
16. Visit to industrial sewage disposal unit
17. Practical Examination

Suggested Reading

1. Bharucha Erach. 2005. Text Book of Environmental Studies for Undergraduate Courses. University Grants Commission, University Press, Hyderabad.
2. Sharma J P. 2003. Introduction to Environment Science. Lakshmi Publications.
3. Chary Manohar and Jaya Ram Reddy. 2004. Principles of Environmental Studies. BS Publishers, Hyderabad.
4. Gupta P K. 2004. Methods in Environmental Analysis – Water. Soil and Air. Agro bios, Jodhpur.
5. Sharma, R.K. & Sharma, G. 2005.Natural Disaster. APH Publishing Corporation, New Delhi.

Beas. 1104 Physical Education 1 (0+1)*

OBJECTIVES

1. The physical education program will develop and reinforce cooperative behavior
2. The physical education program will teach students to establish lifelong fitness goals.

PRACTICAL

Introduction to physical education: Definition, scientific machine principles, objectives, scope, history, development and importance; Physical training and health; Fartlek training and circuit training; Body mechanism and body type: Kretchmark's and Sheldon's classification; Theories of learning; Exercises for good posture; Exercises to develop physical fitness, growth, flexibility - components, speed, strength, endurance, power, flexibility, agility, coordination and balance; Test and measurement in physical education: Physical

fitness test, motor fitness test, ability test, cardiovascular efficiency test and physical fitness index; Calisthenics, weight training, aerobic and anaerobic exercises; Circuit training, interval training, far trek training, pressure training and resistance training; Importance of *Asanas*, free hand exercises and yoga; Recreation: Definition, agencies promoting recreation, camping and re-recreation; Governance of sports in India; Organization of tournaments; National and international events; Drawing of fixtures; Rules and regulations; Coaching and fundamentals of skill development of major games, coaching and tactic development of athletic events.

SEMESTER-II

Pafe. 1204 Food Chemistry of Macronutrients 3 (2+1)

OBJECTIVE

1. To understand the analytical, biochemical, chemical, physical, nutritional, and toxicological aspects of food Macronutrients

THEORY

MODULE I (11 Hours)

Nature Scope and development of food chemistry; Moisture in foods, role and type of water in foods, functional properties of water, water activity and sorption isotherm, molecular mobility and food stability; Dispersed systems of foods: Physicochemical aspects of food dispersion system (Sol, gel, foam, emulations); Rheology of diphase systems.

MODULE II (8 Hours)

Carbohydrates: Changes of carbohydrates on cooking, modification of carbohydrates, dietary fibers and carbohydrates digestibility; Enzymatic and chemical reactions of carbohydrates.

MODULE II (4 Hours)

Proteins in foods: Processing induced, physical, chemical and nutritional changes in protein, chemical and enzymatic modification of protein

MODULE II (10 Hours)

Lipids in foods: Role and use of lipids/fat, crystallization and consistency, chemical aspects of lipids, lipolysis, auto-oxidation, thermal decomposition, chemistry of frying technology of fat and oil; Oil processing: Refining, hydrogenations, inter esterification, safety use of oils and fats in food formulation; Enzymatic and chemical reactions of fats; Rancidity and its types, detection techniques chemical aspects of lipids, antioxidants.

PRACTICAL

Determination of moisture content of foods using different methods; Studies of sorption isotherms of different foods; Swelling and solubility characteristics of starches; Rheological properties of food systems; Determination of crude proteins by micro-Kjeldhal method; Determination of essential amino acids i.e. lysine, tryptophan, methionine, etc.; Isolation of egg and milk protein; Preparation of protein isolate and concentrate of proteins; Determination of acid value, saponification value and iodine number of fat/oil; Assay of amylases, papain and lipases.

Lecture Schedule

1. Moisture in foods, role and type of water in foods
2. Functional properties of water
3. Water activity and sorption isotherm
4. Molecular mobility and foods stability
5. Dispersed systems of foods: Physicochemical aspects of food dispersion system (Sol, gel, foam, emulations)
6. Dispersed systems of foods: Physicochemical aspects of food dispersion system (Sol, gel, foam, emulations)
7. Rheology of diphase systems
8. Carbohydrates classification
9. Changes of carbohydrates on cooking
10. Modification of carbohydrates
11. Dietary fibers and its importance
12. Carbohydrates digestibility
13. Enzymatic reactions of carbohydrates
14. Chemical reactions of carbohydrates
15. Proteins in foods
16. Aminoacids and its classification
17. Processing induced, physical, chemical and nutritional changes in protein
18. Processing induced, physical, chemical and nutritional changes in protein
19. Mid Terminal Examination
20. Chemical and enzymatic modification of protein
21. Lipids in foods: Role and use of lipids/fat
22. Crystallization and consistency of lipids
23. Chemical aspects of lipids structure and function
24. Classification of lipids
25. Lipolysis
26. Auto-oxidation of lipids
27. Thermal decomposition of lipids
28. Chemistry of frying technology of fat and oil
29. Enzymatic and chemical reactions of fats
30. Rancidity and its types
31. Prevention of rancidity

32. Antioxidants
33. Detection of Acid value, Saponification value
34. Detection techniques of chemical aspects of lipids like Iodine value, RM no.

Practical Schedule

1. Determination of moisture content of foods using different methods
2. Studies of sorption isotherms of different foods
3. Swelling and solubility characteristics of starches
4. Rheological properties of food systems
5. Determination of crude proteins by micro-Kjeldhal method
6. Determination of essential amino acids i.e. lysine
7. Determination of essential amino acids i.e. tryptophan
8. Determination of essential amino acids i.e. methionine
9. Isolation of egg protein.
10. Isolation of milk protein
11. Determination of acid value of fat/oil
12. Determination of saponification value of fat/oil
13. Determination of iodine number
14. Assay of amylases
15. Assay of papain
16. Assay of lipases.
17. Practical examination

Suggested Readings

1. John W. Brady. 2013. Introductory Food Chemistry. Comstock Publishing Associates, Cornell University Press, Ithaca, USA.
2. Lillian Hoagland Meyer. 1974. Food Chemistry. The AVI Publishing Co Inc., Connecticut, MA, USA.
3. H.-D. Belitz, W. Grosch and P. Schieberle. 2009. Food Chemisry, 4th Ed. Springer-Verlag Berlin Heidelberg.
4. Owen R, Fennema. 1996. Food Chemistry, 3rd Ed. Marcel Dekker, Inc., New York, USA.

Pafe. 1205 Food Microbiology 3 (2+1)

OBJECTIVES

Upon completion of this course, students are expected to be able to:

1. Understand the role and significance of intrinsic and extrinsic factors on growth and response of microorganisms in foods.
2. Identify ways to control microorganisms in foods.
3. Recognize and describe the characteristics of important pathogens and spoilage microorganisms in foods.
4. Identify the conditions under which the important pathogens and spoilage microorganisms are commonly inactivated, killed or made harmless in foods.

THEORY

MODULE I (10 Hours)

Importance and significance of microbes in food science; Microbial spoilage of foods Factors affecting kinds, numbers, growth and survival of microorganisms in foods; Intrinsic factors; pH,, water activity, nutrients etc., Extrinsic factors: Relative humidity, temperature, gaseous atmosphere; Chemical changes caused by microorganisms: Changes in nitrogenous organic compounds, non-nitrogenous organic compounds, organic acids, other compounds, lipids, pectic substances

MODULE II (10 Hours)

Contamination of foods; Sources of contamination, Genera of bacteria, Maintenance of anaerobic conditions; Asepsis, removal of microorganisms; Intermediate moisture foods; Microbiology of milk and milk products; Microbiology of fruits and vegetables, Microbiology of cereal and cereal products, Microbiology of meat and meat products, Microbiology of fish and other sea foods; Microbiology of poultry and eggs: Microbiology of sugar and sugar products; Microbiology of salts and spices

MODULE III (7 Hours)

Microbiology of canned foods, Shelf life: Calculation of shelf life, Shelf life requirements, deteriorative reactions, accelerated testing; Simulations of product: Package environment interaction, shelf life simulation for moisture, oxygen, and light sensitive products

MODULE IV (6 Hours)

Food borne intoxications and infections types of food involved, toxicity and symptoms, chemical properties, environmental conditions; Food borne viruses: Polio, hepatitis A & E, noroviruses, rota viruses, prion diseases, types of foods involved, toxicity and symptoms, chemical properties, environmental conditions.

PRACTICAL

Isolation of bacteria and molds from foods; Microbial examination of cereal and cereal products: Identification, isolation and confirmation; Microbial examination of vegetable and fruits: Identification, isolation and confirmation; Microbial examination of meat and meat products: Identification, isolation and confirmation; Microbial examination of fish and other sea foods: Identification, isolation and confirmation; Microbial examination of eggs and poultry: Identification, isolation and confirmation; Microbial examination of milk and milk products: Identification, isolation and confirmation; Microbial examination of sugar, salts and spices: Microbial examination of canned products: Identification, isolation and confirmation; Determination and enumeration of pathogenic and indicator organisms in foods (Coliform/Enterococcus); Thermal death time determination; Detection of Salmonella from food sample; Detection of coliforms from water by MPN method; Detection of *Staphylococcus aureus* from food sample.

Lecture Schedule

1. Introduction: Importance and significance of microbes in food science
2. Microbial spoilage of foods, Factors affecting kinds, numbers of microorganisms in food
3. Growth and survival of microorganisms in foods
4. Intrinsic factors; pH, water activity, nutrients etc.
5. Extrinsic factors: Relative humidity, temperature, gaseous atmosphere etc.
6. Chemical changes caused by microorganisms: Changes in nitrogenous organic compounds, non-nitrogenous organic compounds, organic acids, other compounds, lipids, pectic substances
7. Contamination of foods: Sources of contamination
8. Major bacterial Genera involved in food spoilage
9. Maintenance of anaerobic conditions; Asepsis, removal of microorganisms
10. Intermediate moisture foods
11. Microbiology of milk and milk products: contamination, spoilage
12. Microbiology of milk and milk products: preservation
13. Microbiology of fruits and vegetables: contamination, spoilage
14. Microbiology of fruits and vegetables: preservation
15. Microbiology of cereal and cereal products: contamination, spoilage
16. Microbiology of cereal and cereal products: preservation
17. Microbiology of meat and meat products: contamination, spoilage
18. Microbiology of meat and meat products: preservation
19. Microbiology of fish and other sea foods: contamination, spoilage
20. Microbiology of fish and other sea foods: preservation
21. Microbiology of poultry and eggs: contamination, spoilage
22. Microbiology of poultry and eggs: preservation
23. Mid semester Examination
24. Microbiology of sugar and sugar products: contamination, spoilage
25. Microbiology of sugar and sugar products: preservation
26. Microbiology of salts and spices: contamination, spoilage and preservation
27. Microbiology of canned foods: contamination, spoilage
28. Microbiology of canned foods: preservation
29. Shelf life: Calculation of shelf life, Shelf life requirements, deteriorative reactions, accelerated testing
30. Simulations of product: Package environment interaction, shelf life simulation for moisture, oxygen, and light sensitive products
31. Food borne intoxications and infections: types of food involved, toxicity and symptoms, chemical properties, environmental conditions
32. Food borne intoxications and infections: types of food involved, toxicity and symptoms, chemical properties, environmental conditions
33. Food borne viruses: Polio, hepatitis A & E, noroviruses, rota viruses, prion diseases, types of food involved
34. Food borne viruses: toxicity and symptoms, chemical properties, environmental conditions

Practical Schedule

1. Isolation of bacteria and molds from foods
2. Microbial examination of cereal and cereal products: Identification, isolation and confirmation
3. Microbial examination of vegetable and fruits: Identification, isolation and confirmation
4. Microbial examination of meat and meat products: Identification, isolation and confirmation
5. Microbial examination of fish and other sea foods: Identification, isolation and confirmation
6. Microbial examination of eggs and poultry: Identification, isolation and confirmation
7. Microbial examination of milk and milk products: Identification, isolation and confirmation
8. Microbial examination of sugar, salts and spices
9. Microbial examination of canned products: Identification, isolation and confirmation
10. Determination and enumeration of pathogenic and indicator organisms in foods (Coliform / Enterococcus)
11. Detection of coliforms from water by MPN method
12. Determination thermal death time
13. Detection of Salmonella from food sample
14. Detection of Salmonella from food sample
15. Detection of *Staphylococcus aureus* from food sample
16. Detection of *Staphylococcus aureus* from food sample
17. Practical examination

Suggested Reading

1. Martin R. Adams and Maurice O. Moss. 2008. Food Microbiology, 3rd Ed., The Royal Society of Chemistry, Cambridge, UK.
1. James M. Jay. 2000. Modern Food Microbiology, 6th Ed. Aspen Publishers, Inc., Gaithersburg, Maryland, USA.
2. George J. Banwart. 1989. Basic Food Microbiology, 2nd Ed. Chapman & Hall, New York, USA.
3. William C. Frazier and & Dennis C. Westfoff. 1987. Food Microbiology, 4th Ed. Tata McGraw-Hill Education, New Delhi.

Pafe. 1206 Food Thermodynamics 2 (2+0)

OBJECTIVES

1. To acquaint and equip the students with basic concepts of thermodynamics and its application in different food process engineering operation such as heat and mass transfer, refrigeration etc.

THEORY

MODULE I (4 Hours)

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.

MODULE II (6 Hours)

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, entropy, availability and irreversibility.

MODULE III (7 Hours)

Properties of Pure Substances: Thermodynamic properties of pure substances in solid, liquid and vapor phases, P-V-T behaviour of simple compressible substances, phase rule; Thermodynamic cycles: Carnot vapor power cycle, ideal Rankine cycle, Rankine Reheat cycle, air standard Otto cycle, air standard Diesel cycle, air-standard Brayton cycle, vapor-compression refrigeration cycle.

MODULE IV (12 Hours)

Psychrometry: thermodynamic properties of moist air, perfect gas relationship, absolute humidity, relative humidity, percentage humidity, humid volume, total heat, enthalpy, dry bulb temperature, wet bulb temperature, dew point temperature, adiabatic processes, wet bulb depression, humid heat, specific volume, heating, cooling, dehumidifying, sorption isotherms, three stages of water, phase diagram for water, vapour pressure-temperature curve for water, heat requirement for vaporization, measurement of humidity, Properties of steam: Wet, dry saturated, superheated steam, use of steam tables.

LECTURE SCHEDULE

1. Basic concepts: definitions of systems, approaches, thermodynamic systems,
2. Concept of continuum, state and properties of system- thermodynamic properties
3. Extensive and intensive properties - Specific weight and volume - Pressure- Expression in various units
4. Concept of equilibrium, path, process, cyclic process, quasi static process.
5. Equilibrium, state of a system, state diagram, path and process, different modes of work
6. Zeroth law of thermodynamics, concept of temperature, heat and temperature scales.
7. Pdv work, path function - heat and flow work.
8. Heat - Specific heat - Perfect gas and gas laws - Boyle's law, Charle’s law
9. First law of thermodynamics, Energy, enthalpy, specific heats, applications of first law, steady and unsteady flow analysis
10. Internal energy - Enthalpy, specific heat. Heat and work -steady flow process.

11. Conservation of energy - Non flow systems, Isometric , Isobaric processes, Isothermal and polytropic processes
12. Constant internal energy process- steady flow process - energy equation.
13. Second law of thermodynamics, Kelvin-Planck and Clausius statements, reversible and irreversible processes
14. Thermodynamic temperature scale, entropy, availability and irreversibility
15. Properties of Pure Substances- Thermodynamic properties of pure substances in solid, liquid and vapor phases
16. Entropy changes during Isobaric and Isometric processes.
17. Entropy changes during Isothermal and polytropic processes
18. Temperature Entropy diagram – Principle of entropy change - Concepts on entropy - Examples explaining entropy change
19. P-V-T behaviour of simple compressible substances, phase rule.
20. Mid semester Examination.
21. Thermodynamic cycles- Carnot vapor power cycle, ideal Rankine cycle, Rankine Reheat cycle
22. Thermodynamic cycles, air standard Otto cycle, air standard Diesel cycle, air-standard Brayton cycle
23. Thermodynamic cycles, vapor-compression refrigeration cycle- application on commercial refrigeration
24. Psychrometry, Basic concepts definitions, introduction-psychometric terms-psychrometric chart.
25. Psychrometry properties of air - moist air, perfect gas relationship
26. Psychrometry properties of air -Absolute humidity, relative humidity, percentage humidity, humid volume.
27. Total heat, enthalpy, dry bulb temperature, wet bulb temperature, dew point temperature, adiabatic processes.
28. Psychrometry properties of air, wet bulb depression, humid heat, specific volume, heating, cooling, dehumidifying- problems on Psychometry
29. Psychrometry properties, sorption isotherms, three stages of water, phase diagram for water,vapour pressure
30. Thermodynamic of air, temperature curve for water, heat requirement for vaporization, measurement of humidity.
31. Psychrometric process- heating and cooling -humidification and dehumidification
32. Properties of steam: Wet, dry saturated, superheated steam, use of steam tables.
33. Steam tables - Wet steam - dryness fraction, Enthalpy, specific volume, Entropy of water and steam, super heated steam - properties - T-S chart for steam
34. Processes of vapour - pv and Ts diagrams and heat transferred for steam under Isobaric, Isometric processes.

Suggested Reading

1. R.K. Rajput. 2007. Engineering Thermodynamics, 3rd Ed. Laxmi Publications (P) Ltd., Bangalore.

2. J.M. Smith, H.C. Van Ness and M.M. Abbott. 2005. Introduction to Chemical Engineering Thermodynamics, 7th Ed. McGraw-Hill, Inc., NY, USA.
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.
5. Donald B. Brooker, Fred W. Bakker-Arkema and Carl W. Hall. 1976. Drying Cereal Grains. The AVI Publishing Company, Inc., Connecticut, MA, USA.

Beas. 1205 Information Technology and Computer Programming 3 (1+2)

OBJECTIVE

1. To introduce the modern Information Communication technologies to the students and provide exposure to problem solving methods as well as nurture ability to develop small programs in C language for the applications related to their major field of study.

THEORY

MODULE I (6 hours)

Introduction and historical background: Review of computer technology; Basic computer organization - Processor, memory, secondary storage, display devices and other peripheral devices. Categorization of Computers, digital, analog and hybrid; Super computer. Future trends: DNA computer, nanocomputer. Present-day applications. Introduction to systems software, Operating systems, various kinds of OS, functions of OS; Application software and programming languages. Machine language, assembly language, high level language, concept-source code-object code; Compiler, Interpreter and major high level programming languages. Number systems- decimal to binay/octal/hexadecimal conversions and vice versa. Character representations, ASCII, ISCII, Unicode. Algorithms and flow-charts: Input-processing-output model of a computer program; Role of the compiler and the integrated development environment. Brief introduction to Communication modes and media; Computer networks-LAN, WAN, Internet and applications.

MODULE II (6 Hours)

Introduction to C - History of C – Development environment of C- structure of C program- C tokens & keywords- Primary data types, Variables, constants, character constants, length of data types, header files – use of header files. C operators, building and evaluating arithmetic expressions, type conversions, type casting; Relational operators, logical operators. Standard library functions. Input statement, output statement, formatted output; importance of documentation. Decision making – branching, if statement, Nested if, switch statement, go to statement. Looping – while, do- while, nested loops, for loop, nested for loop, break, continue statements.

MODULE III (5 Hours)

Arrays, one dimensional array representation, sorting, searching. Two dimensional arrays – matrix representation, matrix operations. String arrays, representing strings, string operations, string library functions. User defined functions, passing arguments, returning values, recursive functions, storage class, scope and visibility of variables, local & global variables. User defined data types, structures, unions, arrays of structures, structures in user defined functions. Introduction to pointers, passing arguments by address using pointers. Concept of standard input output files, file operations, open, read and write operations, file opening modes. C preprocessor.

PRACTICAL

Familiarizing with Turbo C IDE; Building an executable version of C program; Debugging a C program; Developing and executing simple programs; Creating programs using decision making statements such as if, go to and switch; Developing program using loop statements while, do and for; Using nested control structures; Familiarizing with one and two dimensional arrays; Using string functions; Developing structures and union; Creating user defined functions; Using local, global and external variables; Pointers representation of arrays. File operations.

Lecture Schedule

1. Introduction and historical background: Review of computer technology; Basic computer organization - Processor, memory, secondary storage, display devices and other peripheral devices.
2. Categorization of Computers, digital, analog and hybrid; Super computer. Future trends: DNA computer, nanocomputer. Present-day applications.
3. Introduction to systems software, Operating systems, various kinds of OS, functions of OS; Application software and programming languages. Machine language, assembly language, high level language, concept-source code-object code; Compiler, Interpreter and major high level programming languages.
4. Number systems- decimal to binay/octal/hexadecimal conversions and vice versa. Character representations, ASCII, ISCII, Unicode.
5. Algorithms and flow-charts: Input-processing-output model of a computer program; Role of the compiler and the integrated development environment.
6. Brief introduction to Communication modes and media; Computer networks-LAN, WAN, Internet and applications.
7. Introduction to C - History of C – Development environment of C- structure of C program- C tokens & keywords- Primary data types, Variables, constants, character constants, length of data types, header files – use of header files
8. C operators, building and evaluating arithmetic expressions, type conversions, type casting; Relational operators, logical operators. Standard library functions. Input statement, output statement, formatted output; importance of documentation.
9. Decision making – branching, if statement, Nested if
10. switch statement, go to statement.
11. Looping – while, do- while, nested loops

12. for loop, nested for loop, break, continue statements.
13. Arrays, one dimensional array representation, sorting, searching.
14. Two dimensional arrays – matrix representation, matrix operations. String arrays, representing strings, string operations, string library functions.
15. User defined functions, passing arguments, returning values, recursive functions, storage class, scope and visibility of variables, local & global variables
16. User defined data types, structure, union, arrays of structures and structures in user defined functions. Introduction to pointers, passing arguments by address using pointers.
17. Concept of standard input output files, file operations, open, read and write operations, file opening modes. C preprocessor.

Practical Schedule

1. Number system – conversion from decimal to binary and vice versa
2. Conversion from decimal to octal and vice versa
3. Conversion from decimal to hexadecimal and vice versa
4. Conversion between octal, hex and binary
5. Simple C programs using operators and output statements
6. Programs using input statement and mathematical equations
7. Programs with library functions and if statements
8. Development of programs with if statement
9. Development of programs with nested if
10. Programs with switch statements
11. Illustrating go to statement
12. While loop example programs
13. Do-while loop programs
14. Nested loops with above loop structures
15. Programs with for loops
16. Nested for loop illustration programs
17. One dimensional array creation and calculations and printing
18. Array sorting –selection sort
19. Searching of array
20. Programs with Two dimensional arrays
21. Matrix addition, Transpose
22. Matrix multiplication
23. String manipulation programs
24. Creating User defined functions with return types
25. Functions of various return types and parameters
26. Programs with structures
27. Programs with unions
28. Programs to illustrate pointers
29. Functions passing parameters by address
30. Functions passing structures as parameters
31. Manipulating arrays with pointers

32. File operation – create a file and open and read from
33. File modification
34. Practical Examination

Suggested Reading

1. Mark Allen Weiss. 2014. Data Structures and Algorithm Analysis in C++, 4th Ed. Pearson Education, Boston, USA.
2. SvetlinNakov& Co. 2013.Fundamentals of Computer Programming with c#. Sofia, Bulgaria.
3. E.Balagurusamy. Programming in ANSI C, 4th Ed. Tata McGraw-Hill Publishing Company Limited, New Delhi.
4. P.K Sinha, Priti Sinha, Computer Fundamentals, sixth Ed. BPB Publications
5. ReemaThareja.Computer Fundamentals and Programming in C, 2013
6. Thomas C. Bartee, Digital Computer Fundamentals, 6th Ed.

Pafe. 1207 Fluid Mechanics 3 (2+1)

OBJECTIVES

1. This course gives an introduction to the fundamentals of fluid flow and its behavior so as to equip the students to learn related subjects and their applications in the higher semesters.

THEORY

MODULE I (6 Hours)

Units and dimensions; Properties of fluids; Static pressure of liquids: Hydraulic pressure, absolute and gauge pressure, pressure head of a liquid; Pressure on vertical rectangular surfaces; Flow behavior of viscous foods; Compressible and non-compressible fluids; Surface tension, capillarity; Pressure measuring devices: Simple, differential, micro and inclined manometer, mechanical gauges, piezometer; Floating bodies: Archimedes principle, stability of floating bodies; Equilibrium of floating bodies, metacentric height;

MODULE II (12 Hours)

Fluid flow: Classification, steady, uniform and non-uniform, laminar and turbulent, streamlines and stream tubes, continuity equation; Bernoulli's theorem and its applications; Average velocity for laminar flow of Newtonian fluids, Hagen-Poiseuille equation, hydraulically smooth pipe, Von Karman equation, roughness parameter, friction-factor chart, equivalent diameter, form friction losses in Bernoulli equation; Drag, drag coefficients of typical shapes, Ergun equation, free and hindered settlings, terminal settling velocity ,Stokes' law, Newton's law, criterion for settling regime, fluidization, conditions for fluidization, minimum fluidization velocity; Flow past through the immersed solids, packed and fluidized beds; Navier-Stokes equations in cylindrical co-ordinates, boundary conditions; Simple application of Navier-Stokes equation: Laminar flow between two straight parallel boundaries.

MODULE III (6 Hours)

Flow through pipes: Loss of head, determination of pipe diameter; Determination of discharge, friction factor, critical velocity; Flow through orifices, mouthpieces, notches and weirs; Vena contracta, hydraulic coefficients, discharge losses; Time for emptying a tank; Loss of head due to contraction, enlargement at entrance and exit of pipe; External and internal mouthpieces, types of notches, rectangular and triangular notches, rectangular weirs; Venturimeters, pitot tube, rotameter; Water level point gauge, hook gauge; Dimensional analysis: Buckingham's theorem application to fluid flow phenomena, Froude Number, Reynolds number, Weber number and hydraulic similitude.

MODULE IV (9 Hours)

Turbines and 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; Pressure variation, work efficiency; Pressure requirements for viscous foods to lift them to different heights and selection of pumps. Open channel hydraulics: Classification of open channel and definitions, most economical sections of regular cross-sections; Specific energy concept-critical depth, energy diagrams; Velocity and pressure profiles in open channels; Hydraulic jumps-types.

PRACTICAL

Study of different tools and fittings; Study on flow rate versus pressure drop with U-tube manometer; Verification of Bernoulli's theorem; Floating bodies; Determination of discharge co-efficient for venturimeter, orifice, mouthpiece, V-notch and weir; Verification of emptying time formula for a tank; Determination of critical Reynold's number by Reynold apparatus; Study of reciprocating, centrifugal and gear pump; Study of pumps for viscous fluid; Study of different types of valves; Calibration of rotameter; flow through pipes.

Lecture Schedule

1. Units and dimensions.
2. Properties of fluids.
3. Static pressure of liquids: Hydraulic pressure, absolute and gauge pressure, pressure head of a liquid.
4. Pressure on vertical rectangular surfaces.
5. Flow behavior of viscous foods.
6. Compressible and non-compressible fluids, Surface tension, capillarity.
7. Pressure measuring devices: Simple, differential, micro-, inclined manometer, mechanical gauges, and piezometer.
8. Floating bodies: Archimedis principle, stability of floating bodies.
9. Equilibrium of floating bodies, metacentric height.

10. Fluid flow: Classification, steady, uniform and non-uniform, laminar and turbulent, continuity equation.
11. Bernoulli's theorem and its applications.
12. Average velocity for laminar flow of Newtonian fluids, Hagen-Poiseuille equation, hydraulically smooth pipe, Von Karman equation, roughness parameter, friction-factor chart, equivalent diameter, form friction losses in Bernoulli equation.
13. Drag, drag coefficients of typical shapes, Ergun equation, free and hindered settlings, criterion for settling regime, terminal settling velocity, Stokes' law, Newton's law.
14. Navier-Stokes equations in cylindrical co-ordinates, boundary conditions.
15. Simple application of Navier-Stokes equation: Laminar flow between two straight parallel boundaries.
16. Flow past through the immersed solids, packed and fluidized beds- fluidization, conditions for fluidization, minimum fluidization velocity.
17. Flow through pipes: Loss of head Loss of head due to contraction, enlargement at entrance and exit of pipe.
18. Determination of discharge, friction factor, critical velocity-Determination of pipe diameter.
19. Flow through orifices, mouthpieces, notches and weirs- types of notches, rectangular and triangular notches, rectangular weirs- External and internal mouthpieces.
20. Hydraulic coefficients, discharge losses.
21. Time for emptying a tank.
22. Venturimeters, Pitot tube, rotameter.
23. Water level point gauge, hook gauge.
24. Mid-examination.
25. Dimensional analysis: Buckingham's theorem application to fluid flow phenomena, Froude Number, Reynolds number, Weber number and hydraulic similitude.
26. Turbines and pumps: classification, centrifugal pumps, submersible pumps, reciprocating pumps, positive displacement pump.
27. 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.
28. Reciprocating pumps: Working of reciprocating pump, double acting pump, instantaneous rate of discharge, acceleration of piston and water, gear pump.
29. Pressure variation, work efficiency.
30. Pressure requirements for viscous foods to lift them to different heights and selection of pumps.
31. Open channel hydraulics: Classification of open channel and definitions, most economical sections of regular cross-sections.
32. Specific energy concept-critical depth, energy diagrams.
33. Velocity and pressure profiles in open channels.
34. Hydraulic jumps-types.

Practical Schedule

1. Study of different tools and fittings.
2. Study on flow rate versus pressure drop with U-tube manometer.
3. Verification of Bernoulli's theorem.
4. Determination of metacentric height and radius of gyration of floating bodies.
5. Determination of discharge co-efficient for venturimeter.
6. Determination of discharge co-efficient for orifice.
7. Determination of hydraulic coefficient for mouthpiece.
8. Determination of discharge co-efficient for V-notch.
9. Determination of discharge co-efficient for weir.
10. Verification of emptying time formula for a tank.
11. Calibration of rotameter.
12. Flow through pipes.
13. Determination of critical Reynold's number by Reynold apparatus.
14. Study of reciprocating, centrifugal and gear pump.
15. Study of pumps for viscous fluid.
16. Study of different types of valves.
17. Practical Examination.

Suggested Reading

1. Frank M. White. 2010. Fluid Mechanics, 7th Ed. McGraw-Hill Book Co., Inc., Boston, USA.
2. Yunus A. Çengel and John M. Cimbala. 2006. Fluid Mechanics: Fundamentals and Applications. McGraw-Hill, Inc., New York, USA.
3. Bruce R. Munson, Donald F. Young and Theodore H. Okiishi. 2002. Fundamentals of Fluid Mechanics, 4th Ed. John Wiley & Sons, Inc., New York, USA.
4. E. John Finnemore and Joseph B. Franzini. 2002. Fluid Mechanics with Engineering Applications, 10th Ed. McGraw-Hill, Inc., New York, USA.
5. R. Byron Bird, Warren E. Stewart and Edwin N. Lightfoot. 2002. Transport Phenomena, 2nd Ed. John Wiley & Sons, Inc., New York, USA.

Beas. 1206 Basic Electronics Engineering 3(2+1)

OBJECTIVES

1. To provide an overview of the principles, operation and application of the building blocks like diodes, BJT, OP-amps, Feedback amplifiers, oscillators etc for performing various functions.
2. To understand the internal structure of all instruments that are used in measuring parameters related to electronics and to understand how different bridge networks are constructed and balanced for find out values of capacitance, resistance and inductance.
3. To understand about different transducers, that are used for measurement purpose and their working principles.

THEORY

MODULE I (6 HOURS)

Semiconductors, P-N junction, V-I characteristics of P-N junction, effect of temperature on Barrier voltage, Junction Breakdown, Zener breakdown, avalanche breakdown-Junction capacitance, diode as a circuit element, Half wave rectifier, centre tap Full wave rectifier & bridge rectifiers- efficiency of half wave & full wave rectifiers.

MODULE II (8 HOURS)

Voltage regulators, Zener diode voltage regulator, transistor series regulator, clipper, clamper, voltage multiplier, filter circuits Diode circuits for OR and AND (both positive and negative logic) bipolar junction transistor:, various biasing methods (fixed, self, potential divider), Hartley oscillator, colpitts oscillator, phase shift oscillator , Wein bridge oscillator.

MODULE III (10 HOURS)

OP-AMP, ideal OP-AMP characteristics, linear and non-linear applications of OP-AMP, integrator, active rectifier, comparator, differentiator, OP-AMP voltage regulators; binary adders, Half adders, Full adders, subs tractors

MODULE IV (10 Hours)

Generalized instrumentation systems-Transducers-sensors vs transducer, measurement of displacement, velocity, force measurement using load cells, strain gauge, pressure measurement, low pressure medium and high pressure measurement, Temperature measurement, bimetal strip thermocouple, thermistor-pyrometers.

PRACTICAL

To study V-I characteristics of p-n junction diode: To study half wave. full wave and bridge rectifier: To study transistor characteristics in CE configurations: To design and study fixed and self bias transistor: To design and study potential divider bias transistor: To study a diode as clipper and clamper: To study a OP-AMP IC 741 as inverting and non- inverting amplifier: To study a OP-AMP IC 741 as differentiator and integrator to study a differential amplifier using two transistor: To study a OP-AMP IC 741 as differential amplifier: To study a zener regulator circuit: To study a OP-AMP IC 741 as a active rectifier: To study a OP-AMP IC 741 as a comparator: To familiarize with various types of transducers.

Lecture schedule

1. Semiconductors-Types of semiconductors-Intrinsic semiconductors-Extrinsic semiconductors-Majority and Minority carriers-Mobile charge carriers and immobile ions-Current in Intrinsic semiconductors-Intrinsic conduction-Conventional problems
2. PN Junction-Formation of depletion Layer-Barrier voltage-effect of temperature on Barrier Voltage
3. Forward biased PN Junction- Forward V-I Characteristics- reverse biased PN Junction- reverse V-I characteristics- Combined forward and Reverse V-I characteristics

4. Junction Breakdown-Zener breakdown-avalanche breakdown-Junction capacitance problems.
5. PNJunction diode-Zener diode- Zener voltage regulator
6. Transistor series voltage regulator-photo diode-LED
7. Clippers-positive and negative clipper
8. Biased clipper-combination clipper-clampers
9. Voltage multiplier-Half wave and full wave voltage doubler-voltage tripler –Voltage Quadrupler
10. Filters-LC filter-pi filter
11. Logic Gates-OR - AND gate-
12. Diode OR and AND circuits
13. XOR-NOR-NAND-XNOR gates
14. Bipolar junction transistor-NPN and PNP transistor
15. Transistor biasing-CB configuration-static characteristics
16. CE configuration- relation between α and β- static characteristics
17. CC configuration- relation between transistor currents
18. Mid term Examination
19. DC load line-Q point
20. Different methods of transistor biasing- base bias-base bias with emitter feed back-base bias with collector feed back-voltage divider bias
21. Oscillators-colpits-Hartley
22. Phase shift-wein bridge oscillator
23. Op-Amps-virtual ground and summing point- ideal OP-AMP characteristics
24. Linear amplifier-unity follower-adder-.OP-Amp-sub tractor-integrator-.OP-AMP differentiator-comparator
25. OP-AMP voltage regulators.
26. Generalized Instrumentation system
27. Transducers
28. Functional elements of a measurement system
29. Measurement of displacement using electrodynamics transducer- LVDT-variable inductance transducer-proximity type electromagnetic transducer
30. Measurement of acceleration using eddy current transducer
31. Force measurement- hydraulic load cell-pneumatic load cell-strain gauge.
32. Pressure measurement-manometers-McLeod Gauge-Pirani Gauge-Ionization Gauge-Knudsen Gauge
33. Temperature measurement- resistance thermometer, thermo electric sensors
34. Total radiation Pyrometer-selective absorption pyrometer.

Practical schedule

1. To study V-I characteristics of p-n junction diode
2. To study half wave. Rectifier
3. To Full Wave rectifier
4. To study bridge rectifier
5. To study transistor characteristics in CE configurations

6. To design and study fixed and self bias transistor
7. To study a diode as clipper and clamper
8. To study a OP-AMP IC 741 as inverting amplifier
9. To study a OP-AMP IC 741 as non- inverting amplifier
10. To study a OP-AMP IC 741 as differentiator
11. To study a OP-AMP IC 741 as integrator
12. To study a Zener regulator circuit
13. To study a OP-AMP IC 741 as a active rectifier
14. To study a OP-AMP IC 741 as a comparator
15. To familiarize with various types of transducers
16. To familiarize with various types of transducers
17. Practical Examination.

Suggested Reading

1. A. Anand Kumar. 2014. Fundamentals of Digital Circuits. PHI Pvt. Ltd., New Delhi.
2. A.K. Sawhney. 2010. Course in Electrical and Electronics Measurements and Instrumentation. Dhanpat Rai Publications (P) Limited, New Delhi.
3. V.K. Mehta and Rohit Mehta. 2008. Principles of Electronics. S. Chand and Co., New Delhi.
4. D. Choudhury Roy. 2003. Linear Integrated Circuits. John Wiley International, NY.
5. Sanjeev Gupta. 2002. Electronic Devices and Circuits. Dhanpat Rai Publications (P) Limited, New Delhi.

Beas. 1207 Engineering Mathematics-II 2(2+0)

OBJECTIVES

1. When several of the factors of a problem are known and one or more are unknown, engineers use algebra.
2. The concept of complex geometry is very much useful in constructing machines. Complex analysis have a great role in many circuits.
3. Fourier series represents periodic functions. It is used in the resolution of partial differential equations, which appears in many engineering problems such as heat diffusion, wave propagation and fluid mechanics problem.

MODULE I (12 Hours)

Matrices: Elementary transformations, rank of a matrix, reduction to normal form, Gauss-Jordon method to find inverse of a matrix, consistency and solution of linear equations, Eigen values and Eigen vectors, Cayley-Hamilton theorem, linear transformation, orthogonal transformations, diagonalisation of matrices, bilinear and quadratic forms.

MODULE II (4 Hours)

Functions of a complex variable: Limit, continuity and derivative of complex functions, analytic function, Cauchy-Reimann equations, conjugate functions, harmonic functions.

MODULE III (7 Hours)

Fourier series: Infnite series and its convergence, periodic functions, Fourier series, Euler's formulae, Dirichlet's conditions, functions having arbitrary period, even and odd functions, half range series, harmonic analysis; Partial differential equations.

MODULE IV (10 Hours)

Formation of partial differential equations, Lagrange's linear equation, higher order linear partial differential equations with constant coefficients, solution of non-linear partial differential equations, Charpit's method, application of partial differential equations (one-dimensional wave and heat flow equations, two-dimensional steady state heat flow equation (Laplace equation).

Lecture Schedule

1. Matrices: Elementary transformations. Rank of a matrix.
2. Rank of a matrix.
3. Reduction to normal form.
4. Gauss-Jordon method to find inverse of a matrix.
5. Consistency and solution of linear equations.
6. Eigen values and Eigen vectors.
7. Eigen values and Eigen vectors.
8. Cayley-Hamilton theorem.
9. Linear transformation.
10. Orthogonal transformations
11. Diagonalisation of matrices
12. Diagonalisation of matrices
13. Bilinear and quadratic forms.
14. Limit, continuity and derivative of complex functions.
15. Analytic functions, Cauchy- Reimann equations.
16. Conjugate functions.
17. Harmonic functions.
18. Infinite series and its convergence.
19. Mid Examination
20. Periodic functions.
21. Fourier series, Euler's form.
22. Dirichlet's conditions.
23. Functions having arbitrary period.
24. Even and odd functions, Half range series
25. Harmonic analysis.
26. Formation partial differential equations.
27. Lagrange's linear equations.
28. Higher order linear partial differential equations with constant coefficients.
29. Higher order linear partial differential equations with constant coefficients.
30. Solution of non- linear partial differential equations.
31. Charpit's method.

32. Application of partial differential equations- one dimensional wave equations.
33. One dimensional heat flow equations.
34. Two dimensional steady state heat flow equations.

Suggested Reading

1. B.V. Ramana. 2008. Engineering Mathematics. Tata McGraw-Hill Book Co., New Delhi.
2. B.S. Grewal. 2004. Higher Engineering Mathematics. Khanna Publishers, Delhi.
3. Shanti Narayan 2004. A Textbook of Matrices. S. Chand and Co. Ltd., New Delhi.

Pafe. 1208 Post Harvest Engineering 3 (2+1)

OBJECTIVES

1. To provide knowledge about post harvest handling operations of various crops
2. To provide sound knowledge about various equipments related to post harvest processing
3. To study various material handling systems

THEORY

MODULE I (6 Hours)

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

MODULE II (12 Hours)

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

MODULE III (8 Hours)

Materials handling: Introduction to different conveying equipments used for handling of grains, fruits and vegetables; Scope and importance of material handling devices; Study of different material handling systems: Classification, principles of operation, conveyor system selection/design; 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.

MODULE IV (7 Hours)

Screw conveyor: Principle of operation, capacity, power, troughs, loading and discharge, inclined and vertical screw conveyors; 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.

PRACTICAL

Determination of moisture content of foods by various methods. study of cleaners for grains; Study of washers for fruits and vegetables; Study of graders for grains; Study of graders for fruits and vegetables; Study of decorticators; Study of a maize/sunflower sheller; Study of crop dryers; Study of a RF/MW/tray dryer; Study of hot air dryer and modelling drying kinetics; Study of vacuum dryer and modelling drying kinetics; Study of working principle of spray dryer and spray drying process; Study of drum dryer and liquid food dehydration using drum drying; Study of fluidized bed dryer and drying process; Study of freeze dryer and freeze drying process; Study of rice milling machines; Study of pulse milling machines; Study of different components of flour mill; Study of different materials handling equipment

Lecture Schedule

1. Introduction, scope, production , importance post harvest technology and losses during processing of post harvest technology
2. Moisture content, determination by various methods, water activity, water binding and its effect on enzymatic and non-enzymatic reactions and food texture, control of water activity and moisture
3. Processing steps of Post harvest Handling operations, types, methods and equipment for cleaners and screeners
4. Methods, types and equipment for sorting and grading, efficiency and effectiveness of sorting and grading
5. Principle, working procedure, Types and equipment for separators
6. Principles of working, design and constructional details, operating parameters, maintenance of various decorticators and shellers,
7. Detail description of groundnut decorticators and maize shellers
8. Principle, working procedure, Types and equipment for grin drying

9. Methods and numerical approach of drying
10. Definition, methods, advantage and disadvantage of parboiling
11. Process, nutritional and cooking quality changes of parboiling
12. Principle, working procedure, Types and equipment for dehusking
13. Principle, working procedure ,Types and equipment for polishing and grinding
14. Principle ,working procedures of flour milling machines and pulse milling machines
15. Principle, working procedures of grinders and cutting machines
16. Introduction, working principle and construction for oil expellers
17. Definition, introduction to various types of material handling equipments
18. Midterm examination
19. Scope and importance of material handling devices
20. Classification, principles of operation, conveyor system selection
21. Design and construction of Belt conveyor
22. Principle, characteristics, design, relationship between belt speed and width of belt conveyor
23. Idler spacing, belt tension, drive tension, belt tripper of belt conveyor
24. Advantages, disadvantages, capacity and speed of belt conveyor
25. Advantages, disadvantages, capacity and speed of chain conveyor
26. Design and construction of chain conveyor
27. Principle of operation, capacity, power, troughs ,loading and discharge, inclined screw conveyors
28. Principle of operation, capacity, power, troughs ,loading and discharge, of vertical screw conveyor
29. Advantages, disadvantages, capacity and speed of screw conveyor
30. Principle, classification, operation, advantages, disadvantages, capacity and speed of bucket elevator
31. Description of Bucket pickup, bucket discharge, relationship between belt speed, pickup and bucket discharge and buckets types
32. Principle, operation, advantages, disadvantages, capacity and speed of pneumatic conveying system
33. Power requirement and construction Gravity conveyor
34. Design considerations, capacity and power requirement pneumatic conveying system

Practical Schedule

1. Determination of moisture content of food by various methods
2. Performance evolution of different types of cleaners for grains
3. Performance evolution of different types of washers for fruits and vegetables
4. Performance evolution of different types of graders for grains
5. Performance evolution of different types of graders for fruits and vegetables
6. Experiment on Study of decorticators, maize or sunflower Sheller
7. Experiment on study of crop dryers, microwave and tray dryers
8. Experiment on study of hot air dryer and modeling drying kinetics
9. Experiment on study of vacuum dryer and modeling drying kinetics
10. Experiment on study of spray drying process

11. Experiment on study of drum dryer
12. Experiment on study of study of fluidized bed dryer and freeze drying process
13. Experiment on study of study of pulse milling Machines
14. Experiment on study of screw conveyor
15. Experiment on study of belt conveyor
16. Experiment on study of pneumatic conveying system
17. Practical examination

Suggested Reading

1. Amalendu Chakraverty 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. McGraw-Hill Co., Inc., NY, USA.
4. K.M. Sahay and K.K. singh. 2001. Unit Operations of Agricultural Processing. Vikas Publishing House Pvt. Ltd., Noida, UP.
5. G. Boumans. 1985. Grain Handling and Storage. Elsevier Science Publishers, Amsterdam, The Netherlands.
6. R.L. Earle. 1983. Unit operations in Food Processing. Pergamon Press, New York, USA.

Ncss. 1201 NSS 1 (0+1)

PRACTICAL

Orientation of students towards national problems; Study of the philosophy of N.S.S., fundamental rights, directive principles of state policy, socio-economic structure of Indian society, population and five year plans; Functional literacy: Non-formal education of rural youth, eradication of social evil, awareness programmes, consumer awareness, highlights of the Consumer Act, environment enrichment and conservation, health, family welfare and nutrition; Right to information act.

SEMESTER-III

Pafe. 2109 Food Additives and Preservatives 2 (1+1)

OBJECTIVES

1. To understand the common food additives used and their safety issues.
2. To have an overview on the process induced food toxicants and their health concerns.

THEROY

MODULE I (7 Hours)

Intentional and unintentional food additives, their toxicology and safety evaluation; Naturally occurring food additives; Food colors and dyes: Regulatory aspects of dyes, food

color (natural and artificial), pigments and their importance and utilization as food colour; Processing of natural and artificial food colorants

MODULE II (6 Hours)

Food preservatives and their chemical action. Role and mode of action of salts, chelating agents, stabilizers and thickeners; Humectants/polyhydric alcohol, anti-caking agent, firming agent, flour bleaching and maturing agents, antioxidants, nutritional and non-nutritional sweeteners

MODULE III (3 Hours)

Production of enzymes, leavening agents, fat substitutes, flavor and taste enhancers in food processing; Acidity regulators; Emulsifiers.

PRACTICAL

Evaluation of GRAS aspect of food additives; Estimation of chemical preservatives by TLC (organic and inorganic); Identification of food colour by TLC (organic and inorganic); Quantitative estimation of added dyes; Isolation and identification of naturally occurring food pigments by paper and TLC; Role and mode of action of chelating agent in fruit juice; Role and mode of action of stabilizer and thickener in frozen dairy products (ice-cream); Role and mode of clarifying agent in fruit juices; Role and mode of antioxidant in frozen fish; Role of leaving agent in baked food product; Preservation of coconut shreds using humectants.

Lecture Schedule

1. Food additives-definition-E number-Intentional and unintentional food additives,
2. Toxicology-threshold limits-safety evaluation of food additives
3. Naturally occurring food additives
4. Food colors and dyes-types
5. Regulatory aspects of dyes, food color (natural and artificial).
6. Role of pigments - their importance and utilization as food color.
7. Processing of natural and artificial food colorants.
8. Food preservatives-types and their chemical action.
9. Role and mode of action of salts, chelating agents.
10. Importance of stabilizers and thickeners in processed foods.
11. Humectants/polyhydric alcohol, anti-caking agent.
12. Mid semester examination.
13. Firming agents, flour bleaching and maturing agents.
14. Antioxidants-types, sweeteners-types.
15. Production of enzymes-its role, leavening agents, fat substitutes.
16. Flavor - types and taste enhancers in food processing
17. Acidity regulators and Emulsifiers-types

Practical Schedule

1. Evaluation of GRAS aspect of food additives.

2. Estimation of chemical preservatives by TLC (organic).
3. Estimation of chemical preservatives by TLC (inorganic).
4. Identification of food colour by TLC (organic).
5. Identification of food colour by TLC (inorganic).
6. Quantitative estimation of added dyes.
7. Isolation and identification of naturally occurring food pigments by paper chromatography.
8. Isolation and identification of naturally occurring food pigments by Thin Layer Chromatography.
9. Role and mode of action of chelating agent in fruit juice.
10. Role and mode of action of stabilizers frozen dairy products (ice-cream).
11. Role and mode of action of thickeners in frozen dairy products (ice-cream).
12. Role and mode of clarifying agent in fruit juices.
13. Role and mode of antioxidant in frozen fish.
14. Role of leaving agent in baked food product.
15. Preservation of coconut shreds using humectants.
16. Study on sequestrants and their role in processed foods
17. Practical examination

Suggested Reading

1. H.-D. Belitz, W. Grosch and P. Schieberle. 2009. Food Chemistry. 4th Edition. Springer-Verlag, Berlin,Heidelberg.
2. S.N. Mahindru. 2008. Food Additives: Characteristics, Detection and Estimation. Aph Publishing Corporation, New Delhi.
3. S.S. Deshpande. 2002. Handbook of Food Toxicology. Marcel and Dekker AG, Basel, Switzerland.

Pafe. 2110 Processing Technology of Liquid Milk 2 (1+1)

OBJECTIVE

1. To acquaint and equip the students with production, utilization of milk and value added liquid milk products.

THEORY

MODULE I (3 Hours)

Historical development of dairy in India; Production and utilization of milk; Composition and properties of milk; Liquid milk collection, preservation, processing, packaging and storage - standardized milk, skim milk, sterilized milk, reconstituted/rehydrated milk, recombined milk, flavoured milk, fermented milk, acidophilous milk, etc.

MODULE II (5 Hours)

Cream: definition, classification, manufacture of different types of cream, processing of cream; Fermented milk products: Processing, manufacture, storage and packaging of acidophilus milk, cultured buttermilk and other fermented milk; Bio-chemical changes

occurring during manufacture of fermented milks; Factors affecting these changes and effects of these changes on the quality of finished products.

MODULE III (8 Hours)

Adulterations in milk and its detection; Quality defects in milk - causes and prevention, liquid milk collection, processing, packaging and storage systems and equipment - bulk milk coolers, milk chilling units, milk reception equipment, milk tanks/silos, pasteurizers, sterilizers, centrifuges, clarifiers, filtration units, homogenizers, packaging and filling machines, CIP units, etc.; Hygienic design concepts, sanitary pipes and fittings, corrosion process and their control.

PRACTICAL

Platform tests of raw milk (clot on boiling (COB) test, alcohol test); Determination of physical properties of milk; Determination of proximate composition and biochemical properties of milk; Determination of microbiological properties of milk; Detection of adulterants in milk; Identification and demonstration of liquid milk processing equipment, pipes and fittings; Preparing standardized milk as per requirement; Separation of fat from milk; Pasteurization and homogenization of milk; Packaging of liquid milk; Preparation of curd and yogurt**,** Visit to chilling centre and dairy plant.

Lecture Schedule

1. Dairy introduction- Historical development in India.
2. Production and utilization of milk- composition of milk- properties of milk.
3. Standardized milk- skim milk- sterilized milk- reconstituted/rehydrated milk.
4. Recombined milk- flavoured milk- fermented milk-acidophilous milk.
5. Cream- definition- classification- manufacture of different types of cream
6. Processing and packaging of cream.
7. Fermented milk products-processing- manufacture.
8. Storage and packaging of acidophilus milk- cultured buttermilk- other fermented milk
9. Bio-chemical changes occurring during manufacture of fermented milks.
10. Factors affecting biochemical changes and effects of these changes on the quality of finished products
11. Mid examination
12. Adulterations in milk- its detection- Quality defects in milk - causes and prevention.
13. Liquid milk collection, preservation- processing- packaging- storage systems and equipment
14. Bulk milk coolers, milk chilling units, milk reception equipment, milk tanks/silos,
15. Milk pasteurizers- sterilizers- centrifuges- clarifiers- filtration units- homogenizers, packaging and filling machines.
16. Cleaning in place – definition – merits – types of CIP systems – procedure.
17. Hygienic design concepts-sanitary pipes and fittings- corrosion process -control.

Practical Schedule

1. Platform tests of raw milk (clot on boiling (COB) test)
2. Platform tests of raw milk (alcohol test)
3. Determination of physical properties of milk
4. Determination of proximate composition
5. Study on biochemical properties of milk
6. Determination of microbiological properties of milk
7. Detection of adulterants in milk
8. Identification and demonstration of liquid milk processing equipment, pipes and fittings.
9. Identification and demonstration of liquid milk processing equipment, pipes and fittings.
10. Preparing standardized milk as per requirement
11. Study on separation of fat from milk
12. Milk pasteurization
13. Homogenization of milk
14. Packaging of liquid milk
15. Preparation of curd and yogurt
16. Visit to chilling centre and dairy plant.
17. Practical examination

Suggested Reading

1. A. Kanekanian. 2014. Milk and Dairy Products as Functional Foods. John Wiley & Sons, Ltd., UK.
2. Adnan Y. Tamime. 2009. Milk Processing and Quality Management. Blackwell Publishing Ltd., UK.
3. Pieter Walstra, Jan T.M. Wouters, Tom J. Geurts. 2006. Dairy Science and Technology, 2nd Ed. CRC Press, Boca Raton, FL, USA.
4. Sukumar De. 2005. Outlines of Dairy Technology. Oxford University Press, New Delhi.
5. H.G. Kessler. 1981. Food Engineering and Dairy Technology. Verlag A. Kessler, Fraising (F.R. Germany).
6. Y.H. Hui. 1993. Dairy Science and Technology Handbook, Vol. I, II and III.Wiley-VCH, A.

Pafe. 2111 Processing Technology of Cereals 3 (2+1)

OBJECTIVES

1. To create awareness and knowledge about the processing of major cereals like paddy, maize ,barley, wheat, corn and sorghum
2. To study the storage and handling techniques of cereals
3. To study about the by-products obtained during processing along with a their uses

THEORY

MODULE I (6 Hours)

Present status and future prospects of cereals and millets; Importance, morphology, chemical composition and nutritive value of cereals, major and minor millets; Importance of engineering properties of biological materials-physical, thermal, frictional, aero-dynamic and rheological properties, Chemical composition and nutritive value.

MODULE II (9 Hours)

Paddy processing and rice milling: Conventional milling, modern milling, milling operations, milling machines, milling efficiency; Quality characteristics influencing final milled product; Parboiling; Rice bran stabilization and its methods.

MODULE III (9 Hours)

Wheat milling: Break system, purification system and reduction system; extraction rate and its effect on flour composition; quality characteristics of flour and their suitability for baking; Corn milling: Dry and wet milling of corn, starch and gluten separation, milling fractions and modified starches.

MODULE IV (9 Hours)

Barley: Malting and milling; Oat/Rye: Processing, milling; Sorghum: Milling, malting, pearling; Millets (Pearl millets, finger millets): Processing of millets for food uses; Secondary and tertiary products processing of cereals and millets; By-products processing of cereals and millets; Processing of infant foods from cereals and millets; Breakfast cereal foods: Flaked, puffed, expanded, extruded and shredded.

PRACTICAL

Morphological characteristics of cereals; Physical properties of cereals; Chemical properties of cereals; Parboiling of paddy; Cooking quality of rice; Milling of rice; Conditioning and milling of wheat; Production of sorghum flakes; Production of popcorns, flaked rice, puffed rice, noodles; Preparation of sorghum malt; Determination of gelatinization temperature by amylograph; Processing of value added products from millets; Visit to Cereal processing unit.

Lecture Schedule

1. Introduction, present, future scope and morphology of cereals and millets; Engineering properties of cereals and millets
2. Chemical composition, nutritive value and physico-chemical properties of cereals
3. Chemical composition, nutritive value and physico-chemical properties of millets
4. Processing of paddy, methods of milling and milling efficiency
5. Milling machines and quality characteristics of milled products
6. Introduction, methods, advantages and disadvantages of Parboiling
7. Processing, stabilization and its methods of rice bran
8. Methods and equipments for wheat milling, Break rolls and reduction rolls
9. Types, composition, extraction rate and quality characteristics of flour

10. Extraction rate and its effect on flour composition
11. Introduction, methods and process steps for baking
12. Methods, equipments for corn milling
13. Starch extraction and gluten separation, modified starch, resistance starch
14. Methods, equipments for barley milling
15. Malting and by-products of barley milling
16. Processing methods and equipments for milling of oats.
17. Types and equipments for milling of sorghum
18. Malting, pearling and by-products of sorghum
19. Midterm examination
20. Introduction, methods and equipments for processing of Pearl millets.
21. Introduction, methods and equipments for processing of Finger millets.
22. Secondary and tertiary products processing of cereals
23. Secondary and tertiary products processing of millets
24. By-products processing of cereals
25. By-products processing of cereals
26. By-products processing of millets
27. By-products processing of millets
28. Processing of infant foods from cereals
29. Processing of infant foods from cereals
30. Processing of breakfast cereal foods
31. Processing of infant foods from millets
32. Processing of flaked and puffed products
33. Processing of expanded products and pasta
34. Extrusion methods, advantages and types of extruders.

Practical Schedule

1. Observations of morphological characteristics of cereals
2. Determination of physical properties of cereals
3. Determination of chemical properties of cereals
4. Experiment on parboiling of paddy
5. Determination of cooking quality characteristics of rice
6. Experiment on precondition of rice milling
7. Experiment on rice milling
8. Experiment on wheat milling
9. Experiment on production of sorghum flakes and malt
10. Experiment on production of flaked rice and puffed rice,
11. Experiment on production of popcorns
12. Experiment on production of noodles
13. Determination of gelatinization temperature by amylograph
14. Experiment on processing of value added products from millets
15. Experiment on extrusion process
16. Visit to Cereal processing unit
17. Practical examination

Suggested Reading

1. Amalendu Chakraverty and R. Paul Singh. 2014. Post Harvest Technology and Food Process Engineering. CRC Press, Boca Raton, FL, USA.
2. Elaine T. Champagne. 2004. Rice: Chemistry and Technology, 3rd Ed., AACC International, Inc., St. Paul, MN, USA.
3. Amalendu Chakraverty, Arun S. Mujumdar, G.S. Vijaya Raghavan and Hosahalli S. Ramaswamy. 2003. Handbook of Post Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. Marcel Dekker, Inc., NY, USA.
4. N.L. Kent and A.D. Evers. 1994. Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture, 4th Ed. Elsevier Science Ltd., Oxford, UK.
5. Samuel A. Matz. 1991. The Chemistry and Technology of Cereals as Food and Feed, 2nd Ed. Springer Science + Business Media, NY, USA.
6. E.V. Araullo, D.B. De Padna and Graham. 1976. Rice Post Harvest Technology. IDRC, Canada.

Pafe. 2112 Industrial Microbiology 3 (2+1)

OBJECTIVE

Upon completion of this course, students are expected to be able to:

1. Screen microorganisms with various bioactive potentials
2. Understand the basics of designing industrial sterilization equipments and sterilization standards
3. Understand the basics of designing of fermentor
4. Understand the specific the role of microbes as probiotics
5. Describe the beneficial role of microorganisms in fermented foods and in food processing.
6. Produce various primary and secondary metabolites like, alcohols, organic acids, antibiotics etc. synthesized by microorganisms
7. Recover the products from the fermentation media

THEORY

MODULE I (8 Hours)

History of industrial microbiology; Primary and secondary metabolites produced by the microorganisms; Screening of microorganisms; Preservation of microorganisms; Organizations involved in microbiological work.

MODULE II (8 Hours)

Fermentation media, Industrial sterilization; Definition, thermal death time, media heat sterilization, advantages of continuous sterilization, design of sterilization, deterministic and probabilistic approach in designing of sterilizing equipments, sterilization charts.

MODULE III (10 Hours)

Fermenter: Components of a fermenter, parts of fermenters, peripheral parts and accessories, additional accessories and peripherals. Types of fermenters: Types of fermentations; industrially important secondary metabolites; and microorganisms involved.
Probiotics: Importance, role in fermented foods; organisms involved beneficial effects; Bacteriocins; Nisin; Production of microbial enzymes.

MODULE IV (7 Hours)

Downstream processing; Cell disruption methods: Mechanical disruption methods and non-mechanical disruption methods; Extraction; Purification; Concentration; Product recovery.

PRACTICAL

Isolation and screening of citric acid/ amylase/ protease /antibiotic producing microbes, Production of citric acid/Lactic acid/ Acetic acid, Purification of citric acid/Lactic acid/ Acetic acid and Estimation of citric acid/Lactic acid/ Acetic acid; Standardization of physical factors for higher yields of citric acid; Isolation, identification of cultures producing bio-colours; Production, purification and estimation of beer/ ethanol; Production, purification and assay of fungal amylases/proteases/Lipase; Production and assay of nisin from lactic acid bacteria; Single cell protein production; Starter activity of Baker's yeast Mushroom production.

Lecture Schedule

1. History of industrial microbiology
2. Primary and secondary metabolites produced by the microorganisms
3. Primary and secondary metabolites produced by the microorganisms
4. Primary and secondary metabolites produced by the microorganisms
5. Screening of microorganisms
6. Screening of microorganisms
7. Preservation of microorganisms
8. Organizations involved in microbiological work
9. Fermentation media
10. Industrial sterilization: Definition, thermal death time
11. Heat sterilization of media
12. Continuous sterilization and its advantages
13. Design of sterilization equipments, deterministic and probabilistic approach in designing of sterilizing equipments, sterilization charts
14. Design of sterilization equipments, deterministic and probabilistic approach in designing of sterilizing equipments, sterilization charts
15. Design of sterilization equipments, deterministic and probabilistic approach in designing of sterilizing equipments, sterilization charts
16. Types of Fermenter
17. Fermentor: Components of a fermenter, parts of fermenters, peripheral parts and accessories, additional accessories and peripherals

18. Fermenter: Components of a fermenter, parts of fermenters, peripheral parts and accessories, additional accessories and peripherals
19. Types of fermentations
20. Industrially important secondary metabolites; and microorganisms involved
21. Industrially important secondary metabolites; and microorganisms involved
22. Industrially important secondary metabolites; and microorganisms involved
23. Mid semester Examination
24. Probiotics: Importance, role in fermented foods, organisms involved, beneficial effects
25. Probiotics: Importance, role in fermented foods, organisms involved, beneficial effects
26. Bacteriocins- Nisin
27. Production of microbial enzymes
28. Downstream processing
29. Downstream processing
30. Cell disruption methods: Mechanical disruption methods
31. Non-mechanical disruption methods
32. Product recovery: Extraction, Purification and Concentration of products
33. Product recovery: Extraction, Purification and Concentration of products
34. Product recovery: Extraction, Purification and Concentration of products

Practical Schedule

1. Isolation and screening of citric acid/ amylase/protease/antibiotics producing microbes
2. Production of citric acid
3. Production of Lactic acid
4. Production of Acetic acids
5. Purification of citric acid/Lactic acid/ Acetic acid
6. Estimation of citric acid/Lactic acid/ Acetic acid
7. Standardization of physical factors for higher yields of citric acid
8. Isolation, identification of cultures producing bio-colours
9. Production of beer/ethanol
10. Purification and estimation of beer/ethanol
11. Production of fungal amylases/ proteases/Lipase
12. Purification and assay of fungal amylases/ proteases/Lipase
13. Production and assay of nisin from lactic acid bacteria
14. production of Single cell protein
15. Production of Starter culture of Baker's yeast
16. Cultivation of Mushroom
17. Practical examination

Suggested Reading

1. Nduka Okafor. 2007. Modern Industrial Microbiology and Biotechnology. Science Publishers, Enfield, New Hampshire, USA.

2. Dennis E. Briggs, Chris A. Boulton, Peter A, Brookes and Roger Stevens. 2004. Brewing Science and Practice. Woodhead Publishing Ltd. Cambridge, England.
3. G. Reed. 2004. Prescott & Dunn's Industrial Microbiology, 4th Ed. AVI Publishers, Connecticut, USA.
4. Peter F. Stanbury, Allan Whitakar and Stephen J. Hall. 1995. Principles of Fermentation Technology, 2nd Ed. Elsevier Science Ltd., Burlington, MA, USA.
5. L.E. Casida Jr. 1968. Industrial Microbiology. New Age International Publishers, New Delhi.

Pafe. 2113 Computer Aided Drafting of Food Processing Equipments 2 (1+1)

OBJECTIVES

1. To introduce modern techniques and trends in computer aided design and drafting and to equip the students in preparing technical drawings in standard CAD software.

THEORY

MODULE I (2 Hours)

Introduction-CAD and drafting-hardware and software- input and output devices.

MODULE II (7 Hours)

Drawing editor-setting up the drawings- scales, units and limits-layers, colours and line types- snap, grid and pick commands-drawing entities- line, pline, circle, ellipse, polygons-editing-fill, erase, move, blocks, fillet, extend, trim, modify-text and dimensions

MODULE III (7Hours)

3D drawings-transforming 2D to 3D- drawing output-design and drafting of food processing equipment-shaft, hoppers, bins, pulleys-preparation of production drawings.

PRACTICAL

Understanding hardwares and softwares of CAD. Working with menu and files. Working with snap, grid and pick commands. Working with creation of layers, changing colours and line types. Drawing lines, circles , ellipse and arc. Editing the drawings-copy and rotate. Modifying the drawings-mirror, fillet and chamfer. Modifying the drawings-extend, stretch and trim commands. Hatching the drawings and filling with patterns. Working with measure, divide, block and insert commands. Working with text and dimensions. Positioning the drawing, working with 3D objects and transforming 2D to 3D drawings. Drafting of components like shafts and pulleys Drafting of components like bins and hoppers. Drafting of components of food processing equipments.

Lecture Schedule

1. Introduction to CAD and drafting - details of hardware and software, input and output devices.
2. Drawing editor-setting up the drawing- scale, units, and limits.
3. Draw commands-line, pline, circle, arc and ellipse.
4. Creation of layers, change colours and line types.

5. Snap, grid and pick commands
6. Edit and modify commands-fill, erase and move.
7. Edit commands- copy, rotate, mirror and fillet.
8. Edit commands-chamfer, extend, stretch and trim.
9. Mid Semester Examination
10. Edit commands-measure, divide and block
11. Edit commands-insert and polylines
12. Display commands-zoom, select and pan
13. Text and dimensions
14. Assembly or positioning the drawings-3D drawings-transforming 2D to 3D.
15. Design and drawing of components of food processing equipments-shaft and hopper.
16. Design and drawing of components of food processing equipments-bins and pulleys.
17. Preparation of production drawings and drawing outputs.

Practical Schedule

1. Understanding hardwares and softwares of CAD.
2. Working with menu and files.
3. Working with snap, grid and pick commands.
4. Working with creation of layers, changing colours and line types.
5. Drawing lines, circles , ellipse and arc
6. Editing the drawings-copy and rotate.
7. Modifying the drawings-mirror, fillet and chamfer.
8. Modifying the drawings-extend, stretch and trim commands.
9. Hatching the drawings and filling with patterns.
10. Working with measure, divide, block and insert commands.
11. Working with text and dimensions.
12. Positioning the drawing, working with 3D objects and transforming 2D to 3D drawings.
13. Drafting of components like shafts and pulleys
14. Drafting of components like bins and hoppers.
15. Drafting of components of food processing equipments
16. Drafting of components of food processing equipments
17. Practical examination.

Suggested Readings

1. Berghauser W Tom W. and Schlieve L Paul.1989. Illustrated AutoCAD - Release 10, BPB Publications, B-14,Connaught Place, New Delhi- 1.
2. Burchard Bill and Pitzer David.1999. Inside AutoCAD 2000. Techmedia, New Delhi -2.
3. Grabowski Ralph. 1992. Learn AutoCAD in a day. First Indian edition, BPB Publications, B-14,Connaught place, New Delhi.
4. Katz Geneviere, 1991. Teach Yourself AutoCAD- Release 11. First Indian Edition, BPB Publications, B-14,Connaught place,New Delhi- 1.
5. Raker Daniel and Harbert Rice, 1987. Inside AutoCAD, First Edition, BPB Publications, B-14,Connaught place,New Delhi -1

Pafe. 2114 Food Chemistry of Micronutrients 3 (2+1)

OBJECTIVE

1. To understand the analytical, biochemical, chemical, physical, nutritional, and toxicological aspects of food Macronutrients

THEORY

MODULE I (10 Hours)

Chemistry of food flavour; Philosophy and definitions of flavour, flavourmatics/flavouring compounds, sensory assessment of flavour, technology for flavour retention

MODULE I (10 Hours)

Pigments in animal and plants kingdoms: Heme pigments, chlorophyll, carotenoids, phenolic and flavonoids, betalins, effect of processing on pigment behaviour; Technology for retention of natural colours of food stuffs; Food colorants; Regulatory use of regulatory dyes; Colour losses during thermal processing.

MODULE II (6 Hours)

Vitamins and minerals: Requirements, allowances, enrichment, restorations, fortifications, losses of vitamins and minerals, optimization and retention of vitamins and minerals; Chemistry of anti-nutritional factors.

MODULE III (8Hours)

Enzymes in food industry: Carbohydrases, proteases, lipases; Modification of food using enzymes: Role of endogenous enzymes in food quality, enzymes use as processing aid and ingredients.

PRACTICAL

Preparation of mineral solution by using ash and tri-acid method (dry and wet oxidations); Estimation of calcium; Determination of phosphorus; Determination of iron; Estimation of magnesium; Estimation of tannins and phytic acid from food; Determination of vitamin A (Total carotenoids); Determination of ascorbic acid by dye method; Determination of thiamin and riboflavin; Determination of food colors; Assessment of hydrocolloids as food additives; Assessment of various pectinases from fruits and vegetables.

Lecture Schedule

1. Chemistry of food flavour;
2. Philosophy and definitions of flavour,
3. Flavourmatics/flavouring compounds
4. Flavourmatics/flavouring compounds
5. Sensory assessment of flavour,
6. Technology for flavour retention;
7. Technology for flavour retention

8. Pigments in animal and plants kingdoms: Heme pigments
9. Pigments in animal and plants kingdoms Chlorophyll, carotenoids,
10. Pigments in animal and plants kingdoms phenolics
11. Pigments in animal and plants kingdoms flavonoids and betalins
12. Effect of processing on pigment behaviour;
13. Technology for retention of natural colours of food stuffs;
14. Food colorants;
15. Food additives
16. Regulatory use of regulatory dyes
17. Colour losses during thermal processing;
18. Vitamins and minerals: Requirements, allowances, enrichment, restorations, fortifications,
19. Vitamins and minerals: Requirements, allowances, enrichment, restorations, fortifications
20. Vitamins and minerals: Requirements, allowances, enrichment, restorations, fortifications
21. Losses of vitamins and minerals,
22. Optimization and retention of vitamins and minerals;
23. Mid Exam
24. Chemistry of anti-nutritional factors.
25. Chemistry of anti-nutritional factors
26. Enzymes in food industry:
27. Carbohydrases,
28. Proteases
29. lipase
30. Modification of food using enzymes:
31. Modification of food using enzymes:
32. Role of endogenous enzymes in food quality,
33. Enzymes use as processing aid and ingredients
34. Enzymes use as processing aid and ingredients

Practical schedule

1. Preparation of mineral solution by using ash
2. Preparation of mineral solution by using tri-acid method
3. Estimation of calcium
4. Determination of phosphorus
5. Determination of iron
6. Estimation of magnesium
7. Estimation of tannins from food
8. Estimation of phytic acid from food
9. Determination of vitamin A (Total carotenoids)
10. Determination of ascorbic acid by dye method
11. Determination of thiamin
12. Determination of riboflavin

13. Determination of food colors
14. Assessment of hydrocolloids as food additives
15. Assessment of various pectinases from fruits and vegetables.
16. Practical exam

Suggested Reading

1. yy H.-D. Belitz, W. Grosch and P. Schieberle. 2009. Food Chemisry, 4th Ed. Springer-Verlag Berlin Heidelberg.
2. Owen R, Fennema. 1996. Food Chemistry, 3rd Ed. Marcel Dekker, Inc., New York, USA.

Pafe. 2115 Heat and Mass Transfer in Food Processing 3 (2+1)

OBJECTIVE

1. To acquaint and equip the students with different heat and mass transport phenomena and operations in food processing

THEORY

MODULE I (13 Hours)

Basic heat transfer processes, heat transfer coefficients, properties related to heat transfer; One-dimensional steady state conduction: Theory of heat conduction, Fourier's law and its derivation, Concept of electrical analogy and its application for thermal circuits, heat transfer through composite walls and insulated pipelines; One-dimensional steady state heat conduction with heat generation: Heat flow through slab, hollow sphere and cylinder with linear heat transfer, uniform/non-uniform heat generation, development of equations of temperature distribution with different boundary conditions; Steady-state heat conduction with heat dissipation to environment: Introduction to extended surfaces (fins) of uniform area of cross-section and with equation of temperature distribution with different boundary conditions; Effectiveness and efficiency of the fins; Introduction to unsteady state heat conduction: System with negligible internal resistance and in various geometries.

MODULE II (5 Hours)

Convection: Forced and free convection, use of dimensional analysis for correlating variables affecting convection heat transfer; Concept of Nusselt number, Prandtl number, Reynolds number, Grashoff number, some important empirical relations used for determination of heat transfer coefficient; Heat transfer to flowing fluids.

MODULE III (12 Hours)

Radiation: Heat radiation, emissivity, absorptivity, transmissivity, radiation through black and grey surfaces, determination of shape factors; Introduction to condensing and boiling heat transfer: Film- and drop-wise condensation, effect of non-condensable gases,

boiling heat transfer; Heat Exchangers: General discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers, shell and tube and plate heat exchangers, heat exchanger design; Application of different types of heat exchangers in dairy and food industry.

MODULE IV (3 Hours)

Mass transfer: Fick's law of diffusion, steady state diffusion of gases and liquids through solids, equimolal diffusion, isothermal evaporation of water into air, mass transfer coefficient, application in dairy and food industry.

PRACTICAL

Heat transfer analysis during conduction and convection; Study on various types of heat exchangers used in food industry; Preparation and calibration of thermocouples; Determination of thermal conductivity of different food products; Study of working principle and constructional details of plate heat exchanger; Study of working principle and constructional details of shell and tube heat exchanger. Determination of overall heat transfer coefficient of shell and tube, plate heat exchangers, jacketed kettle used in food industry; Studies on heat transfer through extended surfaces; Studies on temperature distribution and heat transfer in HTST pasteurizer.

Lecture Schedule

1. Introduction to heat and mass transfer processes–different mode of heat transfer– conduction– convection– radiation.
2. Heat transfer coefficients– properties related to heat transfer.
3. Heat conduction– concept–conduction in solids– liquids– gases
4. One dimensional steady state conduction with heat generation– theory of heat conduction.
5. Fourier's law and its derivation– thermal conductivity of material.
6. Concept of electrical analogy and its application for thermal circuits.
7. Heat transfer through composite walls and insulated pipelines
8. Heat flow through slab, hollow sphere and cylinder with linear heat transfer, uniform/non-uniform heat generation,
9. Heat conduction–development of equations of temperature distribution with different boundary conditions
10. Steady state heat conduction with heat dissipation to environment
11. Introduction to extended surfaces (fins) of uniform area of cross-section– with equation of temperature distribution with different boundary conditions
12. Effectiveness – efficiency of the fins
13. Unsteady state heat conduction– introduction – system with negligible internal resistance and in various geometries
14. Convection–concept– heat transfer coefficient – forced and free convection
15. Use of dimensional analysis for correlating variables affecting convection heat transfer

16. Concept of Nusselt number–Prandtl number–Reynolds number–Grashoff number– some important empirical relations used for determination of heat transfer coefficient
17. Concept of Nusselt number–Prandtl number– Reynolds number–Grashoff number– some important empirical relations used for determination of heat transfer coefficient
18. Heat transfer to flowing fluids
19. Radiation–introduction– basic theories.
20. Heat radiation– electromagnetic spectrum–emissivity– absorptivity– transmissivity
21. Radiation through black and grey surfaces– determination of shape factors
22. Mid examination
23. Mechanism of boiling –boiling heat transfer
24. Condensation–introduction –condensing heat transfer- concept-mechanism.
25. Film and drop-wise condensation–effect of non-condensable gases.
26. Heat Exchangers–introduction –concept– general discussion– fouling factors
27. Heat Exchangers-Application in Food Industry
28. Types of heat exchangers– jacketed kettles– LMTD– parallel and counter flow heat exchangers– shell and tube – plate heat exchangers.
29. Types of heat exchangers – jacketed kettles – LMTD – parallel and counter flow heat exchangers – shell and tube – plate heat exchangers.
30. Heat exchanger design
31. Application of different types of heat exchangers in dairy and food industry
32. Mass transfer– introduction– Fick's law of diffusion, steady state diffusion of gases and liquids through solids,
33. Diffusion mass transfer–equimolal diffusion– isothermal evaporation of water into air–mass transfer coefficient
34. Application of mass transfer in dairy and food industry.

Practical Schedule

1. Heat transfer analysis during conduction
2. Heat transfer analysis during convection.
3. Determination of thermal conductivity in a composite wall.
4. Study on various types of heat exchangers used in food industry
5. Determination of heat transfer coefficient in forced convection.
6. Determination of emissivity of the given test surface.
7. Determination of Stefan-Boltzmann constant in radiation heat transfer.
8. Determination of heat transfer coefficient in a parallel flow heat exchangers.
9. Determination of heat transfer coefficient in a counter flow heat exchangers.
10. Preparation and calibration of thermocouple
11. Determination of thermal conductivity of different food products
12. Study of working principle and constructional details of plate heat exchanger
13. Study of working principle and constructional details of shell and tube heat exchanger.
14. Determination of overall heat transfer coefficient of shell and tube, plate heat exchangers, jacketed kettle used in food industry
15. Studies on heat transfer through extended surface

16. Studies on temperature distribution and heat transfer in HTST pasteurizer.
17. Practical examination.

Suggested Reading

1. Eduardo Cao. 2010. Heat Transfer in Process Engineering. The McGraw-Hill Companies, Inc., New York, USA.
2. J.P. Holman. 2010. Heat Transfer, 10th Ed. McGraw-Hill Book Co., Boston, USA.
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.
5. Robert E. Treybal. 1980. Mass Transfer Operations, 3rd Ed. McGraw-Hill Book Company, Auckland, USA

Pafe. 2116 Fundamental Unit Operations of Food Processing 3 (2+1)

OBJECTIVE

1. To acquaint and equip the students with different unit operations of food industries and their design features.

THEORY

MODULE I (8 Hours)

Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger's, Kick's and Bond's equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, burr mill, tumbling mills, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping).

MODULE II (10 Hours)

Mixing: theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for low- or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids; Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machines.

MODULE III (8 Hours)

Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air

filters, filter aids; Extrusion cooking- hot and cold extrusion -type of extruders principle and equipment.

MODULE IV (7 Hours)

Membrane separation: General considerations, materials for membrane construction, ultra-filtration, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, per-evaporation and micro filtration.

PRACTICAL

Determination of fineness modulus and uniformity index; Determination of mixing index of a feed mixer; Power requirement in size reduction of grain using Rittinger's law, Kick's law and Bond's law. Performance evaluation of hammer mill; Performance evaluation of attrition mill; Study of centrifugal separator; Study of freeze dryer and freeze drying process; Study on osmosis in fruits; Determination of solid gain and moisture loss during osmosis; Study of reverse osmosis process; Study of ultra filtration/membrane separation process.

Lecture Schedule

1. Size reduction: Benefits, classification, determination and designation of the fineness of ground material,
2. Principle and mechanisms of comminution of food - sieve/screen analysis, Rittinger's, Kick's and Bond's equations, work index, energy utilization.
3. Grinding and cutting-energy and power requirements in grinding-crushing efficiency, energy utilization.
4. Size reduction equipment - Principal types, crushers (jaw crushers, gyratory, smooth roll).
5. Size reduction equipment - hammer mills and impactors, attrition mills, burr mill-construction and operation, suitability.
6. Size reduction equipment- tumbling mills, tumbling mills, ultra-fine grinders - construction and operation, suitability.
7. Size reduction equipment - fluid jet pulverizer, colloid mill, cutting machines - construction and operation, suitability.
8. Equipments for slicing, dicing, shredding, pulping- principal, working and construction.
9. Mixing - theory of solids mixing, criteria of mixer effectiveness and mixing indices.
10. Rate of mixing, theory of liquid mixing- power requirement for liquids mixing.
11. Mixing equipment - Mixers for low or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, and other mixers).
12. Mixing equipment - mixers for high viscosity liquids and pastes- working and its application
13. Mixing equipments for dry powders and particulate solids – working and its application.

14. Gas liquid mixing – liquid solid mixing – applications.
15. Mechanical Separations- Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation.
16. Centrifugal separations – rate of separations, centrifuge equipment- application in food industries.
17. Mechanical Separations- clarifiers, desludging and decanting machines – advantage and industrial application.
18. Sedimentation - gravitational sedimentation of particles in a fluid - stokes law, sedimentation of particles in gas.
19. Mid semester examination.
20. Filtration- Theory of filtration, rate of filtration, pressure drop during filtration, applications.
21. Filtration – filter media – types and requirements-constant rate filtration – constant pressure
22. Filtration- constant-rate filtration and constant-pressure filtration, derivation of equation.
23. Filtration equipment - plate and frame filter press, rotary filters- advantage and industrial application.
24. Filtration equipment- centrifugal filters and air filters, filter aids -advantage and industrial application.
25. Extrusion cooking - theory of internal heating - advantages of extruded products.
26. Types of extruders and construction, single screw and double screw-selection of extruders.
27. Factors affecting performance of extruders - quality of extruded products - design criteria of extruders.
28. Membrane separation- general considerations, materials for membrane construction.
29. Ultra-filtration, processing variables, membrane fouling.
30. Equipment used for ultra-filtration - applications of ultra-filtration in food processing,
31. Reverse osmosis, principle, equipment - mode of operation, and applications in food industries.
32. Reverse osmosis membrane process – flux equation, fluid equation – effects of processing variables filtration
33. Membrane separation methods, demineralization by electro-dialysis, gel filtration, and applications
34. Membrane separation methods- ion exchange, per-evaporation and micro filtration and applications

Practical Schedule

1. Determination of fineness modulus and uniformity index.
2. Study on equipment used for mixing.
3. Determination of mixing index of a feed mixer.
4. Power requirement in size reduction of grain using Rittinger's law, Kick's law and Bond's law.
5. Performance evaluation of hammer mill.

6. Performance evaluation of attrition mill.
7. Performance evaluation of ball mill.
8. Study of centrifugal separator.
9. Study on working of freeze dryer equipment.
10. Experiment on freeze drying process.
11. Study on osmosis in fruits.
12. Determination of solid gain and moisture loss during osmosis.
13. Study of reverse osmosis process.
14. Study on equipment used for filtration.
15. Calculation of rate of filtration, pressure drop during filtration
16. Study of ultra-filtration and membrane separation process.
17. Practical Examination

Suggested Reading

1. Gordon L. Robertson. 2014. Food Packaging: Principles and Practice, 3rd Ed. CRC Press, Boca Raton, FL, USA.
2. Warren L. McCabe, Julian Smith, Peter Harriott. 2004. Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA.
3. Christie John Geankoplis. 2003. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.
4. George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science+Business Media, New York, USA.
5. J. F. Richardson, J. H. Harker and J. R. Backhurst. 2002. Coulson & Richardson's Chemical Engineering, Vol. 2, Particle Technology and Separation Processes, 5th Ed. Butterworth–Heinemann, Oxford, UK.

Beas. 2108 Statistical Methods and Numerical Analysis 2(1+1)

OBJECTIVES

1. Testing of hypothesis in statistics is necessary in doing the project analysis and research methodology.
2. Numerical methods are very useful in agricultural related subjects.

THEORY

MODULE I (6 Hours)

Statistical methods, testing of hypothesis, concepts, testing of significance based on Z-test, t-test, F-test, Chi-square test, contingency table, correlation, regression, testing of significance of correlation and regression, multiple linear regression, ANOVA, one-way and two-way classifications, factorial experiment concepts -2^2, 2^3, mixed factorials.

MODULE II (7 Hours)

Numerical analysis: Finite differences, various difference operators and their relationships, factorial notation, interpolation with equal intervals, Newton's forward and

backward interpolation formulae, numerical integration, numerical integration by Trapezoidal, Simpson's and Weddle's rules; Numerical solution of ordinary differential equations by Picard's method, Taylor's series method, Euler's method, modified Euler's method, Runge-Kutta method.

MODULE III (3 Hours)

Experimental designs: Basic designs, completely randomized design (CRD) - Layout and analysis with equal and unequal number of observations, randomized block design (RBD) - Layout and analysis, Latin square design (LSD) - Layout and analysis; Response surface methodology.

PRACTICAL

Problems on one sample, two sample Z-tests when population S.D. is known and unknown; Problems on one sample, two sample and paired t-test; Chi-square test – 2×2 and m×n; Contingency table and F-test; Calculation of correlation coefficient and its testing; Fitting of simple linear regressions; Fitting of multiple regression equations; ANOVA: One way/two way; 2^2, 2^3 and mixed factorial experiments; Problems on Newton's forward and backward interpolation formula for equal intervals; Problems on trapezoidal rule; Problems on Simpson's 1/3 and 3/8 rules; Problems on solution of ordinary differential equations of first order and second orders by Runge-Kutta method; Problems on Euler's method. Problems on CRD, RBD, LSD and response surface methodology.

Lecture Schedule

1. Testing of hypothesis, Concepts, testing of significance based on Z-test.
2. t- test, Chi-square test, Contingency table.
3. Correlation and regression, Multiple linear regression, Testing of significance and correlation and regression.
4. Correlation and regression, Multiple linear regression, Testing of significance and correlation and regression.
5. F-test, ANOVA, One way classification, Two way classification.
6. F-test, ANOVA, One way classification, Two way classification
7. Factorial experiment concepts - 2^2, 2^3, mixed factorials.
8. Factorial experiment concepts - 2^2, 2^3, mixed factorials.
9. Finite differences, Various difference operators and their relationships, Factorial notation
10. Interpolation with equal intervals, Newton's forward and backward interpolation formula
11. Mid Examination
12. Numerical integrations, Trapezoidal rule, Simpsons rules, Weddle's rule.
13. Numerical solutions of ordinary differential equations by Picard's method
14. Taylor series method, Euler's method, Modified Euler's method, Runge Kutta method.
15. Basic designs, Completely randomized design, Lay out and analysis with equal number of observations, Lay out and analysis with un equal number of observations.

16. Randomized block design, Lay out and analysis with equal number of observations, Lay out and analysis with un equal number of observations.
17. Latin square design, Response surface methodology.

Practical Schedule

1. Problems on one sample, two sample Z- tests when population SD is known and unknown.
2. Problems on one sample, two sample t- tests and paired t- test.
3. Chi- square test- 2x 2 and $m \times n$, Contigency table
4. Calculation of correlation coefficient and its testing
5. Fitting of simple linear regressions.
6. Fitting of multiple regression equations
7. F test, One way ANOVA
8. Two way ANOVA
9. 2^2, 2^3 and mixed factorial experiment
10. Problems on Newton's forward and backward interpolation formula for equal intervals.
11. Problems on Trapezoidal rule
12. Problems on Simpson's $1/3$, $3/8$ rules.
13. Problems on ordinary differential equations of first order and second order Runge-kutta method.
14. Problems on Modified Euler's method
15. Problems on CRD, RBD, LSD.
16. Problems on Response surface methodology
17. Practical Examination.

Suggested Reading

1. Erwin Kreyszig, 2006. Advanced Engineering Mathematics, 9th Ed. John Wiley & Sons, New York, USA.
2. B.S. Grewal. 2004. Higher Engineering Mathematics. Khanna Publishers, Delhi.
3. P.P. Gupta and C.C. Malik. 1993. Calculus of Finite Differences and Numerical Analysis. Krishna PrakashMandor, Meerut.

SEMESTER-IV

Pafe. 2217 Processing Technology of Dairy Products 3 (2+1)

OBJECTIVE

1. To acquaint and equip the students with different dairy products, its composition and manufacturing processes.

THEORY

MODULE I (7 Hours)

Classification of dairy products; Butter: Definition, composition; processing and production steps, overrun, butter making machines, quality testing of table butter, butter-defects, causes and their prevention, packaging and storage.

MODULE II (9 Hours)

Butter oil and ghee: Definition, composition, processing, equipment, quality tests; Paneer and Cheese: Definition, composition, types, processing steps, process flow diagram, equipment, quality defects, causes and prevention, packaging and storage.

MODULE III (14 Hours)

Ice cream and frozen desserts: Definition, composition, types, processing steps and flow diagram, equipment, quality testing, defects causes and prevention, packaging and storage. Condensed and Dried milk: Definition, composition, role of milk constituents in condensed milk, manufacture of condensed milk, types of standards for dried milk, manufacture of SMP and WMP using roller and spray drying, instantization, recent developments in drying, quality testing, defects, causes and prevention, packaging and storage.

MODULE IV (3 Hours)

Traditional Indian Dairy Products: Definitions, compositions, processing, packaging, storage, equipment and quality testing; By- products of dairy industry and their utilization.

PRACTICAL

Preparation of butter/ table butter, Preparation of ghee, Preparation of paneer; Preparation of selected types of cheese; Preparation of ice-cream and selected frozen desserts; Preparation of condensed milk; Preparation of milk powder; Preparation of selected Indian dairy products; Determination of selected quality parameters of selected dairy products; Visit to dairy plant.

Lecture Schedule

1. Dairy products–introduction –classification.
2. Butter–definition– composition–classification
3. Butter– processing – production steps– overrun
4. Butter making machines
5. Quality testing of table butter.
6. Butter– defects, causes –prevention.
7. Butter packaging–storage.
8. Butter oil –definition- composition– processing–processing equipment– quality tests
9. Butter oil –definition- composition – processing– processing equipment – quality tests
10. Ghee–definition– composition– processing–processing equipment– quality tests
11. Ghee –definition – composition – processing – processing equipment – quality tests

12. Paneer –definition– composition– types– processing steps– process flow diagram.
13. Paneer processing equipment–quality defects–causes and prevention– packaging and storage
14. Cheese– definition– composition– types– processing steps– process flow diagram.
15. Cheese processing equipment– quality defects–causes and prevention – packaging – storage.
16. Cheese processing equipment – quality defects – causes and prevention – packaging – storage.
17. Mid examination
18. Ice cream– definition–composition– types– processing steps – flow diagram
19. Ice cream–manufacturing equipments.
20. Ice cream– quality testing– defects causes and prevention–packaging and storage
21. Frozen desserts–definition–composition–types– processing steps and flow diagram.
22. Frozen desserts equipment– quality testing–defects causes and prevention– packaging and storage.
23. Condensed milk–definition– composition– role of milk constituents in condensed milk.
24. Condensed milk–manufacture of condensed milk– types of standards for dried milk.
25. Dried milk–definition– composition– role of milk constituents in condensed milk.
26. Dried milk manufacture of condensed milk– types of standards for dried milk.
27. Manufacture of SMP using roller and spray drying
28. Manufacture of WMP using roller and spray drying–instantization
29. Recent developments in drying,
30. SMP and WMP –quality testing
31. SMP and WMP – defects -causes and prevention– packaging and storage.
32. Traditional Indian Dairy Products–definitions– compositions– processing– packaging– storage– equipment – quality testing
33. Traditional Indian Dairy Products–definitions– compositions– processing– packaging– storage– equipment – quality testing
34. By- products of dairy industry and their utilization.

Practical Schedule

1. Preparation of butter
2. Preparation of table butter
3. Preparation of ghee
4. Preparation of paneer
5. Preparation of selected type of cheese
6. Preparation of selected type of cheese
7. Preparation of ice-cream
8. Preparation selected frozen desserts
9. Preparation selected frozen desserts
10. Preparation of condensed milk
11. Preparation of milk powder
12. Preparation WMP

13. Preparation SMP
14. Preparation of selected Indian dairy products
15. Determination of selected quality parameters of selected dairy products
16. Visit to dairy products production plant.
17. Practical examination

Suggested Reading

1. A. Kanekanian. 2014. Milk and Dairy Products as Functional Foods. John Wiley & Sons, Ltd., UK.
2. Pieter Walstra, Jan T.M. Wouters, Tom J. Geurts. 2006. Dairy Science and Technology, 2nd Ed. CRC Press, Boca Raton, FL, USA.
3. Sukumar De. 2005. Outlines of Dairy Technology. Oxford University Press, New Delhi.
4. H.G. Kessler. 1981. Food Engineering and Dairy Technology. Verlag A. Kessler, Fraising (F.R. Germany).
5. Y.H. Hui. 1993. Dairy Science and Technology Handbook, Vol. I, II and III. Wiley-VCH, USA.

Pafe. 2218 Processing Technology of Legumes and Oilseeds 3 (2+1)

OBJECTIVES

1. To study the processing of major legumes and oil seeds
2. To study the storage and handling techniques of Legumes and Oilseeds
3. To study the by-products obtained during processing and their uses

THEORY

MODULE I (5 Hours)

Present status and future prospects of legumes and oilseeds; Morphology of legumes and oilseeds; Classification and types of legumes and oilseeds; Chemical composition, nutritional value and anti-nutritional compounds in legumes and oilseeds; Methods of removal of anti- nutritional compounds

MODULE II (9 Hours)

Pulse milling: home scale, cottage scale and modern milling methods, machines, milling quality, milling efficiency, factors affecting milling quality and quantity; Problems in dhal milling industry; Nutritional changes during soaking and sprouting of pulses; Cooking quality of dhal, methods, factors affecting cooking of dhal; Quick cooking dhal, instant dhal; Soybean milk processing and value addition

MODULE III (9 Hours)

Fermented products of legumes; Oil seed milling: Ghanis, hydraulic presses, expellers, solvent extraction methods, machines, milling quality, milling efficiency, factors affecting milling quality and quantity; Problems in oil milling industry; Desolventization;

Refining of oils: Degumming, neutralization, bleaching, filtration, deodorization, their principles and process controls

MODULE IV (10 Hours)

Hydrogenation of oils; New technologies in oilseed processing; Utilization of oil seed meals for different food uses: High protein products like protein concentrates and isolates; By-products of pulse and oil milling and their value addition.

PRACTICAL

Determination of physical properties of legumes and oil seeds; Determination of proximate composition of selected pulses and oilseeds; Determination of nutritional quality of selected pulses and oilseeds; Study of mini dhal mill; Study of mini oil mill; Preconditioning of pulses before milling; Preconditioning of oilseeds before milling; Removal of anti-nutritional compounds from selected pulses and oilseeds; Laboratory milling of selected pulses and its quality evaluation; Laboratory milling of selected oilseeds and its quality evaluation; Laboratory refining of selected oils; Laboratory hydrogenation of selected oils; Study of cooking quality of dhal; Processing of composite legume mix and preparation of value added products; Visit to commercial dhal mills and oil mills.

Lecture Schedule

1. Introduction, Present, future scope and morphology of legumes and oilseeds
2. Chemical composition , nutritive value and physico-chemical properties of legumes
3. Chemical composition ,nutritive value and physico-chemical properties of oil seeds
4. Classification and types of legumes and oilseeds
5. Types, composition and removal of antinutritional factors in legumes and oilseeds.
6. Types and methods of pulse milling
7. Types of milling industry and equipment for milling pulse milling
8. Quality and efficiency of milling, factors affecting milling quality
9. Problems in dhal milling industry
10. Nutritional changes during soaking and sprouting of pulses
11. Methods, and Cooking quality of dhal
12. Quick and instant dhal, factors affecting cooking of dhal
13. Composition and Processing of Soybean
14. soybean milk processing and value added products of soybean
15. Types and processing of fermented products of legumes
16. Introduction, types methods of oil seed extraction
17. Traditional methods of oil seed milling, ghanis and hydraulic presses
18. Extraction of oil seed by screw expellers and its advantages and disadvantages
19. Extraction of oil seed by solvent extraction methods
20. Midterm examination
21. Equipments , milling quality, milling efficiency, factors affecting milling quality of oil seeds
22. Problems in oil milling industry
23. Introduction and processing steps of refining of oil seeds

24. Processing steps of refining of oil seeds
25. Principles and process controls - Hydrogenation of oils
26. New technologies in oilseed processing, supercritical fluid extraction and enfluage
27. New technologies in oilseed processing, steam distillation and expression
28. Definition, methods and types of leaching
29. Utilization of oil seed meals for different food uses
30. High protein products like protein concentrates and isolates
31. By-products of pulse milling
32. By-products of oil seed milling
33. Quality characters of oil and oil products
34. Rancidity, hydrogenation peroxidation and storage stability of oils

Practical Schedule

1. Determination of physical properties of legumes and oil seeds
2. Determination of proximate composition of selected pulses
3. Determination of proximate composition of selected oilseeds
4. Determination of nutritional quality of selected pulses
5. Determination of nutritional quality of selected oilseeds
6. Experiment on Study of mini dhal mill
7. Experiment on Study of mini oil mill
8. Experiment on preconditioning of pulses before milling
9. Experiment on wet of pulses
10. Removal of anti-nutritional compounds from selected pulses and oilseeds
11. Experiment laboratory milling of selected pulses and its quality evaluation
12. Experiment on laboratory milling of selected oilseeds and its quality evaluation
13. Experiment on laboratory hydrogenation of selected oils
14. Experiment study of cooking quality of dhal
15. Experiment on preparation of value added products legume products
16. Visit to commercial dhal mills and oil mills
17. Practical examination

Suggested Reading

1. A. Chakraverty. 2008. Post Harvest Technology of Cereals, Pulses and Oilseeds, 3rd Ed. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Frank D. Gunstone. 2008. Oils and Fats in the Food Industry. John Wiley and Sons, Ltd., West Sussex, UK.
3. Fereidoon Shahidi. 2005. Bailey's Industrial Oil & Fat Products, 6th Ed., Vols. 1 to 6. John Wiley and Sons, Inc. Hoboken, New Jersey, USA.
4. Amalendu Chakraverty, Arun S. Mujumdar, G.S. Vijaya Raghavan and Hosahalli S. Ramaswamy. 2003. Handbook of Post Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. Marcel Dekker, Inc., NY, USA.
5. K.M. Sahay and K.K. Singh. 2001. Unit Operations of Agricultural Processing, 2nd Ed. Vikas Publishing House Pvt. Ltd., Noida.

Pafe. 2219 Food Biochemistry and Nutrition 3 (2+1)

OBJECTIVE

1. To develop analytical skills that allows independent exploration of biological phenomena through the scientific method and to introduce students to modern methods of biochemical experimentation within the disciplines of biology and chemistry.

THEORY

MODULE I (10 Hours)

Biochemistry and its scope, cellular biochemistry; Carbohydrates: Occurrence, classification and structures, physicochemical and metabolic functions, metabolism; Proteins: Occurrence, classification and structures, physicochemical and metabolic functions, metabolism; Lipids: Occurrence, classification and structure, physicochemical and metabolic functions, metabolism;Nucleic acids: Properties, structure and metabolism; Vitamins and minerals: Chemistry and metabolic functions; Enzymes: Chemical nature and nomenclature, classification, sources and properties, mechanism of action, coenzyme and prosthetic groups;; 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

MODULE III (8 Hours)

Metabolism of carbohydrates: Biological role of carbohydrates, glycolysis and respiration, production of ATP, 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; Metabolism of proteins: Breakdown of proteins, transamination, deamination, decarboxylation, nitrogen fixation, urea cycle

MODULE III (10 Hours)

Nutrients: Sources, functions, digestion, absorption, assimilation and transport of carbohydrates, proteins and fats in human beings. Concepts and content of nutrition: metabolic function of nutrients; Water and energy balance, water intake and losses, basal metabolism; Formulation of diets, classification of balanced diet, preparation of balanced diet for various groups; Recommended dietary allowances for various age groups; Malnutrition; Assessment of nutritional status; Food fad and faddism; Potentially toxic substance in human food; Functions of food; Basic food groups; nutrients supplied by food;

MODULE IV (5 Hours)

Physico-chemical and nutritional changes during processing: Changes during food processing treatment of drying and dehydration, irradiation, freezing, fermentation, canning, restoration, enrichment, fortification and supplementation of foods.

PRACTICAL

Preparation of various solutions and buffers; Qualitative and quantitative determination of carbohydrates; Qualitative and quantitative determination of amino acids; Qualitative and quantitative determination of proteins; Qualitative and quantitative determination of lipids; Qualitative and quantitative determination of vitamins; Isolation of enzymes from various sources; Measurement of energy using bomb calorimeter; Determination of pka of acid; Determination of pI for casein; Estimation of sugars by Anthrone method; Estimation of protein by Lowry method; Estimation of amino acid using Biuret reaction; Separation of amino acids using paper chromatography; Separation of amino acids using thin layer chromatography; Separation of amino acids using electrophoresis; Estimation of phosphorus in food sample. Estimation of iron content in foods; Determination of calcium in food samples; Estimation of β-carotene using column chromatography; Estimation of ascorbic acid using dye method; Effects of acids and alkali on pigments.

Lecture Schedule

1. Biochemistry and its scope ,Cellular biochemistry
2. Carbohydrates: Occurrence, classification and structures
3. Physicochemical and metabolic functions, metabolism
4. Proteins: Occurrence, classification and structures
5. Physicochemical and metabolic functions, metabolism
6. Lipids: Occurrence, classification and structure
7. Physicochemical and metabolic functions, metabolism
8. Nucleic acids: Properties, structure and metabolism
9. Vitamins and minerals: Chemistry and metabolic functions
10. Enzymes: Chemical nature and nomenclature, classification, sources and properties
11. Mechanism of action, coenzyme and prosthetic groups, regulation of enzymatic activity
12. Enzyme kinetics, inhibition effects of pH, Allosteric enzymes, derivation of Michaelis-Menten equation
13. Metabolism of carbohydrates: Biological role of carbohydrates
14. Glycolsis and respiration, production of ATP
15. Brief description of electron transport chain, oxidative and substrate phosphorylation
16. Metabolism of lipids: Biological role of lipids
17. breakdown of triglycerides and phospholipids
18. β-oxidation of long chain fatty acids, ketosis
19. Mid Exam
20. Biosynthesis of fatty acids, triglycerides and phospholipids
21. Metabolism of proteins: Breakdown of proteins Transamination, deamination, decarboxylation
22. Nitrogen fixation-Urea cycle
23. Nutrients: Sources, functions, digestion, absorption, assimilation and transport of carbohydrates, proteins and fats in human beings
24. Concepts and content of nutrition: metabolic function of nutrients
25. Water and energy balance, water intake and losses, basal metabolism

26. Formulation of diets, classification of balanced diet, preparation of balanced diet for various groups
27. Recommended dietary allowances for various age groups; Malnutrition Assessment of nutritional status
28. Food fad and faddism
29. Potentially toxic substance in human food
30. Functions of food; Basic food groups; nutrients supplied by food
31. Physico-chemical and nutritional changes during processing: Changes during food processing treatment of drying and dehydration
32. Changes during food processing treatment of irradiation, freezing
33. Changes during food processing treatment of fermentation, canning, restoration
34. Changes during food processing treatment of enrichment, fortification and supplementation of foods.

Practical Schedule

1. Preparation of various solutions and buffers
2. Qualitative and quantitative determination of Monosaccharide ,Disaccharide and polysaccharide
3. Qualitative and quantitative determination of amino acids and proteins
4. Qualitative and quantitative determination of lipids
5. Isolation of enzymes from various sources
6. Measurement of energy using bomb calorimeter
7. Determination of pka of acid
8. Determination of pI for casein
9. Estimation of sugars by Anthrone method
10. Estimation of protein by Lowry method
11. Estimation of amino acid using Biuret reaction
12. Separation of amino acids using paper chromatography
13. Separation of amino acids using thin layer chromatography
14. Separation of amino acids using electrophoresis.
15. Estimation of phosphorus., iron content, calcium in food samples
16. Estimation of β-carotene using column chromatography
17. Estimation of ascorbic acid using dye method
18. Effects of acids and alkali on pigments.
19. Practical Exam

Suggested Reading

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 Biochemisry, 6th Ed. Macmillan Learning, NY, USA.
3. Donald Voet and Judith G. Voet. 2011. Biochemisry, 4th Ed. John Wiley and Sons, Inc., NY, USA.

4. Carolyn D. Berdanier, Elaine B. Feldman and Johanna Dwyer. 2008. Handbook of Nutrition and Food, 2nd Ed. CRC Press, Boca Raton, FL, USA.
5. Bob B. Buchanan, Wilhelm Gruissem and Russell L. Jones. 2002. Biochemistry & Molecular Biology of Plants. John Wiley and Sons, Inc., NY, USA.

Pafe. 2220 Unit Operations in Food Processing-II 3 (2+1)

OBJECTIVE

1. To acquaint and equip the students with different unit operations of food industries and their design features.

THEORY

MODULE I (8 Hours)

Evaporation: Principles of evaporation, mass and energy balance, factors affecting rate of evaporation, thermodynamics of evaporation (phase change, boiling point elevation, Dühring plot; Heat and mass transfer in evaporator, factors influencing the overall heat transfer coefficient, influence of feed liquor properties on evaporation; Evaporation equipment: Natural circulation evaporators, horizontal/vertical short tube, natural circulation with external calandria, long tube, forced circulation; Evaporator ancillary plant, design of evaporation systems, single effect, multiple effect evaporators, feeding methods of multiple effect evaporation systems, feed preheating, vapour recompression systems; Fouling of evaporators and heat exchanges; Recompression heat and mass recovery and vacuum creating devices.

MODULE II (5 Hours)

Food freezing: Introduction, freezing point curve for food and water, freezing points of common food materials, Principles of food freezing, freezing time calculation by using Plank's equation; Freezing systems; Direct contact systems, air blast immersion; Changes in foods; Frozen food properties; freezing time, factors influencing freezing time, freezing/thawing time; Freeze concentration: Principles, process, methods; Frozen food storage: Quality changes in foods during frozen storage; Freeze drying: Heat mass transfer during freeze drying, equipment and practice.

MODULE III (12 Hours)

Expression and Extraction: liquid-liquid extraction processes, types of equipment and design for liquid-liquid extraction, continuous multistage counter current extraction; Leaching: process, preparation of solids, rate of leaching, types of equipment, equilibrium relations; Crystallization and dissolution: Theory and principles, kinetics, applications in food industry, equipment for crystallization; Distillation: Principles, vapour-liquid equilibrium, continuous flow distillation, batch/differential distillation, fractional distillation, steam distillation, distillation of wines and spirits; Baking: Principles, baked foods, baking equipment; Roasting: Principles of roasting, roasting equipment; Frying: theory and principles, shallow or contact frying and deep fat frying, heat and mass transfer in frying, frying equipment; Puffing: Puffing methods, puffing equipment.

MODULE IV (8 Hours)

Pasteurization: Purpose, microorganisms and their reaction to temperature and other influences, methods of heating, design and mode of operation of heating equipment, vat, tubular heat exchanger, plate heat exchanger; Sterilization: Principles, process time, T-evaluation, design of batch and continuous sterilization, different methods and equipments; UHT sterilization, in the package sterilization, temperature and pressure patterns, equipment for sterilizing goods in the package; Aseptic processing: principles, analysis of thermal resilience, duration mathematics of conduction heating; Blanching: principle and equipment; Homogenization, Emulsification.

PRACTICAL

Study of working principle of open pan and vacuum evaporator; Study of single effect evaporator and estimation of heat/mass balance during concentration of liquid foods; Study of double effect evaporator and estimation of heat/mass balance during concentration of liquid foods; Study of multiple effect evaporator and estimation of heat/mass balance during concentration of liquid foods; Study of sterilizer; Design problems on freezers; Numerical problem on thermo bacteriology (D, Z and F); Study of freezers; Freezing of foods by different methods; Determination of freezing time of a food material; Effect of sample particle size and time on solvent extraction process; Effect of temperature on crystallization rate of sugar; Study of blancher, pasteurizers, fryers, homogenizers, irradiators; Determination of oil uptake by the food product during frying; Study on qualitative changes in the fried food product; Visit sugar processing industry.

Lecture Schedule

1. Evaporation- Principles of evaporation, mass and energy balance, factors affecting rate of evaporation.
2. Thermodynamics of evaporation (phase change, boiling point elevation, Dühring plot.
3. Heat and mass transfer in evaporator - factors influencing the overall heat transfer coefficient.
4. Performance of evaporators and boiling point elevation – capacity, economy and heat balance - influence of feed liquor properties on evaporation
5. Evaporation equipment: Natural circulation evaporators, horizontal/vertical short tube, natural circulation with external calandria, long tube, forced circulation.
6. Evaporator ancillary plant, design of evaporation systems, single effect, multiple effect evaporators.
7. Different feeding methods of multiple effect evaporation systems, feed preheating, vapour recompression systems.
8. Fouling of evaporators and heat exchanges; Recompression heat and mass recovery and vacuum creating devices.
9. Food freezing: Introduction, freezing point curve for food and water, freezing points of common food materials.
10. Principles of food freezing, freezing time calculation by using Plank's equation- Freezing time calculation - factors influencing freezing time, freezing/thawing time.

11. Freezing systems -direct contact systems, air blast immersion; Changes in foods; Frozen food properties.
12. Freeze concentration - Principles, process, methods – construction and operation.
13. Frozen food storage - Quality changes in foods during frozen storage - Freeze drying, Heat mass transfer during freeze drying - equipment and practical application.
14. Expression and Extraction - liquid-liquid extraction processes, types of equipment, operation.
15. Design for liquid-liquid extraction, continuous multistage counter current extraction.
16. Leaching - process, preparation of solids, rate of leaching, types of equipment, equilibrium relations.
17. Crystallization and dissolution: Theory and principles, kinetics, applications in food industry, equipment for crystallization.
18. Crystallization – equilibrium, rate of crystal growth – equilibrium crystallization.
19. Distillation: Principles, vapour-liquid equilibrium, continuous flow distillation, batch/differential distillation,
20. Distillation method – flash distillation, differential distillation, fractional distillation, steam distillation, distillation of wines and spirits.
21. Distillation equipments – construction and operation – factors influencing the operation.
22. Mid semester examination.
23. Baking - Principles, baked foods, baking equipment used – working and application.
24. Roasting: Principles of roasting, roasting equipment - working and application.
25. Frying - theory and principles, shallow or contact frying and deep fat frying, heat and mass transfer in frying, frying equipment.
26. Puffing: Puffing methods, puffing equipment - working and application.
27. Pasteurization: Purpose, microorganisms and their reaction to temperature and other influences,
28. Methods of heating, design and mode of operation of heating equipment, vat, tubular heat exchanger, plate heat exchanger.
29. Sterilization: Principles, process time, T-evaluation, design of batch and continuous sterilization, different methods and equipments.
30. UHT sterilization, in the package sterilization, temperature and pressure patterns, equipment for sterilizing goods in the package.
31. Aseptic processing: principles, analysis of thermal resilience, duration mathematics of conduction heating.
32. Blanching- methods of blanching, pre-treatments - principle and application.
33. Homogenizers – homogenization effect, principles and factors, components, efficiency of homogenization.
34. Emulsification – principle – characteristics of mixtures, blending – application of emulsification.

Practical Schedule

1. Study on working of open pan and vacuum evaporator.

2. Study of single effect evaporator and estimation of heat/mass balance during concentration of liquid foods.
3. Study of double effect evaporator and estimation of heat/mass balance during concentration of liquid foods.
4. Study of multiple effect evaporator and estimation of heat/mass balance during concentration of liquid foods.
5. Study on design aspects of sterilizer.
6. Numerical problem on thermo bacteriology (D, Z and F).
7. Design problems on freezers.
8. Study of freezers and Freezing of foods by different methods.
9. Determination of freezing time of a food material.
10. Effect of sample particle size and time on solvent extraction process.
11. Effect of temperature on crystallization rate of sugar.
12. Study of blancher, pasteurizers, fryers and homogenizers.
13. Study of irradiation and equipment used for irradiation.
14. Determination of oil uptake by the food product during frying.
15. Study on qualitative changes in the fried food product.
16. Visit sugar processing industry.
17. Practical Examination

Suggested Reading

1. R. Paul Singh and Dennis R. Heldman. 2014. Introduction to Food Engineering, 5th Ed. Elsevier, Amsterdam, Netherlands.
2. Warren L. McCabe, Julian Smith, Peter Harriott. 2004. Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA.
3. Albert Ibarz and Gustavo V. Barbosa-Cánovas. 2003. Unit Operations in Food Engineering. CRC Press, Boca Raton, FL, USA.
4. Christie John Geankoplis. 2003. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.
5. George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science+Business Media, New York, USA.
6. P. Fellows. 2000. Food Processing Technology: Principles and Practice, 2nd Ed. CRC Press, Boca Raton, FL, USA.

Pafe. 2221 Food Biotechnology 3 (2+1)

OBJECTIVES

1. To explain the concept of biotechnology.
2. Apply biotechnological techniques in food production.
3. To analyze the current status and future prospects of food biotechnology.

THEORY

MODULE I (6 Hours)

Chemical nature of the genetic material, properties and functions of the genetic material, organization of the genetic material in bacteria, eukaryotes and viruses; DNA

replication: Replication fork, DNA polymerases, other enzymes and proteins required for DNA replication, origin of replication, replication of circular DNA molecule

MODULE II (10 Hours)

Transcription and translation: RNA synthesis, types of RNA, genetic code; Mutation and DNA repair, mechanisms of repair of damaged DNA (photo reactivation, excision repair, recombination repair, SOS repair, mismatch repair), transposable elements, plasmids, types of plasmids, genetic recombination in bacteria, transformation, transduction, conjugation, regulation of gene expression in prokaryotes; Expression of foreign genes; Promoter enzymes; Recombinant DNA technology: Restriction enzymes, cloning vectors, cloning procedure, cloning of specific gene and their identification (colony hybridization, C-DNA, southern blotting, polymerase chain reaction).

MODULE III (7 Hours)

Gene cloning: Production of identical cells, isolation and purification of insert DNA, isolation of vector DNA, construction of recombined DNA, introduction of recombined DNA into host cell, identification and selection of cells containing cloned genes; Biosensors: Classification, application in food industry.

MODULE IV (10 Hours)

Application of biotechnology in food: Immobilization of enzymes: Arresting of cell in insoluble matrix, immobilized cell systems, cell attachment in a surface, aggregation, entrapment, containment, physical adsorption, covalent bonding, cross linking, entrapment into polymeric films, microencapsulation, large scale cell immobilization, uses and applications in industries; Ethical issues concerning GM foods: Testing for GMOs, current guidelines for production, release and movement of GMOs, labeling and traceability, trade related aspects, bio-safety, risk assessment, risk management, public perception of GM foods, IPR, GMO Act 2004.

PRACTICAL

Study of auxotroph; Micro-propagation through tissue culture; Strain improvement through U.V. mutation for lactose utilization; Chemical mutagenesis using chemical mutagens (Ethidium bromide); Determination of survival curves using physical and chemical mutagens; Isolation and analysis of chromosomal/genomic DNA from *E. coli* and *Bacillus cereus*; Separation of protoplast using cellulytic enzymes; Production of biomass from fruit and vegetable waste; Introduction of ELISA/Southern blot/DNA finger printing, etc.; Agarose gel electrophoresis of plasmid DNA; Pesticide degradation by pseudomonas spp.

Lecture Schedule

1. Introduction to biotechnology-definition, scope.
2. Genetic material- chemical nature-properties.
3. Genetic material -function and its organization.
4. DNA replication-replication fork, enzymes involved.
5. DNA replication-linear, circular.

6. Genetic code.
7. Transcription
8. Translation
9. Types of RNA
10. Mutation and DNA repair- mechanisms of repair.
11. Isolation of genetic DNA and vector DNA.
12. Introduction to rDNA technology-objectives
13. rDNA technology-procedure.
14. rDNA technology-enzymatic tools.
15. Vectors- Cloning and expression
16. Plasmids-types and properties.
17. Mid- term examination
18. Gene cloning- Identification and selection (colony hybridization, C-DNA, southern blotting)
19. Genetic recombination in bacteria.
20. Transformation- Transduction- Conjugation.
21. Regulation of gene expression in prokaryotes.
22. Expression and amplification of foreign genes- Promoter enzymes
23. Technique of PCR
24. Biosensors-classification and application in food industry.
25. Application of biotechnology in food industry-production of enzymes, organic acids
26. Application of biotechnology in food industry-commercially important compounds.
27. Application of genetics to food production.
28. Role of bio process engineering in biotechnology industry
29. Immobilization of enzymes-technique
30. Immobilization of enzymes-application
31. GM foods- ethical issues, guidelines for production.
32. GM foods-testing for GMOs, release and movement
33. GM foods-labeling and traceability, risk assessment and management- GMO Act 2004.
34. IPR

Practical Schedule

1. Study of auxotroph
2. Micro-propagation through tissue culture
3. Strain improvement through U.V. mutation for lactose utilization
4. Chemical mutagenesis using chemical mutagens (Ethidium bromide)
5. Determination of survival curves using physical and chemical mutagens
6. Isolation and analysis of chromosomal/genomic DNA from *E. coli* and *Bacillus cereus.*
7. Isolation of vector DNA
8. Separation of protoplast using cellulytic enzymes
9. Production of biomass from fruit and vegetable waste.
10. Agarose gel electrophoresis of plasmid DNA

11. Introduction of ELISA/DNA finger printing, etc.
12. Pesticide degradation by pseudomonas spp.
13. Immobilisation of cells.
14. PCR
15. PAGE
16. Blotting techniques
17. Practical Examination.

Suggested Reading

1. B.D. Singh. 2014. Biotechnology - Expanding Horizons. Kalyani Publishers, New Delhi.
2. Meenakshi Paul. 2007. Biotechnology and Food Processing Mechanics. Gene-Tech Books, New Delhi.
3. James D. Watson. 2013. Molecular Biology of the Gene, 7th Ed. Benjamin Cummings, San Francisco, USA.
4. Oliver Brandenberg, Zephaniah Dhlamini, Alessandra Sensi, Kakoli Ghosh and Andrea Sonnino 2011. Introduction to Molecular Biology and Genetic Engineering. FAO, Rome, Italy.
5. Ashok Agarwal and Pradeep Parihar. 2005. Industrial Microbiology: Fundamentals and Applications. Agrobios India, Jodhpur.

Pafe. 2222 Food Refrigeration and Cold Chain 3 (2+1)

OBJECTIVE

1. To acquaint and equip the students with different refrigeration systems, components, working and its application in food industries

THEORY

MODULE I (7 Hours)

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; Air refrigerators working on Bell Coleman cycle: Reversed Brayton or Joule or Bell Coleman cycle, analysis of gas cycle, polytropic and multistage compression.

MODULE II (5 Hours)

Vapour refrigeration: Vapour 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 vapour compression cycle on pressure-enthalpy diagram, super heating, sub cooling; Liquid-vapour regenerative heat exchanger for

vapour compression system, effect of suction vapour super heat and liquid sub cooling, actual vapour compression cycle.

MODULE III (11 Hours)

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; 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.

MODULE IV (10 Hours)

Refrigerated transport: Handling and distribution, cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display;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.

PRACTICAL

Study of vapour compression refrigeration system; Determination of COP of vapour compression refrigeration system; Study of various types of compressors, condensers, expansion valves and evaporative coils used in refrigeration systems; Study of refrigerants, their properties and charts; Study of direct and indirect contact freezing equipment for foods; Study of spray freezing process for foods; Study of food cold storage; Estimation of refrigeration load for cold storage; Estimation of refrigeration load for meat and poultry products; Study of refrigeration system of dairy plant; Estimation of refrigeration load for ice-cream; Study of cooling system for bakery and estimation of refrigeration loads; Estimation of refrigeration load during chocolate enrobing process; Study of refrigerated van; Study of deep freezing and thawing of foods; Study of refrigerated display of foods and estimation of cooling load.

Lecture Schedule

1. Refrigeration-introduction-definition-principle-background with second law of thermodynamics.
2. Application of second law of thermodynamics-refrigerator-unit of refrigeration-coefficient of performance.

3. Production of low temperatures-expansion of a liquid with flashing- reversible/ irreversible adiabatic expansion of a gas/ real gas.
4. Thermoelectric cooling- adiabatic demagnetization.
5. Carnot cycle- reversed Carnot cycle- selection of operating temperatures.
6. Air refrigerators- Bell Coleman cycle- Reversed Brayton - Joule or Bell Coleman cycle.
7. Analysis of gas cycle-polytropic and multistage compression.
8. Vapour refrigeration- reversed Carnot cycle with p-V and T-s diagrams- limitations of reversed Carnot cycle.
9. Modifications in reverse Carnot cycle with vapour as a refrigerant.
10. Dry Vs wet compression- effects- throttling Vs isentropic expansion.
11. Vapour compression system- representation of vapour compression cycle- pressure-enthalpy diagram- super heating- sub cooling.
12. Vapour compression system-liquid-vapour regenerative heat exchanger- effect of suction vapour super heat and liquid sub cooling- actual vapour compression cycle.
13. Vapour-absorption refrigeration system-working- calculations- COP- maximum COP of a heat operated refrigerating machine.
14. Common refrigerants- classification- nomenclature.
15. Refrigerant properties- desirable properties- physical, chemical, safety, thermodynamic and economical.
16. Study on vapour compression refrigeration system- Azeotropes.
17. Components of vapour compression refrigeration system- evaporator- compressor-condenser- expansion valve.
18. Ice manufacturing- principles- systems of ice production.
19. Treatment of water for making ice, brines, freezing tanks, ice cans, air agitation, quality of ice.
20. Mid examination.
21. Cold storage- cold store.
22. Deferent components of cold storage.
23. Design of cold storage for different categories of food resources- size and shape of food.
24. Construction and material of cold storage- insulation-vapour barriers- floors-frost-heave- interior finish and fitting- evaporators- automated cold stores- security of operations.
25. Refrigerated transport-handling- distribution,
26. Cold chain- order picking- refrigerated vans- refrigerated display.
27. Air conditioning-principles- functions
28. Factors affecting comfort air-conditioning- classification- sensible heat factor-industrial air-conditioning.
29. Air-conditioning- problems on sensible heat factor.
30. Winter/summer/year round air-conditioning- unitary air-conditioning systems- central air-conditioning.
31. Physiological principles in air-conditioning- air distribution and duct design methods.
32. Design of complete air-conditioning systems- humidifiers and dehumidifiers.

33. Cooling load calculations of air conditioning-load sources.
34. Air conditioning- product cooling- conducted heat-convected heat- internal heat sources- heat of respiration- peak load.

Practical Schedule

1. Study of vapour compression refrigeration system.
2. Determination of COP of vapour compression refrigeration system.
3. Study of various types of compressors, condensers, expansion valves and evaporative coils used in refrigeration systems.
4. Study of refrigerants, their properties and charts.
5. Study of direct and indirect contact freezing equipment for foods.
6. Study of spray freezing process for foods.
7. Study of food cold storage.
8. Estimation of refrigeration load for cold storage.
9. Estimation of refrigeration load for meat and poultry products.
10. Study of refrigeration system of dairy plant.
11. Estimation of refrigeration load for ice-cream.
12. Study of cooling system for bakery and estimation of refrigeration load.
13. Estimation of refrigeration load during chocolate enrobing process.
14. Study of refrigerated van.
15. Study of deep freezing and thawing of foods.
16. Study of refrigerated display of foods and estimation of cooling load.
17. Practical examination.

Suggested Reading

1. William C. Whitman, William M. Johnson, John A. Tomczyk and Eugene Silberstein. 2009. Refrigeration & Air Conditioning Technology, 6th Ed. Delmar, Cengage Learning, NY, USA.
2. C.P. Arora. 2000. Refrigeration and Air Conditioning, 2nd Ed. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
3. W.F. Stoecker and J.W. Jones.1982.Refrigeration and Air Conditioning, 2nd Ed. McGraw-Hill Book Co., New York, USA.

Pafe. 2223 Processing of Spices and Plantation Crops 3 (2+1)

OBJECTIVE

1. To understand various unit operations involved in the processing of plantation products and spices.

THEORY

MODULE I (2 Hours)

Production and processing scenario of spice, flavor and plantation crops and its scope; Major spices: Post harvest technology, composition.

MODULE II (16 Hours)

Processed products of spices: Ginger, chilli, turmeric, onion and garlic, pepper, cardamom. 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, ajwain; Asafetida, curry leaves.

MODULE III (8 Hours)

Post harvest technology for Tea, coffee, cocoa; Vanilla and annatto processing; Post harvest technology and processing of areca nut, cashew nut, oil palm; Flavors of minor spices; Flavor of major spices.

MODULE IV (7 Hours)

Spice oil and oleoresins: Extraction techniques; Standard specification of spices; Functional packaging of spices and spice products; By-products of plantation crops and spices.

PRACTICAL

Identification and characterization of flavouring compounds of spices; Valuable oil determination; Extraction of oil from clove, pepper, cardamom, chilli; Extraction of oleoresins: Turmeric, ginger, pepper, clove; Peperine estimation in pepper oleoresin; Steam distillation of spices; Determination of curcumin content in turmeric; Chemical analysis of spices: Moisture, valuable oil, specific gravity, refractive index, acid value; Study of standard specification of spices; Packaging study of spices; Preparation of curry powder; Visit to spice processing industry.

Lecture Schedule

1. Production and processing scenario of spice, flavor and plantation crops and its scope.
2. Unit operations in spice processing-cleaning, drying, milling, and grading
3. Processing of Ginger -flow chart-various products, Processing of chilli- drying-dryers, value added products.
4. Processing of turmeric- boiling and polishing-drying methods-equipments and operation.
5. Processing of onion - drying methods-value added products
6. Processing of garlic
7. Processing of pepper- value added products-flow chart-packaging methods.
8. Processing of cardamom- stages of harvest-cleaning, drying, grading equipments.
9. Processing and utilization of Minor spices-herbs, leaves and spartan seasonings
10. Aniseed, Sweet basil-composition and its utilization.
11. Caraway seed, cassia and cinnamon-composition and its utilization.
12. Processing of Clove-stages of harvest-cleaning, drying, grading equipments
13. Coriander-uses, harvesting, drying.
14. Processing of cumin, dill seed -types, harvesting, drying.
15. Processing of fennel seed and its utilization.

16. Processing of nutmeg and mace.
17. Mid-term examination
18. Processing of mint-harvesting, drying, storage.
19. Processing of marjoram and rosemary, saffron-production flow chart.
20. Sage herb, thyme, ajwain, asafoetida, curry leaves-harvesting, drying, preservation, uses.
21. Plantation crops-classification-production & processing-Status and Exports.
22. Processing of Tea-unit operation-flow chart, process and equipments
23. Processing of coffee-Dry and wet processing-Green and cherry Coffee
24. Unit operation-flow charts-equipments and operation
25. Instant coffee powder-flow chart-byproduct utilization of coffee industry
26. Processing of Cocoa-Important unit operation
27. Flow charts in cocoa processing-Equipments-Chocolate processing-flow charts.
28. Processing of vanilla and annatto-flowchart, utilization.
29. Processing of arecanut-different products-unit operation-flow chart equipment and operation
30. Processing of cashew nut-unit operations-flow chart
31. Processing of oil palm-unit operations-flow chart
32. Flavor extraction from spices-minor spices and major spices.
33. Extraction of oleoresins and essential oils from medicinal plants and spices-steam distillation and solvent extraction of oleoresins and essential oils
34. Packaging of processed products-materials-methods-packaging equipment-types construction and operation

Practical Schedule

1. Identification and characterization of flavouring compounds of spices
2. Valuable oil determination
3. Extraction of oil from clove, pepper, cardamom, chilli.
4. Extraction of oleoresins: Turmeric, ginger, pepper, clove.
5. Peperine estimation in pepper oleoresin
6. Steam distillation of spices
7. Determination of curcumin content in turmeric
8. Determination of Moisture content in spices
9. Determination of acid value in spices.
10. Determination of specific gravity of spices.
11. Packaging study of spices
12. Preparation of curry powder
13. Study of standard specification of spices.
14. Microwave assisted extraction of spice oil.
15. Performance evolution of pepper grader
16. Visit to a spice processing industry
17. Practical examination

Suggested Reading

1. J.W. Purseglave, E.G. Brown, C.L. Green and Robins. Spices,Vol. I and II. SRJ Academic Press, New Delhi.
2. J.S. Pruthi. 2001. Spices and Condiments – Major Spices of India. National Book Trust, New Delhi.
3. J.S. Pruthi. 2001. Spices and Condiments – Minor Spices of India. National Book Trust, New Delhi.
4. Kenji Hirasa and Mitsuo Takemasa. 1998. Spice Science and Technology. Marcel Dekker, NY, USA.
5. H. Panda. Handbook on Spices and Condiments (Cultivation, Processing and Extraction). Asia Pacific Business Press Inc., New Delhi.

Beas. 2209 Business Management and Economics 2 (2+0)

OBJECTIVE

1. To learn basic concepts of business management & economics leading to methodologies of decision making.

THEORY

MODULE I (7 Hours)

Definitions, management principles, scientific principles, administrative principles; Maslow's Hierarchy of needs theory; Functions of management: Planning, organizing, staffing, directing, controlling; Organizational structures, principles of organization; Types of organization: Formal and informal, line, line and staff, matrix, hybrid.

MODULE II (7 Hours)

Introduction to economics: Definitions, nature, scope, difference between microeconomics and macroeconomics; Theory of demand and supply, elasticity of demand, price and income elasticity; Markets: Types of markets and their characteristics; National income: GDP, GNP, NNP, disposable personal income, per capita income, inflation.

MODULE III (9 Hours)

Theory of production: Production function, factors of production. Law of variable proportions and law of returns to scale; Cost: Short run and long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost; Break even analysis.

MODULE IV (10 Hours)

Finance management: Definition, scope, objective; Different systems of accounting: Financial accounting, cost accounting, management accounting; Human resource management: Definitions, objectives of manpower planning, process, sources of recruitment, process of selection; Corporate social responsibility: Importance, business ethics.

Lecture Schedule

1. Definitions – Basic management principles
2. Scientific principles of management
3. Administrative principles of management
4. Maslow's Hierarchy of needs theory
5. Functions of management: Planning, organizing, staffing,
6. Functions of management: directing and controlling

7. Organizational structures - principles of organization; Types of organization: Formal and informal, line, line and staff, matrix and hybrid.
8. Introduction to economics: Definitions, nature, scope
9. Difference between microeconomics and macroeconomics
10. Theory of demand and supply
11. Elasticity of demand, price and income elasticity
12. Markets: Types of markets and their characteristics
13. National income: GDP, GNP, NNP
14. Disposable personal income, per capita income, inflation
15. Theory of production: Production function
16. Factors of production. Law of variable proportions and law of returns to scale
17. Cost: cost concepts and cost curves
18. Short run and long run equilibrium
19. Engineering cost curves
20. Short run and long run cost, fixed cost, variable cost, total cost, average cost
21. Marginal cost, opportunity cost
22. Economics of scale
23. Break even analysis and Returns to sale
24. Midtern examination
25. Finance management: Definition, scope, objective
26. Assessing, acquiring and allocation of funds.
27. Financial statements – cash flow statements, statement and balance sheet, financial ratios
28. Different systems of accounting: Financial accounting, cost accounting, management accounting
29. Human resource management: Definitions, objectives of manpower planning Process
30. Sources of recruitment, process of selection
31. Corporate social responsibility: Importance
32. Business ethics.
33. Retail and supply chain management
34. Problems of **r**etail and supply chain management and remedies

Suggested Reading

1. L.M. Prasad. 2001. Principles and Practices of Management, 9th Ed. S. Chand & Sons, New Delhi.
2. Koontz Harold. Principles of Management. Tata McGraw-Hill Education Private Limited, New Delhi.
3. P.C. Thomas. Managerial Economics, 9th Ed. Kalyani Publishers.
4. K.K. Dewett and M.H. Navalur. Modern Economic Theory. S. Chand & Sons, New Delhi.
5. P. Subba Rao. Human Resource Management. Himalaya Publications.
6. S.P. Jain. Financial Accounting. Kalyani Publications, Ludhiana.

SEMESTER-V

Pafe. 3124 Processing Technology of Fruits and Vegetables 3 (2+1)

OBJECTIVES

1. To know the status of fruits and vegetable production in India with importance to losses

2. To study the canning of fruits and vegetables to impart knowledge about the various products
3. To study the various methods of drying of fruits and vegetables

THEORY

MODULE I (8 Hours)

Production and processing scenario of fruits and vegetables in India and world; Scope of fruit and vegetable processing industry in India; Physiological changes during ripening, maturity index, respiration, pre-cooling. Overview of principles and preservation methods of fruits and vegetables; Supply chain of fresh fruits and vegetables

MODULE II (9 Hours)

Primary processing and pack house handling of fruits and vegetables; Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables; Minimal processing of fruits and vegetables; Blanching operations and equipment; Canning: Definition, processing steps, and equipment, cans and containers, quality assurance and defects in canned products.

MODULE III (7 Hours)

FSSAI specifications and preparation and preservation of juices, squashes, syrups, sherbets, nectars, cordials, etc.; Processing and equipment for above products; FSSAI specifications; Preparation, preservation and machines for manufacture of crystallized fruits and preserves

MODULE IV (9 Hours)

Preparation, preservation and machines for manufacture of crystallized fruits and preserves, jam, jelly and marmalades, candies, Preparation, preservation and machines for manufacture of chutney, pickles, sauce, puree, paste, ketchup; toffee, cheese, lather, dehydrated, wafers and papads, soup powders; Production of pectin and vinegar; Commercial processing technology of selected fruits and vegetables for production of various value added processed products

PRACTICAL

Primary processing of selected fruits and vegetables; Canning of Mango/Guava/ Papaya; Preparation of jam from selected fruits; Preparation of jelly from selected fruits; Preparation of fruit marmalade; Preparation of RTS; Preparation of squash; Preparation of syrup; Preparation of raisins, dried fig and dried banana; Preparation of anardana; Preparation of papain; Preparation of pickles; Preparation of dried ginger; Preparation of dried onion and garlic; Preparation of banana and potato wafers; Preparation of dehydrated leafy vegetables; Visit to fruits and vegetables pack house, canning plant, vegetable dehydration plant

Lecture Schedule

1. Production and processing scenario of fruits and vegetables in India and world

2. Scope of fruit and vegetable processing industry in India and world, Physiological changes during ripening, maturity index, respiration, pre-cooling.
3. Introduction , types of principles and preservation methods of fruits and vegetables
4. Supply chain and cold chain logistics of fresh fruits and vegetables
5. Methods of processing, post harvest losses and pack house handling of fruits and vegetables
6. Introduction, types, methods, advantages and disadvantages size reduction operations for fruits and vegetables;
7. Definition, flow chart processing, advantages and disadvantages Minimal processing of fruits and vegetables.
8. Definition, methods and equipments for Blanching operations
9. Definition, methods and processing steps of canning
10. Types of Equipment, containers, quality assurance in canned products
11. Chemical, physical and microbial spoilage of canned products
12. FSSAI specifications for fruits and vegetables products
13. Preparation, flow chart process, preservation and machines for manufacture of crystallized fruits and preserves.
14. Preparation, flow chart process , preservation and machines for manufacture of jam, and jelly
15. Pectin structures, high methoxyl pectin, low methoxyl pectin and setting of jellies
16. Problems in jelly and jam making
17. Preparation, flow chart process ,preservation and machines for manufacture of marmalades and candies
18. Problems in marmalades and candies making
19. Midterm examination
20. Preparation, preservation, types and machines for manufacture of chutney
21. Preparation, preservation, types and machines for manufacture of pickles
22. Problems in pickle making and spoilage aspect of pickles
23. Preparation, preservation, types and machines for manufacture of sauce, puree, paste, ketchup
24. Defects, problems of sauce, puree, paste and ketchup making
25. Preparation, preservation, types and machines for manufacture of toffee, cheese, and lather
26. Preparation, preservation, types and machines for manufacture of dehydrated foods , wafers and papads, soup powders
27. Introduction, methods, preservation, types and machines for preparation pectin
28. Defects, problems of pectin production
29. Introduction , methods, preservation, types and machines for preparation vinegar
30. Defects, problems of vinegar production
31. Commercial processing technology of selected fruits
32. Commercial processing technology of selected vegetables
33. Production of various value added processed products from fruits
34. Production of various value added processed products from vegetables

Practical Schedule

1. Experiment on Preparation of jam from selected fruits
2. Experiment on preparation of jelly from selected fruits
3. Experiment on preparation of fruit marmalade from selected fruits
4. Experiment on Preparation of RTS from selected fruits
5. Experiment on Preparation of squash from selected fruits
6. Experiment on Preparation of syrup from selected fruits
7. Experiment on Preparation of raisins, dried fig
8. Experiment on Preparation of value added product from banana
9. Experiment on Preparation of nectars and cordials
10. Experiment on preparation of papain
11. Experiment on Preparation of pickles
12. Experiment on Preparation of dried ginger
13. Experiment on Preparation of dried onion and garlic
14. Experiment on Preparation of banana and potato wafers
15. Experiment on Preparation of dehydrated leafy vegetables
16. Visit to fruits and vegetables pack house, canning plant, vegetable dehydration plant
17. Practical examination

Suggested Reading

1. U.D. Chavan and J.V. Patil. 2013. Industrial Processing of Fruits and Vegetables. Astral International Pvt. Ltd., New Delhi.
2. Y.H. Hui. 2006. Handbook of Fruits and Fruit Processing. Blackwell Publishing Ltd., Oxford, UK.
3. W.V. Cruess. 2004. Commercial Fruit and Vegetable Products. Agrobios India, Jodhpur.
4. Y. H. Hui, Sue Chazala, Dee M. Graham, K.D. Murrell and Wai-Kit Nip. 2004. Handbook of Vegetable Preservation and Processing. Marcel Dekker, Inc., NY, USA.
5. A.K. Thompson. 2003. Fruit and Vegetables: Harvest, Handling and Storage, 2nd Ed. Blackwell Publishing Ltd., Oxford, UK.
6. Amalendu Chakraverty, Arun S. Mujumdar, G.S. Vijaya Raghavan and Hosahalli S. Ramaswamy. 2003. Handbook of Post Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. Marcel Dekker, Inc., NY, USA.

Pafe. 3125 Food Plant Sanitation 2 (1+1)

OBJECTIVES

1. Gain an understanding of sanitation, hygiene and safety to be maintained in a food industry.
2. To impart knowledge about the laws and regulatory authorities.

THEORY

MODULE I (8 Hours)

Good manufacturing practices, current good manufacturing practices; Standard operating procedures, good laboratory practices, sanitation; Sanitation and the food industry: Sanitation, sanitation laws and regulations and guidelines, establishment of sanitary, potential risks of food borne bioterrorism, bioterrorism protection measures, role of pest management in bio-security; Relationship of microorganisms to sanitation, allergens, allergen control; Food contamination, protection against contamination; Personal hygiene and sanitary food handling: Role of HACCP in sanitation, quality assurance for sanitation cleaning compounds, handling and storage precautions; Sanitizers, sanitizing methods, sanitation equipment.

MODULE II (3 Hours)

Waste product handling, solid waste disposal, liquid waste disposal; Pest control: Insect infestation, cockroaches, insect destruction, rodents, birds, use of pesticides, integrated pest management; Sanitary design and construction for food processing: Site selection, site preparation, building construction considerations, processing and design considerations, pest control design; Low-moisture food manufacturing and storage sanitation: Sanitary construction considerations, receipt and storage of raw materials, cleaning of low-moisture food manufacturing plants.

MODULE III (5 Hours)

Dairy processing plant sanitation: Role of pathogens, sanitary construction considerations, soil characteristics in dairy plants, sanitation principles, cleaning equipment; Meat and poultry plant sanitation: Role of sanitation, sanitation principles, cleaning compounds for meat and poultry plants, sanitizers for meat and poultry plants, sanitation practices, sanitation procedures; Sea food plant sanitation: Sanitary construction considerations, contamination sources, sanitation principles, recovery of by-products; Fruit and vegetable processing plant sanitation: Contamination sources, sanitary construction considerations, cleaning considerations, cleaning of processing plants, cleaners and sanitizers, cleaning procedures, evaluation of sanitation effectiveness; Beverage plant sanitation: Mycology of beverage manufacture, sanitation principles, non-alcoholic beverage plant sanitation, brewery sanitation, winery sanitation, distillery sanitation.

PRACTICAL

Estimation of BOD (Biological Oxygen Demand); Estimation of COD (Chemical Oxygen Demand); Determination of hardness of water; Good Manufacturing Practices (GMPs) and personal hygiene; Sewage treatment: Primary, secondary, tertiary and quaternary; Aerobic and anaerobic sludge treatment; Lab demonstration on state of water; Study of CIP plant; Isolation and identification of Actinomycetes; Enrichment and isolation of cellulose degrading bacteria; Biodegradation of phenol compounds; Bacteriological examination of water: Coliform MPN test; Sampling of airborne microorganisms; Sampling of surfaces - equipment and physical plant; Aerosol sampling and measurement guidelines.

Lecture Schedule:

1. Sanitation -Introduction, Definition and scope -Laws and regulations involved in sanitation.
2. GMP- definition, steps involved-SOP, GLP.
3. Bioterrorism-potential risks of food borne, protection measures.
4. Pest Control - Sanitizing procedures and its importance, Role of pest management in bio-security.
5. Microorganisms and their relationship to Sanitation- allergens, allergen control.
6. Food contamination- protection against contamination-Safe handling.
7. Personal Hygiene practices- Role of HACCP in sanitation.
8. Mid-term examination.
9. Different types of sanitizers- sanitation equipments.
10. Waste product handling- solid waste disposal, liquid waste disposal.
11. Food Plant Design and Construction-Storage Sanitation procedures and its importance.
12. Manufacturing of low-moisture food and storage sanitation.
13. Dairy processing plant sanitation.
14. Meat and poultry plant sanitation.
15. Sea food plant sanitation.
16. Fruit and vegetable processing plant sanitation.
17. Beverage plant sanitation.

Practical Schedule

1. Estimation of BOD (Biological Oxygen Demand).
2. Estimation of COD (Chemical Oxygen Demand).
3. Determination of hardness of water.
4. Good Manufacturing Practices (GMPs) and personal hygiene.
5. Sewage treatment: Primary, secondary, tertiary and quaternary.
6. Aerobic and anaerobic sludge treatment.
7. Lab demonstration on state of water.
8. Study of CIP plant.
9. Isolation and identification of Actinomycetes.
10. Enrichment and isolation of cellulose degrading bacteria.
11. Biodegradation of phenol compounds.
12. Bacteriological examination of water: Coliform MPN test.
13. Sampling of airborne microorganisms.
14. Sampling of surfaces - equipment and physical plant.
15. Aerosol sampling and measurement guidelines.
16. Visit to food processing industries for HACCP verification
17. Practical Examination.

Suggested Reading

1. Michael M. Cramer. 2013. Food Plant Sanitation: Design, Maintenance, and Good Manufacturing Practices. CRC Press, Boca Raton, FL, USA.

2. Ralph Mitchell and Ji-Dong Gu. 2010. Environmental Microbiology, 2nd Ed. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
3. Norman G. Marriott and Robert B. Gravani. 2006. Principles of Food Sanitation, 5th Ed. Springer Science+Business Media, Inc., NY, USA.
4. I.L. Pepper and C.P. Gerba. 2005. Environmental Microbiology: Laboratory Manual, 2nd Ed. Elsevier Academic Press, Amsterdam.
5. Y. H. Hui, Bernard L. Bruinsma, J. Richard Gorham, Wai-Kit Nip, Phillip S. Tong and Phil Ventresca. 2003. Food Plant Sanitation. Marcel Dekker, Inc., NY, USA.

Pafe. 3126 Instrumental Techniques in Food Analysis 3 (2+1)

OBJECTIVES

1. To provide insight into the instrumental analytical techniques more frequently employed for food analysis.
2. To select an appropriate analytical technique when presented with a practical problem
3. To demonstrate practical proficiency in a food analysis laboratory

THEORY

MODULE I (8 Hours)

Concepts of food analysis; Rules and regulations of food analysis; Principles and methodology involved in analysis of foods: Rheological analysis, textural profile analysis of foods; Methods of analysis: Proximate constituents, moisture, adulterations, minerals analysis; Principles and methodology involved in analytical techniques: ion selective electrodes, spectroscopy, ultraviolet visible, florescence, infrared spectro-, atomic absorption and emission, mass spectroscopy, nuclear magnetic resonance and electron spin resonance.

MODULE II (8 Hours)

Chromatography: Adsorption, column, partition, gel-filtration, affinity, ion-exchange, size-exclusion method, gas-liquid, high performance liquid chromatography; Separation techniques: Dialysis, electrophoresis, sedimentation, ultra-filtration, ultracentrifugation, iso-electric focusing, isotopic techniques, manometric techniques; Immuno assay techniques in food analysis; Evaluation of analytical data: Accuracy and precision, statistical significance, co-relations regression, result interpretation.

MODULE III (7 Hours)

Instrumentation and sensors for the food industry; Food compositional analysis using near infra-red absorption technology: Principles of measurement, instrumentation, applications in the food industry, power of process monitoring and trending, practical considerations for implementing on-line measurement, practical aspects of infra-red remote thermometry, radiation thermometers, measurement principles, practical situations, miscellaneous techniques; In-line and off-line FTIR measurements, food applications, calibration and general aspects of routine use; Rapid microbiological methods: Overview

MODULE IV (10 Hours)

Conductance/impedance techniques for microbial assay; chemosensors, biosensors, immunosensors; 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, marker chemical approach, Chemically sensitive semiconductor devices: Solid-state sensors for pH, acidity, ions, gases and volatiles, amperometric, potentiometric and thermometric biosensors; Acoustic sensors, optical immunosensors; Fluorescence sensor systems; Novel sensing receptors, sensor arrays, commercial biosensors.

PRACTICAL

Sampling plan; Sample collection and preparation for analysis; Quality evaluation of raw materials: Fruits, vegetables, cereals, dairy products, meat, poultry products; Quality evaluation of food products for color and taste of marketed products; Analysis of heavy metals using atomic absorption spectrophotometer; Estimation of physic acid using spectrophotometer; Separation of amino acids by two-dimensional paper chromatography; Identification of sugars in fruit juice using TLC; Separation of pralines by ion-exchange chromatography; Molecular weight determination using sephadox-gel; Identification of organic acids by paper electrophoresis; Gel-electrophoresis for analytic techniques; Quantitative determination of sugars and fatty acid profile by GLE; Quantitative make-up of water and fat soluble vitamins using HPLC; Separation of sugars by paper chromatography; Analysis of wheat flour; Analysis of foods for pesticide and drug residues; Study of colorimetry and spectrophotometry; Spectrophotometric method of total chlorophyll (A & B).

Lecture Schedule

1. Concepts of food analysis, rules and regulations of food analysis
2. Principles and methodology involved in analysis of foods: Rheological analysis
3. Principles and methodology involved in analysis of foods: textural profile analysis of foods
4. Methods of analysis: Proximate constituents, moisture
5. Adulterations, minerals analysis
6. Principles and methodology involved in analytical techniques: ion selective electrodes, spectroscopy, ultraviolet visible, florescence spectroscopy
7. Principles and methodology involved in analytical techniques- infrared spectroscopy, atomic absorption and emission, mass spectroscopy,
8. Principles and methodology involved in analytical techniques- nuclear magnetic resonance and electron spin resonance.
9. Chromatography: Adsorption, column, partition, gel-filtration, affinity chromatography
10. Chromatography: ion-exchange, size-exclusion method, gas-liquid, high performance liquid chromatography
11. Separation techniques: Dialysis, electrophoresis
12. Separation techniques: Sedimentation, Ultra-filtration, Ultracentrifugation, Iso-electric focusing

13. Isotopic techniques, manometric techniques
14. Immuno assay techniques in food analysis
15. Evaluation of analytical data: Accuracy and precision, statistical significance
16. Evaluation of analytical data: co-relations regression, result interpretation.
17. Instrumentation and sensors for the food industry.
18. Food compositional analysis using near infra-red absorption technology: Principles of measurement, instrumentation
19. Food compositional analysis using near infra-red absorption technology: applications in the food industry, power of process monitoring and trending
20. practical considerations for implementing on-line measurement.
21. Practical aspects of infra-red remote thermometry, radiation thermometers, measurement principles, practical situations.
22. Miscellaneous techniques; In-line and off-line FTIR measurements, food applications, calibration and general aspects of routine use
23. Rapid microbiological methods: Overview
24. Mid Terminal Examination
25. Conductance/impedance techniques for microbial assay
26. Chemosensors, Biosensors, Immunosensors
27. Electronic noses and tongues and testers
28. Modelling the human nose, electronic nose, electronic tongue
29. Sensors for food flavour and freshness, Introduction to flavour assessment
30. Marker chemical approach, Chemically sensitive semiconductor devices
31. Solid-state sensors for pH, acidity, ions, gases and volatiles
32. Amperometric, Potentiometric and Thermometric biosensors
33. Acoustic sensors, optical immunosensors; Fluorescence sensor systems
34. Novel sensing receptors, sensor arrays, commercial biosensors.

Practical Schedule

1. Sampling plan; Sample collection and preparation for analysis
2. Quality evaluation of raw materials: Fruits, vegetables, cereals, dairy products, meat, poultry products
3. Quality evaluation of food products for color and taste of marketed products
4. Analysis of heavy metals using atomic absorption spectrophotometer
5. Estimation of physic acid using spectrophotometer
6. Separation of amino acids by two-dimensional paper chromatography and Separation of sugars by paper chromatography.
7. Identification of sugars in fruit juice using TLC
8. Separation of pralines by ion-exchange chromatography
9. Molecular weight determination using sephadox-gel
10. Identification of organic acids by paper electrophoresis
11. Gel-electrophoresis for analytic techniques
12. Quantitative determination of sugars and fatty acid profile by GLE
13. Quantitative make-up of water and fat soluble vitamins using HPLC
14. Analysis of wheat flour.

15. Analysis of foods for pesticide and drug residues.
16. Spectrophotometric method of total chlorophyll (A & B).
17. Practical Examination.

Suggested Reading

1. S. Suzanne Nieisen. 2010. Food Analysis Laboratory Manual, 2nd Ed. Springer, NY, USA.
2. Semih Ötles. 2009. Handbook of Food Analysis Instruments. CRC Press, Boca Raton, FL, USA.
3. Da-Wen Sun. 2008. Modern Techniques for Food Authentication. Elsevier Inc., Burlington, MA, USA.
4. S. Suzanne Nieisen. 2003. Food Analysis, 3rd Ed. Kluwer Academic, New York, USA.

Beas. 3110 ICT Applications in Food Industry 3 (1+2)

OBJECTIVES

1. To acquaint and equip the students about different computer software packages available in the field of food process engineering and applications in food processing industries

THEORY

MODULE I (9 Hours)

Importance of computerization in food industry, operating environments and information systems for various types of food industries, Supervisory control and data acquisition (SCADA); SCADA systems hardware, firmware, software and protocols, landlines, local area network systems, modems; Spreadsheet applications: Data interpretation and solving problems, preparation of charts, use of macros to solve engineering problems, use of add-ins, use of solver; Web hosting and webpage design; file transfer protocol (FTP), on-line food process control from centralized server system in processing plant

MODULE II (9 Hours)

Use of MATLAB in food industry; computing with MATLAB, script files and editor/debugger, MATLAB help system, problem solving methodologies, numeric, cell, arrays, matrix operations, user defined functions, programming using MATLAB; debugging MATLAB programs, applications to simulations; Plotting and model building in MATLAB, X-Y plotting functions, subplots and overlay plots, special plot types, interactive plotting in MATLAB, function discovery, regression, the basic fitting interface, three dimensional plots; Introduction to toolboxes useful to food industry, curve fitting toolbox, fuzzy logic toolbox, neural network toolbox, image processing toolbox, statistical toolbox

MODULE III (7 Hours)

Introduction to computational fluid dynamics (CFD), governing equations of fluid dynamics; Models of flow, substantial derivative, divergence of velocity, continuity, momentum and energy equations; Physical boundary conditions, discretization; Applications of CFD in food and beverage industry; Introduction to CFD software, GAMBIT and FLUENT software

MODULE IV (8 Hours)

LabVIEW – LabVIEW environment: Getting data into computer, data acquisition devices, NI-DAQ, simulated data acquisition, sound card, front panel/block diagram, toolbar/tools palette; Components of a LabVIEW application: Creating a VI, data Flow execution, debugging techniques, additional help, context help, tips for working in LabVIEW; LabVIEW typical programs: Loops, while loop, for loop, functions and sub Vis, types of functions, searching the functions palette, creating custom sub Vis, decision making and file I/O, case structure, select (if statement), file I/O; LabVIEW results: Displaying data on front panel, controls and indicators, graphs and charts, arrays, loop timing, signal processing, textual math, math script.

PRACTICAL

Introduction to various features in spreadsheet; Solving problems using functions in spreadsheets; Use of Add-Ins in spread sheet and statistical data analysis using Analysis Tool pack; Solution of problems on regression analysis using Analysis Tool pack in spreadsheet; Solution of problems on optimization using solver package in spreadsheet; Introduction to MATLAB; Writing code using MATLAB programming; Solution of problems using Curve Fitting Toolbox in MATLAB; Solution of problems using Fuzzy Logic Toolbox in MATLAB; Solution of problems using Neural Network Toolbox in MATLAB; Solution of problems using Image Processing Toolbox in MATLAB; Introduction to GAMBIT software; Creation of geometry for laminar flow through pipe using GAMBIT; Introduction to FLUENT software; Import of geometry and application of boundary conditions; Solution of problems on laminar flow using FLUENT; Introduction to Lab VIEW and NI-DAQ.

Lecture Schedule

1. Importance of computerization in food industry – scope and introduction to software package
2. operating environments and information systems for various types of food industries,
3. Supervisory control and data acquisition (SCADA) - application in food processing industries
4. SCADA systems hardware, firmware, software and protocols, landlines, local area network systems, modems;
5. Spreadsheet applications -Data interpretation and solving problems, data interpretation techniques
6. Preparation of charts, use of macros to solve engineering problems,
7. Overview on use of add-ins, use of solver – its application in solving problems

8. Web hosting and webpage design- software involved in web designing and it application
9. On-line food process control from centralized server system in processing plant - file transfer protocol (FTP)
10. Use of MATLAB in food industry – introduction on MATLAB and its components
11. Computing with MATLAB, script files and editor/debugger.
12. MATLAB help system, problem solving methodologies, numeric, cell, arrays, matrix operations,
13. MATLAB user defined functions, programming using MATLAB - Debugging MATLAB
14. MATLAB programs, applications to simulation - – solving equations in MATLAB
15. Plotting and model building in MATLAB, X-Y plotting functions, subplots and overlay plots, special plot types,
16. Interactive plotting in MATLAB, function discovery, regression, the basic fitting interface, three dimensional plots
17. Introduction to toolboxes useful to food industry, curve fitting toolbox- Fuzzy logic toolbox,
18. Neural network toolbox, image processing toolbox, statistical toolbox its application in solving problems
19. Mid semester examination
20. Introduction to computational fluid dynamics (CFD), application of CFD in food processing
21. Governing equations of fluid dynamics, application to solve heat transfer equation
22. Models of flow, substantial derivative, divergence of velocity, continuity, momentum and energy equations;
23. Physical boundary conditions, discretization, using suitable heat and mass transfer condition
24. Applications of CFD in food and beverage industry- applications to simulation - solving equations in CFD software
25. Introduction to CFD software, GAMBIT and FLUENT software- applications food industries.
26. Steps in solving heat and mass transfer equation for different condition using ANSYS FLUENT software
27. Lab VIEW – Lab VIEW environment -Getting data into computer, data acquisition devices, NI-DAQ,
28. Lab VIEW – simulated data acquisition, sound card, front panel/block diagram, toolbar/tools palette
29. Components of a LabVIEW application-LabVIEW environment -Creating a VI, data Flow execution
30. LabVIEW application-debugging techniques, additional help, context help, tips for working in LabVIEW;
31. LabVIEW typical program - Loops, while loop, for loop, functions and sub Vis, types of functions, searching the functions palette

32. Creating custom sub Vis, decision making and file I/O, case structure, select (if statement), file I/O;
33. LabVIEW results- Displaying data on front panel, controls and indicators, graphs
34. LabVIEW results-charts, arrays, loop timing, signal processing, textual math, math script.

Practical Schedule

1. Introduction to various features in spreadsheet
2. Solving problems using functions in spreadsheets
3. Use of Add-Ins in spread sheet and statistical data analysis using Analysis Tool pack
4. Solution of problems on regression analysis using Analysis Tool pack in spreadsheet
5. Solution of problems on optimization using solver package in spreadsheet
6. Overview to MATLAB - Writing code using MATLAB programming
7. Solution of problems using Curve Fitting Toolbox in MATLAB
8. Solution of problems using Fuzzy Logic Toolbox in MATLAB
9. Solution of problems using Neural Network Toolbox in MATLAB
10. Solution of problems using Image Processing Toolbox in MATLAB
11. Overview to GAMBIT software
12. Creation of geometry for laminar flow through pipe using GAMBIT
13. Overview to FLUENT software
14. Import of geometry and application of boundary conditions
15. Solution of problems on laminar flow using FLUENT
16. Overview to LabVIEW and NI-DAQ
17. Practical Examination

Suggested Reading

1. R. Paul Singh. 2014. Computer Applications in Food Technology: Use of Spreadsheets in Graphical, Statistical and Process Analysis. Academic Press, London.
2. William J. Palm III. 2011. Introduction to MATLAB for Engineers, 3rd Ed. McGraw-Hill Companies, Inc., NY, USA.
3. Da-Wen Sun. 2007. Computational Fluid Dynamics in Food Processing. CRC Press, Boca Raton, FL, USA.
4. Nigel Chapman and Jenny Chapman. 2006. Web Design: A Complete Introduction. John Wiley & Sons, USA.
5. National Instruments Corporation. 2005. Introduction to LabVIEW: 3-Hour Hands-On. NI, Austin, Texas.

Pafe. 3127 Food Process Equipment Design 3 (2+1)

OBJECTIVES

1. To equip the students to study the design aspects of the food processing equipments and also to understand the relationship between process design and safety.

THEORY

MODULE I (7 Hours)

Materials and properties: Materials for fabrication, mechanical properties, ductility, hardness, corrosion, protective coatings, corrosion prevention linings equipment, choice of materials, material codes; Design considerations: Stresses created due to static and dynamic loads, combined stresses, design stresses and theories of failure, safety factor, temperature effects, radiation effects, effects of fabrication method, economic considerations; Design of pressure and storage vessels: Operating conditions, design conditions and stress

MODULE II (9 Hours)

Design of shell and its component, stresses from local load and thermal gradient, mountings and accessories; Design of heat exchangers: Design of shell and tube heat exchanger, plate heat exchanger, scraped surface heat exchanger, sterilizer and retort; Design of evaporators and crystallizers: Design of single effect and multiple effect evaporators and its components; Design of rising film and falling film evaporators and feeding arrangements for evaporators; Design of crystallizer and entrainment separator; Design of agitators and separators: Design of agitators and baffles

MODULE III (8 Hours)

Design of agitation system components and drive for agitation; Design of centrifuge separator. Design of equipment components, design of shafts, pulleys, bearings, belts, springs, drives, speed reduction systems; Design of freezing equipment: Design of ice-ream freezers and refrigerated display system; Design of dryers: Design of tray dryer, tunnel dryer, fluidized dryer, spray dryer, vacuum dryer, freeze dryer and microwave dryer; Design of conveyors and elevators: Design of belt, chain and screw conveyor, design of bucket elevator and pneumatic conveyor

MODULE IV (9 Hours)

Design of extruders: Cold and hot extruder design, design of screw and barrel, design of twin screw extruder; Design of fermenters: Design of fermenter vessel, design problems; Hazards and safety considerations: Hazards in process industries, analysis of hazards, safety measures, safety measures in equipment design, pressure relief devices.

PRACTICAL

Design of pressure vessel; Design of shell and tube heat exchangers and plate heat exchanger; Design of sterilizers and retort; Design of single and multiple effect evaporators; Design of rising film and falling film evaporator; Design of crystallizer; Design of tray dryer; Design of fluidized bed dryer; Design of spray dryer; Design of vacuum dryer; Design of microwave dryer; Design of belt and chain conveyor; Design of screw conveyor; Design of bucket elevator and pneumatic conveyor; Design of twin screw extruder; Design of fermenter

Lecture Schedule

1. Introduction and scope of food process equipment designs and classification of materials properties, and mechanical properties

2. Corrosion, corrosion prevention methods for equipment, protective coatings materials, ductility, hardness,
3. Application of Engineering Principles to design and selection of food processing equipments,
4. Material codes : definition ,classification, different types and theories of failure
5. Stresses created due to static ,dynamic loads and combined stresses, Design stresses, and Materials for fabrication
6. Safety factor, temperature effects, radiation effects, effects of fabrication method, economic considerations.
7. Construction and design of pressure vessels - storage tanks
8. Design of shell and its component, design of pulping and crushing equipments
9. Definition, types and Design of heat exchangers
10. Evaporating definition, types and design of evaporators
11. Evaporating systems and design of single effect and multiple effect evaporators
12. Definition, types and design of crystallizer and juice extraction equipments
13. Definition, types and design of agitators and separators
14. Definition, types separators and design of centrifugal separators and homogenizer
15. Considerations for optimization of design of various equipments
16. Introduction, types of equipment components, and design of flavour treating materials
17. Design of equipment components such as shafts, pulleys, bearings, belts, springs, drives, speed reduction systems.
18. Freezing, definition, methods and design of freezers
19. Midterm examination
20. Definition, types of dryers, problems in drying methods
21. Design of tray dryer, tunnel dryer and fluidized bed dryer
22. Design of spray dryer, vacuum dryer and microwave dryer.
23. Introduction, types of conveyors and elevators
24. Design of belt, chain and screw conveyor
25. Design of bucket elevator and pneumatic conveyor
26. Definition, types, methods of extrusion, Cold and hot extruder design
27. Design of single and twin screw extruder
28. Equipments for packing of food- sealing machines
29. Definition and types of fermenters
30. Design of fermenters.
31. Numerical approach on homogenization, drying, freezing and fermentation problems
32. Introduction, definition, types of Hazards and safety considerations
33. Application and analysis of hazards in process industries
34. Types and application of safety measures in equipment design, pressure relief devices

Practical Schedule

1. Design of heat exchangers
2. Numerical approach on design of heat exchangers

3. Design of single effect and multiple effect evaporators
4. Design of rising film and falling film evaporators - Numerical approach
5. Design of continuous dryers
6. Design of Batch dryers
7. Numerical approach of design of dryers
8. Design of freezers
9. Design of crystallizers
10. Design of separators
11. Numerical approach on design of separators and crystallizers
12. Design of conveyors-Belt conveyors
13. Design of conveyors- Screw conveyor and bucket elevators
14. Design of fermenters
15. Design of twin screw extruder
16. Computer assisted design of dryer
17. Practical examination

Suggested Reading

1. R. Paul Singh and Dennis R. Heldman. 2014. Introduction to Food Engineering, 5th Ed. Elsevier, Amsterdam, The Netherlands.
2. Albert Ibarz and Gustavo V. Barbosa-Cánovas. 2003. Unit Operations in Food Engineering. CRC Press, Boca Raton, FL, USA.
3. George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science+Business Media, New York, USA.
4. R. K. Sinnott. 1999. Chemical Engineering, Vol. 6, Chemical Engineering Design, 3rd Ed. Butterworth-Heinemann, Oxford, UK.
5. Kenneth J. Valentas, Enrique Rotstein and R. Paul Singh. 1997. Handbook of Food Engineering Practice. CRC Press, Boca Raton, FL, USA.
6. Peter F. Stanbury, Allan Whitakar and Stephen J. Hall. 1995. Principles of Fermentation Technology, 2nd Ed. Elsevier Science Ltd., Burlington, MA, USA.

Pafe. 3128 Food Storage Engineering 3 (2+1)

OBJECTIVE

1. To acquaint and equip the students with modern storage structures and different aspects of storage methods of food product

THEORY

MODULE I (7 Hours)

Storage: Importance of scientific storage systems, post harvest physiology of semi-perishables and perishables, climacteric and non climacteric fruits, respiration, ripening, changes during ripening, ethylene bio-synthesis; Damages: Direct damages, indirect damages, causes of spoilage in storage (moisture, temperature, humidity, respiration loss, heat of respiration, sprouting), destructive agents (rodents, birds, insects, etc.), sources of infestation and control

MODULE II (8 Hours)

Storage structures: Traditional storage structures, improved storage structures, modern storage structures; Farm silos: Horizontal silos, tower silos, pit silos, trench silos, size and capacity of silos; Storage of grains: respiration of grains, moisture and temperature changes in stored grains; conditioning of environment inside storage through ventilation

MODULE III (14 Hours)

Aeration and stored grain management: purposes of aeration, aeration theory, aeration system design, aeration system operation; Storage pests and control: Damage due to storage insects and pests, its control, seed coating, fumigations, etc.; Damage caused by rodents and its control; Storage of perishables: cold storage, controlled and modified atmospheric storage, hypobaric storage, evaporative cooling storage, conditions for storage of perishable products, control of temperature and relative humidity inside storage

MODULE IV (4 Hours)

Design of storage structures: Functional and structural design of grain storage structures, pressure theories, pressure distribution in the bin, grain storage loads, pressure and capacities, warehouse and silos, BIS specifications, functional, structural and thermal design of cold stores.

PRACTICAL

Visits to traditional storage structures; Layout design, sizing, capacity and drawing of traditional storage structures; Measurement of respiration of fruits/grains in the laboratory; Study on fumigation; Visits to FCI godowns; Design of grain godowns for particular capacity and commodity; Drawing and layout of grain godown for particular commodity and capacity; Visits to cold storage;. Design of cold storage for particular capacity and commodity; Drawing and layout of cold storage for particular commodity and capacity; Visits to CA storage; Design of CA storage for particular capacity and commodity; Drawing and layout of CA storage for particular commodity and capacity; Visits to evaporative cooling system for storage; Storage study in the MAP.

Lecture Schedule

1. Storage –introduction- Importance of scientific storage systems.
2. Post-harvest physiology of semi-perishables and perishables- climacteric and non-climacteric fruits.
3. Respiration – ripening– changes during ripening– ethylene bio-synthesis.
4. Damages during storage–direct damages– indirect damages– causes of spoilage during storage– physiological and environmental factors–remedies.
5. Factors affecting spoilage in storage –moisture– temperature– humidity– respiration loss– heat of respiration– sprouting.
6. Spoilage in storage–destructive agents–rodents– birds–insects.
7. Sources of infestation and control
8. Storage structures– traditional storage structures– different types.

9. Improved storage structures–different types.
10. Improved storage structures– different types.
11. Modern storage structures–different types.
12. Farm silos–horizontal silos– tower silos– pit silos– trench silos– size and capacity of silos.
13. Farm silos –horizontal silos – tower silos – pit silos– trench silos – size and capacity of silos.
14. Mid examination
15. Storage of grains– respiration of grains– moisture and temperature changes in stored grains.
16. Conditioning of environment inside storage through ventilation
17. Aeration and stored grain management
18. Purposes of aeration–aeration theory.
19. Aeration system design– aeration system operation.
20. Aeration system design– aeration system operation.
21. Damage due to insects and pests during storage– its control– seed coating– fumigations.
22. Damage caused by rodents and its control.
23. Storage of perishables– cold storage.
24. Modified atmosphere storage of grains – concept – requirements – advantages – structure requirement.
25. MA storage-construction and operation –selection of gases – mixing and controlling.
26. Controlled atmospheric storage– concepts– gases used–effect of gases– mixing of gases– requirements
27. Hypobaric storage–concept – principle –requirements
28. Evaporative cooling - principles and concept – requirement - types - construction and operation.
29. Conditions for storage of perishable products
30. Control of temperature and relative humidity inside storage.
31. Design of storage structures–functional and structural design of grain storage structures
32. Design of storage structures–pressure theories–pressure distribution in the bin– grain storage loads– pressure and capacities.
33. Warehouse and silos– concept– structure
34. BIS specifications– functional– structural and thermal design of cold stores.

Practical Schedule

1. Assessment of storage loss in food grains, fruits and vegetables storage
2. Visits to traditional storage structures.
3. Layout design, sizing, capacity and drawing of traditional storage structures.
4. Measurement of respiration of fruits/grains in the laboratory.
5. Study on fumigation
6. Visits to FCI godowns.
7. Design of grain godowns for particular capacity and commodity

8. Drawing and layout of grain godown for particular commodity and capacity.
9. Visits to cold storage.
10. Design of cold storage for particular capacity and commodity.
11. Drawing and layout of cold storage for particular commodity and capacity.
12. Visits to CA storage.
13. Design of CA storage for particular capacity and commodity.
14. Drawing and layout of CA storage for particular commodity and capacity.
15. Visits to evaporative cooling system for storage.
16. Storage study on MAP.
17. Practical examination

Suggested Reading

1. P.H. Pandey. 2014. Principles and Practices of Agricultural Structures and Environmental Control. Kalyani Publishers, Ludhiana.
2. Myer Kutz. 2007. Handbook of Farm, Dairy, and Food Machinery. William Andrew, Inc., Norwich, NY, USA.
3. A.M. Michael and T.P. Ojha. 2004. Principal of Agricultural Engineering, Vol. I. Jain Brothers, New Delhi.
4. L.W. Newbaver and H.B. Walker. 2003. Farm Buildings Design. Prentice-Hall Inc., New Jersey, USA.
5. J. Whitaker. 2002. Agricultural Buildings and Structures. Reston Publishing Home, Reston, Virgenia, USA.
6. G. Boumans. 1985. Grain Handling and Storage. Elsevier Science Publishers, Amsterdam, The Netherlands.

Pafe. 3129 Bakery, Confectionery and Snack Products 2 (1+1)

OBJECTIVES

1. To understand about the baking technology and the machineries involved in bakery and confectionery production.
2. To understand about the role of ingredients in bakery and confectionery.

THEORY

MODULE I (7 Hours)

Bakery products: Types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing Confectionery and chocolate products: Types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing

MODULE II (5 Hours)

Dough rheology Product quality characteristics, defects, causes and corrective measures; Snack foods: Types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing

MODULE III (4 Hours)

Snack food seasonings; Breakfast cereals, extruded products - macaroni products and malts: Specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing.

PRACTICAL

Identifications and composition of various ingredients for snacks, bakery and confectionery products; Flours, their classifications and characterization; preparation, packaging and quality evaluation of selected snack items; preparation, packaging and quality evaluation of selected bakery items; preparation, packaging and quality evaluation of selected confectionery items; preparation, packaging and quality evaluation of selected chocolates; Preparation of traditional Indian confection. Visit to bakery, confectionary and snack units (industry).

Lecture Schedule

1. Introduction and scope of baking and confectionery industry in India-world
2. Bakery products: types, specifications, compositions of baking items
3. Ingredients-role and changes during baking, formulations, processing, equipments.
4. Packaging, storage and quality testing of products.
5. Confectionery and chocolate products: types of chocolates, specifications of the products.
6. Compositions, ingredients, formulations, processing, equipment
7. Packaging, storage and quality testing of products
8. Dough rheology- Farinograph, Extensograph, Alveograph, Amylograph
9. Product quality characteristics, defects, causes and corrective measures
10. Mid semester examination
11. Snack foods: types – specifications of the respective products, compositions, ingredients
12. Formulations – processing of snack foods - equipment
13. Packaging - storage and quality testing
14. Snack food seasonings; breakfast cereals – importance of breakfast cereals
15. Extruded products- macaroni products and malts
16. Specifications, compositions, ingredients, formulations
17. Processing, equipment, packaging, storage and quality testing.

Practical Schedule

1. Identifications and composition of various ingredients for snacks and bakery products
2. Identifications and composition of various ingredients for confectionery products
3. Study on flours and their classifications.
4. Analysis of gluten content in the flour
5. Analysis of water absorption capacity of the flour.
6. Estimate the dough raising capacity of the flour.
7. Analyze the pH and acidity in the given flour.
8. Preparation, packaging and quality evaluation of selected snack items

9. Preparation, packaging and quality evaluation of selected bakery items
10. Preparation, packaging and quality evaluation of selected bakery items
11. Preparation, packaging and quality evaluation of selected confectionery items.
12. Preparation, packaging and quality evaluation of selected confectionery items
13. Preparation, packaging and quality evaluation of selected chocolates
14. Preparation of traditional Indian confection.
15. Visit to bakery
16. Visit to confectionary and snack units (industry).
17. Practical examination

Suggested Reading

1. NIIR Board of Consultants & Engineers. 2014. The Complete Technology Book on Bakery Products (Baking Science with Formulation & Production), 3rd Ed. NIIR, New Delhi.
2. Peter P. Grewling. 2013. Chocolates & Confections, 2nd Ed. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
3. E.J. Pyler and L.A. Gorton. 2009. Baking Science & Technology, Vol. II: Formulation & Production, 4th Ed. Sosland Publishing Company, Kansas City, MO, USA.
4. E.J. Pyler and L.A. Gorton. 2008. Baking Science & Technology, Vol. I: Fundamentals & Ingredients, 4th Ed. Sosland Publishing Company, Kansas City, MO, USA.
5. Y.H. Hui. 2007. Handbook of Food Products Manufacturing: Principles, Bakery, Beverages, Cereals, Cheese, Confectionary, Fats, Fruits, and Functional Foods. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
6. John J. Kingslee. 2006. A Professional Text to Bakery and Confectionery. New Age International, New Delhi.

Beas. 3111 Marketing Management and International Trade 2 (2+0)

OBJECTIVE

1. To understand the concept of marketing in theory and practice and to familiarize with the working of markets, determination of prices and techniques of decision making**.**

THEORY

MODULE I (7 Hours)

Marketing: Concept, functions, scope and marketing management; Process: Concepts of marketing-mix, elements of marketing-mix; Market structure and consumer buying behaviour: micro- and macro-environments; Marketing research and marketing information systems

MODULE II (13 Hours)

Market measurement, market forecasting, market segmentation, targeting and positioning; Allocation and marketing resources; Marketing planning process; Product policy and planning: Product-mix, product line, product life cycle; New product development

process; Product brand, packaging, services decisions; Marketing channel decisions; Retailing, wholesaling and distribution; Pricing decisions; Price determination and pricing policy of milk products in organized and unorganized sectors of dairy industry; Promotion-mix decisions

MODULE III (7 Hours)

Advertising: Objectives, budget and advertising message, media planning, personal selling, publicity, sales promotion; World consumption of food: Patterns and types of food consumption across the globe; Salient features of international marketing, composition and direction of Indian exports, international marketing environment, deciding which and how to enter international market; Direct exports, indirect exports, licensing, joint ventures, direct investment and internationalization process, distribution channels

MODULE IV (6 Hours)

WTO and world trade agreements related to food business, export trends and prospects of food products in India; Government institutions related to international food trade: APEDA, Tea Board, Spice Board, MOFPI, etc.

Lecture Schedule

1. Market and Marketing: Concepts
2. Functions, scope of marketing management
3. Concepts of marketing-mix, elements of marketing-mix
4. Market structure and consumer buying behavior – Factors influencing consumer buying behavior
5. Micro- and macro-environments;
6. Marketing research
7. Marketing information systems
8. Market measurement and Market forecasting
9. Market segmentation – variables influencing segmentation
10. Targeting and positioning
11. Allocation and marketing resources
12. Marketing planning process-executive summary, situation analysis action programme, budject and controls
13. Product policy and planning
14. Product-mix, product line, product life cycle
15. New product development process; Product brand, packaging
16. Services decisions
17. Marketing channel decisions; Retailing, wholesaling and distribution
18. Pricing decisions; Price determination
19. Pricing policy of milk products in organized and unorganized sectors of dairy industry
20. Promotion-mix decisions
21. Midterm examination
22. Advertising: Objectives, budget and advertising message
23. Media planning, personal selling, publicity, sales promotion
24. World consumption of food: Patterns and types of food consumption across the globe
25. Salient features of international marketing, composition and direction of Indian exports
26. International marketing environment, deciding which and how to enter international market
27. Direct exports, indirect exports, licensing, joint ventures
28. Direct investment and internationalization process, distribution channels

29. WTO and world trade agreements related to food business
30. Export trends and prospects of food products in India
31. Export trade and government interventions
32. Agriculture and food policy according to WTO
33. WTO-regulations for food industries
34. Government institutions related to international food trade: APEDA, Tea Board, Spice Board, MOFPI, etc.

Suggested Reading

1. Philip Kotler, Kevin Lane Keller, Abraham Koshy, Mithileshwar Jha. 2013. Marketing Management: A South Asian Perspective, 14th Ed. Pearson Education.
2. Willium J. Stanton. 1984. Fundamentals of Marketing. Tata McGraw-Hill Publication, New Delhi.
3. C.N. Sontakki. Marketing Management. Kalyani Publishers, New Delhi.
4. John Daniels, Lee Radebaugh, Brigham, Daniel Sullivan. International Business, 15th Ed., Pearson Education.
5. Aswathappa. International Business. Tata McGraw-Hill Education, New Delhi.
6. Fransis Cherunilam. International Business: Text and Cases, 5th Ed. PHI Learning, New Delhi.

Pafe. 3130 Sensory Evaluation of Food Products 2 (1+1)

OBJECTIVE

1. To understand the foundation and objective of sensory analysis.
2. To understand the principal sensory analysis tests and its application in the innovation, developing and quality control of food.

THEORY

MODULE I (3 Hours)

Introduction, definition and importance of sensory evaluation in relation: to consumer acceptability and economic aspects; factors affecting food acceptance. Terminology related to sensory evaluation. Principles of good practice: the sensory testing environment, test protocol considerations

MODULE II (6 Hours)

Basic principles: Senses and sensory perception, Physiology of sensory organs, Classification of tastes and odours, threshold value factors affecting senses, visual, auditory, tactile and other responses. Discrimination Tests, Procedure: Types of tests – difference tests (Paired comparison, due-trio, triangle) ranking, scoring, Hedonic scale and descriptive tests. Panel selection, screening and training of judges; Requirements of sensory evaluation, sampling procedures; Factors influencing sensory measurements

MODULE III (7 Hours)

Consumer Research – Affective Tests: Objectives. Methods, types or questionnaires, development of questionnaires, comparison of laboratory testing and Consumers studies, limitations. Interrelationship between sensory properties of food products and various

instrumental and physico-chemical tests; Quality Evaluations Application of sensory testing: sensory evaluation in food product development, sensory evaluation in quality control.

PRACTICAL

Determination of threshold value for basic tastes; Odour recognition, difference (PC, Duo-trio, triangle); Determination of threshold value for various odours; Selection of judging panel; Training of judges, for recognition of certain common flavour and texture defects using different types of sensory tests; Descriptive analysis methodology; Sensory evaluation of various food products using different scales, score cards and tests; Texture profile methodology; Estimation of color; Relationship between objective and subjective methods; Designing a sensory laboratory

Lecture Schedule

1. Introduction, definition and importance of sensory evaluation in relation: to consumer acceptability and economic aspects.
2. Factors affecting food acceptance. Terminology related to sensory evaluation.
3. Principles of good practice: the sensory testing environment, test protocol considerations,
4. Basic principles of Senses and sensory perception - Physiology of sensory organs
5. Classification of tastes and odours, threshold value factors affecting senses, visual, auditory, tactile and other responses.
6. Discrimination Tests, Procedure: Types of tests – difference tests (Paired comparison, due-trio, triangle) ranking, scoring,
7. Hedonic scale – definition-types, descriptive tests, Panel selection, screening and training of judges
8. Requirements of sensory evaluation, sampling procedures involved in sensory evaluation.
9. Factors influencing sensory measurements
10. Consumer Research – Affective Tests: Objectives. Methods, types or questionnaires, development of questionnaires in
11. Mid semester examination
12. Comparison of laboratory testing and Consumers studies
13. Limitations of sensory evaluation
14. Interrelationship between sensory properties of food products and various instrumental and physico-chemical tests
15. Quality Evaluations Application of sensory testing
16. Sensory evaluation in food product development
17. Sensory evaluation in quality control

Practical Schedule

1. Determination of threshold value for basic tastes
2. Odour recognition
3. Study on difference test(PC, Duo-trio, triangle).
4. Determination of threshold value for various odours.

5. Study on Selection of judging panel.
6. Study on Training of judges.
7. Recognition of certain common flavour and texture defects using different types of sensory tests
8. Study on Descriptive analysis methodology
9. Sensory evaluation of various food products using different scales, score cards and tests.
10. Sensory evaluation of various food products using different scales, score cards and tests
11. Texture profile methodology
12. Estimation of color of products.
13. Subjective methods- application
14. Objective methods - application
15. Relationship between objective and subjective methods
16. Designing a sensory laboratory.
17. Practical examination

Suggested Reading

1. Amerine, M.A., Pangborn, R.M. and Rossles, E.B. 1965. Principles of Sensory Evaluation of Food. Academic Press, London.
2. Jellinek, G. 1985. Sensory Evaluation of Food - Theory and Practice. Ellis Horwood.
3. Lawless, H.T. and Klein, B.P. 1991. Sensory Science Theory and Applicatons in Foods. Marcel Dekker.
4. Macrae, R., Rolonson Roles and Sadlu, M.J. 1994. Encyclopedia of Food Science & Technology & Nutrition. Vol. XI. Academic Press.
5. Piggot, J.R. 1984. Sensory Evaluation of Foods. Elbview Applied Science Publ.

SEMESTER VI

Pafe. 3231 Processing Technology of Beverages 3 (2+1)

OBJECTIVES

1. To understand various concepts, principles and procedures involved in processing of beverages.
2. To impart knowledge and skills of process techniques and equipments used for the production of beverages to the students.

THEORY

MODULE I (9 Hours)

History and importance of beverages and status of beverage industry; Processing of beverages: Packaged drinking water, juice based beverages, synthetic beverages, still, carbonated, low-calorie and dry beverages

MODULE II (15 Hours)

Importance and role of isotonic and sports drinks, Dairy based beverages, alcoholic beverages, fruit beverages, speciality beverages, tea, coffee, cocoa, spices, plant extracts, etc.; FSSAI specifications for beverages.

MODULE III (4 Hours)

Ingredients, manufacturing and packaging processes and equipment for different beverages-Water treatment and quality of process water; Sweeteners, colorants, acidulants, clouding and clarifying and flavouring agents for beverages;

MODULE IV (5 Hours)

Carbon dioxide and carbonation; Quality tests and control in beverages; Miscellaneous beverages: Coconut water, sweet toddy, sugar cane juice, coconut milk, flavoured syrups. Threshold limits of ingredients

PRACTICAL

Quality analysis of raw water; Determination of density and viscosity of caramel; Determination of colours in soft drinks by wool technique; Preparation of iced and flavoured tea; Preparation of carbonated and non-carbonated beverages; Determination of caffeine in beverages; Determination of brix value, gas content, pH and acidity of beverages; Quality analysis of tea and coffee; Preparation of miscellaneous beverages; Visit to carbonation unit; Visit to mineral water plant

Lecture schedule

1. History and status of beverage industry in the world.
2. Significance and effect of beverages in health.
3. Classification of beverages
4. Processing of beverages- packaging- filling
5. Processing of packaged drinking water
6. Preparation of juice based beverages- RTS, squash
7. Preparation of juice based beverages- cordial and nectar
8. Preparation synthetic beverages, still and carbonated beverages
9. Importance and production of low-calorie and dry beverages
10. Role and processing of isotonic and sports drinks
11. Dairy based beverages- importance, nutritive value, health benefits
12. Preparation of alcoholic beverages- wine, beer
13. Preparation of distilled beverages-brandy, whisky
14. Fruit beverages-methods-significance in health
15. Specialty beverages- role-preparation
16. Tea-plucking methods-tea processing
17. Tea types- black, green, oolong, yellow-processing methods
18. Coffee- varieties-nutrition-harvesting methods.
19. Processing of coffee-changes in composition
20. Brewing of coffee- decaffeination and instant coffee preparation.

21. Cocoa- varieties-harvesting methods-processing-equipments
22. Chocolate processing-types of chocolate products.
23. Mid semester examination
24. Spices and plant extracts- involved in beverages
25. Fssai specifications for beverages.
26. Ingredients, manufacturing and packaging processes and equipment for different beverages
27. Water treatment and quality of process water;
28. Role and type of sweeteners, colorants, acidulants used in beverage industry.
29. Role of clouding and clarifying and flavouring agents for beverages
30. Carbon dioxide and carbonation- methods-equipments
31. Quality tests and control in beverages
32. Miscellaneous beverages: nutritional benefits
33. Miscellaneous beverages involved: coconut water, sweet toddy, sugar cane juice, coconut milk, flavoured syrups.
34. Threshold limits of ingredients in beverage foods

Practical Schedule

1. Quality analysis of raw water.
2. Determination of density and viscosity of caramel.
3. Determination of colours in soft drinks by wool technique.
4. Preparation of iced tea
5. Preparation of flavoured tea
6. Preparation of carbonated beverages.
7. Preparation of non-carbonated beverage-wine.
8. Preparation of non-carbonated beverage-mead.
9. Determination of caffeine in beverages.
10. Determination of brix value and gas content.
11. Determination of acidity of beverages.
12. Determination of pH and acidity of beverages.
13. Quality analysis of tea and coffee;
14. Preparation of miscellaneous beverages.
15. Visit to carbonation unit
16. Visit to mineral water plant.
17. Practical Examination

Suggested Reading

1. Hans Michael Eblinger. 2009. Handbook of Brewing: Processes, Technology, Markets. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim. Germany.
2. Y.H. Hui. 2007. Handbook of Food Products Manufacturing: Principles, Bakery, Beverages, Cereals, Cheese, Confectionary, Fats, Fruits, and Functional Foods. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
3. Philip R. Ashurst. 2005. Chemistry and Technology of Soft Drinks and Fruit Juices, 2nd Ed. Blackwell Publishing Ltd., Oxford, UK.

4. V.K. Joshi and Ashok Pandey. 1999. Biotechnology: Food Fermentation – Microbiology, Biochemistry and Technology, Vol. II. Educational Publishers & Distributors, New Delhi.
5. Alan H. Varnam and Jane P. Sutherland. 1994. Beverages: Technology, Chemistry and Microbiology. Chapman, London, UK.

Pafe. 3232 Food Packaging Technology and Equipment 3 (2+1)

OBJECTIVE

1. To acquaint and equip the students with packaging methods, packaging materials, packaging machineries and modern packaging techniques.

THEORY

MODULE I (7 Hours)

Packaging situations in World, India; Need of packaging; Package requirements, package functions; Package materials: Classification of packages, paper as package material, its manufacture, types, advantages of corrugated and paper board boxes, etc.; Glass as package material, manufacture, advantages, disadvantages; Metal (Aluminium/ tin/ SS) as package material-manufacture, advantages, disadvantages,

MODULE II (12 Hours)

Plastic as package material, classification of polymers, properties of each plastics, uses of each plastics; Lamination: Moulding-Injection, blow, extrusion; Coating on paper and films, Heat sealing methods; Shrink packaging; Stretch packaging; Vacuum packaging, different methods of vacuum packaging

MODULE III (5 Hours)

Aseptic packaging: Need, advantages, process, comparison of conventional and aseptic packaging, system of aseptic packaging and materials used in aseptic packaging; Permeability: Theoretical considerations, permeability of gases and vapours; Permeability of multilayer materials; Permeability in relation to packaging requirement of foods;

MODULE IV (9 Hours)

Active and intelligent packaging; Transport properties of barriers; Simulations of product: Package environment interaction; Packaging of specific foods, mechanical and functional tests on package, packaging materials testing machines; Filling systems, form fill sealing equipment; Printing-equipment used, labelling, principle- different printing methods.

PRACTICAL

Classification of various packages based on material and rigidity; Measurement of thickness of paper, paper boards; Measurement of basic weight and grammage of paper and paperboards; Measurement of water absorption of paper, paper boards; Measurement of bursting strength of paper, paper boards; Measurement of tear resistance of papers; Measurement of puncture resistance of paper and paperboard; Measurement of tensile

strength of paper, paper boards; Measurement of grease resistance of papers; Determination of gas and water transmission rate of package films; Determination of laquer integrity test; Drop test, Box compression test; Identification of plastic films; Determination of seal integrity, ink adhesion; packaging practices followed for packing fruits and vegetables; Shelf life calculations for food products; Head space analysis of packaged food; Study of vacuum packaging machine, bottle filling machine and form-fill-seal machine.

Lecture Schedule

1. Introduction to packaging- Packaging situations in World, India; Need of packaging;
2. Package requirements, package functions- Factors affecting shelf life of food material during storage.
3. Package materials: Classification of packages, paper as package material, its manufacture- Basis for selection of packaging material.
4. Corrugated box- liner and medium – different types of flutes - corrugated paper board manufacturing process.
5. Paper board boxes, - types, advantages of paper as food packaging material and its properties – paper cups – folding cartons – paper bags - solid fiber boards
6. Glass as package material, manufacture- physical properties and suitability- advantages, disadvantages.
7. Metal (Aluminium/ tin/ SS) as package material-manufacture, advantages, disadvantages.
8. Plastic as package material, classification of polymers, properties of each plastics, uses of each plastics.
9. Lamination: Moulding-Injection, blow, extrusion; Coating on paper and films.
10. Biaxially oriented polypropylene, polyethylene terapthalate, polyester materials in lamination – adhesive lamination – extrusion coating - co extrusion – vacuum metallization
11. Properties of packaging materials – tensile, bursting, impact, tear, crease or flex resistance, blocking, orientation and shrinkage.
12. Heat sealing – conductance, impulse, dielectric and hot wire sealing.
13. Flexible pouches -different types of pouches used in food packaging.
14. Multi layered pouches - their properties – advantages and disadvantages of polythene films.
15. Filling systems – filling liquid and viscous products and machineries used.
16. Filling dry products and equipment used - weight filler, volume filler.
17. Shrink packaging – principle, advantages – polymers suitable for shrink packaging
18. Stretch packaging – principle, advantages – polymers suitable for stretch packaging
19. Vacuum packaging– shrink and non-shrink bag methods – thermo forming and vacuum packaging.
20. Mid semester examination.
21. Aseptic packaging: Need, advantages, process, comparison of conventional and aseptic packaging.
22. Aseptic packaging system and materials used in aseptic packaging –equipment, advantages.

23. Performance evaluation of different methods of packaging food products; their merits and demerits; scope for improvements
24. Permeability: Theoretical considerations, permeability of gases and vapours; Permeability in relation to packaging requirement of foods.
25. Permeability of multilayer materials- Tests for water vapour transmission and gas permeability.
26. Active packaging - advantages & disadvantages of these packaging methods - effect of these materials on packed commodities
27. Intelligent packaging - advantages & disadvantages of these packaging methods - effect of these materials on packed commodities
28. Transport properties of barriers - effect of these materials on packed commodities.
29. Simulations of product- package environment interaction.
30. Packaging materials testing machines- Universal testing machine, drop tester, bursting tester, water absorption tester.
31. Packaging materials testing machines torque tester, tear resistance tester - principle of operation and its application
32. Packaging of specific foods, mechanical and functional tests on package.
33. Printing, labeling, principle- different printing methods- advantage and disadvantages.
34. Printing equipment – flexo, off set and rotogravure printing.

Practical Schedule

1. Identification of plastic films and Classification of various packages based on material and rigidity.
2. Measurement of thickness of paper, paper boards.
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 grease resistance of papers.
9. Determination of gas and water transmission rate of package films.
10. Drop test, Box compression test.
11. Determination of seal integrity, ink adhesion.
12. Shelf life calculations for food products.
13. Head space analysis of packaged food.
14. Study of vacuum packaging machine with suitable food material
15. Study of bottle filling machine.
16. Study of form-fill-seal machine.
17. Practical Examination

Suggested Reading

1. Gordon L. Robertson. 2014. Food Packaging: Principles and Practice, 3rd Ed. CRC Press, Boca Raton, FL, USA.

2. Gordon L. Robertson. 2010. Food Packaging and Shelf Life – A Practical Guide. CRC Press, Boca Raton, FL, USA.
3. Jung H. Han. 2007. Packaging for Nonthermal Processing of Food. Blackwell Publishing Ltd., Oxford, UK.
4. Jung H. Han. 2005. Innovations in Food Packaging. Elsevier Science & Technology Books, UK.
5. Richard Coles, Berek McDowell and Mark J. Kirwan. 2003. Food Packaging Technology. Blackwell Publishing Ltd., Oxford, UK

Pafe. 3233 Processing of Meat and Poultry Products 3(2+1)

OBJECTIVES

1. To learn about the composition, nutritive value and processing techniques of meat and poultry.
2. To understand the concept of meat quality, the principle factors influencing it and how to measure its major characteristics.

MODULE I (12 Hours)

Sources and importance of meat and poultry; Status of Meat and poultry industry in India; Pre-slaughter operations and slaughtering operations for animals and poultry; Evaluation of animal carcasses; Factors affecting post-mortem changes, properties and shelf life of meat; Mechanical deboning, grading and aging; Eating and cooking quality of meat

MODULE II (10 Hours)

Preservation of meat by chilling, freezing, pickling, curing, cooking and smoking, dehydration, radiation, chemical and biological preservatives; Meat tenderization; Meat emulsions; Meat cutting and handling; Preparation, preservation and equipment for manufacture of smoked meat and its quality evaluation

MODULE III (2 Hours)

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; Abattoir design and layout

MODULE IV (9 Hours)

Eggs: Structure, composition, quality characteristics, processing, preservation of eggs; Processing and preservation of poultry meat and chicken patties; Meat plant sanitation and safety; By-products of meat, poultry and eggs and their utilization; Safety standards in meat industry: HACCP/ISO/MFPO/FSSAI/Kosher/Halal.

PRACTICAL

Pre-slaughter operations of meat animals and poultry birds; Slaughtering and dressing of meat animals; Study of post-mortem changes; Meat cutting and handling; Preservation of meat by freezing; Preservation of meat by curing and pickling; Preservation of meat by

dehydration; Evaluation of quality and grading of eggs; Preservation of shell eggs; Preparation of value added poultry meat products; Value added egg products; Visit to abattoir.

Lecture schedule

1. Sources and importance of meat and poultry
2. Status of Meat and poultry industry in India
3. Pre-slaughter operations – Antemortem inspection-its importance
4. Slaughtering operations for animals and poultry-stunning, bleeding, and skinning of animals.
5. Suspension of carcass- evisceration, splitting, washing and dressing of carcasses
6. Meat cutting : types and handling of meat cuts
7. Slaughtering techniques-Kosher/Halal- their importance
8. Evaluation of animal carcasses-significance
9. Post mortem inspection - Factors affecting post-mortem changes
10. Properties and shelf life of meat
11. Methods - Mechanical deboning, grading and aging
12. Eating and cooking quality of meat
13. Preservation of meat by chilling, freezing-methods,
14. Preservation techniques - pickling, curing, cooking and smoking,
15. Preservation techniques- dehydration, radiation,
16. Preservatives- chemical and biological
17. Meat tenderization- Artificial and natural
18. Meat emulsions- sausage- types
19. Preparation of sausages- casings-types
20. Preservation and equipment for manufacture of meat sausages and their quality evaluation;
21. Preparation and equipments involved in the manufacture of smoked meat.
22. Preservation and quality evaluation of smoked meat.
23. Mid semester examination
24. Preparation, packaging and equipment for manufacture of dehydrated meat products and their quality evaluation;
25. Abattoir design and layout;
26. Eggs: Structure, composition and its nutritive value
27. Egg – Collection, grading, cleaning, packaging and transport
28. Quality characteristics and processing of egg
29. Preservation of eggs – oil treatment-cold storage-thermosabilization-immersion in liquids
30. Processing and preservation of poultry meat and chicken patties
31. Meat plant sanitation and safety.
32. By-products of meat, poultry and eggs and their utilization.
33. Safety standards in meat industry: HACCP/ISO
34. Safety standards in meat industry :MFPO/FSSAI

Practical Schedule

1. Pre-slaughter operations of meat animals and poultry birds
2. Slaughtering and dressing of meat animals-1
3. Slaughtering and dressing of meat animals-2
4. Study of post-mortem changes
5. Meat cutting and handling-1
6. Meat cutting and handling-2
7. Preservation of meat by freezing
8. Preservation of meat by curing and pickling
9. Preservation of meat by dehydration-1
10. Preservation of meat by dehydration-2
11. Evaluation of quality and grading of eggs
12. Preservation of shell eggs
13. Preparation of value added poultry meat products-1
14. Preparation of value added poultry meat products-2
15. Value added egg products
16. Visit to abattoir.
17. Practical examination

Suggested Reading

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. Fidel Toldrá, Y. H. Hui, Iciar Astiasarán, Wai-Kit Nip, Joseph G. Sebranek, Expedito-Tadeu F. Silveira, Louise H. Stahnke, Régine Talon. 2007. Handbook of Fermented Meat and Poultry. Blackwell Publishing Professional, Ames, Iowa, USA.
4. Joseph Kerry, John Kerry and David Ledward. 2005. Meat Processing-Improving Quality. Woodhead Publishing Ltd., Cambridge, England.
5. NIIR Board of Consultants & Engineers. 2005. Preservation of Meat and Poultry. Asia Pacific Business Press, Inc., Delhi.

Pafe. 3234 Processing of Fish and Marine Products 3 (2+1)

OBJECTIVES

1. To impart basic knowledge in Fish Processing by understanding the basics of Fisheries Science.
2. To acquaint and equip the students with various Fish Processing operations and applications in Sea Food Processing Industries.

THEORY

MODULE I (13 Hours)

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, spoilage of fish- microbiological, physiological, biochemical; Relationship between chilling and storage life, MAP, general aspects of fish freezing, changes in quality during chilled and frozen storage;

MODULE II (6 Hours)

Principles of canning, effect of heat processing on fish, storage of canned fish, pre-process operations, post-process operations, cannery operations for specific canned products; 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;

MODULE III (7 Hours)

Fish protein concentrates (FPC), fish protein extracts (FPE), fish protein hydrolysates (FPH); Preparation protocols of indigenous products: Fish sauce and paste. Novel methods; Low dose irradiation; High pressure treatment, MAP, vacuum packaging, gas packaging;

MODULE IV (7 Hours)

Oxygen absorbents and CO_2 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.

PRACTICAL

Study of anatomy and dressing of fish; Study of anatomy and dressing of prawn and other marine products; Identification of different types of fish - Selection and grading; Identification of different types of prawn and other marine products - Selection and grading; Quality evaluation of fish; Preparation of sun dried and salt cured fish, fish sauce; Chilling and freezing of fish; Preparations of fish protein concentrate; Preparation of fish meal; Preparation of marine fish oils and various fish products; Utilization of fish by-products; Preparation of marine algal products; Preservation of fish: Drying, pickling; Preservation of marine products using fermentation process; Preparation of value added sea products: Cutlets, bullets, wafers; Processing of fish oils; Canning methods for marine fishery products; Estimation of TVB and TMA; Determination of iodine value; Protein estimation by Folin-Lowrey's method; Visit to fish and prawn processing industry.

Lecture Schedule

1. Introduction ,Fisheries resources, global and Indian scenario;
2. Types of fish and other marine products;
3. Classification of fish (fresh water ,brackish and marine),
4. Composition of fish, characteristics of fresh fish,
5. Preservation methods of Fish.
6. Curing of Fish –Smoking, Brining etc.
7. Drying
8. Freezers

9. Cold storage
10. Spoilage of fish- microbiological, Physiological spoilage of Fish. Biochemical spoilage of Fish.
11. Chilling of fish Relationship between chilling and storage life, general aspects of fish freezing.
12. changes in quality during chilled and frozen storage
13. Thermal Processing -effect of heat processing on fish.
14. Principles of canning, storage of canned fish,
15. Canning of Tuna, Mackerel and Sardine.
16. Pre-process operations, post-process operations, cannery operations for specific canned products; Fish products
17. Fish products: Introduction, fish muscle proteins.
18. Surimi process, traditional and modern surimi production lines, quality of surimi products, comparison of surimi
19. Minced Fish products.
20. Fish protein concentrates (FPC)
21. Fish protein extracts (FPE), fish protein hydrolysates (FPH).
22. Preparation protocols of indigenous products
23. Fish sauce and paste.
24. Novel methods; Low dose irradiation
25. High pressure treatment
26. Mid term Examination
27. MAP, Vacuum packaging
28. Gas packaging; Oxygen absorbents and CO_2 generators, ethanol vapour generation, hurdle barrier concept
29. Value added Fish products
30. Preparation of value added sea products: Cutlets, bullets, wafers
31. Processing of fish oils
32. HACCP
33. EU hygienic regulations and ISO 9000 standards
34. New kinds of quality and safety problems emerging in sea food processing and preservation.

Practical Schedule

1. Identification of different types of prawn and other marine products
2. Identification of different types of fish - Selection and grading
3. Study of anatomy and dressing of prawn and other marine products
4. Processing of fish oils
5. Study of anatomy and dressing of fish
6. Preparation of marine algal products
7. Preservation of fish: Drying, pickling
8. Preservation of marine products using fermentation process
9. Preparation of value added sea products: Cutlets, bullets, wafers
10. Identification of different types of fish

11. Selection and grading and Identification of different types of prawn and other marine products
12. Canning methods for marine fishery products
13. Estimation of TVB & Estimation of TMA
14. Determination of iodine value
15. Protein estimation by Folin-Lowrey's method
16. Visit to fish and prawn processing industry.
17. Practical Examination

Suggested Reading

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. Brend W. Rautenstrauss and Thomas Liehr. 2002. Fish Technology. Springer-Verlag, US.
4. G.M. Hall. 1997. Fish Processing Technology, 2nd Ed. Chapman & Hall, London, UK.
5. C.O. Chichester and H.D. Graham. 1973. Microbial safety of Fishery products. Academic Press, New York.

Pafe. 3235 Food Quality, Safety Standards and Certification 2 (2+0)

OBJECTIVES

1. To enable students to understand food safety standards and regulations.
2. To study about various the food quality aspects.
3. To provide knowledge about food safety management system.

THEORY

MODULE I (10 Hours)

Food quality: Definition and its role in food industry; Quality attributes, classification; Color and gloss: Definition, different colors, color measurement by spectrophotometer, Muncell color system and Lovibond tintometer; role in food qualities. Role of viscosity and consistency in food quality; Physical properties: Size and shape, weight, volume, weight volume ratio, length, width, diameter, symmetry, curvature, area; Defects, classification. Genetic-physiological defects: Structural, off color, character; Entomological defects: Holes, scars, lesions, off coloring, curled aves, pathological defects; Mechanical defects, extraneous or foreign material defects; Measurement of defects: Improving visibility by dilution, white background, color differences, standardization of conditions, reference standards, counts and measures, isolation of defects by floatation, elution, electronic sorting and internal defects

MODULE II (6 Hours)

Flavour: Definition and its role in food quality; Taste: Classification, taste qualities, relative intensity, reaction time, effect of disease, temperature, and taste medium on taste, basic tastes, interaction of tastes; Odour: Definition, classification, neutral-mechanisms,

olfactory abnormalities, odor testing, techniques, thresholds, odor intensities, olfaction; Visual, auditory, tactile and other senses, vision, audition, oral perception other than taste; Factors influencing sensory measurements: Attitudinal factors, motivation psychological errors in judgment, relation between stimulus and perception adaptation; Correlation of sensory and instrumental analysis

MODULE III (11 Hours)

Laboratory quality measurement: Types of tests, panel selection and testing environment, serving procedures, instruction to judges, difference tests, directional difference tests, classification of difference tests, two-sample tests, three-sample tests, multisampling tests, comparison of procedures, ranking, scoring, hedonic scaling, dilution procedures, descriptive sensory analysis, contour method, other procedures; Consumer measurement: Factors influencing acceptance and preference, objectives of consumer preference studies, information obtained from consumer study, factors influencing results from consumer surveys, methods of approach, development of the questionnaire, types of questionnaires, serving procedures; Comparison of laboratory panels with consumer panels; Limitations of consumer survey; Quality of raw materials: Physical, chemical and microbial quality; Quality of products during processing and after processing: Color, taste, texture, flavour, appearance; Factors influencing the food qualities: Soil, field practices, harvesting practices, procedures, packaging, transportation, storage, conditions, processing conditions, packaging and storage conditions of finished products. Recording and reporting of quality. Quality inspection, quality control.

MODULE IV (6 Hours)

Quality management and quality assurance: Total quality management, good manufacturing practices, good agricultural practices, good laboratory practices; Quality management systems, QSS; Quality circles, SQC; ISO system. HACCP: Principles, implementation; Plan documentation, types of records; Auditing: Surveillance, audit, mock audit, third party quality certifying audit, auditors and lead auditors; Certification, certification procedures, certifying bodies, accrediting bodies, international bodies.

PRACTICAL

Sensory evaluation of various food products using different scales, score cards and tests; Texture profile methodology; Estimation of color; Relationship between objective and subjective methods; Designing a sensory laboratory. Design and implementation of HACCP system for fruit processing plants. Design and implementation of HACCP system for milk processing plants; Design and implementation of HACCP system for meat processing plants; Design and implementation of HACCP system for fish processing plants; Design and implementation of HACCP system for cereals and pulses processing plants: Microbial analysis of food; Detection and identification of microbial load: Quantification of microbial load; Analysis of chemical hazards; Quality evaluation of food products Part I and II; Presentation of various case studies related to food safety Part; Visit to food processing industries for HACCP verification.

Lecture Schedule

1. Food quality- Definition and its role in food industry.
2. Food quality-Quality attributes classification.
3. Color and gloss- Definition, different colors, color measurement by spectrophotometer.
4. Color and gloss -color measurement by Muncell color system and Lovibond tintometer
5. Role of color measurement in food quality.
6. Role of viscosity and consistency in food quality.
7. Physical properties of food.
8. Various defects and classification- Genetic-physiological defects, pathological defects
9. Various defects and classification- Mechanical defects, extraneous or foreign material defects.
10. Measurement of defects.
11. Flavour-Definition and its role in food quality.
12. Taste- Definition, Classification, various parameters and its role in food quality.
13. Odour- Definition, classification, abnormalities and various testing methods.
14. Various other sensory measurements- Visual, auditory, tactile and other senses.
15. Factors influencing sensory measurements.
16. Correlation of sensory and instrumental analysis.
17. Mid -term examination
18. Laboratory quality measurement- Types of tests, panel selection and testing environment, serving procedures, instruction to judges, difference tests, and directional difference tests.
19. Laboratory quality measurement-classification of difference tests, two-sample tests, three-sample tests, multisampling tests, comparison of procedures, ranking, scoring, hedonic scaling, dilution procedures, descriptive sensory analysis, contour method, other procedures.
20. Quality measurements- ranking, scoring, hedonic scaling, dilution procedures, descriptive sensory analysis, contour method, other procedures.
21. Consumer measurement- Factors influencing acceptance and preference, objectives of consumer preference studies, information obtained from consumer study.
22. Consumer measurement- factors influencing results from consumer surveys, methods of approach, development of the questionnaire, types of questionnaires, serving procedures.
23. Comparison of laboratory panels with consumer panels and limitations.
24. Quality of raw materials-Physical, chemical and microbial quality.
25. Quality of products during processing and after processing: Color, taste, texture, flavour, appearance
26. Factors influencing the food qualities-Soil, field practices, harvesting practices, procedures, packaging, transportation, storage conditions, processing conditions,
27. Factors influencing the food qualities- packaging and storage conditions of finished products.

28. Factors influencing the food qualities- Recording and reporting of quality, Quality inspection, quality control.
29. Principles of quality assurance, TQM, SOP, SSOP.GMP
30. Principles of quality assurance-GAP, GLP.
31. Quality management systems- QSS, SQC.
32. Principles of ISO.
33. HACCP-principles-application of HACCP in food industries.
34. Certification- procedure, bodies.

Suggested Reading

1. Inteaz Alli. 2004. Food Quality Assurance: Principles and Practices. CRC Press, Boca Raton, FL, USA.
2. Ronald H. Schmidt and Gary E. Rodrick. 2003. Food Safety Handbook. John Wiley & Sons, Inc., Hoboken. New Jersey, USA.
3. R.E. Hester and R.M. Harrison. 2001. Food Safety and Food Quality. Royal Society of Chemistry, Cambridge, UK.

Beas. 3212 Instrumentation and Process Control in Food Industry 3 (2+1)

OBJECTIVE

1. To prove sound knowledge in the basic concepts of control theory and instrumentation

THEORY

MODULE I (16 Hours)

Introduction, definitions, characteristics of instruments, static and dynamic characteristics; Temperature and temperature scales; Various types of thermometers; thermocouples, resistance thermometers and pyrometers; 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

MODULE II (9 Hours)

Mechanical scale, electronic tank scale, conveyor scale; 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; Process control: Definition, simple system analysis, dynamic behaviour of simple process, Laplace transform, process control hardware.

MODULE III (4 Hours)

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; Controllers and indicators

MODULE IV (4 Hours)

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.

PRACTICAL

Study on instrumentation symbols; Determination of relative humidity by wet and dry bulb thermometer; Measurement of wind velocity by anemometer; Measurement of intensity of sun shine by sunshine recorders; Study of characteristics of pressure transducers, real-time study of pressure transducers characteristics with PC, characteristics of IC temperature sensor, characteristics of platinum RTD, temperature controlled alarm system; Study of water level to current conversion; Study of characteristics of capacitive transducer.

Lecture Schedule

1. Introduction, definitions, characteristics of instruments, static and dynamic characteristics.
2. Diagrammatic control-center layer, process analysis, instrumentation in the modern plant.
3. Process instrumentation- Temperature and temperature scales.
4. Various types of thermometers - Thermocouples, resistance thermometers and pyrometers.
5. Thermoelectric temperature measurement, thermoelectric effect, temperature measuring instruments, industrial thermocouples.
6. Thermocouple materials, advantages and disadvantages of thermocouples.
7. Thermocouple thermometers, thermal wells, industrial potentiometers.
8. Pressure and pressure scales, manometers, pressure elements differential pressure.
9. pressure and vacuum measurement: measuring elements for gauge pressure
10. Indicating elements for pressure gauges, measurement of absolute pressure, measuring pressures in corrosive fluids
11. Liquid level measurement, different methods of liquid level measurement.
12. Level measurement: direct measurement of liquid level(dip sticks and Lead lines)
13. Indirect measurement of liquid level (Chain or float gauge)
14. Pressure (level) measurements in open vessels- Level measurement in pressure vessels, measurement of interface level.
15. Pressure (level) measurements in open vessels
16. Flow measurement: Kinds of flow, rate of flow, total flow differential pressure meters, variable area meters, food flow metering.
17. Weight measurement: Mechanical scale, electronic tank scale, conveyor scale.
18. Measurement of moisture content, specific gravity, measurement of humidity.
19. Measurement of viscosity, turbidity, color, measurement of density, brix, pH, enzyme sensors.

20. Psychometric method for moisture in gases, hygrometer method for moisture in gases, dew-point method.
21. Mid semester examination.
22. Operation and control of automatic valves- application in food industries.
23. Transmission- Pneumatic and electrical controls - application in food industries.
24. Control elements, control actions, pneumatic and electrical control systems.
25. Process control- Definition, simple system analysis, dynamic behavior of simple process,
26. Process control- Laplace transform, process control hardware- application.
27. Frequency response analysis, frequency response characteristics, Bode diagram and Nyquist plots and stability analysis.
28. Transducers: Classification, self-generating transducers, variable parameter type, digital, actuating and controlling devices.
29. Electrical pressure transducers, resistance type pressure transducer.
30. Inductive and capacitive type pressure transducers, photoelectric pressure transducer
31. Controllers and indicators - temperature control, electronic controllers, flow ratio control, atmosphere control.
32. Controllers and indicators -timers and indicators, food sorting and grading control, discrete controllers, adaptive and intelligent controllers.
33. Computer-based monitoring and control - Importance, hardware features of data acquisition.
34. Computer-based monitoring and control - control computer, signal interfacing, examples in food processing.

Practical Schedule

1. Experimental study on instrumentation symbols
2. Determination of relative humidity by wet and dry bulb thermometer
3. Determination of wind velocity by anemometer
4. Determination of temperature by different thermometers
5. Determination of temperature by different thermocouples
6. Determination of intensity of sun shine by sunshine recorders
7. Experiment on study of characteristics of pressure transducers
8. Experiment on study of viscometer
9. Experiment on study of pH meter
10. Experiment on study of colorimeter
11. Study of pressure transducers characteristics with PC
12. Experiment on study of characteristics of IC temperature sensor
13. Experiment on study of characteristics of platinum RTD
14. Experiment on study of temperature controlled alarm system
15. Experiment on study of water level to current conversion
16. Experiment on study of characteristics of capacitive transducer
17. Practical examination

Suggested Reading

1. Don W. Green and Robert H. Perry. 2008. Perry's Chemical Engineers' Handbook. McGraw-Hill Co., Inc., NY, USA.
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.

Beas. 3213 Project Preparation and Management 2 (1+1)

OBJECTIVE

1. To create an awareness of the need for systematic management of projects, provides the skill in executing various projects, starting from project identification to project implementation.

THEORY

MODULE I (7 Hours)

Overview of project management: Functions and viewpoints of management, evolution of project management, forms and environment of project management; Project life cycle; Project selection: Project identification and screening, project appraisal, project charter, project proposal, project scope, statement of work

MODULE II (5 Hours)

Project planning and scheduling: Work breakdown structure, planning and scheduling of activity networks, network scheduling, precedence diagrams, critical path method, program evaluation and review technique, assumptions in PERT modelling, decision CPM, GERT; Project cost estimating: Types of estimates and estimating methods, dynamic project planning and scheduling, time-cost trade-offs, resource considerations in projects, resource profiles and levelling, limited resource allocation

MODULE III (4 Hours)

Project implementation, monitoring and control: Project management process and role of project manager, team building and leadership in projects, organizational and behavioural issues in project management, project monitoring and control, PERT/cost method, earned value analysis; Project completion and future directions: Project completion and review; Project management: Recent trends and future directions; Computers in project management.

PRACTICAL

Project Feasibility Studies, Project Identification, Market and Demand Analysis, Technical Analysis, Project Cost Estimate, Financial Appraisal of Single Projects, Financial Appraisal of Multiple Projects, Human Aspects in Project Management, Project Organisation, Project Leadership, Motivation in Project Management, Communication in the Project Environment, Conflict in Project Management, Project Scheduling with PERT/CPM, Time-Cost Trade-Off and Crashing of Projects, Application of Project Management Softwares, Contract Management, Project Cost Control (PERT/Cost), Resource Scheduling and

Resource Leveling, Risk Analysis in Project Management, Project Audit and Project Termination, Project Control, Case Studies on Project Management

Lecture Schedule

1. Overview of project management: Functions and viewpoints of management
2. Evolution of project management
3. Forms and environment of project management
4. Project life cycle
5. Project selection: Project identification and screening
6. Project appraisal, project charter
7. Project proposal, project scope, statement of work.
8. Mid term examination
9. Project planning and scheduling: Work breakdown structure, planning and scheduling of activity networks
10. Network scheduling, precedence diagrams, critical path method
11. Program evaluation and review technique, assumptions in PERT modelling, decision CPM, GERT
12. Project cost estimating: Types of estimates and estimating methods, dynamic project planning and scheduling
13. Time-cost trade-offs, resource considerations in projects, resource profiles and leveling, limited resource allocation
14. Project implementation, monitoring and control: Project management process and role of project manager, team building and leadership in projects, organizational and behavioural issues in project management
15. Project monitoring and control-PERT/cost method, earned value analysis
16. Project completion and future directions: Project completion and review
17. Project management: Recent trends and future directions; Computers in project management.

Practical Schedule

1. Project Feasibility Studies
2. Project Identification - Market and Demand Analysis
3. Technical Analysis
4. Project Cost Estimate
5. Financial Appraisal of Single Projects
6. Financial Appraisal of Multiple Projects
7. Human Aspects in Project Management - Project Organisation - Project Leadership
8. Motivation in Project Management, Communication in the Project Environment
9. Conflict in Project Management
10. Project Scheduling with PERT/CPM
11. Time-Cost Trade-Off and Crashing of Projects
12. Application of Project Management Softwares
13. Contract Management, Project Cost Control (PERT/Cost)
14. Resource Scheduling and Resource Levelling
15. Risk Analysis in Project Management, Project Audit and Project Termination
16. Project Control, Case Studies on Project Management
17. Final Practical Examination.

Suggested Reading

1. R. Panneerselvam. 2004. Operations Research, 2nd Ed. International Book House, Mumbai.
2. Prasanna Chandra. Projects. Tata McGraw-Hill Publication, New Delhi.
3. John M. Nicholas. Project Management for Business and Technology – Principles and Practices. Pearson Prentice Hall.
4. Harold Kerzner. Project Management – A System Approach to Planning, Scheduling, and Controlling. CBS Publishers & Distributors.
5. Prasanna Chandra. Projects – Planning, Analysis, Selection, Financing, Implementation, and Review. Tata McGraw-Hill Publishing Company Ltd.
6. P. Gopalakrishnan and V.E. Rama Moorthy. Textbook of Project Management. Macmillan

Pafe. 3236 Emerging Methods of Food Preservation 3 (2+1)

OBJECTIVE

1. To acquaint the students with the novel and emerging technologies in food preservation so as to keep pace with the recent technological developments which are less, energy and cost intensive, while maintaining quality and safety.

THEORY

MODULE I (11 Hours)

Fundamentals of food preservation-methods of food preservation-introduction, type and sources of radiation, dosimetry, mode of action of ionizing radiation –direct and indirect effect, radiation effect on food constituents, dose requirement for different products and regulations. Hurdle technology – Ozone – its role in food industry – generation – application.

MODULE II (12 Hours)

Pulsed electrified sterilization - application. Pulsed light processing - High pressure technology – application, Oscillating magnetic field sterilization, Ultra sound – application in food industry.

MODULE III (5 Hours)

Nano Technology: History, tools and techniques nanomaterials, applications in food packaging and products, implications, environmental impact of nanomaterials and their potential effects on global economics, Enzyme Technology: importance and significance, Effect of Enzyme Technology and its application in food industries.

MODULE IV (5 Hours)

Ohmic heating-fundamentals-UV-sterilization - microwave heating – Microwave assisted process in food processing- Radio Frequency heating- cold plasma technique.

Lecture Schedule

1. Fundamentals of food preservation-methods of food preservation
2. Introduction, scope of emerging food preservation methods

3. Radiation- sources and types of radiation in food industries
4. Dosimetry - mode of action of ionizing radiation, Radiation effect on food constituents direct and indirect effect
5. Radiation dose requirement for different products-Regulations involved in the application of radiation-Equipments
6. Hurdle technology – introduction and importance
7. Different types of hurdles occur in food spoilage-Hurdle effect – examples
8. Homeostasis – multi target preservation- metabolic exhaustion
9. Different types of hazards, physical, chemical and biological hazards.
10. Ozone – introduction and its role in food industry-advantages
11. generation of Ozone and its application
12. Different levels of ozone in preservation
13. Pulsed electric field sterilization – definition and significance-theory
14. Generation of pulsed electric fields- treatment chamber design-
15. Electric field strength- treatment time temperature – pulse geometry-
16. Application of Pulsed electrified sterilization in food industries
17. Pulsed light processing- theory – generation
18. Applications of Pulsed light processing
19. High pressure technology - importance and significance-Theory
20. HPP-equipment Effect of High pressure technology – Applications in food processing
21. Oscillating magnetic field sterilization- importance and significance- theory
22. Equipments for generation of magnetic field pulses - Effect of Oscillating magnetic field sterilization
23. Ultra sound - importance and significance- theory
24. Ultrasonic processing equipment- Application of ultrasound in food industries.
25. Midterm examination
26. Nano Technology - importance and significance
27. Nano materials - Effect of Nano Technology and its impact in global scenario-
28. Application of nano technology in food processing
29. Enzyme Technology- mode of action - importance and significance
30. Major enzymes and potential food applications
31. Ohmic, UV, microwave and radio frequency heating of food – theory and applications
32. Ohmic, UV, microwave and radio frequency heating of food – theory and applications
33. Ohmic, UV, microwave and radio frequency heating of food – theory and applications
34. Cold plasma technique - fundamentals – applications in food processing.

Suggested Readings

1. Fellows, P.J.2001. Food Processing Technology.
2. Leninger, H.A. and Beverlod, W.A. Food Process Engineering, D.Reicle Pub. Corp.
3. Peter Zeuthen and Leif Bogh- Sorensen. Food Preservation Techniques, Wood head Publishing Ltd. Cambridge.
4. Marcus Karel and Daryl B.Lund. Physical Principles of Food Preservation. Marcel Dekkaer Inc. New York.

5. Da-Wen Sun. 2005. Emerging Technologies for Food Processing, Food Science and Technology International, UK

SEMESTER -VII

Beas. 4114 Communication Skills and Personality Development 2 (1+1)

OBJECTIVES

1. To instill in students the confidence and assurance to speak formal as well as colloquial English.
2. To prepare them for career advancement skills such as group discussions, interviews etc.

THEORY

MODULE 1 (6 Hours)

Communication skills: Structural and functional grammar; Meaning and process of communication; Verbal and nonverbal communication; Listening and note taking; Writing skills; Oral presentation skills; Field diary and lab record; Indexing, footnote and bibliographic procedures.

MODULE II (4 Hours)

Reading and comprehension of general and technical articles; Precise writing, summarizing, abstracting; Individual and group presentations; Impromptu presentation; Public speaking; Group discussion and interviews; Organizing seminars and conferences. Language lab components, uses.

MODULE III (6 Hours)

Voice modulation basics and their usage for meaningful impact on people; Attributes of an effective leader; Stress and conflict management; Time management: Personal organization, prioritizing and balancing; Cosmopolitan culture; Impact of non verbal communication; Science of body language; Role of team work.

PRACTICAL

Listening and note taking, writing skills, oral presentation skills; Field diary and lab record; Indexing, footnote and bibliographic procedures; Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; Individual and group presentations; Video recorded mock group discussions and interviews; Attitude management; Setting and achieving a short term goal; Creating a personal vision statement of life; Voice modulation; Practicing conscious body postures and movements; Rapport building; Video recorded practical to evaluate change in confidence level; Team work exercises; Time management.

Lecture Schedule

1. Introduction
2. Structural and functional grammar
3. Meaning and process of communication
4. Verbal and nonverbal communication
5. Listening and note taking, Writing skills; Oral presentation skills
6. Field diary and lab record; Indexing, footnote and bibliographic procedures.
7. Mid Examination
8. Reading and comprehension of general and technical articles; Precise writing
9. Summarizing, abstracting, Impromptu presentation
10. Public speaking (Elocution, Extempore, Debates)
11. Group discussion and interviews; Organizing seminars and conferences; Language lab components and uses.
12. Voice modulation basics and their usage for meaningful impact on people; Attributes of an effective leader
13. Stress and conflict management
14. Time management: Personal organization, prioritizing and balancing
15. Cosmopolitan culture
16. Impact of non verbal communication; Science of body language
17. Role of team work.

Practical Schedule

1. Listening and note taking
2. Writing skills
3. Oral presentation skills
4. Field diary and lab record
5. Indexing
6. Footnote and bibliographic procedures.
7. Reading and comprehension of general and technical articles
8. Precise writing
9. Summarizing and Abstracting
10. Individual and group presentations.
11. Attitude management; Setting and achieving a short term goal
12. Creating a personal vision statement of life
13. Voice modulation; Practicing conscious body postures and movements
14. Rapport building; Video recorded practical to evaluate change in confidence level
15. Team work exercises, Time management
16. Language lab exercises for communication skill development
17. Practical Examination

Suggested Reading

1. Carnegie, Dale. 2012. *How to Win Friends and Influence People in the Digital Age.* Simon & Schuster.
2. Covey Stephen R. 1989. *The Seven Habits of Highly Successful People.* Free Press.

3. Spitzberg B, Barge K & Morreale, Sherwyn P. 2006. *Human Communication: Motivation Knowledge & Skills.* Wadsworth.
4. Verma, KC. 2013. *The Art of Communication*. Kalpaz.

Beas. 4115 Entrepreneurship Development (2+1)

OBJECTIVES

1. To know the rhythm and strength of entrepreneurship
2. To understand the need and importance of entrepreneurship
3. To explore the scope of entrepreneurship

THEORY

MODULE I (9 Hours)

Concept of entrepreneur, entrepreneurship & enterprise, Functions and characteristics of entrepreneur, Innovation and entrepreneurship, Risks involved with entrepreneurship, 6 C's that motivates an entrepreneur, Creativity-invention-innovation, Difference between entrepreneur and manager, Assessing overall business environment in Indian economy, Globalisation, Implications of social-political and economic systems on entrepreneurship

MODULE II (8 Hours)

Importance of planning, budgeting, monitoring, evaluation and follow up in running an enterprise, SWOT analysis, , Environmental analysis, Managing Competition in modern world and Entrepreneurship Development Programmes, incubation and commercialization of ideas and innovations, Women entrepreneurship- Role, importance & problems.

MODULE III (8 Hours)

Project Management-Identification, feasibility study, selection, planning, evaluation and controlling, Government schemes and incentives for promotion of Entrepreneurship, Small and medium enterprises (SMEs)/SSIs & Government policies

MODUL IV (9 Hours)

Social Responsibility of a business, business ethics, an overview on EXIM policies relevant to food processing sector, Venture capital; Contract farming and joint ventures, public-private partnerships; Overview of food industry inputs; Characteristics of Indian food processing industries and export

PRACTICAL

Visit to public enterprise; Visit to private enterprise; Visit to agro-processing/food business centres; SWOC analysis of public enterprises; SWOT analysis of private enterprises; Project proposals as entrepreneur – individual and group; Presentation of project proposals in the class.

Lecture Schedule

1. Concept of entrepreneur, entrepreneurship and enterprise
2. Entrepreneurial characteristics, Distinction between an entrepreneur and a Manager.

3. Agri-entrepreneurship-concept, need and scope
4. Agri-entrepreneurship-concept, need and scope
5. Innovation and entrepreneurship, Risks involved with entrepreneurship.
6. 6 C's that motivates an entrepreneur
7. Assessing overall business environment in Indian economy, Globalisation
8. Implications of social-political and economic systems on entrepreneurship
9. Implications of social-political and economic systems on entrepreneurship
10. Women entrepreneurship- Role, importance & problems.
11. Importance of planning, budgeting, monitoring, evaluation and follow up in running an enterprise
12. Importance of planning, budgeting, monitoring, evaluation and follow up in running an enterprise
13. Environmental analysis techniques and SWOT analysis
14. Generation, incubation and commercialization of ideas and innovations
15. Managing Competition in modern world and Entrepreneurship Development Programmes
16. Managing Competition in modern world and Entrepreneurship Development Programmes
17. Mid term examination
18. Meaning and characteristics of a project, Project Life cycle, Project Management and its need- Identification, feasibility study, selection, planning, evaluation and controlling
19. Meaning and characteristics of a project, Project Life cycle, Project Management and its need- Identification, feasibility study, selection, planning, evaluation and controlling
20. Project appraisal & evaluation- an understanding
21. Project appraisal & evaluation- an understanding
22. Government schemes and incentives for promotion of Entrepreneurship & an understanding on industries promotional institutions
23. Government schemes and incentives for promotion of Entrepreneurship & an understanding on industries promotional institutions
24. Micro, Small& medium enterprises- classification, objectives
25. Characteristics of MSME's, Advantages & disadvantages of MSME's
26. A brief understanding about DIC, KVIC, SIDBI, IDBI, NABARD,
27. A brief understanding about KITCO, KFC, SIDCO, KCIDC & KINFRA
28. Business ethics & social responsibility of an enterprise
29. Venture capital, contract farming and joint ventures
30. Venture capital, contract farming and joint ventures
31. Public- Private partnership (PPP) and its relevancy
32. An overview on EXIM policies relevant to food processing sector
33. An overview on EXIM policies relevant to food processing sector
34. Overview of food industry inputs: Characteristics of Indian food processing industries and export

Practical Schedule

1. Conduct a visit to KINFRA or KILA, understand its importance and write a report about their role in ED
2. Meet a young entrepreneur and arrange an interview, record it either in written format or using your mobile camera (Explore his/her motivation to become an entrepreneur, Product/Service selection, Challenges faced/facing, how he/she managing things etc.)
3. Go and collect the details about setting up an enterprise- Which are the offices, essential documents, how to get a trade license, paper works etc.
4. Make individual PPT presentation about innovative business ideas. Select five best ideas from it and transform it into five Business Plans (Group work)
5. Conduct a SWOC analysis of a private & public organization in your locality and compare it.
6. Present best/model CSR activities of ten enterprises (Global and National)
7. Conduct a GD about PPP or make class seminar on advantages of PPP based on examples
8. Visit a successful agribusiness organization or co-operative and understand its operations
9. Practical examination

Suggested Reading

1. C.B. Gupta and N.P. Srinivasan. 2012. Entrepreneurship Development. S. Chand & Sons, New Delhi.
2. Anil Kumar, S., Poornima, S.C., Mini, K., Abraham and Jayashree, K. 2003. Entrepreneurship Development. New Age International Publishers, New Delhi.
3. Gupta, C.B. 2001. Management: Theory and Practice. Sultan Chand & Sons, New Delhi.
4. Vasant Desai. 2000. Dynamics of Entrepreneurial Development and Management. Himalaya Publishing House, New Delhi.
5. K.P. Sudheer and V.Indira.2018. Entrepreneurship and skill development in Horticultural Processing. New India Publishing Agency, New Delhi.

Student Ready – Experiential Learning Programme

Experiential Learning helps the student to develop competence, capability, capacity building, acquiring skills, expertise, and confidence to start their own enterprise and turn job creators instead of job seekers. This embraces the earning while learning concept. Experiential Learning is a major step forward for high quality professional competence, practical work experience in real life situation to graduates, production oriented courses, production to consumption project working, and inculcates entrepreneurial orientation.

a) Concept

The word ‘experiential’ essentially means that learning and development are achieved through personally determined experience and involvement, rather than on received teaching

or training, typically in group, by observation, study of theory or hypothesis, and bring in innovation or some other transfer of skills or knowledge. Experiential learning is a business curriculum-related endeavour which is interactive.

EL is for building (or reinforcing) skills in project development and execution, decision making, individual and team coordination, approach to problem solving, accounting, marketing and resolving conflicts, etc. The programme has end to end approach. Carefully calibrated activities move participants to explore and discover their own potential. Both activities and facilitation play a critical role in enhancing team performance.

b) Objectives

EL provides the students an excellent opportunity to develop analytical and entrepreneurial skills, and knowledge through meaningful hands on experience, confidence in their ability to design and execute project work.

The main objectives of EL are:

- To promote professional skills and knowledge through meaningful hands on experience.
- To build confidence and to work in project mode.
- To acquire enterprise management capabilities

Exlp. 4101 Student READY - Experiential Learning Programme - I 7 (0+7)

&

Exlp. 4102 Student READY - Experiential Learning Programme - II 7 (0+7)

These two programmes will be undertaken by the students during the VIIth semester with a weightage of 0+7 credit hours each in relevant pilot plants established for processing of various commodities, preferably on campus. This shall include development of Detailed Project Report on setting up of an enterprise in the selected areas of product manufacture and evaluation of the module. The students will be divided into groups and can undergo the programme in any of the modules as listed below based on the facilities in the institution in full spirit of the concepts and objectives of the experimental learning programme as envisaged above.

- Fruit and Vegetable based products
- Cereal based products
- Oil seed based products
- Bakery and confectionary
- Beverage production
- Spice based products
- Meat based products
- Fish based products
- Dairy products
- Pulses and millet based products

- Plantation crops products preservation
- Non thermal methods of food preservation
- Drying technology
- Packaging technologies

Proj. 4101 Student READY - Research Project 3 (0+3)

Students (individual/ group) will undertake a Project with a credit load of 0+3 credit hours on investigation of selected problems of special interests in Food Processing Technology. The work includes library work, field or laboratory research, recording data, analyzing data and writing of report, etc.

Semr. 4101 Student READY - Seminar 1 (0+1)

Seminar includes preparation of synopsis, presentation and discussion by each student on current topics/ interests in Food Processing Technology with weightage of 0+1credit hours.

SEMESTER –VIII

Idtr. 4201 Student READY - Industrial Tour 2 (0+2).

Educational Tour of two- three weeks to various industries within and outside the state of the university and submission of report on Industrial Tour.

Student READY -In Plant Training

Technology and globalization are ushering an era of unprecedented change. The need and pressure for change and innovation is immense. To enrich the practical knowledge of the students, In-plant Training shall be mandatory in the last semester for a period of up to 10 weeks. In this training, students will have to study a problem in industrial perspective and submit the reports to the university. Such In-plant Trainings will provide an industrial exposure to the students as well as to develop their career in the high tech industrial requirements. In-plant Training is meant to correlate theory and actual practices in the industries. It is expected that sense of running an industry may be articulated in right way through this type of industrial attachment mode.

Objectives

- To expose the students to industrial environment which cannot be simulated in the university.
- To familiarize the students with various materials, machines, processes, products and their applications along with relevant aspects of shop management.
- To make the students understand the psychology of the workers, and approach to problems along with the practices followed at factory

- To make the students understand the scope, functions and job responsibility-ties in various departments of an organization.
- Exposure to various aspects of entrepreneurship during the programme period.

Iplt. 4201 Student READY - In-Plant Training 20 (0+20)

In-plant Training of one semester duration with a credit load of 0+20 credit hours for a period of up to 10 weeks at relevant food processing industry, machinery manufacturer, marketing or other agencies. The In-plant Training is intended to expose the students to an environment in which they are expected to be associated in their future career. The students will be required to have hands-on-experience in one or more commercial establishments.