

BROWN BOOK

2016



**PROFESSOR JAYASHANKAR TELANGANA STATE
AGRICULTURAL UNIVERSITY**
FACULTY OF AGRICULTURAL ENGINEERING AND TECHNOLOGY
RAJENDRANAGAR, HYDERABAD - 30.

Detailed Lecture Out Lines - 2016

B.Tech. (Food Technology) Degree

1. Department wise list of courses, course numbers and credit hours

Sl. No.	Course Number	Title of the Course	Credit hours
I. Food Process Technology (FDPT)			
1	FDPT 211	Fundamentals of Food Processing	3 (2+1)
2	FDPT 212	Processing Technology of Liquid Milk	2 (1+1)
3	FDPT 213	Processing Technology of Cereals	3 (2+1)
4	FDPT 214	Processing Technology of Dairy Products	3 (2+1)
5	FDPT 215	Processing Technology of Legumes and Oilseeds	3 (2+1)
6	FDPT 216	Processing Technology of Fruits and Vegetables	3 (2+1)
7	FDPT 311	Processing Technology of Beverages	3 (2+1)
8	FDPT 312	Processing of Meat and Poultry Products	3 (2+1)
9	FDPT 313	Bakery, Confectionery and Snack Products	3 (2+1)
10	FDPT 314	Processing of Spices and Plantation Crops	3 (2+1)
11	FDPT 315	Food Packaging Technology and Equipment	3 (2+1)
12	FDPT 316	Processing of Fish and Marine Products	3 (2+1)
13	FDPT 317	Sensory Evaluation of Food Products	3 (1+2)
Total			38(24+14)

II. Food Process Engineering (FDPE)			
1	FDPE 121	Fluid Mechanics	3 (2+1)
2	FDPE 122	Post Harvest Engineering	3 (2+1)
3	FDPE 221	Food Thermodynamics	3 (2+1)
4	FDPE 222	Unit Operations of Food Processing-I	3 (2+1)
5	FDPE 223	Heat and Mass Transfer in Food Processing	3 (2+1)
6	FDPE 224	Unit Operations of Food Processing-II	3 (2+1)
7	FDPE 225	Food Refrigeration and Cold Chain	3 (2+1)
8	FDPE 321	Food Process Equipment Design	3 (2+1)
9	FDPE 322	Food Storage Engineering	3 (2+1)
10	FDPE 421	Instrumentation and Process Control in Food Industry	3 (2+1)
Total			30(20+10)

III. Food Safety and Quality Assurance (FDSQ)			
1	FDSQ 131	General Microbiology	3 (2+1)
2	FDSQ 132	Food Biochemistry and Nutrition	3 (2+1)
3	FDSQ 133	Food Chemistry of Macronutrients	3 (2+1)
4	FDSQ 134	Food Microbiology	3 (2+1)
5	FDSQ 231	Industrial Microbiology	3 (2+1)
6	FDSQ 232	Food Chemistry of Micronutrients	3 (2+1)
7	FDSQ 331	Instrumental Techniques in Food Analysis	3 (1+2)

8	FDSQ 332	Food Biotechnology	3(2+1)
9	FDSQ 333	Food Plant Sanitation	2 (1+1)
10	FDSQ 334	Food Additives and Preservatives	2 (1+1)
11	FDSQ 335	Food Quality, Safety Standards and Certification	2 (2+0)
Total			30(19+11)
IV. Food Business Management (FDBM)			
1	FDBM 141	Business Management and Economics	2 (2+0)
2	FDBM 241	ICT Applications in Food Industry	3 (1+2)
3	FDBM 242	Marketing Management and International Trade	2 (2+0)
4	FDBM 341	Entrepreneurship Development	3 (2+1)
5	FDBM 342	Project Preparation and Management	2 (1+1)
6	FDBM 441	Communication and Soft Skills Development	2 (0+2)
Total			14(8+6)
V. Food Plant Operations (FDPO)			
1	FDPO 451	Student READY - Experiential Learning Programme - I	7 (0+7)
2	FDPO 452	Student READY - Experiential Learning Programme - II	7 (0+7)
3	FDPO 453	Student READY - Research Project	3 (0+3)
4	FDPO 454	Student READY - Seminar	1 (0+1)
5	FDPO 455	Student READY - Industrial Tour	2 (0+2)
6	FDPO 456	Student READY – Internship/In-Plant Training	20 (0+20)
Total			40(0+40)
VI. Basic Engineering (BASE)			
1	BASE 161	Engineering Drawing and Graphics	3 (1+2)
2	BASE 162	Workshop Technology	3 (1+2)
3	BASE 163	Electrical Engineering	3 (2+1)
4	BASE 164	Computer Programming and Data Structures	3 (1+2)
5	BASE 165	Basic Electronics Engineering	3 (2+1)
Total			15(7+8)
VII. Basic Sciences and Humanities (BASH)			
1	BASH 101	Comprehension and Communication Skills in English	2 (1+1)
2	BASH 102	Engineering Mathematics-I	2 (2+0)
3	BASH 103	Crop Production Technology	3 (2+1)
4	BASH 104	Engineering Mathematics-II	2 (2+0)
5	BASH 201	Statistical Methods and Numerical Analysis	2 (1+1)
6	BASH 301	Environmental Science and Disaster Management	2 (1+1)
Total			13(9+4)

2. Semester wise course numbers, courses, and credit hours`

Sl. No.	Course number	Course title	Credit hours
I Semester			
1	BASH 101	Comprehension and Communication Skills in English	2 (1+1)
2	BASH 102	Engineering Mathematics-I	2 (2+0)
3	BASH 103	Crop Production Technology	3 (2+1)
4	FDSQ 131	General Microbiology	3 (2+1)
5	FDSQ 132	Food Biochemistry and Nutrition	3 (2+1)
6	FDBM 141	Business Management and Economics	2(2+0)
7	BASE 161	Engineering Drawing and Graphics	3 (1+2)
8	BASE 162	Workshop Technology	3 (1+2)
9	COCA 100	NSS/NCC (Non-credit)	1 (0+1)
			21 (13+8)
II Semester			
1	BASH 104	Engineering Mathematics-II	2 (2+0)
2	FDPE 121	Fluid Mechanics	3 (2+1)
3	FDPE 122	Post Harvest Engineering	3 (2+1)
4	FDSQ 133	Food Chemistry of Macronutrients	3 (2+1)
5	FDSQ 134	Food Microbiology	3 (2+1)
6	BASE 163	Electrical Engineering	3 (2+1)
7	BASE 164	Computer Programming and Data Structures	3 (1+2)
8	BASE 165	Basic Electronics Engineering	3 (2+1)
9	COCA 200	Physical Education(Non-credit)	1 (0+1)
			23 (15+8)

III Semester			
1	BASH 201	Statistical Methods and Numerical Analysis	2 (1+1)
2	FDPT 211	Fundamentals of Food Processing	3 (2+1)
3	FDPT 212	Processing Technology of Liquid Milk	2 (1+1)
4	FDPT 213	Processing Technology of Cereals	3 (2+1)
5	FDPE 221	Food Thermodynamics	3 (2+1)
6	FDPE 222	Unit Operations in Food Processing-I	3 (2+1)
7	FDSQ 231	Industrial Microbiology	3 (2+1)
8	FDSQ 232	Food Chemistry of Micronutrients	3 (2+1)
9	COCA 300	Yoga, Ethics and Moral Education (Non-credit)	1(0+1)
			22 (14+8)
IV Semester			
1	FDPT 214	Processing Technology of Dairy Products	3 (2+1)
2	FDPT 215	Processing Technology of Legumes and Oilseeds	3 (2+1)
3	FDPT 216	Processing Technology of Fruits and Vegetables	3 (2+1)
4	FDPE 223	Heat and Mass Transfer in Food Processing	3 (2+1)
5	FDPE 224	Unit Operations in Food Processing-II	3 (2+1)
6	FDPE 225	Food Refrigeration and Cold Chain	3 (2+1)
7	FDBM 241	ICT Applications in Food Industry	3 (1+2)
8	FDBM 242	Marketing Management and International Trade	2 (2+0)
			23(15+8)
V Semester			
1	BASH 301	Environmental Sciences & Disaster Management	2 (1+1)
2	FDPT 311	Processing Technology of Beverages	3 (2+1)
3	FDPT 312	Processing of Meat and Poultry Products	3 (2+1)
4	FDPT 313	Bakery, Confectionery and Snack Products	3 (2+1)
5	FDPE 321	Food Process Equipment Design	3 (2+1)
6	FDPE 322	Food Storage Engineering	3 (2+1)
7	FDSQ 331	Instrumental Techniques in Food Analysis	3 (1+2)
8	FDSQ 332	Food Biotechnology	3 (2+1)
			23 (14+9)
VI Semester			
1	FDPT 314	Processing of Spices and Plantation Crops	3 (2+1)
2	FDPT 315	Food Packaging Technology and Equipment	3 (2+1)
3	FDPT 316	Processing of Fish and Marine Products	3 (2+1)
4	FDPT 317	Sensory Evaluation of Food Products	3 (1+2)
5	FDSQ 333	Food Plant Sanitation	2 (1+1)
6	FDSQ 334	Food Additives and Preservatives	2(1+1)
7	FDSQ 335	Food Quality, Safety Standards and Certification	2 (2+0)
8	FDBM 341	Entrepreneurship Development	3 (2+1)
9	FDBM 342	Project Preparation and Management	2(1+1)
			23 (14+9)

VII Semester			
1	FDPE 421	Instrumentation and Process Control in Food Industry	3 (2+1)
2	FDBM 441	Communication and Soft Skills Development	2 (0+2)
3	FDPO 451	Student READY - Experiential Learning Programme - I	7 (0+7)
4	FDPO 452	Student READY - Experiential Learning Programme - II	7 (0+7)
5	FDPO 453	Student READY - Research Project	3 (0+3)
6	FDPO 454	Student READY - Seminar	1 (0+1)
			23 (2+21)
VIII Semester			
1	FDPO 455	Student READY - Industrial Tour	2 (0+2)
2	FDPO 456	Student READY - Internship/In-Plant Training	20 (0+20)
			22 (0+22)
Grand Total			180(87+93)

COMPREHENSION AND COMMUNICATION SKILLS IN ENGLISH

Objective: By the end of the course the students will be able to understand the basic concepts of comprehension, understand the fundamentals of grammar, enhance their vocabulary and Improve their skills in written communication.

Lecture**Topic****Theory**

- 1 Introduction-Importance of English language and communication skills in the engineering profession
- 2 Reading of selected texts and discussion-War minus Shooting – Reading Comprehension – Vocabulary building.
- 3 A Dilemma – Reading Comprehension – Vocabulary building.
- 4 You and your English – Reading comprehension – Vocabulary building.
- 5 Parts of Speech-Proper use of Pronouns-adjectives and adverbs-Phrases and clauses
- 6 Proper use of phrases and clauses
- 7 Voice and degree of comparison
- 8 Agreement and disagreement between subject and verb-main features likes, dislikes and enquires
- 9 Debate and group discussion
- 10 Basic sentence patterns-Types of sentences-Paragraph writing
- 11 Basic rules of composition-Note making and note taking
- 12 Development of vocabulary-Vocabulary building tasks- Synonyms-Antonyms-Homonyms-Homophones
- 13 Reference skills-Use of Dictionary-Thesaurus Dictionary- Indexing and Glossary-contents
- 14 Business Correspondence – Letter writing
- 15 Cohesion, Coherence and Style
- 16 Precis writing

Practical

- 1 Functional Grammar-Present tense-Past tense-Future tense-Direct and Indirect Speech-Direct and Indirect Narration
- 2 Spoken English-Monophthongs-Diphthongs-Vowels and Consonants
- 3 Effective Listening Skills- Developing Listening Skills.
- 4 Listening to short talks with the help of cassettes.
- 5 Reading skills- skimming – scanning – extensive reading.
- 6 Active and passive Voice- Voice change.
- 7 Parts of Speech- Prepositions- determiners.
- 8 Word formation with parts of speech.
- 9 Types of sentences in English-Simple sentence- Compound sentence- complex sentence and compound complex sentence.
- 10 Word stress- Intonation patterns.
- 11 Report writing –Types of reports- Laboratory reports – Inspection reports- presentation of reports.

- 12 Letters- Types of Letters- personal letters- official letters- Business letters- Applications.
- 13 Interview and Mock interview
- 14 Telephonic Conservation
- 15 Composition-Business Correspondence
- 16 Semester final Practical examination

References

- 1 Alice Oshima and Ann Hogue. 1998. Writing Academic English. Addison Wesley Longman
- 2 N. Krishnaswamy and T. Sriraman. 1995. Current English for Colleges. Macmillan India Ltd.

ENGINEERING MATHEMATICS-I

Objective: By studying Ordinary Differential Equations students will learn to formulate ordinary differential equations (ODEs) and seek understanding of their solutions, either obtained exactly or approximately by analytic or numerical methods. Students get the ability to find the effects of changing conditions on the system being investigated. Calculus helps the engineers to assess food processing models and control systems. By the end of the course student can construct different mathematical models in food technology and analysis. Further they can study and compare the existing results with real life situations.

**Lecture
Theory****Topic**

- 1 Differential calculus: Taylor's and Maclaurin's expansions: Explanation of Taylor's and Maclaurin's Theorem. Some Algebraic, Trigonometric and Lagarithmatic function's expansions.
- 2 Indeterminate forms: Various types of indeterminate forms, explanation of L- Hospital's Rule. Few example problems on indeterminate forms.
- 3 Problems on Curvature and asymptotes: Length of arc in Cartesian and polar coordinates. Few examples on finding the Radius of curvature.
- 4 Problems on Tracing of curves: Problems on Tracing of curves by checking varies properties
- 5 Function of two or more independent variables, Partial differentiation: Explanation on functions of several variables. Definition of Partial Differentiation and some examples.
- 6 Homogeneous functions and Euler's theorem: Explanation on varies types of homogeneous functions with various examples. Problems on Euler's theorem.
- 7 Composite functions and Total derivatives: Explanation of chain rule. Definition of Total derivative and some problems.
- 8 Problems on Maxima and Minima: Explanation about critical point, saddle point and its applications. Various types of problems on finding of Maxima and Minima.
- 9 Integral calculus: Reduction formulae, rectification of standard curves: Problems on finding the area of a surface revolution of Cartesian and polar functions.
- 10 Volumes and surfaces of revolution of curves: Introduction on Volumes and surfaces of revolution of curves. Various Problems on Cartesian and polar functions.
- 11 Problems on Double and Triple Integrals: Definition of triple Integration. Various Problems on triple integration for Cartesian and polar functions.
- 12 Change of order of Integration: Different problems on changing the order of integration for two and three independent variables functions. Problems gamma and beta functions.
- 13 Application of double and triple integrals to find area and volume: Various agricultural applications to find area and volume by using on double and triple integrals.

- 14 Ordinary differential equations::Formation of Differential Equations: Introduction Differential Equation, Formation of differential equation by eliminating arbitrary constants and arbitrary functions.
- 15 Linear Differential Equations and Bernoulli's differential equations: Introduction to Linear Differential Equation. Solving the Linear Differential & Bernoulli's Differential Equation with some example problems.
- 16 Exact differential equations: Introduction to Exact Differential Equation.Solving the Exact Differential Equation with some example problems.
- 17 Equations reducible to exact form by integrating factors: various Integrating factors. Problems on Solving the Non Exact differential equation.
- 18 Differential Equations of first order and higher degree & Clairaut's equation: Introduction, solving the various types of first order first degree problems.
- 19 Differential equations of higher orders: Introduction, solving the various types of higher order problems. Introduction of complementary function and Particular Integrals. Solving various types of higher order problems.
- 20 Method of variation of parameters: Solving various types of higher order problems by using variation of parameters.
- 21 Cauchy's and Legendre's linear equations: - Introduction on Cauchy's and Legendre's linear equations. Some related problems
- 22 Simultaneous linear differential equations with constant coefficients: Introduction of Simultaneous differential equations. Solving various types of Simultaneous differential problems by using variation of parameters.
- 23 Series solution techniques of differential equations, Bessel's differential equations: Introduction of differential equations of series solution. Solving various types' differential equations with its series solution.
- 24 Legendre's differential equations: Solving various types Legendre's differential equations problems with its series solution.
- 25 Vector calculus: Differentiation of vectors, scalar and vector point functions: Introduction of vectors with some basic applications, Definition of differentiation of Vector functions.
- 26 Vector differential operators, Gradient of a scalar point function: Introducing various Vector differentials Operators, and problems on gradient of functions.
- 27 Divergence and Curl of a vector point function and their physical interpretations: – Introducing Divergence and Curl of a vector point functions and problems on divergence and curl of functions.
- 28 Identities involving Del, grad, Curl, and Second order differential operators: Various types of Identities, derivations on second order differential operators.
- 29 Problems on Line integrals and their physical interpretations: Define the line integral. Various problems on Line integrals and its applications.
- 30 Problems on surface integrals and their physical interpretations:: Define the surface integral. Various problems on surface integrals and its applications.
- 31 Problems on Volume integrals and their physical interpretations: Define the volume integral. Various problems on volume integrals and its applications

- 32 Stoke's divergence and Green's theorems (without proofs): Explanation of Stoke's and Green's theorem.

References

- 1 Higher Engineering Mathematics by Grewal B S 2004. Khanna publishers Delhi
- 2 Differential calculus by Shanti Narayan. 2004, S. Chand and Co. Ltd. New Delhi.
- 3 Integral calculus by Shanti Narayan 2004. S.Chand and Co. Ltd., New Delhi.
- 4 Vector calculus by Shanti Narayan. 2004. A Text Book of Vector.
S. Chand and Co. Ltd. New Delhi.
- 5

CROP PRODUCTION TECHNOLOGY

Objective: By the end of the course the students will be able

- To know the food production practices for major food crops in India
- To know the production practices for Horticultural crops grown in India
- To know the yielding varieties grown in India

Lecture**Topic****Theory**

- 1 Classification of crops
- 2 Effect of different weather parameters on crop growth and development
- 3 Principles of tillage
- 4 Soil-water-plant relationship
- 5 Crop rotation, cropping systems, relay cropping and mixed cropping
- 6 Crop production technology for major cereal crops viz., paddy, wheat, maize, pearl millet, sorghum, etc
- 7 Crop production technology for major cereal crops viz., paddy, wheat, maize, pearl millet, sorghum, etc
- 8 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.;
- 9 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.;
- 10 Crop production technology for major oilseed crops viz., groundnut, sesame, rapeseed, mustard, castor, etc.:
- 11 Crop production technology for major oilseed crops viz., groundnut, sesame, rapeseed, mustard, castor, etc.:
- 12 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.;
- 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 for major pulse crops viz., pigeon pea, cowpea, gram, green gram, black gram, etc
- 15 Crop production technology for major pulse crops viz., pigeon pea, cowpea, gram, green gram, black gram, etc
- 16 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.;
- 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 Crop production technology for major spices and cash crops viz., cumin, coriander, funnel, ginger, garlic, sugarcane, etc.
- 19 Crop production technology for major spices and cash crops viz., cumin, coriander, funnel, ginger, garlic, sugarcane, etc.
- 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 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.
- 22 Horticulture: Scope of horticultural crops.
- 23 Soil and climatic requirements for fruits and vegetables, nursery raising and management
- 24 Crop production technology for major fruit crops viz., mango, banana, sapota, aonla, pomegranate, guava, etc
- 25 Crop production technology for major fruit crops viz., mango, banana, sapota, aonla, pomegranate, guava, etc
- 26 Crop production technology for major fruit crops viz., mango, banana, sapota, aonla, pomegranate, guava, etc
- 27 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.
- 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 for major vegetable crops viz., potato, onion, tomato, chilli and other green and leafy vegetables:
- 30 Crop production technology for major vegetable crops viz., potato, onion, tomato, chilli and other green and leafy vegetables:
- 31 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
- 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

Practical

- 1 Examination of soil profile in the field
- 2 Examination of soil profile in the field
- 3 Introduction to different equipments utilized in a weather observatory
- 4 Identification of seed of different agricultural crops and their varieties
- 5 Study of seed viability and germination test
- 6 Identification of different weeds and methods of their control
- 7 Identification of different weeds and methods of their control

- 8 Use of different inter-culturing equipments
- 9 Study of water requirement of different crops
- 10 Fertilizer application methods and equipments
- 11 Judging maturity time for harvesting of crop
- 12 Identification and description of important fruit and vegetable crops;
- 13 Preparation of nursery
- 14 Study of different garden tools
- 15 Practices of pruning and training in some important fruit crops
- 16 Practical examination

References

- 1 S. Prasad and U. Kumar. 2010. Principles of Horticulture. Agrobios
- 2 T. Yellamanda Reddy and G.H. Shankar Reddy. 1995. Principles of Agronomy. Kalyani Publishers
- 3 S.S. Singh. Principles and Practices of Agronomy. 1985. Kalyani Publishers

GENERAL MICROBIOLOGY

Objective: By the end of the course the students will be able to know about different types of micro organisms that invade food and knowledge about pathogenic organism. To impart knowledge about metabolic activities of micro organisms (Bacteria and fungi). To know about microbial culture media and their applications and preservation

**Lecture
Theory****Topic**

- 1 Evolution and scope of Microbiology. Haeckel's Kingdom protista. Prokaryotic and Eukaryotic protests. Whittaker's Five kingdom concept. Kingdom prokaryote after Bergey's Manual of Systematic Bacteriology
- 2 History of microbiology. Spontaneous generation vs. Biogenesis. Contributions of different scientists to the microbiology. Germ theory of Diseases
- 3 Microbial classification, Nomenclature and Identification; Taxonomic groups, General methods of classifying bacteria
- 4 Microscopy and Microscopes: Bright field microscopy, Resolving power, Numerical aperture, Limit of resolution. Magnification, Dark field microscopy
- 5 Types of Microscopes: Fluorescent antibody technique, Immuno fluorescence, Phase contrast microscopy, Electron microscope. Smears and staining methods
- 6 Morphology and fine structure of bacteria: Size, shape and arrangement of bacterial cells. Bacterial structures - flagella and motility, pili, capsules, sheaths, prosthecae and stalks
- 7 Cellwall, Cytoplasmic membrane, Protoplasts, Spheroplasts, Mesosomes, Cytoplasm, Ribosomes, Cytoplasmic inclusions and Vacuoles, Nuclear material, Endospores and Cysts.
- 8 Cultivation of bacteria, Nutritional requirements. Nutritional classification of bacteria- Phototrophs, Chemotrophs, Autotrophs and Heterotrophs; Obligate parasites
- 9 Bacteriological media, Types of media, Physical conditions required for growth
- 10 Growth of bacteria, Normal growth cycle (growth curve) of bacteria. Transitional periods between growth phases. Synchronous growth. Continuous Culture
- 11 Quantitative measurement of bacterial growth. Direct microscopic count. Electronic enumeration of cell numbers. Plate count method, membrane filter count
- 12 Turbidimetric methods. Determination of Nitrogen content. Determination of dry weight of cells
- 13 Reproduction of bacteria. Binary fission, Budding. Distinguishing characteristics of fungi, morphology of fungi. Asexual reproduction of fungi and sexual reproduction of fungi. Cultivation of fungi
- 14 Introduction to Yeast. Morphological characteristics. Reproduction and cultural characteristics
- 15 Introduction to algae- Morphology, Reproduction and Rickettsia. Introduction to Protozoa - Morphology and Reproduction of protozoa

- 16 Introduction to viruses: Discovery and significance. General characteristics. Morphology and structure (Morphological groups of phages)
- 17 Phage structures, phage nucleic acids and replications of bacterial viruses
- 18 Lysogeny, Food borne viruses (Polio, hepatitis, gastroenteritis viruses).
- 19 Nutrient transport phenomenon: Passive diffusion, facilitated diffusion; Group translocation, active transport
- 20 Microbial genetics; Bacterial recombination, Bacterial conjugation, Bacterial Transduction
- 21 Bacterial transformation. Regulation and expression of gene activity. (Lac operon).
- 22 Energy production: Oxidation and reduction reactions. Energy production by anaerobic processes (Glycolysis, Pentose Phosphate Pathway, Entner-Doudoroff pathway, fermentation)
- 23 Energy production by aerobic processes: TCA cycle, energy yield in aerobic respiration.
- 24 Mutations. Types of mutations, Mutagenesis, Mutation rate - repair of mutations, Phenotypes of bacterial mutants. Designation of bacterial mutants.
- 25 Destruction of microorganisms. Physical agents - High temperature, thermal death time and decimal reduction time, application of high temperatures for destruction of microorganisms.
- 26 Destruction of microorganisms - low temperatures, Desiccation, Osmotic pressure, Radiation, U.V. light, x-rays, Gamma rays, Cathode rays, Bacteriological filters
- 27 Control of micro organisms by chemical agents. Characteristics of an ideal antimicrobial chemical agent. Phenol and phenolic compounds, lactose
- 28 Alcohols, Halogens, Heavy metals and their compounds, dyes, Synthetic detergents, Quaternary ammonium compounds, Aldehydes, Gases as Agents
- 29 Control of microorganisms by antibiotics. Chemotherapeutic agents and chemotherapy. Characteristics of antibiotics
- 30 Mode of Action of Antibiotics. Antifungal, antibiotics, antiviral chemo-therapeutic agents. Anti tumor antibiotics, synthetic chemotherapeutic agents
- 31 Pure culture: Methods of isolation of pure cultures
- 32 Maintenance and preservation of pure cultures, Culture collections.

Practical

- 1 Instruction and acquainting with equipment used in microbiology;
- 2 Experiment on Microscopy
- 3 Experiment on Micrometry
- 4 Cleaning and sterilization of glassware
- 5 Preparation of nutrient agar media and techniques of inoculation
- 6 Staining methods- study on monochrome staining
- 7 Study on Gram staining
- 8 Study on Negative staining
- 9 Study on Capsule staining
- 10 Study on Flagella staining
- 11 Study on Endospore staining
- 12 Pure culture techniques (streak plate/pour plate/spread plate)

- 13 Introduction to Identification procedures (morphology and cultural characteristics)
- 14 Growth characteristics of bacteria and fungi: Determination of microbial numbers, direct plate count, generation time
- 15 Factors influencing growth: pH, temperature and growth curves for bacteria
- 16 Methods of microbial culture preservation for bacteria, yeast and anaerobic culture methods

References

- 1 M.J. Pelczar, E.C.S.Chan and N.R. Kreig, Microbiology, Mc. Graw Hill Publication Co., New York.
- 2 P Tauro K. K. Japur and K.S. yadav, An introduction to Microbiology, Wiley Eastern Limited, New Delhi.
- 3 L.M. Prescott, J. P. Harley and Donal A. Klein, Microbiology, 3rd Edition Wm.C. Brown Publishers
- 4 C.B. Power and H.F. Dagainawala, General Microbiology, Himalaya Publishing
- 5 Ronald M Atlas, 1995, Principles of Microbiology 1st Edition, Mosby Year Book Inc., St. Louis Missouri.
- 6 David White, 1995, The physiology and Biochemistry of Prokaryotes, Oxford Univ. Press, U.K.

FOOD BIOCHEMISTRY AND NUTRITION

Objective: By the end of the course the students will be able

- To understand the concepts of Food biochemistry and Nutrition principles
- To know the about food compositions
- To study the chemical properties and metabolism of nutrients and biochemical reactions occurring in foods
- To understand about functionary of nutrients and absorption

**Lecture
Theory**

Topic

- 1 Definition, scope of Biochemistry and Nutrition, introduction to cellular biochemistry, nutrients, and their interaction. Basic foods and Nutrients ,
- 2 Carbohydrate -Definition, occurrence, classification and structures, physicochemical and metabolic functions, metabolism
- 3 Protein-Definition, occurrence, classification and structures, physicochemical and metabolic functions
- 4 Lipids- Definition, occurrence, classification and structure, physicochemical and metabolic functions ,metabolism
- 5 Nucleic acid -Properties, structure and metabolism; Vitamins and minerals: Chemistry and metabolic functions
- 6 Enzymes: Chemical nature and nomenclature, classification, sources and properties, functions,mechanism of action, coenzyme and prosthetic groups
- 7 Nutrition: metabolic function of nutrients
Water and energy balance, water intake and losses, basal metabolism of Nutrients
- 8 Formulation of diets, classification of balanced diet, preparation of balanced diet for various groups. Recommended dietary allowances (RDI) for various age groups for Indians.
- 9 Definition, Nutritional Status, Malnutrition Assessment of nutritional status in vulnerable groups- Pregnant, lactating mothers and children.
- 10 Food fad and faddism; Potentially toxic substance in human food and its effect on malnutrition among population.
- 11 Health hazards due to malnutrition, symptoms and prophylactic measures for eradication.
- 12 Definition, Introduction to enzymes, coenzymes Mechanism of enzyme action:, regulation of enzymatic activity, enzyme kinetics,
- 13 Enzyme activity -inhibition effects of pH, allosteric enzymes, derivation of Michaelis-Menten equation;
- 14 Nutrients: Sources, functions, digestion, absorption, assimilation and transport of carbohydrates, proteins and fats in human beings
- 15 Metabolism of carbohydrates: Biological role of carbohydrates, glycolysis and respiration, production of ATP
- 16 Brief description of electron transport chain, oxidative and substrate phosphorylation

- 17 Metabolism of lipids: Biological role of lipids, breakdown of triglycerides and phospholipids.
- 18 β -oxidation of long chain fatty acids, ketosis
- 19 Biosynthesis of fatty acids, triglycerides and phospholipids.

- 20 Metabolism of proteins: Breakdown of proteins and transamination,
- 21 Deamination and decarboxylation of Proteins
- 22 Over view of Nitrogen fixation and urea cycle
- 23 Minerals: Functions, sources, factors affecting absorption of minerals, absorption promoters, absorption inhibitors, effect of deficiency
- 24 Hormones –Types, Functions and their mechanism in body metabolism.
- 25 Vitamins – Classification and functions
- 26 Sources and effects of deficiency of Fat soluble vitamins
- 27 Sources and effects of deficiency of water soluble vitamins
- 28 Relationship between vitamins and hormones in terms of their biological role
- 29 Physico-chemical and nutritional changes during processing
- 30 Changes during food processing treatment of drying and dehydration, irradiation, freezing,
- 31 Changes during fermentation, canning, restoration and enrichment in foods.
- 32 Fortification and supplementation of foods.

Practical

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

References

- 1 Gaile Moe, Danita Kelley, Jacqueline Berning and Carol Byrd-Bredbenner. 2013. Wardlaw's Perspectives in Nutrition: A Functional Approach. McGraw-Hill, Inc., NY, USA.
- 2 David L. Nelson and Michael M. Cox. 2012. Lehninger Principles of Biochemistry, 6th Ed. Macmillan Learning, NY, USA.
- 3 Donald Voet and Judith G. Voet. 2011. Biochemistry, 4th Ed. John Wiley and Sons, Inc., NY, USA.
- 4 Carolyn D. Berdanier, Elaine B. Feldman and Johanna Dwyer. 2008. Handbook of Nutrition and Food, 2nd Ed. CRC Press, Boca Raton, FL, USA..Bob B. Buchanan, Wilhelm Gruissem and Russell L. Jones. 2002. Biochemistry & Molecular Biology of Plants. John Wiley and Sons, Inc., NY, USA.
- 5 Jeremy M. Berg, John L. Tymoczko, Lubert Stryer and Gregory J. Gatto, Jr. 2002. Biochemistry, 7th Ed. W.H. Freeman and Company, NY, USA.
- 6 Lehninger, A.L., Nelson, D.A and Cox, M.M. 2005. *Principles of Biochemistry*. CBS Publishers and Distributors, Delhi.
- 7 Swami Nathan. Food & Nutrition, Vol.I & Vol. II. The Bangalore Printing and publishing Co. Ltd., Bangalore.
- 8 Nutritive Value of Indian Foods. NIN Publications.

BUSINESS MANAGEMENT AND ECONOMICS

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

- learn about basic concepts of Human resource Management and organisational behaviour
- learn about basic concepts finance management

Lecture**Topic****Theory**

- 1 Definition of Management, Principles of Management, Importance and Scope of Management
- 2 Functions of Management, Role of Managers in an Organisation.
- 3 Theories of Management – Scientific Management Theory, Fayols Theory, Maslow’s Hierarchy of Needs Theory.
- 4 Types of Organizations and Organizational Structures
- 5 Forms of Organization
- 6 Departments in the Organisation and their Functions
- 7 Human Resource Management – Definition and Functions
- 8 Manpower Planning and Recruitment
- 9 Process of Selection, Training in an Organisation (HRD)
- 10 Marketing Management – Definition, Importance, Market Segmentation, Targeting, Branding
- 11 4P’s of Marketing Mix (Product, Price, Promotion, Place)
- 12 Corporate Social Responsibility – Meaning, Role and Importance
- 13 Business Ethics
- 14 Customer Relationship Management (CRM)
- 15 Different Systems of Accounting : Financial Accounting, Cost Accounting, Management Accounting - Need, Objectives and Advantages
- 16 Financial Management : Definition, Scope and Objectives
- 17 Introduction to Economics – Definitions, Nature, Scope
- 18 Difference between Micro and Macro Economics
- 19 Demand – Definition – Determinants – the Law of Demand – Increase, Decrease, Contraction and Extension of Demand
- 20 Types of Elasticity of Demand and its Significance
- 21 The Law of Supply, Increase, Decrease, Extension and Contraction in Supply
- 22 Markets : Types of Markets, Characteristics of Markets
- 23 Theory of Production
- 24 Laws of Returns
- 25 Law of Variable Proportions
- 26 Production Function
- 27 Factors of Production
- 28 Cost : Short Run and Long Run Cost, Fixed Cost, Variable Cost, Total Cost, Average Cost, Marginal Cost, Opportunity Cost

- 29 Break Even Analysis
- 30 National Income: GDP, GNP, NNP, DPI, PCI
- 31 Inflation – Meaning, Types, Causes and Remedies
- 32 Agribusiness – Scope, Salient Features, Importance and Constraints

References

- 1 S.Subba Reddy et al. 2004 . Agricultural Economics. Oxford & IBH Publishing Co. Pvt Ltd. New Delhi.
- 2 Dewett, K.K. and Varma, J.D., 1985. Elementary Economic Theory. S.Chand & Company Ltd., New Delhi.
- 3 Jhingan,M.L.1983. Macroeconomic Theory. Vikas Publishing House Pvt. Ltd., New Delhi.
- 4 S.Subba Reddy and P.Raghu Ram. 1996. Agricultural Finance and Management. Oxford & IBH Publishing Co. Pvt Ltd., New Delhi.
- 5 Acharya S.S and N.L.Agarwal. Agricultural Marketing in India. 1992. Oxford & IBH Publishing Co. Pvt Ltd. New Delhi.

ENGINEERING DRAWING AND GRAPHICS

Objective: By the end of the course the students will be able to understand how to represent the product graphically before manufacture and also to understand how to develop the optimum design. To know exact shapes of components and to understand how to develop the surfaces of components

Lecture Theory**Topic**

- 1 First and third angle methods of projection
- 2 Preparation of working drawing from models and isometric views
- 3 Drawing of missing views and different methods of dimensioning
- 4 Concept of sections, revolved and oblique sections
- 5 Sectional drawing of simple machine parts
- 6 Types of rivet heads and riveted joints, process of producing leak proof joints
- 7 Threads nomenclature, profiles, multi start, left and right hand and conventional representation of threads
- 8 Nuts and bolts- square headed, hexagonal, types of lock nuts, studs, machine screws, cap screw and wood screw, foundation bolts
- 9 Application of computers for design CAD, define, benefits, system components and computer hardware for CAD, display, input and output devices
- 10 Graphic primitives, display file, frame buffer, display control, display processors, line generation, graphics software. Points and lines, polygons, filing of polygons, text primitive, windowing and clipping, view port
- 11 Homogeneous coordinates, transformations, planners and space curves design
- 12 Analytical and synthetic approaches, parametric and implicit equations
- 13 B-spline and Bezier curves and Geometric modeling techniques, wire frames
- 14 Introduction to solid modeling, introduction to numeric control, basic components of NC system, NC coordinate and motion control system
- 15 Computer numerical control, direct numerical control, combined CNC /DNC
- 16 NC machine tools and control units, tooling for NC machines, part programming, punched tape coding and format, Manual and computer assisted programming

Practical

- 1 Introduction of drawing scales
- 2 Principles of orthographic projections
- 3 References planes
- 4 Points and lines in space and traces of lines and planes
- 5 Auxiliary planes and true shapes of oblique plain surface
- 6 True length and inclination of lines
- 7 Projections of solids
- 8 Change of position method, alteration of ground lines
- 9 Section of solids and interpenetration of solid-surfaces
- 10 Development of surfaces of geometrical solids

- 11 Isometric projection of geometrical solids
- 12 Preparation of manual drawings with dimensions from models and isometric drawings of objects and machine components
- 13 Preparation of manual drawings with dimensions from models and isometric drawings of objects and machine components
- 14 Preparation of sectional drawings of simple machine parts
- 15 Drawing of riveted joints and thread fasteners
- 16 Drawing of riveted joints and thread fasteners
- 17 Demonstration on computer graphics and computer aided drafting use of standard software
- 18 Demonstration on computer graphics and computer aided drafting use of standard software
- 19 Sectional drawings of engineering machines
- 20 Computer graphics for food engineering applications
- 21 Computer graphics for food engineering applications
- 22 Interpretation of sectional views of food equipment and components
- 23 Interpretation of sectional views of food equipment and components
- 24 Practice in the use of basic and drawing commands on AutoCAD
- 25 Practice in the use of basic and drawing commands on AutoCAD
- 26 Practice in the use of basic and drawing commands on AutoCAD
- 27 Generating simple 2-D drawings with dimensioning using AutoCAD
- 28 Generating simple 2-D drawings with dimensioning using AutoCAD
- 29 Small Projects using CAD/CAM
- 30 Small Projects using CAD/CAM
- 31 Small Projects using CAD/CAM
- 32 Practical examination

References

- 1 Ibrahim Zeid. 2004. Mastering CAD/CAM. McGraw-Hill Book Co.
- 2 Kunwoo Lee. 1999. Principles of CAD/CAM/CAE Systems. Prentice-Hall
- 3 N.D. Bhat and V.M. Panchal. 1995. Machine Drawing. Charotar Publishing House
- 4 N.D. Bhat. 1995. Elementary Engineering Drawing. Charotar Publishing House

WORKSHOP TECHNOLOGY

- Objective:**
- To Impart knowledge and skills to students in manufacturing process of machines
 - Tools and equipments and hands on training on various aspects of machine shop for encouraging entrepreneur development for engineering enterprises

Lecture Theory**Topic**

- | | |
|----|---|
| 1 | Introduction to workshop technology- Manufacturing process- Classification of Manufacturing process. |
| 2 | Study of ferrous and no- ferrous materials- abrasive materials- silica- ceramics- glasses- graphite- diamond. |
| 3 | Heat treatment processes- introduction- hardening – tempering- annealing – normalizing |
| 4 | Basic workshop process- Welding – Smithy and forging Carpentry, Bench work and Fitting – sheet metal – mechanical working of metals. |
| 5 | Welding – Introduction- types of welding- types of electrodes- welding joints – welding techniques and equipments- safety measures. |
| 6 | Gas welding – arc welding – soldering – brazing – estimation of welding and soldering cost. |
| 7 | Smithy and forging – tools and their uses- different forging operations- defects of forging. |
| 8 | Carpentry- types of woods and their characteristics |
| 9 | Wood working machines- types- band saw- wooden lathe circular saw. |
| 10 | Wood planner and pattern layout – safety precautions |
| 11 | Introduction to various workshop machines- Lathe- milling machine- shaper and planer- drilling and boring machine- grinder and CNC machine. |
| 12 | Study of different machine parameters- length of cut, RPM, cutting speed, time and time allowances. |
| 13 | Estimation of machining time for different lathe operations |
| 14 | Estimation of machining time for casting – shaping – slotting – planing operations – work holding and tool holding devices. |
| 15 | Sheet metal work- introduction – metals used- measuring tools- |
| 16 | Sheet metal joints- allowance for sheet metal- estimation of cost- Safety precautions. |

Practical

- | | |
|------|---|
| 1 | Study of various carpentry tools |
| 2 | Study of wood working machines |
| 3 | Practice on planing using different planers |
| 4 | Practice on sawing wood using different carpentry cutting tools |
| 5&6 | Preparation of T-Lap joint |
| 7&8 | Preparation of mortise and Tenon joint |
| 9&10 | Study of various types of fitting tools |
| 11 | Practice on filing |

- 12 Practice on sawing
- 13 Practice on chipping, chiseling
- 14&15 Study of various types of sheet metal tools
- 16 Study of various welding machine, processes, tools , their uses and precautions
- 17&18 Butt welding of two pieces
- 19 Arc welding of two pieces
- 20&21 Study of various casting processes and equipments, tools and their uses
- 22&23 Exercise on mould making using one piece pattern and two piece pattern
- 24&25 Demonstration of mould making using sweep patten and match plate pattern
- 26 Taper turning on lathe
- 27 Step turning on lathe
- 28 Thread cutting on lathe
- 29 Study of lathe machine
- 30 Study of milling, drilling machine
- 31 Jobs on ARC welding Oxyacetylene gas welding
- 32 Practical Examination

References

- 1 B.S. Raghuwamsi. 1996. A Course in Workshop Technology
- 2 W.A.J. Chapman. 1989. Workshop Technology
- 3 S.K. Hazra Choudari and S.K. Bose. 1982. Elements of Workshop Technology

Physical Education

Objective: To improve the physical skills and fitness of the students to make them more active, alert and successful

Lecture**Topic****Practicals**

- 1 Introduction to physical education
- 2 Definition, scientific machine principles, objectives, scope, history, development and importance
- 3 Physical training and health
- 4 Fartlek training and circuit training
- 5 Body mechanism and body type
- 6 Kretchmark's and Sheldon's classification
- 7 Theories of learning
- 8 Exercises for good posture, Exercises to develop physical fitness, growth, flexibility - components, speed, strength, endurance, power, flexibility, agility, coordination and balance
- 9 Test and measurement in physical education
- 10 Physical fitness test, motor fitness test, ability test, cardiovascular efficiency test and physical fitness index
- 11 Calisthenics, weight training, aerobic and anaerobic exercises
- 12 Circuit training, interval training, far trek training, pressure training and resistance training
- 13 Importance of *Asanas*, free hand exercises and yoga
- 14 Recreation: Definition, agencies promoting recreation, camping and re-recreation
- 15 Governance of sports in India, Organization of tournaments; National and international events
- 16 Drawing of fixtures; Rules and regulations; Coaching and fundamentals of skill development of major games, coaching and tactic development of athletic events.

ENGINEERING MATHEMATICS-II

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

- Enhances the awareness of the existence of mathematical objects such as matrices which will not be suitable to the same rules of operations in the real number systems.
- By the end of the course student can construct different mathematical models in food science and some of the fields.
- Further they can study and compare the existing results with real life situations.

Lecture**Topic****Theory**

- 1 Matrices: Elementary Transformations: Introduction of Matrices, Types of Matrices, Singular and Non-Singular Matrices, Inverse of 2×2 Matrices, Row and Column Operations, some Similar basic problems.
- 2 Rank of a matrix and its Applications: Definition of rank of matrix, Properties of rank of matrix, problems on Rank of matrices for square and rectangular matrices.
- 3 Gauss-Jordan method to find inverse of a matrix: Working rule for finding the Inverse of a Matrix by Gauss Jordan method. Some related problems
- 4 Finding Rank of matrix by Reduction to Echelon form:: Working rule to find rank of matrices by Echelon form, some related lower and higher order matrices to find rank by reducing to Echelon form.
- 5 Finding Rank of matrix by Reduction to Normal form:: Working rule to find rank of matrices by Normal form, some related lower and higher order matrices to find rank by reducing to Normal form.
- 6 Finding Rank of matrix by Reduction to PAQ form: Working rule of a square matrix reduction into PAQ form. Some related problems.
- 7 Solution of linear equations- Consistency: Consistency and Inconsistency of system of linear equations. Some problems on finding the number of solution of system of equations.
- 8 Problems on Eigen values: Introduction to Eigen values. Related properties on Eigen values. Some Problems
- 9 Problems on Eigen vectors: Introduction to Eigen Vectors. Related properties on Eigen vectors. Some Problems
- 10 Cayley-Hamilton theorem to find inverse of A:. Definition of Cayley –Hamilton Theorem. Finding the inverse, positive and negative powers of matrices by Cayley Hamilton Theorem.
- 11 Diagonalization of matrices by Linear transformation: - Working rule of forming diagonal matrix. Examples on diagonal matrices of order 3×3 .
- 12 Diagonalization of matrices by Orthogonal Transformation: Definition of Quadratic form. Some Properties and Examples.
- 13 Bilinear and Quadratic forms: Working rule of conversion from Quadratic form to

- Canonical form with few examples. Define Nature of Rank on of Quadratic form.
- 14 Complex Analysis: Functions of a Complex variable: Introduction of Complex variables, some example problems on limit of a function.
 - 15 Limit and Continuity of functions: Introduction on Continuity of complex functions with examples, Problems on derivability of complex functions.
 - 16 Derivative and Cauchy-Riemann equations: various types Problems on Cauchy-Riemann equations of complex functions.
 - 17 Problems on Analytic functions: Introduction on derivability of complex functions. Problems on Analytic functions with examples.
 - 18 Harmonic functions and conjugate functions: Problems on derivability of complex harmonic functions. Problems on harmonic & conjugate harmonic functions.
 - 19 Fourier series: Infinite series and its convergence , Periodic functions: Introduction on Infinite series ,Examples on its convergence. Problems on convergence of Periodic functions.
 - 20 Dirichlet's conditions, Fourier series: Explanation of dirichlet's conditions, Problems on Fourier series.
 - 21 Even and odd functions, Euler's formulae: Explanation of Even and odd functions with examples. Problems on Euler's formulae.
 - 22 Functions having arbitrary period: Introduction on arbitrary period of functions, Examples on its convergence.
 - 23 Half range series, Harmonic analysis: Introduction on Half range series of functions, Examples on its convergence.
 - 24 Partial differential equations: Elimination of one and two arbitrary functions: Introduction on functions of several variables, solving of various examples on functions of one and more variables.
 - 25 Formation of Partial differential equations: Introduction, Problems on Formation of Partial differential equations.
 - 26 Solutions of Linear Partial differential equations of first order: – Working rule of Lagrange's linear equation of first order. Problems on finding the solutions of Linear Partial differential equations.
 - 27 Higher order linear Partial differential equations with constant coefficients: Working rule of solving Higher order linear Partial differential equation. Problems on finding the solutions of Higher order linear Partial differential equations.
 - 28 Solution of non-linear Partial differential equations: Working rule of non- linear Partial differential equation. Problems on finding the solutions of non- Linear Partial differential equations.
 - 29 Charpit's method: Introduction on Charpit's method. Problems on Linear Partial differential equations by using Charpit's method.
 - 30 Application of Partial differential equations: Explanation on various applications of Partial differential equations. Problems on finding the solutions of Partial differential equations.
 - 31 Applications of One dimensional wave equations, heat flow equations and Laplace Equation: Explanation on various applications of Partial differential equations like wave

- , Heat and Laplace equations of one variable.
- 32 Applications of Two dimensional wave and heat flow and Laplace Equations: Explanation on various applications of Partial differential equations like wave , heat and Laplace equations of two variables.
- 16 To familiarize with various types of transducers-II

References

- 1 A text book of matrices by Shanti Narayan 2004. S.Chand and Co. Ltd., New Delhi.
- 2 Higher engineering mathematics by Grewal B S 2004.Khanna publishers Delhi.
- 3 Engineering mathematics by Ramana B V 2008.Tata McGraw-Hill.New Delhi.
- 4 Advanced Engineering Mathematics- Erwin. KREYSZING 10th Addition 2015.
- 5 Differential Equations and Complex Analysis by Dr.Hari Arora—Katson publications

Fluid Mechanics

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

- Gain knowledge on Bernoullies theory, Buckingham's Pi theorem, Darcy's and Chezy's theoerm
- Understand flow of fluids through mouth pieces, flow through orifices and pumps
- To know fluids flowing process in food and beverage industry industry

Lecture**Topic****Theory**

- 1 Introduction of fluids- definitions- Units and dimensions, Properties of fluids.
- 2 Static pressure of liquids: Hydraulic pressure, absolute and gauge pressure, pressure head of a liquid.
- 3 Pressure on vertical rectangular surfaces.
- 4 Flow behaviour of viscous foods, Compressible and non-compressible fluids.
- 5 Derivation of equations for Surface tension and capillarity.
- 6 Pressure measuring devices: Simple, differential, micro-, inclined manometer, mechanical gauges: diaphragm, bellows and bourdon tube pressure gauges. piezometer.
- 7 Floating bodies: Archimedis principle, stability of floating bodies.
- 8 Equilibrium of floating bodies, metacentric height. Buoyancy of flotation. Kinematics of fluid flow.
- 9 Fluid flow: Introduction-Classification, steady, uniform and non-uniform, laminar and turbulent flows with examples, continuity equation.
- 10 Practical applications of Bernoulli's theorem, Venturimeter, Pitot tube, Orifice meter and Rotameter.
- 11 Introduction- Navier-Stokes equations in cylindrical co-ordinates, boundary conditions.
- 12 Simple application of Navier-Stokes equation: Laminar flow between two straight parallel boundaries.
- 13 Flow past through the immersed solids, packed and fluidized beds.
- 14 Flow through simple pipes - Loss of head in pipes, Darcy's formula for loss of Head in pipes, Chezy's formula for loss of head in pipes - determination of pipe diameter - determination of discharge - friction factor - critical velocity
- 15 Determination of discharge, friction factor, critical velocity.
- 16 Flow through orifices, mouthpieces, notches and weirs. Types of orifices.
- 17 Vena contracta, hydraulic coefficients, discharge losses.
- 18 Time of Emptying a square, rectangular or circular tank through an orifice at its bottom, Time of emptying a Hemispherical tank through an orifice at its bottom
- 19 Loss of head due to contraction, enlargement at entrance and exit of pipe.
- 20 External and internal mouthpieces, types of notches, rectangular and triangular notches, rectangular weirs.
- 21 Venturimeters, pitot tube, rotameter.
- 22 Water level point gauge, hook gauge.

- 23 Dimensional analysis: Buckingham's theorem application to fluid flow phenomena.
- 24 Froude Number, Reynolds number, Weber number and hydraulic similitude.
- 25 Turbines and pumps: classification, centrifugal pumps, submersible pumps, reciprocating pumps, positive displacement pump.
- 26 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,
- 27 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, Velocity and pressure profiles in open channels, Hydraulic jumps-types.

Practical

- 1 Study of different tools and fittings
- 2 To plot flow rate versus pressure drop with U-tube manometer
- 3 Verification of Bernoulli's theorem
- 4 Determination of discharge co-efficient for venturi
- 5 Determination of discharge co-efficient for Orifice
- 6 Determination of discharge coefficient of V-Notch
- 7 Verification of emptying time formula for a tank
- 8 Determination of critical Reynold's number by Reynold's apparatus
- 9 Study of reciprocating, centrifugal and gear pumps.
- 10 Calibration of Rotameter
- 11 Study of different types of valves
- 12 Problems on venturimeter
- 13 Problems on orifices
- 14 Problems on flow through pipes
- 15 Problems on pumps
- 16 Problems on weirs

References

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

POST HARVEST ENGINEERING

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

- Know about the post harvest losses and it's management
- Know about principles involved in different post harvest engineering operations and their applications
- To know about food handling systems

Lecture**Topic****Theory**

- 1 Overview of post harvest technology: Concept and science, current production and current post harvest losses, reasons for losses, importance of loss reduction and value addition
- 2 Water activity concept-water activity in different foods, water binding and its effect on enzymatic and non-enzymatic reactions and food texture, controlling measures of water activity and moisture.
- 3 Post Harvest Handling operations-introduction-different types of unit operations and Principles of Food Processing
- 4 Methods and Principles of Food Processing-II
- 5 Cleaning: Cleaning of grains, washing of fruits and vegetables, types of cleaners, screens, types of screens, rotary screens, and vibrating screens.
- 6 Machinery for cleaning of fruits and vegetables (air cleaners, washers), cleaning efficiency, care and maintenance
- 7 Sorting and grading: methods of grading , Grading- Size grading, colour grading, specific gravity grading
- 8 Screening, equipment for grading of fruits and vegetables, grading efficiency, care and maintenance
- 9 Separation equipment – Separation based on size (fixed aperture and variable aperture), shape, pneumatic separation, specific gravity separation
- 10 Separation based on surface texture, colour sorting, Magnetic separator, destoners, electrostatic separators, pneumatic separator
- 11 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.
- 12 Thin layer drying, Moisture content, Equilibrium moisture content, Hysteresis, Drying curves,
Constant - rate period, Falling - rate period
- 13 Tray and cabinet dryer, Tunnel dryer, Puff-drying, Fluidized - Bed drying, Spray drying, Freeze - Drying
- 14 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
- 15 Parboiling – Starch gelatinization methods, parboiling operations, parboiling methods (traditional and modern), drying equipment
- 16 Milling: milling, polishing, grinding, milling equipments, dehuskers, polishers

- (abrasion, friction, water jet),
- 17 Wet milling – Flow chart, cleaning, steeping, degerming, germ separation, germ oil, refining of oils, separation of hulls and fiber, gluten-starch separation.
 - 18 Size Reduction and Separation-Introduction, Grinding and cutting, Energy used in grinding,
Kick's law, Rittinger's law, Bond's law
 - 19 Cutting & Grinding Equipment, Jaw crusher, Gyratory crusher, Hammer mill, Ball mill, Tumbling mill.
 - 20 Oil expellers, mechanical expression devices – hydraulic press - flow chart, screw press – expeller – configuration, radial and axial pressure in a barrel, machine efficiency and power requirement
 - 21 Importance of material handling devices – principles should be taken into account for selection of proper conveying equipment - Screw conveyor - capacity and power requirement
 - 22 Scope and importance of material handling devices: Study of different material handling systems: Handling equipment for raw materials and ingredients
 - 23 Conveying equipments used for handling of fruits and vegetables
 - 24 Classification, principles of operation, conveyor system selection/design
 - 25 Belt conveyor: Principle, characteristics, design, relationship between belt speed and width, capacity,
 - 26 Belt conveyor: inclined belt conveyors, idler spacing, belt tension, drive tension, belt tripper
 - 27 Chain conveyor: Principle of operation, Capacity and speed, conveying chain advantages, disadvantages
 - 28 Screw conveyor: Principle of operation, capacity, power, troughs, loading and discharge, inclined and vertical screw conveyors
 - 29 Bucket elevator: Principle, classification, operation, capacity, speed, bucket pickup, bucket discharge
 - 30 The relationship between belt speed, pickup and bucket discharge, buckets types advantages, disadvantages.
 - 31 Pneumatic conveying system: Capacity and power requirement, types, air/product separators
 - 32 Gravity conveyor design considerations, capacity and power requirement.

Practical

- 1 Study of cleaners for grains;
- 2 Study of washers for fruits and vegetables;
- 3 Study of graders for grains;
- 4 Study of graders for fruits and vegetables;
- 5 Study of decorticators;
- 6 Study of a maize/sunflower sheller;
- 7 Study of crop dryers;
- 8 Study of a RF/MW/tray dryer;
- 9 Study of hot air dryer and modelling drying kinetics;
- 10 Study of vacuum dryer and modelling drying kinetics;

- 11 Study of working principle of spray dryer and spray drying process;
- 12 Study of drum dryer and liquid food dehydration using drum drying;
- 13 Study of fluidized bed dryer and drying process;
- 14 Study of freeze dryer and freeze drying process;
- 15 Study of rice milling machines and pulse milling machines;
- 16 Study of different components of flour mill and different materials handling equipment.

References

- 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 James G. Brennan. 2006. Food Processing Handbook. Wiley-VCH Verlag GmbH & Co. KGaA. Weinheim, Germany.
- 5 K.M. Sahay and K.K. Singh. 2001. Unit Operations of Agricultural Processing. Vikas Publishing House Pvt. Ltd., Noida, UP.
- 6 G. Boumans. 1985. Grain Handling and Storage. Elsevier Science Publishers, Amsterdam, The Netherlands.
- 7 R.L. Earle. 1983. Unit operations in Food Processing. Pergamon Press, New York, USA.
- 8 Carl W. Hall and Denny C. Davis. 1979. Processing Equipment for Agricultural Products. The AVI Publishing Company, Inc., Connecticut, MA, USA.
- 9 S.M. Henderson and R.L. Perry. 1966. Agricultural Process Engineering, 2nd Ed. The AVI Publishing Company, Inc., Connecticut, MA, USA.

FOOD CHEMISTRY OF MACRONUTRIENTS

Objective: By the end of the course the students will be able

- to gain knowledge on macro nutrients in foods and absorption
- to understand industrial application of different macronutrients
- to understand the changes that occurs in foods during processing.

**Lecture
Theory**

Topic

- 1 Food chemistry - Definition, Introduction, Importance and History of Food Chemistry. Scope of Macronutrients and their chemistry
- 2 Moisture in foods - Role and type of water in foods, Functions of water in body metabolism
- 3 Water activity and sorption isotherm - Role of water activity in enhancing the shelf life of foods - Hysteresis - Humectants - Role of Humectants in enhancing the shelf life of foods
- 4 Rheology of diphasic systems- Colloidal system - Types of colloidal system
- 5 Sols - Types of sols, lyophilic sols, lyophobic sols, Characteristics Comparison, Preparation, purification and Properties of sols
- 6 Gels-Types of Gels, properties of gels, Food gels.
- 7 Emulsions - Types of emulsions, Preparation and properties of emulsions
- 8 Foam – Formation, chemistry and structure, Foaming agents
- 9 Changes of carbohydrates on cooking - Changes in pectic substances, Changes in starch
- 10 Physical and chemical reactions involved in food processing
- 11 Starch - Starch granules, Granule gelatinization (Gelatinization of starch), Hydrolysis of starch, Crude fibre
- 12 Browning reactions - Enzymatic browning and non enzymatic browning
- 13 Functional properties of sugars
- 14 Pure proteins of plant and animal origin with their functional characteristics
- 15 Plant proteins - cereal proteins, tuber proteins and pulse storage proteins
- 16 Milk proteins - Casein, whey proteins and colostrums
- 17 Egg proteins - Egg white proteins, Egg yolk proteins
- 18 Lipids - Introduction - Fatty acids, Acylglycerols, Phospholipids
- 19 Classification of edible fats - Milk fats, lauric acids, vegetable butters, oleic-Linoleic acids, linolenic acids, Animal fats, Marine oils
- 20 Physical aspects of lipids - Crystallization, Consistency
- 21 Chemical aspects of lipids - Lipolysis, Auto-oxidation, Thermal decomposition, polymerization
- 22 Edible fats and oils - Melting properties, chemical properties
- 23 Technology of edible fats and oils - Rendering, pressing, solvent extraction
- 24 Chemistry of fat and oil processing : Refining, Hydrogenation, Interesterification. safety use of oils and fats in food formulation
- 25 Frying technology of edible fats and oils - Chemistry of frying,
- 26 Behaviour of food during frying, chemical and physical changes, Tests for assessing the

- quality of frying oils
- 27 Anti-oxidants-Natural and synthetic anti oxidants, Mechanism of action, examples and mode of application
- 28 Rancidity and its types, detection techniques
- 29 Enzymes in food industry - Amylases, pectinolytic enzymes, cellulases and hemicellulases
- 30 Proteases - Endopeptidases, Metallo peptidases
- 31 Lipid hydrolyzing enzymes - Lipases, Phospholipases
- 32 Chemical reactions of interest to food processing.

Practical

- 1 Determination of moisture content in 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 Rheological properties of food systems
- 6 Determination of crude proteins by micro-Kjeldhal method
- 7 Determination of essential amino acids i.e. lysine, tryptophan, methionine, etc.
- 8 Isolation of egg and milk protein;
- 9 Preparation of protein isolate in foods
- 10 Preparation of concentrate of proteins in foods
- 11 Determination of acid value in fats/ oils
- 12 Determination of saponification value and iodine number of fat/oil
- 13 Assay of Amylases on foods
- 14 Assay of papain in foods
- 15 Assay of lipases in foods
- 16 Practical examination

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

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

- know about Contamination of Food
- know about the food spoilage organisms
- know about food preservation techniques
- know about enumeration and detection of microorganisms in foods

Lecture**Topic****Theory**

- 1 Importance and significance of microbes in food science, Microbial spoilage of foods. Cause of spoilage classification of foods by ease of spoilage. Factors affecting kinds and numbers of microorganisms in food
- 2 Factors affecting growth and survival of microorganisms in foods. Intrinsic factors – Nutrient content, pH, buffering capacity, redox potential (En), Inhibitory substances and biological structures (Antimicrobial barriers and constituents) water activity
- 3 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
- 4 Contamination of Foods. Sources of contamination. Green plants and Fruits, Animals, Sewage, Soil, Water, Air
- 5 Microorganism's importance in Food Microbiology. Moulds - General characteristic of moulds, classification and identification of moulds
- 6 Yeasts and Yeast like fungi - General characteristics of yeasts, classification and identification of yeasts, yeasts of industrial importance
- 7 Bacteria - Morphological characteristics important in Food Bacteriology. Cultural and Physiological characteristics important in food bacteriology. Genera of bacteria important in Food Bacteriology groups of bacteria important in food bacteriology
- 8 Principles of Food Preservation. Methods of Food preservation, application in food preservation
- 9 Asepsis, removal of microorganisms, Maintenance of anaerobic conditions; Intermediate moisture foods
- 10 Microbiology of milk and milk products; Contamination, preservation, pasteurization and ultra pasteurization, vat pasteurization. Vaccination, use of low temperatures, freezing, drying etc.,
- 11 Spoilage of milk and cream, gas production proteolysis, ropiness, changes in milk fat. Alkali production. Flavor changes & colour changes
- 12 Spoilage of milk at different temperatures. Condensed and dry milk products. Flavour defects, color defects
- 13 Microbiology of fruits and vegetables, contamination, preservation of vegetables,

- asepsis, chilling, freezing, drying, preservatives, CA storage, MA storage. Spoilage of fruits and vegetables.
- 14 Microbiology of cereals and cereal products; contamination, preservation and spoilage of flours
 - 15 Microbiology of cereal products; Spoilage-Bread, Mold, Rope, Red bread, Chalky Bread
 - 16 Microbiology of meat and meat products; Contamination, preservation.
 - 17 Spoilage of meat and meat products. Invasion of tissues by microorganisms and growth of microorganisms in meat
 - 18 General types of spoilage of meats. Spoilage under anaerobic conditions, spoilage of different kinds of meats
 - 19 Microbiology of fish and other sea foods. Contamination, preservation, spoilage

 - 20 Factors influencing kind and rate of spoilage, evidences of spoilage, bacteria causing spoilage
 - 21 Microbiology of poultry and eggs. Contamination, preservation, spoilage. Changes during storage. Changes not caused by microorganisms and changes caused by microorganisms
 - 22 Microbiology of sugar and sugar products. Sources of contamination, spoilage and Prevention
 - 23 Microbiology of salts and spices, sources of contamination, spoilage and prevention, fatty foods and rancidity
 - 24 Microbiology of canned foods; Causes of spoilage, appearance of the unopened container, types of biological spoilage of canned foods. Flat sour spoilage, TA spoilage, sulfide spoilage
 - 25 Types of spoilage of canned foods by bacteria, yeasts, molds. Spoilage of canned meat and fish
 - 26 Shelf life: Calculation of shelf life, Shelf life requirements, deteriorative reactions, accelerated testing; Simulations of product:
 - 27 Package environment interaction, Shelf life simulation for moisture, oxygen, and light sensitive products
 - 28 Food borne intoxications and infections, Types of food involved in intoxications and infections, toxicity and symptoms,
 - 29 Food borne intoxications and infections; chemical properties, environmental conditions
 - 30 Food borne viruses: Polio, Hepatitis A & E, Noro viruses, Rota viruses and Prion diseases,
 - 31 Types of food involved in Food borne viruses, toxicity and symptoms
 - 32 Food borne viruses; chemical properties, environmental conditions.

Practical

- 1 Isolation of bacteria from foods
- 2 Isolation of molds from foods
- 3 Enumeration of microorganisms by aerobic colony count (ACC)
- 4 Microbial examination of cereal and cereal products: Isolation, Identification and

- Confirmation
- 5 Microbial examination of meat and meat products: Isolation, Identification and Confirmation
 - 6 Microbial examination of fish and other sea foods: Isolation, Identification and Confirmation
 - 7 Microbial examination of eggs and poultry: Isolation, Identification and Confirmation
 - 8 Microbial examination of milk and milk products: Isolation, Identification and Confirmation
 - 9 Microbial examination of sugar, salts and spices: Isolation, Identification and Confirmation
 - 10 Microbial examination of canned products: Isolation, Identification and Confirmation
 - 11 Determination and enumeration of pathogenic and indicator organisms in foods (Coli form/Enterococcus)
 - 12 Thermal death time determination
 - 13 Detection of Salmonella from food sample
 - 14 Detection of E.coli forms from water by MPN method
 - 15 Detection of *Staphylococcus aureus* from food sample.
 - 16 Detection of *Clostridium botulinum* from food sample.

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- 1 Martin R. Adams and Maurice O. Moss. 2008. Food Microbiology, 3rd Ed., The Royal Society of Chemistry, Cambridge, UK.
- 2 James M. Jay. 2000. Modern Food Microbiology, 6th Ed. Aspen Publishers, Inc., Gaithersburg, Maryland, USA.
- 3 George J. Banwart. 1989. Basic Food Microbiology, 2nd Ed. Chapman & Hall, New York, USA.
- 4 William C. Frazier and & Dennis C. Westhoff. 1987. Food Microbiology, 4th Ed. Tata McGraw-Hill Education, New Delhi.
- 5 Frazer, Math and Deibel, Laboratory Manual for Food Microbiology, Burgers Publishers –Minnesota, USA.
- 6 Carlvan Derzant and Splittsoessev, Methods for Microbial Examination of Foods, APHA Publishers, Washington DC, USA.

ELECTRICAL ENGINEERING

Objective: By the end of the course the students will be able

- To know the fundamentals of electronics
- To know the laws related to Electronics and their applications.
- To know the ways to minimize the power consumption

**Lecture
Theory**

Topic

- 1 AC Fundamentals: Definitions of cycle, frequency, time period
- 2 AC Fundamentals: amplitude, Peak value, RMS value,
- 3 AC Fundamentals: Average value, Electro motive force, reluctance etc,
- 4 Laws of magnetic circuits,
- 5 Phase relations and vector representation,
- 6 AC through resistance, inductance and capacitance,
- 7 A.C. series and parallel circuits,
- 8 Simple R-L, R-C and R-L-C circuits,
- 9 3 Phase Systems: Star and Delta connections, Relationship between line and phase voltages
- 10 3 Phase Systems: currents in Star and Delta connections,
- 11 3Phase Systems: various methods of single and three phase power measurement.
- 12 Transformer : Principle of working,
- 13 Transformer : construction of single phase transformer, emf equation,
- 14 Phasor diagrams, Ideal transformer, transformer on no load, Transformer under load,
- 15 Equivalent circuits, Transformer losses, efficiency, Regulation, Open and short circuit test.
- 16 Single phase induction motor: double field revolving theory, equivalent circuit,
- 17 Single phase induction motor: characteristics, phase split, shaded pole motors.
- 18 Poly-phase induction motor: Construction, operation, equivalent circuit,
- 19 Poly-phase induction motor: phasor diagram, effect of rotor resistance,
- 20 Poly-phase induction motor: torque equation, starting and speed control methods,
- 21 Poly-phase induction motor: torque equation, starting and speed control methods,
- 22 D.C. Machine (generator and motor): Types, Construction and Operation,
- 23 D.C. Machine (generator and motor): EMF equation, armature reaction,
- 24 D.C. Machine (generator and motor): commutation of D.C. generator and their characteristics,
- 25 D.C. Motors, their starting, speed controls and characteristics.
- 26 Electric Power Economics, Maximum demand charge,
- 27 Load factor, power factor and power factor improvement,
- 28 Characteristics of different electrical measuring systems and equipment's,
- 29 Electrical Wiring, system of wiring, domestic wiring installation,
- 30 Industrial electrification, protection devices,
- 31 Earthing, use of Multimeter,

32 Circuit protection devices, fuses, MCB, ELCB & relays.

Practical

- 1 Study of voltage resonance in L.C.R. circuits at constant frequency: (a) Star connection study of voltage and current relation.
- 2 Study of voltage resonance in L.C.R. circuits at constant frequency: (b) Delta connection study of voltage and current relation.
- 3 Measurement of Power in 3 phase circuit by wattmeter and energy meter: (a) for balanced loads,
- 4 Measurement of Power in 3 phase circuit by wattmeter and energy meter: (b) for unbalanced loads.
- 5 Polarity test, no-load test, efficiency and regulation test of single-phase transformer,
- 6 Starting of induction motors by: (a) D.O.L.
- 7 Starting of induction motors by: (b) Manual star delta
- 8 Starting of induction motors by: (c) Automatic star delta starts.
- 9 Starting of slip ring induction motors by normal and automatic rotor resistance starters.
- 10 Test on 3 phase induction motor- determination of efficiency, line current, speed slip and power factor at various outputs.
- 11 Determination of relation between the induced armature voltage and speed of separately excited D.C. generator.
- 12 Magnetization characteristics of D.C. generator.
- 13 Study the starter connection and starting reversing and adjusting speed of a D.C. motor.
- 14 Problems on Industrial Electrification.
- 15 Study of various circuit protection devices.
- 16 Study of various measuring instruments.

References

- 1 B.L. Theraja and A.K. Theraja. 2005. A Textbook of Electrical Technology. Vol. II. S. Chand & Company Ltd., New Delhi.
- 2 Vincent Del Toro. 2000. Electrical Engineering Fundamentals. Prentice-Hall India Private Ltd. New Delhi.

COMPUTER PROGRAMMING AND DATA STRUCTURES

Objective: To enable the students to apply computer programming techniques for finding analytical solutions to food engineering problems by learning “C” programming and data structures and write the computer programs on their own by the end Of course.

Lecture Theory**Topic**

- 1 Introduction and historical background: Brief description about the computer & its parts. Processor, memory, secondary storage, display devices and other peripheral devices; Basic computer organization, future trends
- 2 Introduction to high level languages: Brief Introduction to systems software, applications software and ‘C’ programming language.
- 3 Variable: Variable Definition, Types of Variables and explanation, Fundamental Attributes of Variables, Rules for Declaring Variables & Explanation about the Typecasting.
- 4 Data types: Define Data type, Defining type using ‘Typedef’, Explanation about the Integer Data type(short/Long), Character, Float, Double &Enum Data types.
- 5 Operators: Explanation Assignment Operators, Arithmetic Operator, Increment Operator(pre & post increments), Decrement Operator(pre & post decrement), Relational operator, logical operator, Bitwise Operator.
- 6 Operators: Conditional,& and * Pointer,Comma, Dot,Arrow and [] and () Operators and Building and Evaluating expressions.
- 7 Standard Library Functions & Input and Output: Explain about Standard Library Functions in C programming language. Explain about Returned values of printf() and scanf(),What is return type of getchar(), fgetc() and getc() ?, Scansets in C, puts() vsprintf() for printing a string,What is use of %n in printf()?,How to print % using printf()?,Difference between printf, sprintf and fprintf? And Difference between getc(), getchar(), getch() and getche()
- 8 Decision Making & Branching: If Statement,If-Else,Nested If-Else,Else-If Ladder, Multiple Condition inside If,Multiple Statements in If Block,Introduction to Switch Statement,Rules of Using Switch Case,Invalid Ways of Using Switch Case,Conditional Operation : ?: Operator,Rules and Jumping Statements : GotoStatement,Break.
- 9 Looping: For Loop: Introduction | Flowchart,Different Ways of Writing For Loop, Nesting of For Loop,While Loop Introduction,Infinite While Loop,Do-While Loop, Differentiation : For Loop Vs While Loop, Differentiation : For Loop Vs Do-While Loop and Differentiation : While Loop Vs Do-While Loop.
- 10 Introduction to Data Structures and Arrays and Structures: Over view of Data Structures,Array Representation.
- 11 String functions: strcpy, strcat, strchr, strcmp, strrev, strlen, strdup, strset, strncmp, strcmp, strstr, strtok.
- 12 Arrays: Definition of arrays, declaration of arrays, properties, types; single dimensional arrays, double dimensional arrays, multi-dimensional arrays, array operations.
- 13 Structures & unions: Defining and declaring a structure. Defining and declaring a union.

- 14 Pointers: Definition and declaration of pointers, initialization and implementation of pointers.
- 15 Stacks, Push/Pop operations: Introduction to data structures, defining a stack, representing a stack using array, push operation, pop operation, empty stack, fully occupied stack, applications of stack.
- 16 Queues, Insertion and deletion operations: Defining a queue, types of queues, linear queues, circular queues, dequeues. Operations on queues, enqueue, dequeue, empty queue, fully occupied queue. Linked Lists: Defining a linked list, types of linked lists – single linked lists, double linked lists, circular linked lists.

Practical

- 1 Familiarizing with Turbo C IDE
- 2 Building an executable version of C program
- 3 Debugging a C program
- 4 Developing and executing simple programs
- 5 Developing and executing simple programs
- 6 Decision making programs using if
- 7 Decision making programs using if else and go to
- 8 Decision making programs using switch
- 9 Developing program using while loop statement
- 10 Developing program using do while loop statements
- 11 Developing program using for loop statements
- 12 Developing program using for loop statements
- 13 Developing programs using nested control structures
- 14 Implementation of Arrays
- 15 Problems on multidimensional Arrays
- 16 Programs using the string functions
- 17 String Functions.
- 18 Structures implementation
- 19 Union
- 20 Functions using return type
- 21 Function calling
- 22 Functions parameters call by value, call by reference.
- 23 User defined functions
- 24 Using local, global & external variables
- 25 Pointers implementations in function
- 26 Pointers usage in arrays.
- 27 Program to implement stacks.
- 28 Performing stack operations
- 29 Queues:- A program to implement Queue operations using arrays.
- 30 Linked List
- 31 Insertion Deletion in Data Structures.

32 Searching a particular file using Linear search and Binary search.

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- 1 Mark Allen Weiss. 2014. Data Structures and Algorithm Analysis in C++, 4th Ed. Pearson Education, Boston, USA.
- 2 Svetlin Nakov & Co. 2013. Fundamentals of Computer Programming with c#. Sofia, Bulgaria.
- 3 F.Balagurusamy. 2008. Object Oriented Programming with C++, 4th Ed. Tata McGraw-Hill Publishing Company Limited, New Delhi.

BASIC ELECTRONICS ENGINEERING

Objective: By the end of the course the students will be able

- To know about principles of Electronics Engineering
- To know basic concepts related to different Electronics instruments used in food industry

Lecture**Topic****Theory**

- 1 Semiconductors.
- 2 P—n junction
- 3 V—I characteristics of p—n junction
- 4 Diode as a circuit element
- 5 Rectifier
- 6 Clipper
- 7 Damper, voltage multiplier, capacitive filter.
- 8 Diode circuits for OR & AND (both positive and negative logic), bipolar junction transistor:
- 9 Operating point. Classification (a.B & C) of amplifier.
- 10 Various biasing methods (fixed. Self potential divider).
- 11 H-parameter model of a transistor.
- 12 Analysis of small signal. CE amplifier.
- 13 Phase shift oscillator, analysis of differential amplifier using transistor.
- 14 Ideal OP-AMP characteristics.
- 15 Linear and non-linear applications of OP-AMP (adder. Subtractor.
- 16 Integrator, active rectifier.
- 17 Comparator
- 18 Differentiator
- 19 Differential, instrumentation amplifier and oscillator).

- 20 Zener diode voltage regulator.
- 21 Transistor series regulator.
- 22 Current limiting.
- 23 OP-AMP voltage regulators.
- 24 Basic theorem of boolean algebra.
- 25 Combinational logic circuits(basic gates. SOP rule and kmap).
- 26 Binary ladder D/A converter, successive approximation A/D converter, generalized instrumentation,
- 27 Temperature. Velocity, force and pressure using potentiometer.
- 28 Resistance thennometer. Thermocouples.
- 29 Bourclen tube.
- 30 LVDT
- 31 Strain gauge
- 32 Tacho-generator.

Practical

- 1 To study V-I characteristics of p-n junction diode:
- 2 To study half wave. full wave and bridge rectifier:
- 3 To study transistor characteristics in CE configurations:
- 4 To design and study fixed and self bias transistor:
- 5 To design and study potential divider bias transistor:
- 6 To study a diode as clipper and clamper:
- 7 To study a OP-AMP IC 741 as inverting and non- inverting amplifier:
- 8 To study a OP-AMP IC 741 as differentiator and integrator to study a differential amplifier using two transistor:
- 9 To study a OP-AMP IC 741 as differential amplifier:
- 10 To study a zener regulator circuit:
- 11 To study a OP-AMP IC 741 as a active rectifier-I
- 12 To study a OP-AMP IC 741 as a active rectifier-II
- 13 To study a OP-AMP IC 741 as a comparator-I
- 14 To study a OP-AMP IC 741 as a comparator-II
- 15 To familiarize with various types of transducers-I
- 16 To familiarize with various types of transducers-II

References

- 1 Electrical Engineering Fundamentals by Vincent Del Toro
- 2 Electrical and Electronics Engineering for Scientists by K.A.Krishnamurthy and M.R.Raghuveer
- 3 Circuits and Systems: A Modern Approach by A. Papoulis

NCC/NSS

Objective: To improve the physical skills and fitness of the students to make them more active, alert and successful

Practical's**Topic**

- 1 Orientation of students towards national problems
- 2 Study of the philosophy of N.S.S.
- 3 NSS programmes and activities
- 4 Fundamental rights and directive principles of State Policy
- 5 Socio-economic structure of Indian society
- 6 Population and five year plans
- 7 Functional Literacy - Non-formal education of rural youth
- 8 Eradication of social evil and awareness programmes
- 9 Consumer awareness and highlights of the Consumer Act.
- 10 Consumer awareness and highlights of the FSSAI ACT, 2006
- 11 Environment enrichment and conservation
- 12 Health, family welfare and nutrition
- 13 Hygienic Food Production and food preparation practices
- 14 Disaster management
- 15 Right to information act.
- 16 Special camping programme

STATISTICAL METHODS AND NUMERICAL ANALYSIS

Objective By the end of the course, the students will be able to gain the knowledge on advanced aspects of different statistical and mathematical methods to be able to apply for solving engineering problems in the Food Engineering sector

Lecture**Topic****Theory**

- 1 Statistics - statistical methods - testing of hypothesis – concepts – introduction - mean, median, mode, null hypothesis, alternative hypothesis - sampling distribution - random sampling.
- 2 Testing of significance based on Z-test and t-test - explanation of large & small sample tests - Z and t-tests if S.D is known and S.D is unknown - problems on one sample and two sample Z-tests.
- 3 Testing of significance through variance F-test and Chi-square tests - explanation of small sample F-test – related problems - enumeration data - 2x2 contingency table - explanation of Chi-square test with examples
- 4 Testing of significance based on contingency table - correlation and regression – definition - types of correlation – methods - test of significance of correlation coefficient (direct and indirect method) – definition - direct method - deviation method - properties of regression coefficient – related problems.
- 5 Multiple linear regression - ANOVA (one-way and two-way classifications) - factorial experiment concepts (2^2 , 2^3 , mixed factorials) - definition, direct method - deviation method - properties of regression coefficient - problems on ANOVA.
- 6 Numerical analysis - finite differences - various difference operators and their relationships - factorial notations – interpolation, extrapolation - explanation of forward, backward and central differences with suitable examples - symbolic relations and separation of symbols.
- 7 Interpolation with equal intervals - Newton's forward and backward interpolation formula – introduction - solving problems by using Newton's forward and backward interpolation formulas.

- 8 Numerical integrations – trapezoidal - Simpson's 1/3, 3/8 rule and Weddle's rules – introduction - solving problems on trapezoidal, Simpson's 1/3 and Simpson's 3/8 rule.
- 9 Numerical solutions of ordinary differential equations by Picard's and Taylor's series methods – introduction - solving problems on ordinary differential equations by using Picard's method & Taylor's series method.
- 10 Numerical solutions of ordinary differential equations by Euler's method and modified Euler's methods – introduction - solving ordinary differential equations problems by using Euler's method & modified Euler's method.
- 11 Numerical solutions of ordinary differential equations by Runge-Kutta methods – introduction - solving related problems
- 12 Laplace Transformation - introduction of Laplace transformation - L.T of elementary functions - properties of Laplace transformation - introduction, definition, linear Property, Laplace transform of various functions
- 13 Laplace transformation of derivatives and integrals - multiplication by t^n and divided by t - inverse Laplace transforms - convolution theorem - explanation of formulas of Laplace transforms of derivative and integrals - explanation of formulas of multiplication by t and t^n , divided by t - example problems
- 14 Applications of Laplace transforms to solve ordinary differential equations and simultaneous differential equations - working rule to solve the differential equation by L.T method - solving simultaneous differential equation by using L.T method.
- 15 Experimental designs - basic designs, Completely randomized design (CRD) - layout and analysis - Randomized block design (RBD) - layout and analysis - various example problems on basic designs, CRD and RBD
- 16 Latin square design (LSD) - layout and analysis - response surface methodology - various example problems on Latin square design.

Practical

- 1 Problems on one sample, two sample Z-tests when population S.D. is known and unknown
- 2 Problems on one sample, two sample paired t-test
- 3 Problems on one sample, two sample Chi-Square test
- 4 Problems on 2x2 and m x n contingency table and F-test

- 5 Calculation of correlation coefficient and its testing
- 6 Fitting of simple linear regressions - fitting of multiple regression equations
- 7 Problems on ANOVA - one way / two way - 2^2 , 2^3 and mixed factorial experiments
- 8 2^2 , 2^3 and mixed factorial experiment concepts.
- 9 Problems on Newton's forward and backward interpolation formula for equal intervals
- 10 Problems on numerical integrations of trapezoidal rule, Simpson's 1/3 and 3/8 rules
- 11 Numerical solution of ordinary differential equations of first order and second order by Runge-Kutta method.
- 12 Problems on numerical solutions of ordinary differential equations by Euler's method
- 13 Problems on Laplace transformations
- 14 Problems on inverse Laplace transformations
- 15 Problems on Laplace transformations and their application to solution of ordinary differential equation
- 16 Response surface methodology - Problems on CRD, RBD & LSD experimental designs.

References

- 1 Basic Statistics by Agarwal B L. Wiley Eastern Ltd. New Age International. Ltd.
- 2 A Text Book of Agricultural Statistics by Rangaswamy R. New Age Int. publications Ltd.
- 3 A Hand book of Agricultural Statistics by Chandel SRS. Achal Praskasam Masndir, Kanpur
- 4 Fundamental Applied Statistics by Gupta S.C. Fundamental Applied Statistics.
- 5 Statistics for Agricultural Sciences by Nageswara Rao G., B.S Publications.

FUNDAMENTALS OF FOOD PROCESSING

Objective By the end of the course, the students will be able to know different concepts involved in food spoilage, food processing and food preservation principles and technologies.

Lecture

Topic

Theory

- 1 Sources of food - food classification - basic four, basic five (ICMR), basic seven - perishables – semi perishables and non-perishables
- 2 Food spoilage - types- factors affecting spoilage - definition of food spoilage - major types of food spoilage - micro biological, bio-chemical, physical and enzymatic spoilage (bio-chemical spoilage)
- 3 Spoilage by insects, parasites and rodents - mechanical spoilage (physical spoilage) - chemical spoilage
- 4 Factors affecting food spoilage - extrinsic - temperature, RH, O₂, CO₂ - intrinsic - pH, moisture content, a_w, R_h
- 5 General principles of food preservation - physical methods - chemical methods - fermentation - other methods
- 6 Preservation by salt - principle, method and effect on food quality
- 7 Preservation by sugar - principle, method and effect on food quality
- 8 Preservation by heat treatment - principle and equipment for blanching
- 9 Preservation by canning - different unit operations involved in canning - equipment used in canning - types of canning containers
- 10 Preservation by heat treatment - principle and equipment for pasteurization
- 11 Preservation by heat treatment - principle and equipment for sterilization
- 12 Preservation by low temperature - types of cold preservation - chill storage - procedure of low temperature storage - types of freezing equipment used
- 13 Various changes occurring during freezing and thawing - methods of food freezing - quick fast freezing and slow freezing - factors affecting storage

- 14 Preservation by drying - definition of drying - advantages of dried foods - sun drying
- 15 Mechanical dehydration - direct heated drier - indirect heated drier - cabinet drier - tunnel drier - drum drier - fluidized bed drier - spray drier
- 16 Factors affecting dehydration of food - dehydration - methods of dehydration - advantages & disadvantages of dehydration - equipment
- 17 Changes in constituents of food materials - shrinkage, case hardening - thermo plasticities - reconstitution properties - thin layer drying – deep bed drying
- 18 Preservation by concentration - principle - methods of concentration - film evaporators - falling evaporators
- 19 Preservation by radiation - food irradiation - what is food irradiation - forms of energy - ionizing radiation and sources - units of radiation - effects of radiation - irradiation doses for treating foods - mechanism underlying irradiation - advantages - disadvantages
- 20 Preservation by chemicals - antioxidants, mould inhibitors, antibodies, acidulants etc.
- 21 Preservation by fermentation - principles, methods, equipment
- 22 Non-thermal preservation processes - pulsed electric field & pulsed intense light processing - principle - equipment - mechanism - effect on quality - advantages - disadvantages
- 23 Non-thermal preservation processes - ultrasound - principles - method – equipment
- 24 Non-thermal preservation processes - dielectric heating - principle – method - equipment
- 25 General information on ohmic heating - parameters of importance in ohmic heating - novel uses of ohmic heating – equipment
- 26 Infrared heating – introduction - principle and uses- theories and infrared properties – technologies – equipment – applications - case studies and modelling
- 27 Hydrostatic pressure treatment of food – introduction – principle - method - effects of high pressure on biological materials - potential applications
- 28 Microwave heating - principles - advantages of microwave heating - factors affecting microwave heating - industrial applications of microwave heating

- 29 Quality tests for physico-chemical properties - sensory attributes of stored foods
- 30 Shelf life - Introduction - factors influencing shelf-life
- 31 Measuring shelf-life - predicting shelf-life - extending shelf-life
- 32 Shelf-life of milk and milk products, confectionery products, fruits and vegetables, cereals, fats and oils

Practical

- 1 Demonstration of various perishable food items and degree of spoilage
- 2 Blanching of selected food items
- 3 Preservation of food by heat treatment - pasteurization
- 4 Preservation of food by high concentration of sugar - jam
- 5 Preservation of food by using salt - pickle
- 6 Preservation of food by using acidulants i.e. pickling by acid, vinegar or acetic acid
- 7 Preservation of food by using chemical preservatives
- 8 Preservation of bread, cake using mold inhibitors
- 9 Drying of fruit slices - pineapple slices, apple slices in cabinet drier
- 10 Drying of green leafy vegetables
- 11 Drying of mango /other pulp by foam-mat drying
- 12 Drying of semisolid foods using roller dryers
- 13 Drying of foods using freeze-drying process
- 14 Demonstration of preserving foods under cold vs. freezing process
- 15 Processing of foods using fermentation technique, i.e. preparation of sauerkraut
- 16 Study on effect of high pressure on microbe, study on effect of pulsed electric field on food.

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PROCESSING TECHNOLOGY OF LIQUID MILK

Objective By the end of the course, the students will be able to know about milk, its constituents, nutritive value, collection and its hygienic handling practices and manufacture of indigenous liquid milk products.

Lecture**Topic****Theory**

- 1 Historical development of dairy in India
- 2 Primary production - utilization & consumption trends in India
- 3 Basic physical - chemical properties of milk - composition of milk - properties of milk - changes in milk and its constituents
- 4 Collection and reception of milk - testing milk for quality - chilling the incoming milk
- 5 Heat exchangers - heat treatment - holding - different types of heat exchangers
- 6 Centrifugal separators and milk fat standardisation
- 7 Standardisation of fat content in milk and cream
- 8 Designing a process line - process design considerations
- 9 Preservation, processing, packaging and storage - standardized milk, skim milk, sterilized milk, reconstituted / rehydrated milk
- 10 Preservation, processing, packaging and storage - recombined milk, flavoured milk, fermented milk, acidophilus milk
- 11 Cream - definition - classification - physico-chemical properties - processing of cream - production - factors influencing fat percentage of cream - manufacture of different types of creams
- 12 Fermented milk products - processing, manufacture, storage and packaging of acidophilus milk, cultured butter milk, other fermented milk
- 13 Bio chemical changes occurring during manufacture of fermented milks - factors affecting these changes and effects of these changes on the quality of finished products - adulterations in milk and its detection - quality defects in milk - causes and prevention

- 14 Liquid milk collection, processing, packaging and storage systems - equipment - bulk milk coolers, milk chilling units - milk reception equipment, milk tanks/silos - pasteurizers, sterilizers, centrifuges - clarifiers, filtration units
- 15 Homogenizers - packaging and filling machines, CIP units, etc.
- 16 Hygienic design concepts, sanitary pipes and fittings, corrosion process and their control.

Practical

- 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 of milk
- 5 Determination of 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
- 8 Determination of total solids
- 9 Preparing standardized milk as per requirement
- 10 Separation of fat from milk
- 11 Pasteurization and homogenization of milk
- 12 Sterilization - turbidity test
- 13 Packaging of liquid milk
- 14 Preparation of curd and yogurt
- 15 Visit to chilling centre and dairy plant.
- 16 Practical examination

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PROCESSING TECHNOLOGY OF CEREALS

Objective By the end of the course, the students will be able to know about different cereals and millets - nutritional importance, processing technology of cereals & millets and acquaint with knowledge on utilization of by-products from cereals, preparation of ready to eat breakfast cereals and instant cereal foods

Lecture**Topic****Theory**

- 1 Introduction - cereals & millets production and consumption - current status and future prospects in India
- 2 Morphology - general structure of a grain - physico-chemical properties of major and minor millets
- 3 Composition and nutritive value of cereals - physico - chemical properties of cereals, major and minor millets - bulk density, true density, porosity, sphericity, roundness, 1000 grain weight, coefficient of friction and angle of repose
- 4 Thermal properties - specific heat - thermal conductivity - thermal diffusivity
- 5 Paddy processing - seed grading - rice milling – terminology - milling equipment – Engelberg huller, centrifugal sheller
- 6 Rice milling – under-runner disk husker, rubber roll sheller, husking action of rubber rolls
- 7 Rice milling – paddy separator (Satake type, Schule type), whiteners (Schele type, satake type), rice grader, milling efficiency
- 8 Quality characteristics influencing final milled product - processing issues - rice grading - storage - FSSAI regulations
- 9 Parboiling of paddy – introduction, advantages, disadvantages, process variables, changes in chemical constituents
- 10 Parboiling – starch gelatinization methods, parboiling operations, parboiling methods (traditional and modern) - drying equipment
- 11 Rice husk and rice bran utilization – commercial products and food products processing - uses of bran - instability of bran - stabilization of rice bran, factors affecting the rate of formation of FFA

- 12 Rice bran oil - extraction - refining - packaging - storage - FSSAI regulations
- 13 Wheat milling – introduction, dry milling, unit operations (selection, blending, cleaning, conditioning / tempering, grinding / milling) - equipment
- 14 Wheat milling – flour grades - wet milling - break system, purification system and reduction system - extraction rate and its effect on flour composition
- 15 Semolina - pasta production - packaging - storage - FSSAI regulations
- 16 Asian noodle processing - packaging - storage - FSSAI regulations
- 17 Quality characteristics of flour and their suitability for baking
- 18 Corn - pop corn - dry and wet milling of corn
- 19 Barley - malting and milling
- 20 Starch and gluten separation - milling fractions and modified starches
- 21 Oat / Rye - processing, milling
- 22 Sorghum - milling, malting, pearling
- 23 Millets - nutritional composition, processing - malting - extrusion
- 24 Cereal based fermented foods and beverages
- 25 New cereal based probiotic foods
- 26 By-products processing of cereals and millets
- 27 Processing of infant foods
- 28 Breakfast cereal foods – flaked
- 29 Breakfast cereal foods - Puffed
- 30 Breakfast cereal foods - expanded
- 31 Breakfast cereal foods - extruded and shredded.
- 32 Cereal based health foods - bioactive compounds

Practical

- 1 Morphological characteristics of cereals
- 2 Physical properties of cereals
- 3 Chemical properties of cereals

- 4 Parboiling of paddy
- 5 Cooking quality of rice
- 6 Milling of rice
- 7 Conditioning and milling of wheat
- 8 Production of sorghum flakes
- 9 Production of popcorns
- 10 Production of flaked rice
- 11 Production of puffed rice
- 12 Production of noodles
- 13 Preparation of sorghum malt
- 14 Determination of gelatinization temperature by amylograph
- 15 Processing of value added products from millets
- 16 Visit to cereal processing unit

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FOOD THERMODYNAMICS

Objective By the end of the course, the students will be able to understand the basic concepts of thermodynamics, thermodynamic systems, thermodynamic cycles and laws of thermodynamics. Also, they learn about thermodynamic properties of pure substances in different phases and gain knowledge on humidification and dehumidification processes and steam

Lecture**Topic****Theory**

- 1 Basic concepts - definitions, approaches
- 2 Thermodynamic system
- 3 Thermodynamic properties and equilibrium
- 4 State of a system, state diagram, path and process
- 5 Different modes of work
- 6 Zeroth law of thermodynamics - applications.
- 7 Concept of temperature, heat and their units.
- 8 First law of thermodynamics - energy, enthalpy - concept of enthalpy in biological systems.
- 9 Specific heat, applications of first law
- 10 Steady and unsteady flow analysis
- 11 Second law of thermodynamics - Kelvin-Planck and Clausius statements
- 12 Reversible and irreversible processes
- 13 Thermodynamic temperature scale
- 14 Entropy, availability and irreversibility
- 15 Properties of pure substances - thermodynamic properties of pure substances in solid phase
- 16 Properties of pure substances - thermodynamic properties of pure substances in liquid phase

- 17 Properties of pure substances - thermodynamic properties of pure substances in vapor phase
- 18 P-V-T behaviour of simple compressible substances - phase rule
- 19 Thermodynamic cycles - Carnot vapor power cycle
- 20 Ideal Rankine cycle, Rankine reheat cycle
- 21 Air standard Otto cycle, air standard Diesel cycle
- 22 Air-standard Brayton cycle, vapor-compression refrigeration cycle
- 23 Psychometry - thermodynamic properties of moist air, perfect gas relationship
- 24 Psychometry - absolute humidity, relative humidity, percentage humidity, humid volume
- 25 Total heat, enthalpy, dry bulb temperature
- 26 Wet bulb temperature, dew point temperature
- 27 Adiabatic processes, wet bulb depression, humid heat
- 28 Specific volume, heating, cooling
- 29 Dehumidifying, sorption isotherms, three stages of water
- 30 Phase diagram for water, vapour pressure-temperature curve for water
- 31 Heat requirement for vaporization - measurement of humidity
- 32 Properties of steam - wet, dry saturated, superheated steam, use of steam tables

Practical

- 1 Determination of dryness fraction of steam
- 2 Determination of state of air using psychometric chart
- 3 Determination of state of air using hygrometer-I
- 4 Determination of state of air using hygrometer-II
- 5 Use of psychometric chart during drying process-I
- 6 Use of psychometric chart during drying process-II
- 7 Use of psychometric chart during humidification process -I

- 8 Use of psychometric chart during humidification process-II
- 9 Demonstration of equilibrium sorption isotherms-I
- 10 Demonstration of equilibrium sorption isotherms-II
- 11 Use of psychometric chart during heating process
- 12 Use of psychometric chart during cooling process
- 13 Use of psychometric chart during de-humidification process-I
- 14 Use of psychometric chart during de-humidification process-II
- 15 Visit to food plant with steam utilization-I
- 16 Visit to food plant with steam utilization-II

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UNIT OPERATIONS OF FOOD PROCESSING-I

Objective By the end of the course, the students will be able to understand different food processing equipments that are being used in food industries and also study about the principles, operation and maintenance of food processing equipments viz., material handling, cleaning, grading, mixing, forming, size reduction, cutting, grinding, centrifugation, filtration, evaporation and ion exchange

Lecture**Topic****Theory**

- 1 Size reduction - introduction - benefits - classification
- 2 Determination and designation of the fineness of ground material
- 3 Sieve /screen analysis - principle and mechanisms of comminution of food
- 4 Rittinger's, Kick's and Bond's equations - work index - energy utilization
- 5 Size reduction equipment – principle types, crushers (jaw crushers, gyratory, smooth roll)
- 6 Size reduction equipment - hammer mills and impactors - attrition mills - buhr mills
- 7 Size reduction equipment - tumbling mills, ultra fine grinders
- 8 Size reduction equipment - fluid jet pulverizer, colloid mill
- 9 Cutting machines (slicing, dicing, shredding, pulping)
- 10 Mixing - theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing
- 11 Theory of liquid mixing - power requirement for liquids mixing
- 12 Mixing equipment - mixers for low or medium viscosity liquids (paddle agitators, impeller agitators, powder - liquid contacting devices, other mixers)
- 13 Mixing equipment - mixers for high viscosity liquids and pastes
- 14 Mixing equipment - mixers for dry powders and particulate solids
- 15 Mechanical separations - theory, centrifugation

- 16 Liquid-liquid centrifugation, liquid-solid centrifugation
- 17 Mechanical separations - clarifiers - de-sludging and decanting machines
- 18 Filtration - theory of filtration - rate of filtration - pressure drop during filtration - applications
- 19 Filtration - constant-rate filtration and constant-pressure filtration, derivation of equation
- 20 Filtration equipment - plate and frame filter press
- 21 Filtration equipment - rotary filters, centrifugal filters and air filters, filter aids
- 22 Membrane separation - general considerations - materials for membrane construction
- 23 Membrane separation methods - introduction - differences - applications
- 24 Ultra-filtration - introduction - construction
- 25 Membrane separation - processing variables, membrane fouling
- 26 Applications of ultra-filtration in food processing
- 27 Reverse osmosis - mode of operation, influence of different factors on reverse osmosis - applications.
- 28 Demineralization by electro-dialysis
- 29 Gel filtration - influence of different factors and applications.
- 30 Ion exchange process - kinetics - applications
- 31 Per-evaporation - introduction - applications
- 32 Micro filtration - introduction - principle - application

Practical

- 1 Determination of fineness modulus
- 2 Determination of uniformity index
- 3 Determination of mixing index of a feed mixer
- 4 Power requirement in size reduction of grain using Rittinger's law
- 5 Power requirement in size reduction of grain using Kick's law
- 6 Power requirement in size reduction of grain using Bond's law

- 7 Performance evaluation of hammer mill
- 8 Performance evaluation of attrition mill
- 9 Study of centrifugal separator
- 10 Study of freeze dryer
- 11 Study of freeze drying process
- 12 Study of osmosis in fruits
- 13 Determination of solids gain
- 14 Study of moisture loss during osmosis
- 15 Study of reverse osmosis process
- 16 Study of ultra filtration / membrane separation process.

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INDUSTRIAL MICROBIOLOGY

Objective By the end of the course, the students will be able to know about Industrial fermentation techniques, different industrially important micro organisms and different products produced by industrial fermentation process. Also, to know about different growth regulators (Hormones).

Lecture

Topic

Theory

- 1 Microbes as friends - normal flora - history of Industrial Microbiology - microbes influencing our lives - primary metabolites & secondary metabolites produced by the microorganisms
- 2 Screening of microorganisms - primary screening - isolation of desired and interested microorganisms - secondary screening - yield potential of microbes - qualitative and quantitative approach
- 3 Strain improvement - preservation of microorganisms - organizations involved in microbiological work
- 4 Fermentation media - characteristics of ideal production medium, raw materials as media, precursors and inducers, repressors, antifoams.
- 5 Industrial sterilization - principles of sterilization - sterilization of equipment - sterilization of production media and sterilization of air.
- 6 Types of fermentors - stirred tank fermentors - packed bed fermentors - fluidized bed fermentors - bubble column fermentor - air lift fermentor - cylindrical fermentors – flocculated cell culture fermentor - multi phase bioreactors - trickling bed bioreactors - tubular fermentor - mechanically agitated stirred tank reactors - deep jet fermentor - cyclone column fermentor - novel see saw bioreactor - stirred tank fermentor (CSTF).
- 7 Fermentor - components of a fermentor - parts of fermentors - peripheral parts and accessories - alternative vessel designs - additional accessories and peripherals - feed pumps - exit gas analysis - common measurements and control systems (speed control, temperature control, control of gas supply, control of pH, control of oxygen)
- 8 Types of fermentations - solid substrate fermentation - submerged fermentation – factors affecting submerged culture - batch fermentation - fed batch fermentation – sub-batch fermentation - continuous fermentation -

multiple fermentations - multistage fermentations.

- 9 Industrially important secondary metabolites - production of organic acids - citric acid, lactic acid, itaconic acid, acetic acid, gluconic acid, kojic acid, gallic acid - production - microorganisms & metabolisms - fermentation conditions - inoculums preparation – carbon and nitrogen source - trace elements - pH and temperature - aeration and agitation - yield and recovery - uses of organic acids
- 10 Production of antibiotics - screening of antibiotic producers - β - lactam antibiotics – penicillin - amino glycoside antibiotics - tetracyclines, chloramphenicol, griseofulvin, macrolide antibiotics, rifamycins. streptomycin - chemical nature and biosynthesis – commercial production - inoculums - media - fermentation process - temperature - aeration - pH - biomass production - recovery and purification - uses of antibiotics
- 11 Probiotics – importance - organisms involved - beneficial effect - role in fermented dairy foods - Yoghurt - *Lactobacillus acidophilus* - *Bifidobacterium* - *Lactobacillus delbrueckii* - *Lactobacillus bulgaricus* - standard number of probiotics to be used - probiotic cheese - *Lactobacillus salivarius* - *Bifido bacterium bifidum* - Kefir - combination of lactic acid bacteria and yeasts- therapeutic and medicinal value - enhances digestion.
- 12 Bacteriocins - nisin - production - metabolism - fermentation conditions – inoculum preparation - carbon and nitrogen source - trace elements - pH and temperature requirement - recovery and purification
- 13 Biocolours - carotenoids - lycopene – Angkak - production - using fungi - *Monascus purpureus*- history and traditional uses - morphology - fermentation conditions - pigment of *M.purpureus* - health benefits - toxicology - safe consumption
- 14 Plant growth regulators and hormones - role in metabolic activity of plants – microorganisms involved in the production of auxins, gibberellins, cytokinins – purification - role of ethylene and abscissic acid in plant metabolic activity
- 15 Production of microbial enzymes - solid state fermentation - fermentors - medium - advantages and disadvantages - submerged fermentation - steps of enzyme production - factors affecting submerged culture - production of amylases, proteases, pectinases, cellulases
- 16 Extraction of enzymes - physical disruption method - chemical treatment method - purification of enzyme - removal of nucleic acids and cell debris – preliminary purification - final purification - applications
- 17 Downstream processing - steps involved in the purification of biological - Capture intermediate - polishing - cell disruption methods - chemical

- methods - mechanical methods – sonication - freeze - thawing - concussion device - liquid shear - colloid mill - french press
- 18 Centrifugation - flocculation and coagulation - filtration - product concentration - extraction - chromatography - size exclusion - ion exchange - affinity - hydrophobic interaction - immobilized metal ion affinity chromatography - HPLC - gas chromatography – supercritical fluid chromatography - electrophoresis - mass spectrometry
- 19 Microbial polysaccharides - bacterial polysaccharides - localization and description - xanthan - pullan - curdlan – exo-polysaccharides from lactic acid bacteria - dextran – from extremophilic bacteria
- 20 Fungal polysaccharides - cell wall polysaccharides - lichen cell wall polysaccharides - fungal exo-polysaccharides - production of polysaccharides - culture techniques and fermentation parameters - agitation - pH - aeration - culture medium - immobilized microorganisms - solid state fermentation
- 21 Applications of polysaccharides - polysaccharides as food additives – pharmaceutical applications - oligosaccharides derivatives
- 22 Production of amino acids – historical developments - manufacturing methods – extractive isolation - chemical synthesis - enzymatic catalysis - fermentative production - L–glutamic acid – L-lysine - uses and applications
- 23 Energy production by aerobic processes - TCA cycle, energy yield in aerobic respiration.
- 24 Mutations - types of mutations, mutagenesis, mutation rate - repair of mutations, phenotypes of bacterial mutants - designation of bacterial mutants.
- 25 Destruction of microorganisms - physical agents - high temperature, thermal death time and decimal reduction time, application of high temperatures for destruction of microorganisms.
- 26 Production of vitamins - general aspects - nomenclature and classification - vitamin B complex - vitamin B₁₂, Vitamin B₂ - production of these vitamins - production by fermentation of *Ashbya gossypii* - Vitamin C
- 27 Production of bio insecticides - *Bacillus thuriengensis* - insecticidal protein - endotoxin - engineering with endotoxin gene - rDNA technology - inserting into maize - cotton - rice - BT cotton
- 28 Production of SCP - single cell protein advantages - source of SCP - production of bacterial biomass - production using waste - starchy waste - from algae - nutritive value of SCP - consumption of SCP - uses of SCP
- 29 Baker’s yeast - development and history - the Vienna process - production of

- yeast - nutrient materials - concentration of sugar - aeration - temperature - pH - molasses ammonia process - yeast from sulphite liquor - Florylin yeast - food and fodder yeast - yeast products - fat from yeast - vitamins from yeast
- 30 Batch fermentation - fed batch fermentation – sub-batch fermentation – continuous fermentation - multiple fermentations - multistage fermentations
- 31 Food based fermented products - cheese – types - ripening of cheese - yogurt – buttermilk - acidophilus milk - cream - fermented vegetables - sauerkraut - pickles - silage – kimchi
- 32 Olives - fermented meat - fish - bread and other fermented plant products – fermented cereal foods. wine, production and beer production and mushroom production

Practical

- 1 Isolation and screening of citric acid
- 2 Isolation and screening of amylase
- 3 Isolation and screening of protease
- 4 Isolation and screening of antibiotic producing microbes
- 5 Production, purification and estimation of citric acid
- 6 Production, purification and estimation of lactic acid
- 7 Production, purification and estimation of acetic acid
- 8 Standardization of physical factors for higher yields of citric acid
- 9 Isolation, identification of cultures producing bio-colours
- 10 Production, purification and estimation of beer
- 11 Production, purification and estimation of ethanol
- 12 Production, purification and assay of enzymes (fungal amylases, proteases and lipase)
- 13 Production and assay of nisin from lactic acid bacteria
- 14 Production and assay of single cell protein production (mushroom)
- 15 Production and assay of starter activity of baker's yeast
- 16 Preparation of food based fermented product

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FOOD CHEMISTRY OF MICRONUTRIENTS

Objective By the end of the course the students will be able to gain knowledge on role of micronutrients in imparting flavor, taste and color, different chemical & enzymatic reactions occurring in foods during processing, understand biochemical mechanism behind flavor production and perception, color, industrial application of different micronutrients

Lecture

Topic

Theory

- 1 Introduction - definition of micronutrient - classification of micronutrients - significance and scope of micronutrient for health
- 2 Flavor – definition - methods for flavor analysis - taste and nonspecific saporous sensations - taste substances - sweet, bitter, sour, and salty sensations - structural basis of taste modalities, non-specific saporous substances - flavour enhancers - astringency, pungency and cooling
- 3 Flavors related to spices - sulfur containing volatiles in *Allium* sp. - sulfur containing volatiles in *Cruciferae*
- 4 Flavors related to vegetables - methoxy alkyl pyrazine volatiles in vegetables – volatiles derived from fatty acids by enzymatic action - volatile from branched chain amino acids
- 5 Flavors related to fruits - flavors derived from the shikimic acid pathway - volatile terpenoids - citrus flavors - flavors of herbs
- 6 Flavor volatiles from lactic acid - ethanol fermentation - fats and oils - muscle foods and milk
- 7 Pigments - introduction - pigments in animal and plant tissue - heme compounds - chlorophyll, carotenoids and betalains.
- 8 Heme compounds – myoglobin / haemoglobin - structure of heme compounds - myoglobin - chemistry and color - cured meat pigments - stability of meat pigments
- 9 Chlorophyll - structure and derivatives of chlorophyll - physical characteristics
- 10 Alterations of chlorophyll by enzymatic heat and acid - metallo complex formation - allomerization - photodegradation

- 11 Loss of green color during thermal processing - different technologies of green colour preservation - acid neutralization to retain chlorophyll,
- 12 High temperature short time processing - enzymatic conversion to chlorophyllides - commercial application of metal complex - regreening of thermal processing
- 13 Carotenoids - structures of carotenoids - occurrence and distribution - physical and chemical properties
- 14 Chemical properties of carotenoids - oxidation, anti oxidative activity, cis/trans isomerization – stability during processing
- 15 Flavonoids and other phenols - anthocyanins - structure - color and stability of anthocyanins
- 16 Factors affecting stability of anthocyanins - structural transformation and pH – temperature - oxygen and ascorbic acid - light, sugars and their degradation products, metals, sulfur dioxide, co pigmentation, enzyme reactions
- 17 Other flavonoids - physical properties - importance in foods – pro-anthocyanidins – tannins - quinoids and xanthones
- 18 Betalaines - structure - physical properties - chemical properties - conversion of betacyanin to betaxanthin
- 19 Food colorants - regulatory aspects - properties of certified dyes - use of certified dyes - colors exempt from certification
- 20 Vitamins – introduction - toxicity of vitamins - different sources of vitamins – dietary recommendation
- 21 Bioavailability of vitamins - general causes of variation / losses of vitamins in foods
- 22 Fat soluble vitamins - water soluble vitamins - vitamin like compounds - optimization of vitamin retention - enrichment – restoration - fortification
- 23 Minerals - introduction - principles of mineral chemistry - nutritional aspects of minerals - essential mineral elements - recommended dietary allowances – bioavailability
- 24 Minerals composition of foods - ash - fortification - effect of processing - enrichment - restorations - losses of minerals - optimization and retention of minerals in foods
- 25 Chemical and functional properties of minerals in foods
- 26 Thickeners and stabilizers in foods - chemical composition of acacia gum,

- agar, alginic acid, carrageen, guar gum, specific function and utilization in foods
- 27 Hydroxy propyl methyl cellulose - locust bean gum, methyl cellulose, pectin, sodium carboxy methyl cellulose, tragacanth gum – specific function and utilization in foods
- 28 Saponin, phytic acid, hemagglutinins or lectins and their chemistry
- 29 Modification of food using enzymes
- 30 Role of endogenous enzymes in food quality - color - texture - flavor and aroma changes in foods - nutritional quality
- 31 Enzymes as processing aids and ingredients - biocatalytic production of sweeteners - enzymes in milk and dairy products - modifying lipids - production of desirable effects - removal of unwanted constituents.
- 32 Enzymes in baking – brewing - fermentation

Practical

- 1 Preparation of mineral solution by using ash and tri-acid method (dry and wet oxidations)
- 2 Estimation of calcium
- 3 Determination of phosphorus
- 4 Determination of iron
- 5 Estimation of magnesium
- 6 Estimation of tannins and phytic acid from food
- 7 Determination of vitamin A (total carotenoids)
- 8 Determination of ascorbic acid by dye method
- 9 Determination of thiamin
- 10 Determination of riboflavin
- 11 Determination of food niacin
- 12 Determination of folic acid
- 13 Determination of food colors
- 14 Assessment of hydrocolloids as food additives

- 15 Assessment of various pectinases from fruits and vegetables
- 16 Assessment of various pectinases from fruits and vegetables

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PROCESSING TECHNOLOGY OF DAIRY PRODUCTS

Objective By the end of the course, the students will be able to know about production of various dairy products, quality control aspects and equipments and also about manufacturing process for production of indigenous products

Lecture**Topic****Theory**

- 1 Introduction – classification - indigenous products
- 2 Butter - definition - classification - composition - method of manufacture - packaging and storage - butter over run
- 3 Quality testing of table butter – butter - defects, causes and their prevention - FSSAI regulations
- 4 Butter oil - definition - composition - nutritive value - methods of manufacture, cooling, packaging, storage and distribution - defects in butter oil, their causes and prevention
- 5 Anhydrous milk fat (AMF) (butteroil) - production of AMF - AMF refining
- 6 Ghee - definition, composition, processing, equipment, quality tests - FSSAI regulations
- 7 Paneer - definition, composition, types, processing steps, process flow diagram
- 8 Methods of preparation of kheer, rabri, kulfi and lassi- FSSAI regulations
- 9 Manufacture of indigenous milk products - ghee, khoa, chhana - method of manufacture, packaging and storage - nutritive value
- 10 Cheese - definition - classification - composition - nutritive value - cheese production – general procedures for hard and semi-hard cheese
- 11 Cheese making modes - removal of whey and principles of curd handling - ripening and storage of cheese
- 12 Processing lines for hard and semi-hard and semi-soft cheese
- 13 Cottage cheese - method of manufacture - different varieties of cheese - defects in cheese, their causes and prevention – FSSAI regulations

- 14 Ice cream – definition - categories of ice cream - ice cream process-formulation - homogenisation and pasteurisation - packing, extrusion and moulding
- 15 Hardening and cold storage – packaging - equipment, quality testing - FSSAI regulations
- 16 Over run in ice cream - defects in ice cream, their causes and prevention
- 17 Frozen desserts - definition, composition, formulations - types, processing steps and flow diagram
- 18 Equipment, quality testing, defects - causes and prevention - packaging and storage - FSSAI regulations
- 19 Condensed milk - raw material for condensed milk - manufacture of unsweetened condensed milk - sweetened condensed milk (SCM)
- 20 Equipments – packaging – storage - quality testing - FSSAI regulations
- 21 Dried milk - definition, composition, role of milk constituents dried milk - uses of milk powder - production of milk powder
- 22 Basic drying installations - production of instant powder - SMP and WMP production - packing milk powder
- 23 Recent developments in drying, quality testing, defects, causes and prevention, packaging and storage - FSSAI regulations
- 24 Casein (industrial) - method of manufacture - defects - uses - casein (edible) – method of preparation - uses
- 25 Indian milk confectionery - manufacturing, packaging and storage of khoa based sweets kalakhand and gulabjamun – FSSAI - regulations
- 26 Manufacturing, packaging and storage of chhana based sweets sandesh and rasogulla - FSSAI regulations
- 27 Paneer, dahi and shrikhand - method of manufacture, packaging and storage - FSSAI regulations
- 28 Cultures and starter manufacture - process technology - manufacture of cultures under aseptic conditions
- 29 Yoghurt - factors affecting the quality of yoghurt - production lines - production of yoghurt mix
- 30 Kefir – buttermilk - dairy spreads – kumiss - miscellaneous milks

- 31 By-products of dairy industry - classification - principle and method of utilization
- 32 Dairy effluents - organic pollutants - dairy waste water - sewage treatment

Practical

- 1 Preparation of butter / table butter
- 2 Preparation of ghee
- 3 Preparation of paneer
- 4 Preparation of selected type of cheese
- 5 Preparation of ice-cream
- 6 Selected frozen desserts
- 7 Preparation of condensed milk
- 8 Preparation of milk powder
- 9 Preparation of selected Indian dairy products
- 10 Determination of selected quality parameters of selected dairy products
- 11 Determination of Fat in Dahi, Cream, Ice cream
- 12 Determination of milk protein in milk solids (not fat) of condensed / evaporated milk
- 13 Determination of over run in ice cream
- 14 Determination of over run in cream and butter
- 15 Visit to dairy plant
- 16 Dairy Bi-product utilization

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PROCESSING TECHNOLOGY OF LEGUMES AND OIL SEEDS

Objective By the end of the course, the students will be able to know about different pulses processing aspects and preparation of products with pulses and also learn about different oil seeds, oil milling by expellers, solvent extraction of oils, refining of oils and utilization of oil seed meals for different food uses.

Lecture

Topic

Theory

- 1 Introduction – legumes – pulses - oil seeds – production - consumption trends in India - pulses contribution to food security
- 2 Morphology of legumes and oilseeds - grain structure
- 3 Classification and types of legumes and oilseeds
- 4 Respiration of pulses stored under different storage conditions
- 5 Chemical composition, nutritional value, minor components of pulses and oil seeds - potential impact on human health
- 6 Anti-nutritional factors in pulses and their chemistry - methods of removal of anti-nutritional factors
- 7 Milling of pulses – introduction, composition and structure – important unit operations in pulse milling – cleaning, conditioning, dehulling and splitting, polishing of dhal and grading of dhal - red gram – process technology (methods) - flow charts – equipment
- 8 Milling of pulses – red gram – process technology (methods) - flow charts – equipment - black gram – green gram process technology – flowcharts – equipment
- 9 Physical and chemical changes during the processing of legumes
- 10 Dehulling of pulses - advantages - methods of dehulling - traditional and modern methods of dehulling
- 11 Dehulling pretreatments - wet treatment, soaking, chemical treatment, dry treatment, oil treatment and heat treatment
- 12 Seed characteristics that affect dehulling - nature of seed coat and physical characteristics of grains

- 13 Storage of pulses - insect control measures in pulses - grading of dhals – packaging - FSSAI regulations
- 14 Nutritional changes during soaking and sprouting of pulses - cooking quality of dhal – methods - factors affecting cooking of dhal
- 15 Quick cooking dhal and instant dhal - uses of pulses - role of pulses in cookery - medicinal value of pulses
- 16 Pulse proteins - processing, characterization, functional properties and applications in food and feed
- 17 Soybeans - nutritional profiles and health effects - soya milk production - value added products of soya
- 18 Fermented products of legumes
- 19 Post harvest technology of oil seeds – handling - drying and storage - grading – pre-treatments - cleaning - dehulling - size reduction - flaking - heat treatment
- 20 Oil extraction - rendering - traditional methods - ghani - power ghanis – hydraulic press - expellers - principle and structural design of expeller
- 21 Solvent extraction process - principle - pre-treatment - breaking - cracking - flaking - extraction principles - factors affecting the extraction process – desolventisation
- 22 Processing of oil seeds - production and refining of cotton seed oil – mechanical expression of cotton seed oil - refining of crude cotton seed oil
- 23 Solvent extraction of soya bean oil - sunflower oil - palm oil - coconut oil
- 24 Refining of oils - degumming - neutralization - bleaching - filtration – deodorization - winterization - principles and process controls
- 25 Hydrogenation - products based on hydrogenated fats - margarine - shortenings – salad oils - vanaspati - salad dressings - rancidity in fats and oils - types of rancidity – tests or rancidity
- 26 Quality control aspects of edible oils- FSSAI regulations of edible oils & hydrogenated oils & fats
- 27 New technologies in oilseed processing
- 28 Utilization of oil seed meals for different food uses - high protein products like protein concentrates and isolates
- 29 By-products of pulse and oil milling and their value addition.

- 30 Olive oil and health benefits
- 31 Anticancer and cholesterol lowering activities of tocotrienols
- 32 Factors affecting the quality of frying oils and fats

Practical

- 1 Determination of physical properties of legumes and oil seeds
- 2 Determination of proximate composition of selected pulses and oilseeds
- 3 Determination of nutritional quality of selected pulses and oilseeds
- 4 Study of mini dhal mill
- 5 Study of mini oil mill
- 6 Preconditioning of pulses before milling
- 7 Preconditioning of oilseeds before milling
- 8 Removal of anti-nutritional compounds from selected pulses and oilseeds
- 9 Laboratory milling of selected pulses and its quality evaluation
- 10 Laboratory milling of selected oilseeds and its quality evaluation
- 11 Laboratory refining of selected oils
- 12 Laboratory hydrogenation of selected oils
- 13 Study of cooking quality of dhal
- 14 Processing of composite legume mix and preparation of value added products
- 15 Visit to commercial dhal mills.
- 16 Visit to commercial oil mills.

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PROCESSING TECHNOLOGY OF FRUITS AND VEGETABLES

Objective By the end of the course the students will be able to learn processing of fruits & vegetables, different preservation techniques to improve the shelf life of all kinds of fruits and vegetables

Lecture

Topic

Theory

- 1 Production and processing scenario of fruits and vegetables in India and world - scope of fruit and vegetable processing industry in India - present status, constraints and prospective.
- 2 Maintaining the post-harvest quality of fruits and vegetables
- 3 Overview of principles of preservation - drying / dehydration - process - types - pre-treatments required - factors affecting rate of dehydration - reconstitution – coefficient of rehydration
- 4 Quality parameters of fresh-cut fruit and vegetable products
- 5 Managing safety and quality in the supply chain
- 6 Use of HACCP in fruit and vegetable production and post-harvest pre-treatment
- 7 Measuring fresh fruit and vegetable quality - advanced optical methods
- 8 Primary processing and pack house handling of fruits and vegetables
- 9 Minimal processing of fresh fruits and vegetables - peeling, cutting, shredding, cleaning, washing, drying
- 10 Browning inhibition – bio-control agents – packaging - edible coatings - storage conditions - processing guidelines for particular vegetables
- 11 New modified atmosphere packaging (MAP) techniques for fresh prepared fruit and vegetables
- 12 Smart packaging systems - edible coatings for fruits
- 13 Blanching operations and equipment
- 14 Canning - definition, processing steps, and equipment
- 15 Cans and containers, quality assurance and defects in canned products

- 16 FSSAI specifications for preparation and preservation of juices and squashes
- 17 FSSAI specifications for preparation and preservation of syrups and sherbets
- 18 FSSAI specifications for preparation and preservation of nectars and cordials
- 19 Processing and equipment for above products - FSSAI specifications
- 20 Preparation, preservation and machines for manufacture of crystallized fruits and preserves
- 21 Preparation, preservation and machines for manufacture of jam, jelly
- 22 Preparation, preservation and machines for manufacture of marmalades, candies
- 23 Preparation, preservation and machines for manufacture of chutney, pickles
- 24 Preparation, preservation and machines for manufacture of sauce, puree
- 25 Preparation, preservation and machines for manufacture of paste, ketchup
- 26 Preparation, preservation and machines for manufacture of toffee, cheese
- 27 Preparation, preservation and machines for manufacture of lather, dehydrated wafers
- 28 Preparation, preservation and machines for manufacture of papads and soup powders
- 29 Production of pectin
- 30 Production of vinegar
- 31 Commercial processing technology of selected fruits for production of various value added processed products.
- 32 Commercial processing technology of selected vegetables for production of various value added processed products.

Practical

- 1 Primary processing of selected fruits and vegetables
- 2 Canning of mango / guava / papaya
- 3 Preparation of jam from selected fruits
- 4 Preparation of jelly from selected fruits
- 5 Preparation of fruit marmalade

- 6 Preparation of RTS
- 7 Preparation of squash
- 8 Preparation of syrup
- 9 Preparation of raisins, dried fig and dried banana
- 10 Preparation of anardana
- 11 Preparation of papain
- 12 Preparation of pickles
- 13 Preparation of dried ginger - Preparation of dried onion and garlic
- 14 Preparation of banana and potato wafers
- 15 Preparation of dehydrated leafy vegetables
- 16 Visit to fruits and vegetables pack house, canning plant, vegetable dehydration plant.

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HEAT AND MASS TRANSFER IN FOOD PROCESSING

Objective By the end of the course the students will be able to acquire knowledge from different modes of heat transfer, extended surfaces, boiling and condensation process and principles of heat exchangers which are very essential In dairy and food industries

Lecture**Topic****Theory**

- 1 Introduction, definition of heat transfer - applications of heat transfer in food processing - basic heat transfer processes - conduction, convection and radiation.
- 2 Heat transfer coefficients.
- 3 Thermal conductivity, specific heat, density and thermal diffusivity.
- 4 Derivation for one-dimensional steady state heat conduction.
- 5 Theory of heat conduction
- 6 Fourier's law and its derivation
- 7 Concept of electrical analogy and its application for thermal circuits
- 8 Heat transfer through composite walls and insulated pipelines
- 9 One-dimensional steady state heat conduction with heat generation
- 10 Heat flow through slab, hollow sphere and cylinder with linear heat transfer
- 11 Uniform /non-uniform heat generation
- 12 Development of equations of temperature distribution with different boundary conditions
- 13 Steady state heat conduction with heat dissipation to environment
- 14 Introduction to extended surfaces (fins) of uniform area of cross-section and equation of temperature distribution with different boundary conditions
- 15 Effectiveness and efficiency of the fins
- 16 Introduction to unsteady state heat conduction
- 17 System with negligible internal resistance and in various geometries

- 18 Convection - forced and free convection
- 19 Use of dimensional analysis for correlating variables affecting convection heat transfer
- 20 Concept of Nusselt number, Prandtl number, Reynolds number, Grashoff number
- 21 Some important empirical relations used for determination of heat transfer coefficient
- 22 Heat transfer to flowing fluids
- 23 Radiation - heat radiation, emissivity, absorptivity, transmissivity
- 24 Radiation through black and grey surfaces, determination of shape factors
- 25 Introduction to condensing and boiling heat transfer
- 26 Film and drop-wise condensation - effect of non-condensable gases - boiling heat transfer
- 27 Heat Exchangers - general discussion, fouling factors, jacketed kettles
- 28 LMTD - parallel and counter flow heat exchangers, shell and tube and plate heat exchangers, heat exchanger design
- 29 Application of different types of heat exchangers in dairy and food industry
- 30 Mass transfer - Fick's law of diffusion, steady state diffusion of gases and liquids through solids
- 31 Equimolar diffusion - isothermal evaporation of water into air - mass transfer coefficient
- 32 Mass transfer - application in dairy and food industry

Practical

- 1 Heat transfer analysis during conduction
- 2 Heat transfer analysis during convection
- 3 Study on various types of heat exchangers used in food industry
- 4 Preparation thermocouples
- 5 Calibration of thermocouples
- 6 Determination of thermal conductivity of different food products

- 7 Study of working principle of plate heat exchanger
- 8 Study of constructional details of plate heat exchanger
- 9 Study of working principle of shell and tube heat exchanger
- 10 Study of constructional details of shell and tube heat exchanger.
- 11 Determination of overall heat transfer coefficient of shell and tube used in food industry
- 12 Determination of overall heat transfer coefficient of plate heat exchangers used in food industry
- 13 Determination of overall heat transfer coefficient of jacketed kettle used in food industry
- 14 Studies on heat transfer through extended surfaces
- 15 Studies on temperature distribution in HTST pasteurizer.
- 16 Studies on heat transfer in HTST pasteurizer.

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UNIT OPERATIONS IN FOOD PROCESSING-II

Objective By the end of the course the students will be able to understand different food processing equipments and processes that are being used in food industries. To study about the principles, operation and maintenance of food processing unit operations viz., mechanical separation, clarification, filtration, membrane separation, distillation, crystallization, expression, freezing, frying, baking, irradiation, microwave heating, leaching and extraction.

Lecture**Topic****Theory**

- 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 Influence of feed liquor properties on evaporation
- 5 Evaporation equipment - natural circulation evaporators, horizontal / vertical short tube evaporators
- 6 Natural circulation with external calandria, long tube, forced circulation
- 7 Evaporator ancillary plant, design of evaporation systems, single effect, multiple effect evaporators
- 8 Feeding methods of multiple effect evaporation systems, feed preheating, vapour recompression systems
- 9 Fouling of evaporators and heat exchanges
- 10 Recompression heat and mass recovery and vacuum creating devices
- 11 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
- 12 Freezing systems - direct contact systems, air blast immersion
- 13 Changes in foods - frozen food properties

- 14 Freezing time - factors influencing freezing time - freezing/thawing time
- 15 Freeze concentration - principles, process, methods
- 16 Frozen food storage - quality changes in foods during frozen storage
- 17 Freeze drying - heat mass transfer during freeze drying, equipment and practice.
- 18 Expression and Extraction - liquid-liquid extraction processes - types of equipment and design for liquid-liquid extraction - continuous multistage counter current extraction
- 19 Leaching - process, preparation of solids, rate of leaching, types of equipment, equilibrium relations
- 20 Crystallization and dissolution - theory and principles, kinetics, applications in food industry, equipment for crystallization
- 21 Distillation - principles, vapour-liquid equilibrium, continuous flow distillation, batch / differential distillation, fractional distillation, steam distillation, distillation of wines and spirits
- 22 Baking - principles, baked foods, baking equipment
- 23 Roasting - principles of roasting, roasting equipment
- 24 Frying - theory and principles, shallow or contact frying and deep fat frying, heat and mass transfer in frying, frying equipment
- 25 Puffing - puffing methods, puffing equipment
- 26 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
- 27 Sterilization - principles, process time, T-evaluation, design of batch and continuous sterilization, different methods and equipments
- 28 UHT sterilization, in the package sterilization, temperature and pressure patterns
- 29 Equipment for sterilizing goods in the package
- 30 Aseptic processing - principles, analysis of thermal resilience, duration - mathematics of conduction heating
- 31 Blanching - principle and equipment
- 32 Homogenization, emulsification.

Practical

- 1 Study of working principle of open pan evaporator
- 2 Study of working principle of vacuum evaporator
- 3 Study of single 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 of sterilizer
- 6 Design problems on freezers
- 7 Numerical problem on thermo bacteriology (D, Z and F values)
- 8 Study of freezers
- 9 Freezing of foods by different methods
- 10 Determination of freezing time of a food material
- 11 Effect of sample particle size and time on solvent extraction process
- 12 Effect of temperature on crystallization rate of sugar
- 13 Study of blancher, pasteurizers, fryers, homogenizers, irradiators
- 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

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FOOD REFRIGERATION AND COLD CHAIN

Objective By the end of the course the students will be able to understand cold chain management and operations in food and beverage industry. They also study about the principles, operation and maintenance of refrigeration systems and cold storages

Lecture**Topic****Theory**

- 1 Principles of refrigeration - definition, background with second law of thermodynamics
- 2 Production of low temperatures - unit of refrigerating capacity, coefficient of performance
- 3 Production of low temperatures - expansion of a liquid with flashing, reversible / irreversible adiabatic expansion of a gas / real gas
- 4 Production of low temperatures - thermoelectric cooling, adiabatic demagnetization
- 5 Air refrigerators working on reverse Carnot cycle - Carnot cycle, reversed Carnot cycle, selection of operating temperatures
- 6 Air refrigerators working on Bell Coleman cycle – reversed Brayton or Joule or Bell Coleman cycle
- 7 Analysis of gas cycle, polytropic and multistage compression
- 8 Vapour refrigeration - vapor as a refrigerant in reversed Carnot cycle with P-V and T-S diagrams - limitations of reversed Carnot cycle
- 9 Vapour compression system - modifications in reverse Carnot cycle with vapour as a refrigerant (dry vs. wet compression, throttling vs. isentropic expansion)
- 10 Representation of vapor compression cycle on pressure- enthalpy diagram, super heating, sub cooling
- 11 Liquid-vapour regenerative heat exchanger for vapour compression system
- 12 Effect of suction vapour super heat and liquid sub cooling, actual vapour compression cycle

- 13 Vapour-absorption refrigeration system - process, calculations, maximum coefficient of performance of a heat operated refrigerating machine
- 14 Common refrigerants and their properties - classification, nomenclature
- 15 Desirable properties of refrigerants - physical, chemical, safety, thermodynamic and economical
- 16 Azeotropes
- 17 Components of vapour compression refrigeration system - evaporator, compressor, condenser and expansion valve
- 18 Ice manufacture - principles and systems of ice production
- 19 Treatment of water for making ice, brines, freezing tanks, ice cans, air agitation, quality of ice
- 20 Cold storage - cold store, design of cold storage for different categories of food resources, size and shape
- 21 Cold storage - construction and material, insulation, vapour barriers, floors, frost-heave, interior finish and fitting
- 22 Cold storage - evaporators, automated cold stores, security of operations
- 23 Refrigerated transport - handling and distribution, cold chain
- 24 Refrigerated transport - refrigerated product handling, order picking refrigerated vans, refrigerated display
- 25 Air-conditioning - meaning, factors affecting comfort air-conditioning
- 26 Air-conditioning - classification, sensible heat factor, industrial air-conditioning, problems on sensible heat factor
- 27 Winter / summer / year round air-conditioning, unitary air-conditioning systems
- 28 Central air-conditioning, physiological principles in air-conditioning, air distribution and duct design methods
- 29 Design of complete air-conditioning systems
- 30 Humidifiers and dehumidifiers
- 31 Cooling load calculations: Load sources, product cooling
- 32 Cooling load calculations - conducted heat, convective heat, internal heat sources, heat of respiration, peak load etc.

Practical

- 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 loads
- 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

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ICT APPLICATIONS IN FOOD INDUSTRY

Objective By the end of the course the students will be able to understand application information and communication technology in running of different food processing equipments and operations. They also understand the principles and applications of different IT tools

Lecture **Topic**

Theory

- 1 Importance of computerization in food industry, operating environments and information systems for various types of food industries, Supervisory Control and Data Acquisition (SCADA)
- 2 SCADA systems hardware, firmware, software and protocols, landlines, local area network systems, modems
- 3 Spreadsheet applications - data interpretation and solving problems, preparation of charts, use of macros to solve engineering problems, use of add-ins, use of solver
- 4 Web hosting and webpage design - file transfer protocol (FTP), on-line food process control from centralized server system in processing plant
- 5 Use of MATLAB in food industry - computing with MATLAB, script files and editor / debugger
- 6 MATLAB help system, problem solving methodologies, numeric, cell, arrays, matrix operations, user defined functions, programming using MATLAB - debugging MATLAB programs, applications to simulations
- 7 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
- 8 Introduction to toolboxes useful to food industry, curve fitting toolbox, fuzzy logic toolbox, neural network toolbox, image processing toolbox, statistical toolbox
- 9 Introduction to computational fluid dynamics (CFD), governing equations of fluid dynamics
- 10 Models of flow, substantial derivative, divergence of velocity, continuity, momentum and energy equations - physical boundary conditions, discretization

- 11 Applications of CFD in food and beverage industry - introduction to CFD software - GAMBIT and FLUENT software
- 12 LabVIEW – LabVIEW environment - getting data into computer, data acquisition devices
- 13 LabVIEW-NI-DAQ, simulated data acquisition, sound card, front panel / block diagram, toolbar/tools palette
- 14 Components of a LabVIEW application - creating a VI, data Flow execution, debugging techniques, additional help, context help, tips for working in LabVIEW
- 15 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
- 16 LabVIEW results - displaying data on front panel, controls and indicators, graphs and charts, arrays, loop timing, signal processing, textual math, math script.

Practical

- 1 Introduction to various features in spread sheet-I
- 2 Introduction to various features in spread sheet-II
- 3 Solving problems using functions in spread sheets-I
- 4 Solving problems using functions in spread sheets-II
- 5 Use of add-ins in spread sheet and statistical data analysis using analysis tool pack-I
- 6 Use of add-ins in spread sheet and statistical data analysis using analysis tool pack-II
- 7 Solution of problems on regression analysis using analysis tool pack in spreadsheet-I
- 8 Solution of problems on regression analysis using analysis tool pack in spreadsheet-II
- 9 Solution of problems on optimization using solver package in spreadsheet-I
- 10 Solution of problems on optimization using solver package in spreadsheet-II
- 11 Introduction to MATLAB-I
- 12 Introduction to MATLAB-II

- 13 Writing code using MATLAB programming-I
- 14 Writing code using MATLAB programming-II
- 15 Solution of problems using curve fitting toolbox in MATLAB-I
- 16 Solution of problems using curve fitting toolbox in MATLAB-II
- 17 Solution of problems using fuzzy logic toolbox in MATLAB-I
- 18 Solution of problems using fuzzy logic toolbox in MATLAB-II
- 19 Solution of problems using neural network toolbox in MATLAB-I
- 20 Solution of problems using neural network toolbox in MATLAB-II
- 21 Solution of problems using image processing toolbox in MATLAB-I
- 22 Solution of problems using image processing toolbox in MATLAB-II
- 23 Introduction to GAMBIT software-I
- 24 Introduction to GAMBIT software-II
- 25 Creation of geometry for laminar flow through pipe using GAMBIT-I
- 26 Creation of geometry for laminar flow through pipe using GAMBIT-II
- 27 Introduction to FLUENT software-I
- 28 Introduction to FLUENT software-II
- 29 Import of geometry and application of boundary conditions-I
- 30 Import of geometry and application of boundary conditions-II
- 31 Solution of problems on laminar flow using FLUENT
- 32 Introduction to LabVIEW and NI-DAQ.

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MARKETING MANAGEMENT AND INTERNATIONAL TRADE

Objective To impart knowledge to the students on marketing concept, marketing, management of food industry & international trade. Students gain knowledge on resource management, capital management, food industry management, international trade, GATT, WTO, Government institutions related to international trade, agencies of international trade

Lecture

Topic

Theory

- 1 Marketing concept, functions, scope and marketing management
- 2 Marketing process
- 3 Concepts of marketing-mix, elements of marketing-mix - 4Ps of marketing - product - place - price - promotion - 4 c's of marketing mix
- 4 Market structure – meaning - components of market structure - dynamics of market structure – conduct and performance
- 5 Consumer buying behaviour – micro and macro-environments – analysis of buying process
- 6 Steps or stages in the buying process - role of individuals in the buying process and determinants of buyer behaviour (psychological factors and social factors)
- 7 Marketing research and marketing information systems
- 8 Market measurement, market forecasting
- 9 Market segmentation - methods of market segmentation
- 10 Target marketing - market penetration - market positioning
- 11 Allocation and marketing resources
- 12 Marketing planning process
- 13 Product policy and planning - product life cycle - introduction stage - growth - maturity - saturation - decline - why products fail - extending the life cycle of a product
- 14 Product-mix

- 15 Product line, product life cycle
- 16 New product development process
- 17 Product branding
- 18 Packing - packaging – types of packing and packaging - advantages of packing and packaging
- 19 Services decisions
- 20 Marketing channel decisions - retailing, wholesaling and distribution
- 21 Pricing decisions - price determination - pricing policy of milk products in organized and unorganized sectors of dairy industry
- 22 Promotion-mix decisions
- 23 Advertising, objectives, budget and advertising message, media planning
- 24 Personal selling, publicity, sales promotion
- 25 World consumption of food - patterns and types of food consumption across the globe
- 26 Salient features of international marketing, composition and direction of Indian exports
- 27 International marketing environment, deciding which and how to enter international market
- 28 Direct exports, indirect exports, licensing
- 29 Joint ventures, direct investment and internationalization process, distribution channels
- 30 WTO and world trade agreements related to food business
- 31 Export trends and prospects of food products in India
- 32 Government institutions related to international food trade - APEDA, Tea Board, Spice Board, MoFPI etc

Practical

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- 3 C.N. Sontakki. Marketing Management. Kalyani Publishers, New Delhi.
- 4 John Daniels, Lee Radebaugh, Brigham, Daniel Sullivan. International Business, 15th Ed., Pearson Education
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ENVIRONMENTAL SCIENCE AND DISASTER MANAGEMENT

Objective By the end of the course the students will be able to understand about environment, ecology, ecosystems and various resources in the environment, Pollution and energy resources etc.

Lecture**Topic****Theory**

- 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 ecology - objectives and classification, concepts of an ecosystem structure and function of ecosystem - components of ecosystem - producers, consumers, decomposers
- 4 Bio-geo-chemical cycles - hydrological cycle, carbon cycle, oxygen cycle, nitrogen cycle, sulfur cycle - energy flow in co-system - food chains - grazing, detritus, food webs - ecological pyramids
- 5 Major ecosystems - forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystem, estuarine ecosystem
- 6 Population and natural resources - development of habitation patterns and environmental factors governing human settlement
- 7 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 water resources - water resources, Indian scenario - water sources - surface and ground water sources, uses and overuses of water resources, problems due to overexploitation of water resources
- 9 Forest resources - Indian scenario - importance of forests - ecologically and economically, uses of forest products, forest types – deforestations - causes and effects, forest degradation in India
- 10 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.

- 11 Environmental pollution - water pollution - introduction, water quality standards, sources of water pollution, classification of water pollutants, effects of water pollutants, eutrophication
- 12 Air pollution - composition of air, structure of atmosphere, ambient air quality standards, classification of air pollutants, sources of common air pollutants like SPM, SO₂, NO_x, natural and anthropogenic sources, effects of common air pollutants
- 13 Land and noise pollution - introduction, lithosphere, land uses, causes of land degradation, sources of noise pollution, effects of noise pollution
- 14 Radioactive pollution - food processing industry waste and its management - management of urban waste water - recycling of organic waste - recycling of factory effluent
- 15 Control of environmental pollution through law - composting of biological waste - sewage, uses of water disposal - effluent treatment
- 16 Current environmental global issues - global warming and green house gas effects - acid rain, depletion of ozone layer.

Practical

- 1 Environment and its analysis
- 2 Water quality parameters
- 3 Collection of sample for pollution study
- 4 Determination of pH from sample
- 5 Determination of acidity from sample
- 6 Determination of alkalinity from sample
- 7 Determination of pH / acidity / alkalinity from sample
- 8 Estimation of dissolved oxygen
- 9 Estimation of BOD
- 10 Estimation of COD
- 11 Estimation of nitrates
- 12 Estimation of phosphates

- 13 Estimation of pollutant elements
- 14 Estimation of heavy / toxic elements
- 15 Estimation of lead / mercury
- 16 Visit to industrial sewage disposal unit.

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- 1 Gilbert M. Masters and Wendell P. Ela. 2013. Introduction to Environmental Engineering and Science. Pearson Education Limited
- 2 Suresh K. Dhameja. 2009. Environmental Engineering and Management. S. K. Kataria & Sons
- 3 Bernard J. Nebel and Richard T. Wright. 1993. Environmental Science: The Way the World Works. Prentice-Hall Professional

PROCESSING TECHNOLOGY OF BEVERAGES

Objective By the end of the course the students will be able to know about selection of raw materials, formulation and processing of various beverages and also about role of water and importance of quality water in beverages development

Lecture

Topic

Theory

- 1 Introduction – beverages – alcoholic – non-alcoholic (dairy, fruits & vegetables, soft drinks) – production - consumption trends
- 2 Processing of beverages
- 3 Packaged drinking water - water treatment – packaging - FSSAI regulations
- 4 Fruit based beverages – production – types - formulations – FSSAI regulations
- 5 Synthetic beverages - raw materials – processing – packaging – quality - FSSAI regulations
- 6 Carbonated fruits and soft drink beverages production - raw materials – processing – packaging – quality - FSSAI regulations
- 7 Production of low calorie drinks - raw materials – processing – packaging – quality - FSSAI regulations
- 8 Production of instant beverage mixes - fruits, dairy and synthetic - raw materials – processing – reconstitution – packaging – quality - FSSAI regulations
- 9 Production of isotonic and sports drinks - raw materials – processing – reconstitution – packaging – quality - FSSAI regulations
- 10 Dairy based beverages - flavoured milks – yoghurt - probiotic drinks - raw materials – processing – reconstitution – packaging – quality - FSSAI regulations
- 11 Alcoholic beverages - beer production - wine production - other alcoholic beverages
- 12 Fruit beverages - RTS, nectars, cordials, squashes, syrups – formulations -

- process flow chart – quality - FSSAI regulations
- 13 Speciality beverages - non-dairy probiotic beverages – quality - FSSAI regulations
 - 14 Tea - varieties of tea - types of tea - processing practices - speciality teas - chemical composition - harvesting of tea leaves - black tea manufacture - instant tea production – quality - FSSAI regulations
 - 15 Coffee fruit, processing and by-products - composition and functional properties of green and roasted coffee beans and coffee beverage - coffee by-products – quality - FSSAI regulations
 - 16 Cocoa – processing - cocoa butter - chocolate production – quality - FSSAI regulations
 - 17 Spices - production of herbal drinks – quality - FSSAI regulations
 - 18 Ingredients, manufacturing and packaging processes and equipment for different beverages
 - 19 Water treatment and quality of process water
 - 20 Sweeteners for beverages
 - 21 Colorants for beverages
 - 22 Acidulants for beverages
 - 23 Clouding and clarifying agents for beverages
 - 24 Natural, nature identical and artificial flavouring agents for beverages
 - 25 Carbon dioxide and carbonation
 - 26 Quality tests and control in beverages
 - 27 Quality tests and control in beverages
 - 28 Miscellaneous beverages - coconut water
 - 29 Sweet toddy
 - 30 Sugar cane juice
 - 31 Coconut milk
 - 32 Flavoured syrups.

Practical

- 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 and flavoured tea
- 5 Preparation of carbonated beverages
- 6 Preparation of non-carbonated beverages
- 7 Determination of caffeine in beverages
- 8 Determination of brix value of beverages
- 9 Determination of gas content of beverages
- 10 Determination of pH of beverages
- 11 Determination of acidity of beverages
- 12 Quality analysis of tea
- 13 Quality analysis of coffee
- 14 Preparation of miscellaneous beverages
- 15 Visit to carbonation unit
- 16 Visit to mineral water plant.

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- 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.
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- 6 Alan H. Varnam and Jane P. Sutherland. 1994. Beverages: Technology, Chemistry and Microbiology. Chapman, London, UK.
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PROCESSING OF MEAT AND POULTRY PRODUCTS

Objective By the end of the course the students will be able to enable the students to learn about national and international prospects of meat industry along with processing and preservation technology of meat, egg and poultry products

Lecture**Topic****Theory**

- 1 Introduction - sources and development of meat and poultry industries in India - importance of meat and meat industries in national economy
- 2 Pre-slaughter operations and slaughtering operations for animals
- 3 Pre-slaughter operations and slaughtering operations for poultry
- 4 Ante-mortem examination of meat animal - principles and judgements
- 5 Post-mortem examination of carcass - principles of judgement
- 6 Slaughtering of meat - scientific methods of slaughter - stunning techniques - mechanical, electrical, chemical methods – ritual / religious methods of slaughter - Jewish, Halal, Jhatka and Spanish methods
- 7 Post-mortem changes in meat – rigor mortis – bio-chemical changes associated with rigor mortis which lead to the conversion of muscle to meat - factors - pH decline, resolution of rigor – autolytic, proteolytic enzymes - microbial invasion and loss of structural integrity
- 8 Mechanical deboning, grading and aging - eating and cooking quality of meat
- 9 Meat quality parameters - meat color - water holding capacity - marbling - quantum of connective tissue - firmness and storage conditions
- 10 Palatability characters of meat and factors affecting meat quality
- 11 Preservation of meat by chilling, freezing, pickling, curing, cooking and smoking
- 12 Preservation of meat by dehydration, radiation, chemical and biological preservatives
- 13 Methods of tenderization - aging, enzymes and curing - factors affecting tenderness
- 14 Processing technology of meat products - basic processing - comminution – mechanical deboning - emulsification - meat emulsion - methods of

- stabilization of meat emulsion meat extension – pre-blending - hot processing
- cooking techniques
- 15 Dressing and cutting of carcass in sheep, pig and buffalo - grading of meat and packaging of meat
 - 16 Preparation, preservation and equipment for manufacture of smoked meat and its quality evaluation
 - 17 Preparation, packaging and equipment for manufacture of dehydrated meat products and their quality evaluation
 - 18 Preparation, preservation and equipment for manufacture of meat sausages and their quality evaluation
 - 19 Abattoir design and layout
 - 20 Ante-mortem and post-mortem examination of poultry birds - principles of judgement
 - 21 Pre-slaughter care, handling, transport and dressing of a poultry bird
 - 22 Eggs - structure, composition, quality characteristics of eggs
 - 23 Egg quality characteristics - internal quality - Haugh's unit - terms indicating defective quality and egg grading
 - 24 Microbial spoilage of eggs - types of spoilage in eggs - indications - organisms causing spoilage
 - 25 Preservation and maintenance of eggs - preservation of shell eggs - egg cleaning – oil Treatment - cold storage - thermo stabilization - immersion in liquids
 - 26 Processing and preservation of poultry meat - chilling, freezing, curing, smoking, dehydration, canning and radiation
 - 27 Processing of value added products - chicken barbecue, chicken sausage, meat balls and pickling
 - 28 Retort pouch technology for meat products
 - 29 Meat plant sanitation and safety
 - 30 By-products of meat and their utilization
 - 31 By-products of poultry and eggs and their utilization
 - 32 Safety standards in meat industry – HACCP / ISO / MFPO / FSSAI / Kosher / Halal.

Practical

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

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BAKERY, CONFECTIONERY AND SNACK PRODUCTS

Objective By the end of the course the students will be trained in Bakery & Confectionery and gained knowledge about different raw materials used and their role, knowledge on different equipments, processing of different products, packaging & quality maintenance

Lecture**Topic****Theory**

- 1 Flours - wheat flour classification - flour characteristics – gluten - other flours
- 2 Major baking ingredients – sweeteners – eggs - yeast & leavening agents - fat replacers – water - functional additives
- 3 Principles of baking - mixing, dough making, and dough makeup - fermentation, baking, sensory attributes of bakery products
- 4 Bread - manufacture, quality control, enzymes in bread making, sour dough, frozen dough
- 5 Cake manufacture, types of cakes, quality control
- 6 Cracker manufacture, types and quality control
- 7 Muffins and bagels manufacture, types and quality control
- 8 Biscuit manufacture - classification, baking techniques
- 9 Recipes for hard doughs - pizza, crisp bread and pretzel - cream crackers, soda crackers and water biscuits - puff biscuits - savoury or snack crackers - semisweet biscuits
- 10 Recipes for short doughs - plain biscuits, biscuits for cream sandwiching, biscuits for other secondary processing, chemicals present in the recipes of this group, secondary processes
- 11 Recipes for dietetic biscuits - recipes based on exclusion or substitution of particular ingredients, recipes based on inclusion of particular ingredients, recipes based on reduction of fat, sugar and salt, labelling of dietetic biscuits
- 12 Pizza and burger manufacture, types and quality testing
- 13 Confectionery - major ingredients – sugars - dairy ingredients - gums and

- gelling agents or hydrocolloids - food additives - emulsifiers, colours and flavours
- 14 Confectionery plant - steam injection cooking - vacuum cooking - continuous plant
 - 15 Sugar glasses in the chemistry of boiled sweets - formulation of boiled sweets - manufacturing processes for boiled sweets
 - 16 Grained sugar products – fondant – fudge – chocolate - covered liqueur sweets
 - 17 Pan coating - toffees and caramels - gums, gelled products and liquorice
 - 18 Chewing gum - aerated products
 - 19 Sugar-free confectionery – lozenges - tableting
 - 20 Product quality characteristics, defects, causes and corrective measures
 - 21 Chocolate processing - different steps involved in chocolate processing - ingredients, mixing, refining
 - 22 The snack industry - history, domestic and global status - ingredients and general equipment – alkaline - cooked corn products
 - 23 Starches for snack foods - oils and industrial frying
 - 24 Hot air dryers
 - 25 Potatoes and potato chips
 - 26 Use of dried potatoes in snack foods
 - 27 Tortilla chip processing
 - 28 Snack foods from formers and high-shear extruders
 - 29 Snack foods from cooking extruders
 - 30 Snack food seasonings
 - 31 Breakfast cereals
 - 32 Snack food seasonings - malts - specifications, composition, ingredients, formulations, processing, equipment, packaging and storage, quality testing.

Practical

- 1 Identifications and composition of various ingredients for snacks products
- 2 Identifications and composition of various ingredients for bakery products
- 3 Identifications and composition of various ingredients for confectionery products
- 4 Flours, their classifications and characterization
- 5 Preparation, packaging and quality evaluation of selected snack items-I
- 6 Preparation, packaging and quality evaluation of selected snack items-II
- 7 Preparation, packaging and quality evaluation of selected bakery items-I
- 8 Preparation, packaging and quality evaluation of selected bakery items-II
- 9 Preparation, packaging and quality evaluation of selected confectionery items-I
- 10 Preparation, packaging and quality evaluation of selected confectionery items-II
- 11 Preparation, packaging and quality evaluation of selected chocolates-I
- 12 Preparation, packaging and quality evaluation of selected chocolates-II
- 13 Preparation of traditional Indian confection-I
- 14 Preparation of traditional Indian confection-II
- 15 Visit to bakery, confectionary (industry).
- 16 Visit to snack food units (industry).

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FOOD PROCESS EQUIPMENT DESIGN

Objective By the end of the course the students will be able to acquire knowledge on theoretical aspects to be considered for properties of materials for designing of Food Process Equipment and to acquire knowledge on hazards and safety considerations: safety measures, safety measures in equipment designing.

Lecture

Topic

Theory

- 1 Materials and properties - materials for fabrication, mechanical properties, ductility, hardness, corrosion
- 2 Materials and properties - protective coatings, corrosion prevention linings of equipment.
- 3 Materials and properties - choice of materials, material codes
- 4 Design considerations - stresses created due to static and dynamic loads, combined stresses
- 5 Design considerations - design stresses and theories of failure, safety factor
- 6 Design considerations - temperature effects, radiation effects
- 7 Design considerations - effects of fabrication method, economic considerations
- 8 Design of pressure and storage vessels - operating conditions, design conditions and stress
- 9 Design of pressure and storage vessels - design of shell and its components, stresses from local load
- 10 Design of pressure and storage vessels - thermal gradient, mountings and accessories
- 11 Design of heat exchangers - design of shell and tube heat exchanger, plate heat exchanger
- 12 Design of heat exchangers - scraped surface heat exchanger, sterilizer and retort
- 13 Design of evaporators and crystallizers - design of single effect evaporators and its components
- 14 Design of evaporators and crystallizers - design of multiple effect evaporators

- and its components
- 15 Design of rising film and falling film evaporators
 - 16 Design of feeding arrangements for evaporators
 - 17 Design of crystalliser and entrainment separator
 - 18 Design of agitators and separators - design of agitators and baffles
 - 19 Design of agitation system components and drive for agitation
 - 20 Design of centrifuge separator
 - 21 Design of equipment components, design of shafts, pulleys, bearings,
 - 22 Design of belts, springs, drives, speed reduction systems
 - 23 Design of freezing equipment - design of ice-cream freezers and refrigerated display system
 - 24 Design of dryers - design of tray dryer, tunnel dryer, fluidized dryer
 - 25 Design of dryers - spray dryer, vacuum dryer, freeze dryer and microwave dryer
 - 26 Design of conveyors and elevators - design of belt, chain and screw conveyor,
 - 27 design of bucket elevator and pneumatic conveyor
 - 28 Design of extruders - cold and hot extruder design, design of screw and barrel
 - 29 design of twin screw extruder
 - 30 Design of fermenters - design of fermenter vessel, design problems
 - 31 Hazards and safety considerations - hazards in process industries, analysis of hazards
 - 32 Hazards and safety considerations - safety measures, safety measures in equipment design, pressure relief devices.

Practical

- 1 Design of pressure vessel
- 2 Design of shell and tube heat exchangers and plate heat exchanger
- 3 Design of sterilizers and retort
- 4 Design of single and multiple effect evaporators

- 5 Design of rising film and falling film evaporator
- 6 Design of crystallizer
- 7 Design of tray dryer
- 8 Design of fluidized bed dryer
- 9 Design of spray dryer
- 10 Design of vacuum dryer
- 11 Design of microwave dryer
- 12 Design of belt and chain conveyor
- 13 Design of screw conveyor
- 14 Design of bucket elevator and pneumatic conveyor
- 15 Design of twin screw extruder
- 16 Design of fermenter

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FOOD STORAGE ENGINEERING

Objective By the end of the course the students will be able to know about importance of food storage. To know about the factors affecting food storage and design of food storage structures

Lecture**Topic****Theory**

- 1 Storage - importance of scientific storage systems, post harvest physiology of semi-perishables and perishables
- 2 Storage - climacteric and non climacteric fruits
- 3 Storage - respiration, ripening, changes during ripening, ethylene bio-synthesis
- 4 Damages - direct damages, indirect damages
- 5 Damages - causes of spoilage in storage (moisture, temperature, humidity, respiration loss, heat of respiration, sprouting)
- 6 Damages - destructive agents (rodents, birds, insects, etc.) - sources of infestation and control
- 7 Storage structures - traditional storage structures
- 8 Storage structures - improved storage structures
- 9 Storage structures - modern storage structures
- 10 Farm silos - horizontal silos, tower silos
- 11 Farm silos - pit silos, trench silos
- 12 Farm silos - size and capacity of silos
- 13 Storage of grains - respiration of grains
- 14 Storage of grains - moisture and temperature changes in stored grains
- 15 Conditioning of environment inside storage through ventilation
- 16 Aeration and stored grain management - purposes of aeration, aeration theory
- 17 Aeration and stored grain management - aeration system design
- 18 Aeration and stored grain management - aeration system operation

- 19 Storage pests and control - damage due to storage insects
- 20 Storage pests and control - damage due to storage pests
- 21 Storage pests and control - control, seed coating, fumigations, etc
- 22 Damage caused by rodents and its control
- 23 Storage of perishables - cold storage, controlled and modified atmospheric storage
- 24 Storage of perishables - hypobaric storage, evaporative cooling storage, conditions for storage of perishable products
- 25 Storage of perishables - control of temperature and relative humidity inside storage
- 26 Design of storage structures - functional and structural design of grain storage structures
- 27 Design of storage structures - pressure theories, pressure distribution in the bin
- 28 Design of storage structures - grain storage loads, pressure and capacities
- 29 Design of storage structures - warehouse and silos
- 30 BIS specifications- functional design of cold stores
- 31 BIS specifications- structural design of cold stores.
- 32 BIS specifications - thermal design of cold stores.

Practical

- 1 Layout design, sizing, capacity and drawing of traditional storage structures
- 2 Measurement of respiration of fruits in the laboratory
- 3 Measurement of respiration of grains in the laboratory
- 4 Study on fumigation
- 5 Visits to FCI go-downs
- 6 Design of grain go-downs for particular capacity and commodity
- 7 Drawing and layout of grain go-down for particular commodity and capacity
- 8 Visits to cold storage
- 9 Design of cold storage for particular capacity and commodity

- 10 Drawing and layout of cold storage for particular commodity and capacity
- 11 Visits to CA storage
- 12 Design of CA storage for particular capacity and commodity
- 13 Drawing and layout of CA storage for particular commodity and capacity
- 14 Visits to evaporative cooling system for storage
- 15 Storage study in the MAP
- 16 Visits to traditional storage structures

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INSTRUMENTAL TECHNIQUES IN FOOD ANALYSIS

Objective By the end of the course the students will be able to understand the concepts of techniques in food analysis, about instrumentation and to understand the nature of biochemical methods and approaches used in food analysis.

Lecture **Topic**

Theory

- 1 Definitions of the terms used for food analysis.
- 2 Rules and regulations of food analysis - principles and methodology involved in analysis of foods
- 3 Rheological analysis, textural profile analysis of foods
- 4 Methods of analysis - proximate constituents, moisture, adulterations, minerals analysis - principles and methodology involved in analytical techniques - ion selective electrodes
- 5 Spectroscopy, ultraviolet, visible, fluorescence, infrared spectro, atomic absorption and emission, mass spectroscopy, nuclear magnetic resonance and electron spin resonance.
- 6 Chromatography - adsorption, column, partition, gel-filtration, affinity, ion-exchange, size exclusion method, gas-liquid, high performance liquid chromatography
- 7 Separation techniques - dialysis, electrophoresis, sedimentation, ultra-filtration, ultracentrifugation, isoelectric focusing, isotopic techniques, manometric techniques, immuno assay techniques in food analysis
- 8 Evaluation of analytical data - accuracy and precision, statistical significance, co-relations regression, result interpretation
- 9 Introductory note on instrumentation and sensors for the food industry
- 10 Food compositional analysis using near infra-red absorption technology - principles of measurement
- 11 Instrumentation applications in the food industry, power of process monitoring and trending, practical considerations for implementing on-line measurement
- 12 Practical aspects of infra-red remote thermometry, radiation thermometers, measurement principles, practical situations, miscellaneous techniques - in-line and off-line

- 13 FTIR measurements - food applications, calibration and general aspects of routine use
- 14 Rapid microbiological methods - overview, conductance / impedance techniques for microbial assay - chemosensors, biosensors, immunosensors
- 15 Electronic noses and tongues - sensors for food flavour and freshness, electronic noses, tongues and testers - introduction to flavor assessment, modelling the human nose, electronic nose, electronic tongue, marker
- 16 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

- 1 Introduction to techniques of food analysis, rules in laboratory
- 2 Sampling plan, sample collection and preparation for analysis
- 3 Sensory evaluation of products
- 4 Quality evaluation of raw materials - fruits and vegetables
- 5 Quality evaluation of raw materials - cereals, pulses and dairy products
- 6 Quality evaluation of raw materials - meat and poultry products
- 7 Quality evaluation of food products for color and taste of marketed products
- 8 Analysis of minerals in plant samples
- 9 Analysis of minerals in animal samples
- 10 Analysis of minerals using atomic absorption spectrophotometer
- 11 Analysis of heavy metals using atomic absorption spectrophotometer
- 12 Concept of colorimetry in food analysis
- 13 Technique of spectrophotometry in food analysis
- 14 Estimation of total chlorophyll by spectrophotometric method
- 15 Estimation of phytic acid using spectrophotometer
- 16 Identification of sugars in fruit juice using TLC
- 17 Separation of sugars by paper chromatography

- 18 Separation technique by ion-exchange chromatography
- 19 Molecular weight determination using sephadox-gel
- 20 Identification of organic acids by paper electrophoresis
- 21 Analytical technique of gel-electrophoresis for identification
- 22 Quantitative determination of sugars
- 23 Quantitative make-up of fat soluble vitamins using HPLC
- 24 Quantitative make-up of fat soluble vitamins using HPLC
- 25 Quantitative determination of fatty acid profile by GLE
- 26 Quantitative make-up of water soluble vitamins using HPLC
- 27 Quantitative make-up of water soluble vitamins using HPLC
- 28 Analysis of wheat flour
- 29 Qualitative analysis and quantification of toxins and anti-nutritional factors in foods
- 30 Analysis of foods for pesticide residues
- 31 Determination of drug residues
- 32 Introduction to Microwave Assisted Process (MAPTM)

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- 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

Objective By the end of the course the students will be able to get knowledge about basics and fundamentals of molecular biology and to know about rDNA technology and their applications in different areas. To know about application of biotechnology in particular to food industries and also know about GM foods production and their management.

Lecture

Topic

Theory

- 1 Prospectus of biotechnology - new development in the science of gene manipulation – a rash of new companies - to commercialize the new technology, human genome sequencing project - potential for human therapy - regulation of transcription of particular genes - making easy to use cloning kits - recombinant DNA technology in all biological disciplines
- 2 Molecular genetics - chromosomes - genome - genes - chromonemata - nucleosomes - heterochromatin - organization of chromosomes - nature of gene - definitions of gene - classical - modern - gene as unit of physiological function - transmission - mutation - cistron - recon - muton - number of genes - functions of genes
- 3 Fundamentals of molecular biology - DNA as genetic material - Hershey and chase experiment - RNA as genetic material - viruses and bacteriophages - genetic material organization - transcription - translation
- 4 Chemistry and biology of DNA - structural elements of nucleic acids - sugar – anionic group - nitrogenous bases - purines - pyrimidine's - nucleosides - nucleotides – phosphoric acid - ATP - GTP - CTP - UTP - TTP - functions of nucleotides - chemical energy carriers - building blocks of nucleic acids - physiological messengers - components of coenzymes - enzymes effectors- active substrates
- 5 Primary conformation of DNA - secondary conformation of DNA - Watson and Crick model - types of DNA - A, B, Z - tertiary conformation of DNA - higher level of chromatin structure - denaturation and renaturation - types of RNA - mRNA- rRNA- tRNA - sRNA - hnRNA – functions - scRNAs – snRNAs
- 6 Biological role of DNA in cell - control of metabolic activity of cell - maintenance and regulation of cell activity - DNA replication – semi-conservative model - the Meselson stahl experiment
- 7 Requirements for DNA synthesis - substrate - primer - proteins - DNA polymerase - I, II, III - helicase - topoisomerase - primase - ligase - ssb

- proteins - mechanism of replication - initiation - elongation - termination
- 8 DNA repair, mechanisms of repair of damaged DNA (photo reactivation, excision repair, recombination repair, SOS repair, mismatch repair)
- 9 Genetic recombination - gene transfer mechanism - conjugation - process - F plasmid - hfr factor - transformation - competence - gram positive transformation - gram negative transformation
- 10 Micro injection - calcium chloride mediated - calcium phosphate mediated – electroporation - particle bombardment method - transduction - generalized transduction - co-transduction - abortive transduction - specialized transduction
- 11 Strain improvement - importance of pure culture - isolation and purification of pure cultures - alteration of genes by mutation - induced mutation - frame shift mutations
- 12 Chromosomal mutation - additions - deletions - use of rDNA technology to alter the genes - better yield of metabolites - primary metabolites - secondary metabolites
- 13 Regulation of gene expression – induction - repression - LAC operon - the operon model - promoter – operator - structural genes - lac Z gene - lac Y gene - lac A gene and promoter enzymes - regulation of lac operon - negative regulation - positive regulation
- 14 Gene manipulation tools - different enzymes used - helicases - premases – topoisomerases - RNA polymerase I, II - holoenzyme - sigma factor - DNA gyrase - DNA polymerase - I, II, III
- 15 Restriction enzymes - restriction endonucleases - nomenclature of enzymes - three letter code - molecular scissors - nature of cutting ends - blunt ends - sticky ends – isoschizomers - recognition sites - star activity - neoisoschizomers - cleavage - mechanism of action - uses of restriction enzymes
- 16 Recombinant DNA technology - selection of DNA - selection of suitable vehicle – cloning vector - selection of suitable enzyme - introduction of rDNA - screening of host cells - selection based on antibiotic resistance - complementation of nutritional defects - assay of biological activity - immunochemical method - colony hybridization - expression of target gene in the host cell
- 17 Plasmids - occurrence - extra chromosomal DNA - cloning vectors - plasmids as vectors - bacteriophages - lambda phage vector - bacteriophage M13 vectors - cosmids as vectors - eukaryotes as vectors - plant viruses - pBR322

- insertion vector - replacement vector - shuttle vectors - phasmids - artificial chromosomes - bacterial artificial - yeast artificial (YAC)
- 18 Gene cloning - production of identical cells - isolation and purification of insert DNA - isolation of vector DNA - construction of recombinant DNA - introduction of recombinant DNA into host cell - identification and selection of cells containing cloned genes
- 19 Expression of foreign genes - transformation - calcium chloride mediated – calcium phosphate mediated - microinjection - liposome mediated gene transfer – electroporation
- 20 Selection of cells containing cloned genes - selection based on antibiotic resistance - complementation of nutritional defects - assay of biological activity - immunochemical method - colony hybridization - expression of target gene in the host cell - shot gun method - DNA libraries - genomic DNA libraries - cDNA libraries - protoplast transformation
- 21 Biosensors - classification - field of application - transducers - electrochemical biosensors - voltammetric - potentiometric - conductometric - chemical sensitive field effect transistors (CHEMFET)
- 22 Optical biosensors - biological components - method of immobilization - pressure biosensors - thermometric biosensors - glucose biosensors - glycerol biosensors - ethanol biosensors
- 23 Enzyme technology - microbial enzymes - production of enzymes - solid state fermentation - fermentors - medium - advantages and disadvantages - submerged fermentation - steps of enzyme production - factors affecting submerged culture
- 24 Immobilization of enzymes - arresting of cell in insoluble matrix - immobilized cell systems - cell attachment to a surface - aggregation - entrapment - containment - physical adsorption - covalent binding - cross linking - entrapment into polymeric films - microencapsulation - large scale cell immobilization - uses and applications in industries
- 25 Application of biotechnology in food - building up of high biological value protein – nucleic acid sequences as diagnostic tools - protein engineering - vitamin production - amino acid production - antibiotic production – biopolymers
- 26 Application of biotechnology in pharmaceuticals - identification of disease causing genes - production of hormones - vaccines - interferon - regulatory proteins – antibiotics
- 27 Application of biotechnology in agriculture - improvement of nutritional

- quality - post harvest technology - changing plants at their genetic level - to develop nitrogen fixation – production of disease resistant plants
- 28 Bio gas plant - anaerobic digestion - methane formation - methanogenic fermentations - methane oxidation - hydrocarbon degradation - anaerobic digester designs - positive and negative features of anaerobic process
- 29 Ethical issues concerning GM foods
- 30 Testing for GMOs, current guidelines for production, release and movement of GMOs, labelling and traceability, trade related aspects
- 31 Bio-safety, risk assessment, risk management, public perception of GM foods
- 32 IPR (Intellectual Properties Right), GMO Act 2004

Practical

- 1 Study of auxotroph
- 2 Micro propagation through tissue culture
- 3 Strain improvement
- 4 Strain improvement through U.V. mutation for lactose utilization
- 5 Chemical mutagenesis using chemical mutagens (*Ethidium bromide*)
- 6 Determination of survival curves using physical mutagens
- 7 Determination of survival curves using chemical mutagens
- 8 Isolation and analysis of chromosomal / genomic DNA from *E.coli*
- 9 Isolation and analysis of chromosomal / genomic DNA from *Bacillus cereus*
- 10 Separation of protoplasts
- 11 Separation of protoplasts using cellulytic enzymes
- 12 Production of biomass from fruit waste
- 13 Production of biomass from vegetable waste
- 14 Introduction of ELISA / southern blot / DNA finger printing
- 15 Agarose gel electrophoresis of plasmid DNA
- 16 Pesticide degradation by *Pseudomonas spp.*

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- 6 Ashok Agarwal and Pradeep Parihar. 2005. Industrial Microbiology: Fundamentals and Applications. Agrobios India, Jodhpur.

PROCESSING OF SPICES AND PLANTATION CROPS

Objective By the end of the course the students will be able to know about spice processing and their marketable standards, plantation crops and their importance in Indian economy, post harvest technology of spices, value added products of spices, packaging of processed spices, food, medicinal and pharmaceutical uses of different spices

Lecture**Topic****Theory**

- 1 Introduction - production and processing scenario of spices - spice flavours - processing issues
- 2 Flavour and plantation crops and its scope
- 3 Ginger - post harvest technology, processing-composition, processed products – oleoresins - essential oils
- 4 Chilli - post harvest technology, processing composition, processed products – oleoresins - essential oils
- 5 Turmeric - post harvest technology, processing composition, processed products – oleoresins – essential oils
- 6 Onion & garlic - post harvest technology, processing composition, processed products
- 7 Pepper - post harvest technology, processing composition, processed products – oleoresins - essential oils
- 8 Cardamom - post harvest technology, processing composition, processed products – oleoresins - essential oils
- 9 All spice and annie seed - post harvest technology, processing composition, processed products – oleoresins - essential oils
- 10 Sweet basil and caraway seed - post harvest technology, processing composition, processed products – oleoresins - essential oils
- 11 Cassia and cinnamon - post harvest technology, processing composition, processed products – oleoresins - essential oils

- 12 Mace, and nutmeg - post harvest technology, processing composition, processed products – oleoresins - essential oils
- 13 Clove - post harvest technology, processing composition, processed products - oleoresins - essential oils
- 14 Coriander - post harvest technology, processing composition, processed products – oleoresins - essential oils
- 15 Cumin, dill seed, fennel seeds - post harvest technology, processing composition, processed products – oleoresins - essential oils
- 16 Mint - post harvest technology, processing composition, processed products - oleoresins and essential oils
- 17 Marjoram, rosemary, sage, thyme and savory - post harvest technology, processing composition, processed products
- 18 Ajowan, asafoetida and curry leaves - post harvest technology, processing composition, processed products
- 19 Saffron - post harvest technology, processing composition, processed products
- 20 Tea - post harvest technology, processing composition, processed products
- 21 Coffee - post harvest technology, processing composition, processed products
- 22 Cocoa - post harvest technology, processing composition, processed products
- 23 Post harvest technology for vanilla and annatto processing
- 24 Post harvest technology and processing of areca nut
- 25 Post harvest technology and processing of cashew nut
- 26 Post harvest technology and processing of oil palm
- 27 Flavours of minor spices
- 28 Flavour of major spices
- 29 Spice oil and oleoresins - extraction techniques – specifications - properties
- 30 Standard specification of spices (ASTA, FSSAI standards)
- 31 Functional packaging of spices and spice products
- 32 By-products of spices and plantation crops

Practical

- 1 Identification and characterization of flavouring compounds of spices
- 2 Valuable oil determination
- 3 Extraction of oil from clove, pepper
- 4 Extraction of oil from cardamom, chilli
- 5 Extraction of oleoresins - turmeric, ginger
- 6 Extraction of oleoresins - pepper, clove
- 7 Peperine estimation in pepper oleoresin
- 8 Steam distillation of spices
- 9 Determination of curcumin content in turmeric
- 10 Chemical analysis of spices
- 11 Moisture, valuable oil, specific gravity
- 12 Refractive index, acid value
- 13 Study of standard specification of spices
- 14 Packaging study of spices
- 15 Preparation of curry powder
- 16 Visit to spice industry

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Extraction). Asia Pacific Business Press Inc., New Delhi.

7 S. Gupta. Handbook of Spices and Packaging with Formulae. Engineers India Research Institute, New Delhi.

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FOOD PACKAGING TECHNOLOGY AND EQUIPMENT

Objective By the end of the course the students will be able to know about different types of paper based packaging materials, plastic based package material, metal and glass based packaging material and also about advanced packaging techniques and packaging machinery

Lecture**Topic****Theory**

- 1 Introduction - packaging situation in World, India – estimating the total cost of food packaging - role of packaging in food processing & preservation
- 2 Need of packaging, packaging requirements, package functions, package materials and classification of packages
- 3 Paper as package material, its manufacture, types, advantages of corrugated and paper board boxes, etc
- 4 Glass as package material, manufacture, advantages and disadvantages
- 5 Parts of glass container - coatings for glass - test for thermal shocks - finishes and closures.
- 6 Metal (aluminium) as package material - manufacture, advantages, disadvantages
- 7 Metal (tin) as package material - manufacture, advantages, disadvantages
- 8 Lacquers - evaluation of lacquers
- 9 Double seaming - seam defects and their corrections.
- 10 Metal (SS) as package material - manufacture, advantages, disadvantages
- 11 Plastic as package material, classification of polymers
- 12 Polyolefins as package material - manufacture, properties, advantages, disadvantages, uses
- 13 Polyesters as package material - manufacture, properties, advantages, disadvantages, uses
- 14 Polyvinyl chloride as package material - manufacture, advantages, disadvantages, uses, properties

- 15 Polyvinylidene chloride as package material - manufacture, properties, advantages, disadvantages, uses
- 16 Polystyrene as package material - manufacture, properties, advantages, disadvantages, uses
- 17 Polyamid as package material - manufacture, properties, advantages, disadvantages, uses
- 18 Ethylene vinyl alcohol as package material - manufacture, properties, advantages, disadvantages, uses
- 19 Laminates and co-extrusions as package material - manufacture, properties, advantages, disadvantages, uses
- 20 Coating on paper - coating on films
- 21 Aseptic packaging - need, advantages, process - aseptic packaging - comparison of conventional and aseptic packaging, system of aseptic packaging - aseptic packaging - materials used in aseptic packaging
- 22 Uses of aseptic packaging for milk, fruits and vegetables beverages
- 23 Innovative food packaging solutions - oxygen scavengers - carbon dioxide absorbers and emitters - moisture control agents – antimicrobials - ethylene absorbers and adsorbers - temperature control - self-heating and cooling
- 24 Permeability - theoretical considerations, permeability of gases and vapours
- 25 Permeability of multilayer materials
- 26 Permeability in relation to packaging requirement of foods
- 27 Transport properties of barriers
- 28 Predicting packaging characteristics to improve shelf-life
- 29 Simulations of product - package environment interaction
- 30 Smart package devices – barcodes - radio frequency identification tags – time - temperature indicators - gas indicators - biosensors
- 31 Applications of intelligent packaging - enhancing food safety and biosecurity - enhancing food quality and convenience
- 32 Packaging of specific foods, mechanical and functional tests on package

Practical

- 1 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 tensile strength of paper, paper boards
- 9 Measurement of grease resistance of papers
- 10 Determination of gas and water transmission rate of package films
- 11 Determination of laquer integrity test, drop test, box compression test
- 12 Identification of plastic films - determination of seal integrity, ink adhesion
- 13 Packaging practices followed for packing fruits and vegetables
- 14 Shelf life calculations for food products
- 15 Head space analysis of packaged food
- 16 Study of vacuum packaging machine, bottle filling machine and form-fill-seal machine

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PROCESSING OF FISH AND MARINE PRODUCTS

Objective By the end of the course the students will be able to gain knowledge in the areas of fish and other marine food preservation and processing technology

Lecture

Topic

Theory

- 1 Fisheries resources, global and Indian scenario
- 2 Types of fish and other marine products
- 3 Classification of fish (fresh water and marine), biochemical composition of fish, characteristics of fresh fish
- 4 Post-mortem changes in fish and quality assessment - types of fish spoilage – enzymatic - chemical & microbial
- 5 Spoilage of fish - microbiological, physiological, biochemical - relationship between chilling and storage life, MAP
- 6 Spoilage indices of fish - factors affecting spoilage of fish
- 7 Quality assessment of fish and fish products by sensory and chemical methods
- 8 Preservation of fresh fish
- 9 Quality of water and ice in fish handling and processing
- 10 General aspects of fish freezing, changes in quality during chilled and frozen storage
- 11 Principles of canning, effect of heat processing on fish, storage of canned fish, pre-process operations
- 12 Post-process operations, cannery operations for specific canned products
- 13 Fish products - introduction, fish muscle proteins
- 14 Surimi process - traditional and modern surimi production lines
- 15 Quality of surimi products, comparison of surimi and fish mince products
- 16 Fish protein concentrates (FPC)

- 17 Fish protein extracts (FPE)
- 18 Fish protein hydrolysates (FPH)
- 19 Preparation protocols of indigenous products - fish sauce, fish paste - novel methods
- 20 Low dose irradiation
- 21 High pressure treatment
- 22 MAP, vacuum packaging, gas packaging
- 23 Smart packaging systems - oxygen absorbents and CO₂ generators, ethanol vapour generation
- 24 Value added fish products
- 25 Fish packaging
- 26 Assessment of quality of fish - bacteriological considerations
- 27 Quality certification and its importance in global context - sea food testing- FSSAI regulations
- 28 HACCP in fish and marine processing
- 29 EU hygienic regulations
- 30 ISO 9000 standards
- 31 New kinds of quality and safety problems emerging in sea food processing
- 32 Modern fish and marine products preservation techniques

Practical

- 1 Study of anatomy and dressing of fish, prawn and other marine products.
- 2 Identification of different types of fish, prawn and other marine products - selection and grading
- 3 Quality evaluation of fish
- 4 Preparation of sun dried and salt cured fish, fish sauce
- 5 Chilling and freezing of fish
- 6 Preparations of fish protein concentrate, fish meal
- 7 Preparation of marine fish oils and various fish products

- 8 Utilization of fish by-products
- 9 Preparation of marine algal products
- 10 Preservation of fish - drying, pickling
- 11 Preservation of marine products using fermentation process
- 12 Preparation of value added sea products - cutlets, bullets, wafers - processing of fish oils
- 13 Canning methods for marine fishery products
- 14 Estimation of TVB and TMA
- 15 Determination of iodine value - protein estimation by Folin-Lowrey's method
- 16 Visit to fish and prawn processing industry

References

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SENSORY EVALUATION OF FOOD PRODUCTS

Objective By the end of the course the students will be able to understand the importance of sensory evaluation in product, raw materials selection, formulation, processing and storage, different sensory evaluation methods and also about selection of panels and conducting of food tasting by subjective and objective methods

Lecture

Topic

Theory

- 1 Introduction, definition and importance of sensory evaluation in relation to consumer acceptability and economic aspects
- 2 Factors affecting food acceptance
- 3 Terminology related to sensory evaluation
- 4 Principles of good practice - the sensory testing environment, test protocol considerations, basic principles
- 5 Senses and sensory perception, physiology of sensory organs, classification of tastes and odours, threshold value
- 6 Factors affecting senses, visual, auditory, tactile and other responses.
- 7 Discrimination tests, procedure - types of tests – difference tests (paired comparison, due-trio, triangle) ranking, scoring
- 8 Hedonic scale and descriptive tests
- 9 Panel selection, screening and training of judges
- 10 Requirements of sensory evaluation, sampling procedures
- 11 Factors influencing sensory measurements
- 12 Consumer research – affective tests – objectives - methods, types or questionnaires
- 13 Development of questionnaires, comparison of laboratory testing and consumers studies, limitations.
- 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, sensory evaluation in quality control.

Practical

- 1 Determination of threshold value for basic tastes - odour recognition
- 2 Odour recognition, difference (PC, duo-trio, triangle)
- 3 Determination of threshold value for various odours
- 4 Selection of judging panel
- 5 Training of judges, for recognition of certain common flavour and texture defects using different types of sensory tests-I
- 6 Training of judges, for recognition of certain common flavour and texture defects using different types of sensory tests-II
- 7 Descriptive analysis methodology
- 8 Sensory evaluation of various food products using different scales
- 9 Sensory evaluation of various food products using different score cards
- 10 Sensory evaluation of various food products using different tests-I
- 11 Sensory evaluation of various food products using different tests-II
- 12 Sensory evaluation of various food products using different tests-III
- 13 Texture profile methodology
- 14 Estimation of color
- 15 Relationship between objective and subjective methods
- 16 Designing a sensory laboratory
- 17 Market survey of various existing products - I
- 18 Market survey of various existing products - II
- 19 Formulation of new products based corporate decision
- 20 Formulation of protein – energy rich products
- 21 Formulation of low calorie (fat replacer) products
- 22 Formulation products with low sodium content
- 23 Formulation of glycemic index based products

- 24 Formulation of cholesterolemic index based foods
- 25 Formulation of phyto-chemical based products
- 26 Product development based on above formulation depending on local sources / technology – I
- 27 Product development based on above formulation depending on local sources / technology- II
- 28 Product development based on above formulation depending on local sources / technology – III
- 29 New product development for infant / weaning foods, geriatric, physiological status, athletes
- 30 New product development for infant / weaning foods, geriatric, physiological status, athletes
- 31 New product development for infant / weaning foods, geriatric, physiological status, athletes
- 32 Quality assessment of products developed

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FOOD PLANT SANITATION

Objective By the end of the course the students will be able to know about the relation of microorganisms to sanitation and contamination of food and knowledge about the sanitation, laws and sanitizer designs and different food plant sanitations

Lecture

Topic

Theory

- 1 Good manufacturing practices, current good manufacturing practices - standard operating procedures, good laboratory practices
- 2 Sanitation - sanitation and the food industry - sanitation, sanitation laws and regulations and guidelines, establishment of sanitary
- 3 Potential risks of food borne bioterrorism, bioterrorism protection measures, role of pest management in bio-security
- 4 Relationship of microorganisms to sanitation, allergens, allergen control
- 5 Food contamination, protection against contamination - personal hygiene and sanitary food handling
- 6 Role of HACCP in sanitation, quality assurance for sanitation, cleaning compounds, handling and storage precautions
- 7 Sanitizers, sanitizing methods, sanitation equipment, waste product handling, solid waste disposal, liquid waste disposal
- 8 Pest control - insect infestation, cockroaches, insect destruction, rodents, birds, use of pesticides, integrated pest management
- 9 Sanitary design and construction for food processing - site selection, site preparation, building construction considerations, processing and design considerations, pest control design
- 10 Low-moisture food manufacturing and storage sanitation - sanitary construction considerations, receipt and storage of raw materials, cleaning of low-moisture food manufacturing plants
- 11 Dairy processing plant sanitation - role of pathogens, sanitary construction considerations, soil characteristics in dairy plants, sanitation principles,

cleaning equipment

- 12 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
- 13 Sea food plant sanitation - sanitary construction considerations, contamination sources, sanitation principles, recovery of by-products
- 14 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
- 15 Beverage plant sanitation - mycology of beverage manufacture, sanitation principles
- 16 Non-alcoholic beverage plant sanitation, brewery sanitation, winery sanitation, distillery sanitation

Practical

- 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 *Actinomyces*
- 10 Enrichment and isolation of cellulose degrading bacteria
- 11 Biodegradation of phenol compounds
- 12 Bacteriological examination of water - coli form
- 13 MPN test
- 14 Sampling of airborne microorganisms

- 15 Sampling of surfaces - equipment and physical plant
- 16 Aerosol sampling and measurement guidelines.

References

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- 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.

FOOD ADDITIVES AND PRESERVATIVES

Objective At the end of the course students will be learning about various food additives and preservatives, their advantages and disadvantages, methods of addition, acceptable levels and their action on food.

Lecture

Topic

Theory

- 1 Definition of food additives, need for additives, general classification of food additives
- 2 Classification of intentional and unintentional food additives - glossary of additives – contaminants - agricultural, animal and radioactive fallouts.
- 3 Different classes of food additives and preservatives - permitted GRAS - food additives and their tolerance - toxicity intensity, exogenous and endogenous factors affecting toxicity or safety of toxicants - regulations governing exemptions and amendments - acceptable daily intake (ADI's) for Non GRAS food additives.
- 4 Antioxidants, chelating agents, colouring and curing agents, emulsifiers, flavour enhancers, flour improvers, pH control agents, thickeners, stabilizers, non-nutritive sweeteners and other additives etc.
- 5 Colour additives, reasons for colour usage, natural and artificial colors, natural and synthetic food dyes, toxic effects, safety evaluation of colors, certification of food colors and regulatory laws.
- 6 Role of pigments - their importance and utilization as food color - classification of pigments - carotenoids, anthocyanins, lycopene and xanthophylls
- 7 Processing of natural and artificial food colorants
- 8 Definition of a preservative - natural and chemical preservatives, list and category of preservatives - role and functions of food preservatives in food processing industry.
- 9 Definition, natural and synthetic surface active agents, role of surfactants and starch modifiers as food additives - properties of surface active agents - types of modified starches - extruded, dextrinized, gelatinized, starch esters, cross linked and oxidised starches.

- 10 Action of salt as a preservative - chelating agent - definition and its action as a food additive, sequestering agent - mechanism of action of stabilizers and thickeners - gelatine, agar, pectin and carboxy methyl cellulose
- 11 Definition, functions, mechanism of action of humectants, bleaching and maturing agents.
- 12 Definition of antioxidant, sweeteners - types of rancidity in foods - natural and synthetic antioxidants - classification of sweeteners - bulk and intense sweeteners, nutritive and sugar replacements - safety, maximum permissible limits and regulations of their usage
- 13 Production of enzymes and their role as food additives and preservative.
- 14 Definitions, functions, role of anti-caking agent, firming agent, leavening agents and fat substitutes as food additives - natural and synthetic leavening agents – natural and synthetic fat substitutes - fat mimetics, carbohydrate polyesters, retro fats and other modified fats
- 15 Definition, functions, role of flavours and taste enhancers as food additives - natural and synthetic flavours, essential oils, flavour enhancers - MSG (Disodium and mono sodium glutamates) etc.
- 16 Mechanism of action of emulsifiers and acidity regulators (acidulants) in preservation and in food processing - natural and synthetic emulsifiers, CMC (critical micelle concentration) used in food industry.

Practical

- 1 Evaluation of GRAS aspect of food additives
- 2 Estimation of chemical preservatives by TLC (organic and inorganic)
- 3 Identification of food colour by TLC (organic and inorganic)
- 4 Quantitative estimation of added dyes (Permitted)
- 5 Quantitative estimation of added dyes (Non permitted)
- 6 Isolation and identification of naturally occurring food pigments by paper and TLC
- 7 Role and mode of action of salts in preservation
- 8 Role and mode of action of chelating agents in fruit juice
- 9 Role and mode of action of stabilizer and thickener in frozen dairy products (ice-cream)

- 10 Role and mode of clarifying agent in fruit juices
- 11 Estimation of antioxidants in foods (BHA and BHT)
- 12 Role and mode of antioxidant in frozen fish
- 13 Estimation of chlorophyll and lycopene content in foods.
- 14 Role of leavening agent in baked food product
- 15 Preservation of coconut shreds using humectants
- 16 Determination of chemical preservatives and synthetic sweetening agents.

References

- 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. Alpha Publishing Corporation, New Delhi.
- 3 S.S.Deshpande. 2002. Handbook of Food Toxicology. Marcel and Dekker AG, Basel, Switzerland.

FOOD QUALITY, SAFETY STANDARDS AND CERTIFICATION

Objective By the end of the course the students will be able to understand the concepts of food quality rules and regulations, food standards and role of food quality to keep up Indian and international standards in food industry.

Lecture**Topic****Theory**

- 1 Definition of food quality, scope and importance in food industry - management of food quality in food processing industry.
- 2 Classification of quality attributes - colour, gloss in foods – definition - measurement of colour by objective and subjective methods - usage of spectrophotometer, Munsell color system and Lovibond tintometer etc. - role of colour in food industry.
- 3 Role of viscosity and consistency in food quality - physical properties - size and shape, weight, volume, weight volume ratio, length, width, diameter, symmetry, curvature, area
- 4 Quality attributes - defects, classification - genetic defects, physiological defects - structural, off color, character and other morphological defects - entomological defects - holes, scars, lesions, off coloring, curled and other pathological defects.
- 5 Mechanical defects, extraneous or foreign material defects - measurement of defects - improving visibility by dilution, white background, color differences
- 6 Standardization of conditions, reference standards, counts and measures, isolation of defects by floatation, elution, electronic sorting and internal defects
- 7 Flavour - definition, classification, qualitative and quantitative assessment of flavour, thresholds and its importance in food industry.
- 8 Taste - classification, taste qualities, relative intensity, reaction time effect of disease, temperature, and taste medium on taste, basic tastes, interaction of tastes - assessment of taste thresholds.
- 9 Odour - definition, classification, neutral-mechanisms, perception - olfactory abnormalities, odor testing, techniques, thresholds, odor intensities, olfaction
- 10 Visual, auditory, tactile and other senses, vision, audition, oral perception

other than taste

- 11 Factors influencing sensory measurements - attitudinal factors, motivation psychological errors in judgment, relation between stimulus and perception adaptation
- 12 Correlation of sensory and instrumental analysis - laboratory quality measurement - types of tests, panel selection and testing environment, serving procedures, instruction to judges
- 13 Types and classification of tests - difference tests, directional difference tests, classification of difference tests, two-sample tests, three-sample tests, multisampling tests and other miscellaneous testing procedures.
- 14 Comparison of procedures, ranking, scoring, hedonic scaling, dilution procedures, descriptive sensory analysis, contour method, other procedures
- 15 Consumer measurement - factors influencing acceptance and preference
- 16 Objectives of consumer preference studies, information obtained from consumer study, factors influencing results from consumer preferences.
- 17 Surveys - different types, methods of approach – subjective and objective methods for assessment of consumer preference.
- 18 Development of the questionnaire, types of questionnaires, serving procedures - comparison of laboratory panels with consumer panels - limitations of consumer survey
- 19 Testing of physical, chemical and microbial quality in raw materials used for the food processing industry.
- 20 Quality of products during processing and after processing - color, taste, texture, flavour, appearance
- 21 Factors influencing the food qualities - soil, field practices, harvesting practices, procedures, packaging
- 22 Raw materials transportation, storage, conditions, processing conditions
- 23 Raw material collection, packaging and storage conditions of finished products.
- 24 Recording and reporting of quality of raw materials
- 25 Over view of quality attributes, inspection of raw materials for their quality and approval for their usage
- 26 Concept of quality control - quality management and quality assurance

- 27 Concepts of good manufacturing practices
- 28 Good agricultural practices, good laboratory practices
- 29 Quality management systems, QSS, quality circles, SQC, ISO system
- 30 HACCP - principles, implementation - plan documentation, types of records
- 31 Auditing - surveillance, audit, mock audit, third party quality certifying audit, auditors and lead auditors
- 32 Over view of certification procedures, certifying bodies, accrediting bodies, international bodies.

Practical

References

- 1 Imteaz Ali 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.

ENTREPRENEURSHIP DEVELOPMENT

Objective By the end of the course the students will be able to describe the concept of entrepreneurship, characteristics of entrepreneur, motivation and entrepreneurship and project management, gain knowledge and skills in project formulation, project report preparation and evaluation of projects understanding SWOT, generation, incubation and commercialization of ideas and innovations; Women entrepreneurship and Corporate entrepreneurship: explaining entrepreneurship development programme, government policies, government schemes and incentives for promotion of entrepreneurship.

Lecture

Topic

Theory

- | | |
|----|--|
| 1 | Entrepreneurship – meaning - definition – concept of entrepreneur - functions of entrepreneur |
| 2 | Importance and growth of entrepreneurship |
| 3 | Qualities of entrepreneur – distinction between an entrepreneur and a manager - role of entrepreneurship |
| 4 | Ethics and social responsibility of business |
| 5 | Entrepreneurship development |
| 6 | Assessing overall business environment in the Indian economy |
| 7 | Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs |
| 8 | Globalization and the emerging business / entrepreneurial environment |
| 9 | Concept of entrepreneurship, entrepreneurial and managerial characteristics |
| 10 | Managing an enterprise |
| 11 | Motivation and entrepreneurship development |
| 12 | Importance of planning, monitoring, evaluation and follow up - managing competition |
| 13 | Entrepreneurship development programmes (EDPs) – objectives and phases of EDPs |

- 14 Problems of EDPs, criteria for assessment of evaluation of EDPs
- 15 SWOT analysis – concept – objectives - advantages – opportunities and threats analysis - strengths and weakness analysis - procedure of SWOT analysis
- 16 Researching / managing competition - ways to define possible competitors
- 17 Generation, incubation and commercialization of ideas and innovations
- 18 Women entrepreneurship - role and importance, problems
- 19 Corporate entrepreneurship
- 20 Role, mobility of entrepreneur - entrepreneurial motivation
- 21 Planning and evaluation of projects
- 22 Growth of firm and factors inducing growth
- 23 Project identification and selection
- 24 Project feasibility study
- 25 Post planning of project, project planning and control
- 26 New venture management – creativity
- 27 Government schemes and incentives for promotion of entrepreneurship
- 28 Government policy on small and medium enterprises (SMEs) / SSIs
- 29 Export and import policies relevant to food processing sector
- 30 Venture capital - contract farming and joint ventures, public-private partnerships
- 31 Overview of food industry inputs
- 32 Characteristics of Indian food processing industries and export - social responsibility of business.

Practical

- 1 Visit to public enterprise
- 2 Visit to private enterprise
- 3 Visit to a successful agro-processing / food business centres
- 4 Visit to a sick agro-processing / food business centres

- 5 SWOT analysis of public enterprises
- 6 SWOT analysis of private enterprises
- 7 Development of project proposals – idea generation
- 8 Development of project proposals - formulation of business plan
- 9 Development of project proposals-formulation of commercialization
- 10 Evaluation of problems associated with entrepreneurship
- 11 Case studies of public enterprises
- 12 Case studies of private enterprises
- 13 Presentation of project reports by the students
- 14 Project proposals as entrepreneur
- 15 Study of Government schemes and incentives for promotion of entrepreneurship
- 16 Government policies on small and medium enterprises (SMEs) / SSIs

References

- 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.

PROJECT PREPARATION AND MANAGEMENT

Objective By the end of the course the students will be able to describe the concept of project and evolution of project management gain knowledge and skills in project formulation, project report preparation and evaluation of projects. Understanding critical path method, program evaluation and review technique, assumptions in PERT modelling, decision CPM, GERT and understand the project monitoring and completion and future directions and review. Students will understanding the critical path method, prepare a project, calculate the project cost and time frame, understand the strategic issues in projects and write and present a tentative project proposal.

Lecture

Topic

Theory

- 1 Overview of project management - functions and viewpoints of management
- 2 Evolution of project management, forms and environment of project management
- 3 Project life cycle - project selection - project identification and screening
- 4 Project appraisal, project charter, project proposal, project scope, statement of work
- 5 Project planning and scheduling - work breakdown structure, planning and scheduling of activity networks
- 6 Network scheduling, precedence diagrams
- 7 Critical Path Method, program evaluation and review technique, assumptions in PERT modelling, decision CPM, GERT
- 8 Project cost estimating - types of estimates and estimating methods
- 9 Dynamic project planning and scheduling, time-cost trade-offs
- 10 Resource considerations in projects, resource profiles and levelling, limited resource allocation
- 11 Project implementation, monitoring and control
- 12 Project management process and role of project manager
- 13 Team building and leadership in projects, organizational and behavioural

issues in project management

- 14 Project monitoring and control, PERT / cost method, earned value analysis
- 15 Project completion and future directions - project completion and review
- 16 Project management - recent trends and future directions - computers in project management

Practical

- 1 Study about the Critical Path Method
- 2 Study about the PERT
- 3 Study of Gantt chart
- 4 Study of work breakdown structure
- 5 Program evaluation and review technique
- 6 Study of project cost and budgeting
- 7 Study of project strategic issues
- 8 Study of application of computers in project management
- 9 Study of risk in project management
- 10 Study of international projects
- 11 Study of resource considerations in projects
- 12 Case study project management
- 13 Writing a winning project proposal-I
- 14 Writing a winning project proposal-II
- 15 Presentation of a project proposal
- 16 Skills required for a project manager

References

- 1 R. Panneerselvam. 2004. Operations Research, 2nd Ed. International Book House, Mumbai
- 2 Prasanna Chandra. Projects. Tata McGraw-Hill Publication, New Delhi.
- 3 Prasanna Chandra. Projects. Tata McGraw-Hill Publication, New Delhi.

- 4 John M. Nicholas. Project Management for Business and Technology – Principles and Practices. Pearson Prentice Hall.
- 5 Harold Kerzner. Project Management – A System Approach to Planning, Scheduling, and Controlling. CBS Publishers & Distributors.

INSTRUMENTATION AND PROCESS CONTROL IN FOOD INDUSTRY

Objective By the end of the course the students will be able to understand the different instruments used in different operations of food industries. To know about working principles of different instruments used in different operations.

Lecture**Topic****Theory**

- 1 Introduction, definitions, characteristics of instruments.
- 2 Static and dynamic characteristics of instruments.
- 3 Formal description - empirical scales - Celsius scale.
- 4 Various types of thermometers.
- 5 Thermocouples, resistance thermometers and pyrometers.
- 6 Pressure and pressure scales, manometers - U-tube manometer, inverted U-tube manometer, micro manometer, inclined manometer.
- 7 Pressure elements - Bourdon tube, diaphragm and bellows.
- 8 Liquid level measurement, different methods of liquid level measurement, liquid level measurement devices.
- 9 Flow measurement - types of flow.
- 10 Flow measurement - rate of flow, total flow - differential pressure meters.
- 11 Flow measurement - variable area meters – construction - working method - food flow metering - measurement of food flow theoretically and instrumentally.
- 12 Weight measurement - mechanical scale, electronic tank scale, conveyor scale
- 13 Measurement of moisture content, measurement of humidity
- 14 Measurement of specific gravity
- 15 Measurement of viscosity
- 16 Measurement of density, brix, pH

- 17 Measurement of turbidity
- 18 Measurement of color
- 19 Enzyme sensors, automatic valves
- 20 Transmission - pneumatic and electrical
- 21 Control elements, control actions, pneumatic and electrical control systems
- 22 Process control - definition, simple system analysis, dynamic behaviour of simple process, Laplace transform, process control hardware
- 23 Frequency response analysis, frequency response characteristics
- 24 Bode diagram – introduction – definition – applications - Nyquist plots – introduction – definition – applications - stability analysis.
- 25 Transducers – classification - ideal characteristics - applications, self-generating transducers – definition – types - advantages and disadvantages.
- 26 Transducers - variable parameter type, digital, actuating and controlling devices
- 27 Controllers and indicators - temperature control, electronic controllers
- 28 Controllers and indicators - flow ratio control, atmosphere control, timers and indicators
- 29 Controllers and indicators - food sorting and grading control, discrete controllers
- 30 Controllers and indicators - adaptive and intelligent controllers
- 31 Computer-based monitoring and control - importance, hardware features of data acquisition
- 32 Computer-based monitoring and control - control computer, signal interfacing, examples in food processing

Practical

- 1 Study on instrumentation symbols
- 2 Determination of relative humidity by wet bulb thermometer
- 3 Determination of relative humidity by dry bulb thermometer
- 4 Measurement of wind velocity by anemometer
- 5 Measurement of intensity of sun shine by sunshine recorder

- 6 Measurement of pH and control
- 7 Study of characteristics of pressure transducers
- 8 Real-time study of pressure transducers characteristics with PC
- 9 Characteristics of IC temperature sensor
- 10 Characteristics of platinum RTD
- 11 Temperature controlled alarm system
- 12 Temperature controlled alarm system
- 13 Study of water level to current conversion
- 14 Measurement of thermal conductivity & control
- 15 Study of characteristics of capacitive transducer
- 16 Measurement of mass flow & control

References

- 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.

COMMUNICATION AND SOFT SKILLS DEVELOPMENT

Objective To develop the communication and soft skills in the students. The basic concepts of communication and augmenting skills in verbal and non verbal communication etc will be learnt and will learn a clear concept of communication skills by using AV aids, improve their reading skills, report writing and group discussion and improve their soft skills

Topic**Practical**

- 1 Communication skills - structural and functional grammar
- 2 Meaning and process of communication
- 3 Verbal and nonverbal communication - listening and note taking
- 4 Writing skills - oral presentation skills - field diary and lab record - indexing, footnote and bibliographic procedures
- 5 Reading and comprehension of general and technical articles
- 6 Precise writing, summarizing, abstracting
- 7 Individual and group presentations - impromptu presentation
- 8 Public speaking - group discussion and interviews
- 9 Soft skills and hard skills
- 10 Self development - etiquette and manners
- 11 Positive attitude and self confidence
- 12 Stress and conflict management
- 13 Time management - personal organization
- 14 Prioritizing and balancing - cosmopolitan culture
- 15 Impact of non verbal communication
- 16 Science of body language - role of team work.
- 17 Listening and note taking
- 18 Writing skills

- 19 Précis writing
- 20 Reading and comprehension (written and oral) of general and technical articles
- 21 Micro-presentations and impromptu presentations
- 22 Public speaking exercises
- 23 Introduction to soft skills and hard skills
- 24 Communication skills, verbal and non-verbal communication and oral presentation skills
- 25 Self development - etiquette and manners
- 26 Break the iceberg – FEAR
- 27 Priority management and time management
- 28 Positive attitude and self confidence
- 29 Motivation skills and personality
- 30 Goal setting - decision making - career planning
- 31 Resume building, interviewing skills
- 32 Group discussions

References

- 1 Mamatha Bhatnagar and Nitin Bhatnagar. 2011. Effective Communication and Soft Skills. Person Education.
- 2 Meenakshi Raman, Sangeeta Sharma. Technical Communication Principles and Practice
- 3 Harold Wallace and Ann Masters. Personality Development. Cengage Publishers.
- 4 Andrea J. Rutherford. Basic Communication Skills for Technology. Pearson Education