FIRST SEMESTER

Math 111 3 (3+0)
Engineering Mathematics – I

(48 Lectures)

Unit 1 Algebra

Permutation and combination, Binomial, logarithmic and exponential series, probability-introduction, addition, and multiplication rules and simple problems based on these.

Unit 2 Coordiante Geometry

Coordinates, distance between points, coordinates of division of a straight line joining two points, area of a triangle and a quadrilateral, equation of straight line, change of axes, pair of straight lines, circle, parabola, ellipse and hyperbola.

Unit 3 Differential Calculus

Functions, limits, continuity, derivative, rules of differentiation, derivatives of algebraic rational, trigonometric, inverse trigonometric, exponential and logarithmic functions, equation of tangents and normals, maxima and minima.

Unit 4 Matrices and Eigen Values

Matrices, definition, addition and multiplication of matrices, Complex and unitary matrices, some special matrices, determinants upto order 3, Elementary row and column transformation, Eigen values and eigen vectors

Unit 5 Vector Calculus

Point function, Vectors, scalar and vector products of two vectors, equation of straight lines and planes, product of three or more vectors, Gradient, divergence and curl of a vector and their physical interpretations, Line, Surface and Volume integrals, Greens, Stokes and Gauss divergence theorem.

Unit 6 Multiple Integral

Integration, methods of integration including integration by parts, integration of products and power of trigonometric functions, trigonometric substitution in integrals, integrals involving $(Ax^2 + Bx + C)$, partial fraction, definite integrals, properties of definite integrals, Double and triple integral, Change of order, Change of variables, Beta and Gamma functions, Application to area, volume, Dirichlet integral and applications.

Text Books

1. Analytical Geometry of Two and Three Dimensions by Vasavada Hema.
2. Integral Calculus by Shanti Narayan, S Chand and Distributors, Ltd.
3. Mathematics for Scientists and Engineers, by Harold Cohen, Prentice Hall Isnc., New Jersey.
4. Math Concepts for Food Engineering by Richard W. Hartel, T. A. Howell, D. B. Hyslop, CRC Press.

Reference Books

1. Advanced Engineering Mathematics, by E. Kreyszig, Wiley Eastern

FQA 111 3 (2+1)
General Chemistry

(32 lectures + 16 Practicals)

Unit 1 Inorganic

Chemical bonds and molecules : Characteristics of covalent bond, ionic bond, co-ordinate bond, vander waals forces, hydrogen bond, metallic bond, factors affecting the formation of ionic/covalent compounds, Born Haber cycle, shapes of molecules, valence bond theory (hybridization), VSEPR concept, structure of water. Radioactivity: Radioactivity, types of radiation, properties of radiation, determination and measurement of radioactivity, types of radioactive decay, group displacement law, rate of disintegration and half life period. Acids and Bases: Elementary idea of Bronsted-Lowry and Lewis concepts of acids and bases (proton-donor acceptor and electron donor acceptor systems), relative strength of Lewis acids and bases , pH of solutions, buffers, acid base indicators, pH range of indicators, choice of suitable indicator

Unit 2 Organic

Nomenclature of organic compounds : Concept of functional group, nomenclature, basic rules of IUPAC nomenclature, nomenclature of mono-, bi-functional and aromatic compounds, Stereochemistry : Isomerism – Definition and classification, structural isomerism (chain, position and functional), stereoisomerism, properties of stereoisomers, chirality, enantiomers, asymmetric carbon atom, configuration and conformation, Hydrogen bonding: Concept of hydrogen bonding, intermolecular and intramolecular hydrogen bonding, hydrogen bonding in alcohols, carboxylic acids and other molecules, Alcohols, aldehydes and ketones, carboxylic acids, amines, phenols, Important properties and their reactions.

Unit 3 Physical

States of matter: Gases: Kinetic theory of gases, derivation of the kinetics gas equation, characteristics of gases, Gas laws, Boyle's law, Charles law, Gay Lussac's law, Avogadro's law, Ideal gas equation, van der Waal's equation of state, liquefaction of gases, methods of liquefaction, Liquids: Introduction, surface tension, viscosity, their experimental determination, refractive index, molar refraction, optical activity, specific rotation , Nernst distribution law, Chemical-kinetics: Introduction, rate of reaction, law of mass action, order of reaction - first order, second order, units of rate constant. Introduction to analytical techniques : Chemical methods, chromatography, spectroscopic, fluorescence, photochemistry, their principle and analytical applications

Practical	**Title**
1	Safety in chemistry laboratory
2	Oxidation reduction titration using $KMnO_4$ and potassium dichromate
3	Estimation of sodium thiosulphate, potassium dichromate and copper sulphate in the unknown samples
4	To determine pH of the solutions using pH meter
5	Volumetric titrations
6	Complexometric titration
7	Acid base titration using two burettes
8	Melting point determination
9	Boiling point determination
10	Detection of functional groups in organic compounds
11	To determine soluble solids using Abbe's refractometer
12	To determine the viscosity of given liquid using Brookfield viscometer
13	To determine viscosity of the liquids using Ostwald viscometer
14	Determination of specific gravity of liquids using specific gravity bottle method
15	Spectrophotometric determination of ascorbic acid
16	Separation of compound using paper chromatography/TLC

Text books

1 Concise Inorganic chemistry, 5th ed, Blackwell science Ltd by J D Lee
2 Organic chemistry, 6th ed., Pearson Education Ltd by R T Morrison & R N Boyd
3 Essentials of Physical Chemistry {24th Ed.} S. Chand and Company Ltd byB S Bahl, G D Tuli and Arun Bahl
4 Advanced inorganic chemistry by Malik, Tulli, Madan, Pathania
5 Analytical chemistry by B.K. Sharma

Reference books

1 Organic chemistry, 8th ed., John Wiley & sons byT W Graham Solomons and C B Fryhle
2 Physical chemistry R.Chand & Co by S C Khetarpal and Yogesh Sharma
3 Physical Chemistry, Prentice Hall by G K Vemulapalli

FQA 112 3 (2+1)

General Microbiology

(32 lectures + 16 Practical)

Unit 1 Introduction

Scope and history of microbiology (notable contributions of Leeuwenhoek, Pasteur, Koch, etc.), classification and identification of micro organism, ocular and stage micrometers, size determination of microorganisms. Principles of microscopy; uses of microscopes, simple and compound microscope, phase contrast, dark field, ultra violet, fluorescent, electron microscope (SEM and TEM). Principles and types of stains and staining techniques.

Unit 2 Microbial Ultra Structure and Functions

General structure of prokaryotic and eukaryotic cell, cell wall, plasma membrane, protoplasm, endoplasmic reticulum, lysosome, golgi apparatus, centriole, cilia, flagellum, storage bodies and ribosomes, chloroplasts, mitochondria and nucleus.

Unit 3 Microbial Morphology, Metabolism and Growth

General morphological , cultural characteristics and reproduction of bacteria (bacterial metabolism – nutrition and respiration, bacterial reproduction, growth curve) fungi, algae, protozoa and viruses (bacterial viruses, animal viruses)

Unit 4 Cultivation and preservation of micro-organisms

Importance, methods of isolation and cultivation, pure culture technique, enumeration methods for micro-organisms, preservation of microorganism

Unit 5 Control of microorganisms

Physical and Chemical agents, antibiotics and other chemotherapeutic agents

Unit 6 Bacterial genetics

Structure of DNA, difference between DNA and RNA, bacterial recombination (transformation, transduction, conjugation), bacterial mutations (spontaneous and induced), plasmids – properties, types, applications

Unit 7 Principles of immunology

Innate and acquired immunity, difference between active and passive immunity , antigen and antibody reactions – neutralization, precipitation and agglutination

Unit 8 Applied and environmental microbiology

Definitions and scope of industrial and environmental microbiology, microbiology of water and waste water, air, soil and industrial microbiology. Industrial uses of bacteria, yeasts and molds.

Practical	Title
1	Guidelines for safety and food microbiology laboratory work
2	Study of microscope and equipment commonly used in microbiology laboratory
3	Sterilization of glassware used in microbiology laboratory
4	Observation of permanent slides
5	Study of bacterial morphology by monochrome staining
6	Demonstration of morphology of cells by negative staining
7	Grams Staining technique.
8	Preparation of culture media and making Agar plates and Agar Slants
9	Measurement of microbes: Calibration of microscope using stage and ocular micrometer and measuring size of microbes
10	Identification of Gram (+) and Gram (-) bacteria
11	Isolation of microorganisms using Streak plate method
12	Isolation of microorganisms using Spread plate , pour plate method.
13	Control of microorganism by phenol coefficient method
14	Identification of spores by spore staining
15	Aseptic transfer technique and enumeration of microbes by serial dilution technique
16	Microbiological examination of water for coliforms by MPN technique

Text books

1. General Microbiology (Macmillan Press Ltd.) by Roger Y Stanier, John L Ingraham, Mark L Wheelis and Page R Painter
2. Microbiology (Tata McGraw Hill) by M J Pelczar, E C S Chan and N R Krieg
3. Elements of microbiology Vol. 1 & 2 by Modi

Reference Books

1. Industrial Microbiology McGraw Hill Book Co. New York byS C Prescott and C G Dunn
2. Fundamental Principles of Bacteriology Read books byA J Salle
3. Biology of microorganisms by T D Brock
4. Microbiology by Bernard D Davis, R Dulbecco, H N Eisen and H S Ginsberg
5. Fundamentals of microbiology byI Edward Alcano
6. Microbiology – An Introduction by G J Tortora, B R Funke and C L Case
7. General Microbiology Vol. II. by C B Powar and H F Daginawala

FPE 111 4 (2+2)

Basic Mechanical Engineering

(32 Lectures + 32 Practical)

Unit 1 Introduction

Introduction to basic materials- ferrous & non-ferrous materials and important engineering materials such as timber, abrasive materials, silica, ceramics, glasses, graphite, diamond, plastic polymers and composite materials, their properties and applications. Safety measures in workshop. Indian Factory Acts on safety.

Unit 2 Measuring and Gauging

Basic measuring instruments and gauges.

Unit 3 Heat treatment processes

Introduction to hardening, tempering, annealing, normalizing, etc.

Unit 4 Welding Shop

Introduction, types of welding, types of electrodes, types of flames, types of welding joints, edge preparation, welding techniques and equipments; Gas welding and gas cutting, arc welding. Introduction to soldering and brazing and their uses. Estimation of welding and soldering cost.

Unit 5 Blacksmith Shop

Introduction to different tools and their uses; Different forging operations, defects of forging; brief ideas about power hacksaw, etc.

Unit 6 Carpentry Shop

Introduction to various carpentry tools and materials; type of woods and their characteristics, brief ideas about band saw, wooden lathe circular saw, wood planner, etc.

Unit 7 Machine Shop

Introduction to various workshop machines (1) Lathe, (2) Milling machine, (3) Shaper and planner, (4) Drilling and boring machine, (5) Grinder and (6) CNC machines. Length of cut, feed, depth of cut, RPM, cutting speed, time, time allowances. Estimation of machining time for different Lathe operations. Estimation of machining time for casting, shaping, slotting & planning operations, work holding and tool holding devices

Unit 8 Sheet-Metal Shop

Introduction, different operations, sheet metal joints. Allowances for sheet metal, operations & joints, estimate of cost.

Practical	**Title**
1	Identification of different materials of manufacture.
2	Demonstration of different measuring instruments and measurement technique.
3	Identification of various hand tools.
4	Demonstration of various power tools and machine tools.
5-8	Simple exercises in Filing, Fitting, Chipping, Hack sawing, Chiseling, Tapping, etc.
9	Introduction to welding machine, processes, tools, their use and precautions.
10-11	Simple exercises on arc welding.
12-13	Simple exercises in gas welding.
14-15	Demonstration of various casting processes and equipments, tools and their use.
16-17	Exercises on mould making using one piece pattern and two piece pattern
18	Demonstration of moud making using sweep pattern and match plate pattern
19-24	Simple exercises on turning: step turning, taper turning, drilling and threading.
25-27	Introduction to shaper and planner machine and preparations of various jobs on them.
28-30	Introduction to drilling machines and preparation of a related jobs.
31-32	Demonstration of other important operations and preparation of additional jobs.

Text Books

1. Principles of Manufacturing Materials and Processes, by J.S.Campbell, Tata McGraw-Hill.
2. Basic Engineering Thermodynamics, by Joel Rayner, ELBS
3. Workshop Technology, Vols I & II, by W A J Chapman, ELBS

4. Mechanical Estimates and Costs by T. K. Bagga & S. C. Sharma, Khanna publishers, Delhi-6.

Reference Books

1. Shop Theory, by J Anderson & E E Tatro, Tata McGraw-Hill
2. Basic Mechanical Engineering, by T. S. Rajan, Wiley Eastern Ltd.
3. Basic Mechanical Engineering by Dr. R. P. Arora, Prof. B. K. Raghunath, Prof. J. P. Patel

FPE 112 4 (3+1)
Basic Electrical Engineering

(48 Lectures + 16 Practical)

Unit 1 AC Fundamentals

Definitions of cycle, frequency, time period, amplitude, Peak value, RMS value, Average value, etc. Equations of alternating voltages and currents, AC through resistance, inductance and capacitance. AC circuits, series and parallel circuits, Simple R-L, R-C and R-L-C circuits, circuit breakers.

Unit 2 3 Phase Systems

Star and Delta connections. Relationship between line and phase voltages and currents in Star and Delta connections. Power in three phase system with a balanced load. Measurement of power in 3 phase circuits.

Unit 3 Transformer

Introduction, Principle of operation, emf equation, phasor diagrams. Ideal transformer. Transformer on no load, Transformer under load, Equivalent circuits, Transformer losses, efficiency, Regulation, Open and short circuit test.

Unit 4 Alternator

Elementary principles. Construction and types of alternators. emf in alternators.

Unit 5 Induction Motor

Construction, rotor winding squirrel cage and phase wound rotors. Analysis of current and torque, motor housing, starting of motors, different starters. Selection of motors and its controls.

Unit 6 D.C. Machine:

(a) Types, Construction and Operation of DC generator and their characteristics.
(b) D.C. Motors, their starting, speed controls and characteristics.

Unit 7 Electric Power Economics

Maximum demand charge, Load factor and Power factor correction.

Unit 8 Electrical Wiring

Connectors & switches, system of wiring, domestic wiring installation, sub circuits in domestic wiring, simple control circuit in domestic installation, industrial electrification

Unit 9 Safety & protection

Safety, electric shock, first aid for electric shock other hazards of electrical laboratories & safety rules, use of Multimeter, grounding, importance of grounding, equipment of grounding for safety. Circuit protection devices, fuses, MCB, ELCB & relays.

Unit 10 Electrical Measuring Equipments

Classification, Characteristics of different electrical measuring systems and equipments.

Practical	**Title**
1-2	Study of voltage resonance in L.C.R. circuits at constant frequency: (a) Star connection study of voltage and current relation (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, (b) for unbalanced loads.
4	Voltage and current relation in 3 phase transformers of various kinds of primary and secondary connection systems.

5-6	Starting of induction motors by; (a) D.O.L., (b) Manual stardelta, (c) Automatic stardelta.
7	Starting of slipring induction motors by normal and automatic rotor starters.
8	Test on 3 phase induction motor- determination of efficiency, line current, speed slip and power factor at various outputs.
9	Determination of relation between the induced armature voltage and speed of separately excited D.C. generator.
10	Magnetization characteristics of D.C. generator.
11	Study the starter connection and starting reversing and adjusting speed of a D.C. motor.
12-13	Problems on Industrial Electrification.
14-15	Study of various circuit protection devices.
16	Study of various measuring instruments.

Text Books

1. Basic Electrical Engineering by V. N. Mittle (Tata McGraw-Hill Publications).
2. Electrical Technology by B. L. Theraja & A. K. Theraja, Vol. I, II and IV.
3. Electrical Technology by H. Cotton (CBS Publishers).

Reference Books

1. Electrical Estimating & costing by Surjitsingh (Dhanpat Rai & Co.)

Ag 111 3(2+1)
Crop Production Technology

(32 Lectures + 16 Practical)

Unit 1 Classification of crops, Effect of different weather parameters on crop growth and development. Principles of tillage. Soil-water-plant relationship, crop rotation, cropping systems, relay cropping and mixed cropping

Unit 2 Crop Production Technology for major cereal crops viz., paddy, wheat, maize, pearl millet, sorghum, etc.; Major varieties, sowing time, method of sowing, spacing, interculturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.

Unit 3 Crop Production Technology for major oilseed crops viz., groundnut, sesame, rapeseed, mustard, castor, etc.; Major varieties, sowing time, method of sowing, spacing, interculturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.

Unit 4 Crop Production Technology for major pulse crops viz., pigeon pea, cowpea, gram, greengram, blackgram, etc.; Major varieties, sowing time, method of sowing, spacing, interculturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.

Unit 5 Crop Production Technology for major spices and cash crops viz., cumin, coriander, funnel, ginger, garlic, sugarcane, etc.; Major varieties, sowing time, method of sowing, spacing, interculturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.

Unit 6 Horticulture: Scope of horticultural. Soil and climatic requirements for fruits and vegetables, nursery raising and management.

Unit 7 Crop Production Technology for major fruit crops viz., mango, banana, sapota, aonla, pomegranate, guava, etc.; Major varieties, time of transplanting, spacing, interculturing, fertilizer and water requirement, time and method of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.

Unit 8 Crop Production Technology for major vegetable crops viz., potato, onion, tomato, chilli and other green and leafy vegetables; Major varieties, sowing time, method of sowing, spacing, interculturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.

Practical	**Title**
1	Examination of soil profile in the field.
2	Introduction to different equipments utilized in a weather observatory.
3-4	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	Use of different interculturing equipments.
8-9	Study of water requirement of different crops.
10-11	Fertilizer application methods and equipments.
12	Judging maturity time for harvesting of crop.
13	Identification and description of important fruit and vegetable crops.
14	Preparation of nursery.
15	Study of different garden tools.

16 Practices of pruning and training in some important fruit crops.

Text Books

1. Principles of Agronomy, by: T. Y. Reddy and G. H. Shankara Reddy
2. Principles and Practices of Agronomy, by: S. S. Singh
3. Principles of Horticulture, by: Prasad and Kumar

Reference Books

1. Fundamentals of Agronomy, by: Rajat D.
2. Principles of Horticulture, by: Denison.

Eng 111 2 (1+1)

Language & Communication Skills (16 Lectures + 16 Practical)

Unit 1 Introduction: Importance of language and communication skills in the engineering profession.

Unit 2 Spoken and conversational English : Main features; agreement, disagreement, likes, dislikes and enquiries; debate and discussion

Unit 3 Basic sentence patterns in English: agreement between subject and verb; proper use of pronouns, adjectives and adverbs; proper use of phrases and clauses. Some basic rules of composition.

Unit 4 Concept of register; development of vocabulary; reference skills - dictionary, thesaurus, indexing, contents, glossary; reading of selected texts and discussions; vocabulary building tasks.

Unit 5 Note-taking and note-making; linkage; development of paragraphs; cohesion, coherence and style.

Tutorials Grammar Tenses

1 Voice-Change,
2 Direct/Indirect narration,
3 Prepositions and Determiners,
4 Word-formation with parts of Speech,
5 Types of sentences,
6 Elementary Knowledge of English Sound with Word-stress,
7 Intonation Pattern.
8 Composition -
9 Letter,
10 Application,
11 Summary and report writing.

Reference Books

1. Intermediate English Grammar, by Raymond Murphy, Cambridge Uni. Press.
2. High School English Composite & Grammar, by Wren & Martin, S. Chand & Co.
3. Good English, by G H Vallins, Rupa & Co.
4. The Prose Readers : Essays for college writers, by Kim Flachman & Michal Flachman, Prentice-Hall of India

SECOND SEMESTER

Math 121 3(3+0)

Engineering Mathematics – II

(48 Lectures)

Unit 1 Differential Equations

Ordinary differential equations of the first, second and arbitrary orders, Exact differential equations, Linear differential equations of first order, Linear differential equations of nth order with constant coefficients, Complementary functions and particular integrals, Simultaneous linear differential equations, Solutions of second order differential equations by changing dependent and independent variables, Method of variation of parameters, Applications to engineering problems

Unit 2 Laplace Transform

Laplace transform, Existence theorem, Laplace transform of derivatives and integrals, Inverse Laplace transform, Unit step function. Dirac delta function, Laplace transform of periodic functions, Convolution theorem, Application to solve simple linear and simultaneous differential equations.

Unit 3 Fourier Series and Partial Differential Equations

Periodic functions, Trignometric series, Fourier series of period 2, Eulers formulae, Functions having arbitrary period, Change of interval, Even and odd functions, Half range sine and cosine series, Introduction of partial differential equations, Linear partial differential equations with constant coefficients of 2^{nd} order and their classifications - parabolic, elliptic and hyperbolic with illustrative examples.

Unit 4 Applications of Partial Differential Equations

Method of separation of variables for solving partial differential equations,Wave equation up to two-dimensions, Laplace equation in two-dimensions, Heat conduction equations up to two-dimensions, Equations of transmission Lines

Unit 5 Curve Fitting and Solution of Equations

Correlation and Regression, Interpolation, Binomial distribution, Poisson distribution, Normal distribution, Method of least squares and curve fitting of straight line and parabola, Solution of cubic and bi-quadratic equations.

Unit 6 Infinite Series

Convergence and divergence of series, tests of convergence, Alternating series, absolutely and conditionally convergent series, uniform convergence.

Text Books

1. Higher Engineering Mathematics, by B S Grewal, Khanna Publishers
2. Engineering Mathematics, by Shanti Narayan, S Chand and Co. Ltd.

Reference Books

1. Advanced Engineering Mathematics, by E. Kreyszig, Wiley Eastern

FQA 121 3 (2+1)

Food Chemistry

(32 lectures + 16 Practical)

Unit 1 Introduction

Definition, approach to study of food chemistry

Unit2 Water

Definition of water in foods, Physical properties of water and ice, Structure of water and ice, Interaction of water with solutes, Sorption phenomenon, Types of water, Water activity and food spoilage

Unit 3 Carbohydrates

Classification (mono, oligo and poly saccharides), Structure of important polysaccharides (starch, glycogen, cellulose, pectin, hemicellulose, gums), Chemical reactions of carbohydrates, Modified celluloses and starches, Browning reactions in foods

Unit 4 Fats and oils

Classification of lipids. Identification of natural fats and oils using Physical properties-melting point, softening point, specific gravity, refractive index, smoke, flash and fire point, turbidity point. Chemical properties-Reichert Meissel value, polenske value, iodine value, peroxide value, saponification value. Auto-oxidation, rancidity, lipolysis, flavour reversion Technology of edible fats and oils (extraction, refining, hydrogenation)

Unit 5 Proteins

Protein classification and structure, properties of proteins (electrophoresis, sedimentation, amphoterism and denaturation,), functional properties of proteins, nature of food proteins (plant and animal proteins), and reactions involved in processing, reactions with alkali, enzyme catalysed reactions involving hydrolysis and proteolysis, texturized proteins.

Unit 6 Enzymes

Introduction, classification, enzyme inhibitors (protease, alpha amylase, invertase, other enzyme inhibitors), immobilized enzymes, enzymes in food processing (amylases, proteases, pectinases, oxidoreductases), uses of enzymes in food industry

Unit 7 Flavour

Definition, basic tastes and taste factors, smell sensation, visual appearance and flavour, texture sensation, flavour compounds, flavour enhancers

Unit 8 Natural food pigments

Introduction, food pigments (chlorophyll, carotenoids, anthocyanins and flavonoids, beet pigments)

Unit 9 Food additives

Introduction, importance of food additives in food processing , classification of additives – antioxidants, chelating agents, coloring agents, sweetners, antimicrobial agents, emulsifiers, stabilizers, anticaking agents, thickners, firming agents, clarifying agents, preservatives (class I, II)

Unit 10 Food Toxicology

Definition, scope and general principles of food toxicology, classification of food toxicants, toxicants and allergens in foods derived from plants, animals, marine, algae and mushroom, microbial toxins, derived food toxicants – processing and packaging, toxicology and food additives , toxicological aspects of nutrient supplements, chemicals from processing – auto-xidation products, carcinogens in smoked foods

Practical	Title
1	Estimation of moisture content in a given food sample
2	Estimation of reducing sugars by Lane and Eynon method
3	Estimation of crude fibre content in food samples
4	Determination of protein by Kjeldahl's method
5	Estimation of total ash, acid soluble and water soluble ash
6	Extraction of fat from given food sample by Soxhlet apparatus
7	Determination of smoke point and percent fat absorption for different fats and oils
8	Determination of percent free fatty acids in given food sample
9	Estimation of peroxide value in fats and oils
10	Estimation of iodine value in oils
11	Estimation of saponification value in oils
12	Determination of refractive index of fats and oils
13	Determination of specific gravity of fats and oils
14	Estimation of antinutritional factors (Trypsin inhibitor) in foods
15	Determination of carotenoids with respect to flour pigments
16	Estimation of water activity in a given sample of food

Text books

1 Food Chemistry, 3rd Ed., Marcell Dekker, New York by O R Fennema

2 Food Chemistry CBS Publisher, Delhi by L H Meyer

Reference books

1 Enzymes in Food Technology, CRC Press, Canada by R J Whitehurst and B A Law

2 Food Enzymes, Chapman and Hall, New York by Dominic W S Wong

3 Food : The Chemistry and its Components, 4th Ed., RSC, UK by T S Coultate

4 Mechanism and Theory in Food Chemistry, CBS Publishers by Dominic W S Wong

5 Food Facts and Principles New Age International (P) Ltd. Publishers, New Delhi) by N Shakuntala Manay and M Shadaksharaswamy

6 Food Chemistry (Springer Publ.) by H D Belitz and W Groech

7 Food Chemistry by L W Aurand and A E Wood

8 Chemical Analysis of Foods and Food Products byM B Jacobs

9 Pearson's Chemical Analysis of Foods by H Egan, R S Kirk, R Sawyer

FQA 122 3 (2+1)

Food Microbiology

(32 lectures + 16 Practicals)

Unit 1 Introduction

Definition, history of microorganism in food, scope of food microbiology

Unit 2 Microorganisms important in food industry

Types of microorganisms, their importance in foods, classification of food borne bacteria, their morphology and distinguishing features with examples.

Unit 3 Growth of microorganisms in foods

Intrinsic (pH, moisture content, redox potential, nutrient content, antimicrobial constituents and biological structures) and extrinsic factors (temp., RH, presence and concentration of gases) governing growth of microorganisms in food.

Unit 4 Food spoilage

Chemical changes caused by microorganisms in foods (breakdown of proteins, carbohydrates, fats and other constituents during spoilage), specific microorganisms causing spoilage of milk and milk products, meat, fish, egg, cereals, fruits, vegetables and their processed products, quality defects in canned foods, sugar and confectionary products

Unit 5 Food fermentations

General description of fermenters, parts and their functions, different types of fermentations (static, submerged, agitated, batch, continuous). Microbial culture selection by screening methods and strain improvement. Starter cultures - definition, types, Fermentation - definition, types (acid, alcohol). Fermented foods - types, methods of manufacture for vinegar, ethyl alcohol, cheese, yoghurt, baker's yeast and traditional Indian foods.

Unit 6 Microbial Foodborne Diseases

Introduction, types of microbial foodborne diseases (foodborne intoxications and foodborne infections), symptoms and prevention of some commonly occurring food borne diseases.

Unit 7 Food Preservation

Principles of preservation, methods of food preservation – high temperature, low temperature, drying, radiation, chemical preservatives, bio-preservatives, hurdle technology, active packaging, novel processing technologies.

Practical Title

1 Safety guidelines in food microbiology laboratory

2	Cleaning and sterilization of glassware
3	Enumeration of coliforms, yeasts and molds and total viable bacteria in fruits and vegetables. dairy products
4	Enumeration of coliforms, yeasts and molds and total viable bacteria in dairy products.
5	Enumeration of aerobic spore forming bacteria in food sample.
6	Estimation of alcohol content in fermented product
7	Isolation and identification scheme for detection of Salmonella in foods
8	Casein hydrolysis by microorganism on SMA
9	Starch hydrolysis by microorganism using starch agar
10	Evaluation of Starter Culture by Starter Activity Test
11	Assessment of surface sanitation by swab /rinse method and assessment of personnel hygiene by hand wash
12	To study the given sample (milk) using Methylene blue reduction test (MBRT)
13	To find total viable bacteria and coliforms in water by membrane filtration technique
14	To study microflora of air
15	Evaluation of canned products for anaerobic spore formers
16	Preparation of Yoghurt

Text books

1 Food Microbiology, TMH, New Delhi by W C Frazier & D C Westhoff

2 Modern Food Microbiology, CBS Publication, New Delhi by J M Jay

Reference books

1 Essentials of Food Microbiology, Arnold, London byJohn Garbutt

2 Microbiology,5th Ed., TMH, New Delhi by M J Pelczar, E C S Chan and Noel R Krieg

3 Microbiology of Safe Food, Blackwell Science, Oxford by S J Forsythe

4 Developments in Food Preservation Elsevier Applied Science Publishers, London and New York by Stuart Thorne

5 Fundamentals of Food Microbiology AVI Publishing Co. Inc., Connecticut, USA by M L Fields

6 Microbiology of foods by J C Ayres, J O Mundt, W E Sandine, W H Freeman

FPE 121 3(1+2)

Basic Civil Engineering

(16 Lectures + 32 Practical)

Unit 1 Introduction

Role of Civil Engineering in the field of engineering, technology and infrastructure.

Unit 2 Structural Design

Building systems; design loads. Building drawing conventions; Elementary building bye-laws; building classification. Structural steel work.

Unit 3 Design and drawings

The theory of projections – Introduction. Types of axonometric drawings. Perspective drawings (one point, two point). Oblique drawings. Orthographic projection (Parallel projection). Isometric drawing. Different rendering techniques and rendering symbols used in architectural drawings.

Unit 4 Material of construction

Materials of construction; building components and their requirements.

Unit 5 Basic Construction

Foundations – definition, purpose of foundation, causes of failure of foundation. Elements of Building Construction: Walls and types. Masonry – stone masonry, brick masonry. Stairs, lintels and arches. Plastering and pointing. Roof and roof coverings. Damp proofing and water proofing.

Unit 6 Low cost building

Specification for low cost buildings.

Unit 7 Estimating and Costing

Preliminary estimates for building / projects.

Unit 8 Safety measures

Causes and prevention of cracks in buildings.

Practical	**Title**
1-2	Studies of building material, property and characterization.

3-4	Studies on engineering materials, construction and properties.
5-6	Design and drawing of steel roof truss;
7-8	Design and drawing of RCC building;
9-10	Types of foundations, Site inspection and preliminary investigation,
11	Materials used for damp proofing. Treatment for damp proofing and water proofing.
12	A visit to stone masonry and brick masonry sites.
13-14	Drawing of different types of stairs.
15-18	Preliminary estimates for a building.
19-32	Introduction of drawing scales; Principles of orthographic projections; References planes; Points and lines in space and traces of lines and planes; Auxiliary planes and true shapes of oblique plain surface; True length and inclination of lines; Projections of solids (Change of position method, alteration of ground lines); Section of solids and Interpenetration of solid-surfaces; Development of surfaces of geometrical solids; Isometric projection of geometrical solids.

Reference Books

1. Basic Civil Engineering, by P. D. Despande Nirali Prakashan, Pune
2. Elements of Civil Engineering, by Phadke, Phadke and Palwe, Nirali Prakashan, Pune
3. Building Construction by Arora and Bindra,

FPE 122 3 (2+1)

Thermodynamics

(32 Lectures + 16 Practicals)

Unit 1 Fundamental Concepts

Introduction: Thermodynamics: terminology, definition and scope, microscopic and macroscopic approaches, engineering thermodynamics: definition, some practical applications of engineering thermodynamics.

System: System (closed system) and control volume (open system), characteristics of system boundary and control surface, surroundings, fixed, moving and imaginary boundaries, examples.

Thermodynamic State: Thermodynamic state, state point, identification of a state through properties, definition and units, intensive and extensive various property diagrams, path and process, quasi-static process, cyclic and non-cyclic processes, restrained and unrestrained processes.

Thermodynamic Equilibrium: Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium. Zeroth law of thermodynamics, temperature as an important property, temperature scale.

Unit 2 Work and Heat

Mechanics, definition of work and its limitations, thermodynamic definition of work and heat, sign convention, displacement works at part of a system boundary and at whole of a system boundary, expressions for displacement works in various processes through p-v diagrams, shaft work and electrical work, other types of work, examples and practical applications.

Unit 3 First Law of Thermodynamics

Statement of the First law of thermodynamics for a cycle, derivation of the first law of processes

Energy, internal energy as a property, components of energy, thermodynamic distinction between energy and work

Concept of enthalpy, definitions of specific heats at constant volume and at constant pressure.

Extension of the First law to control volume, steady state-steady flow energy equation, important applications such as flow in a nozzle, throttling, adiabatic mixing etc., analysis of unsteady processes, case studies.

Unit 4 Properties of Gas and Gas Mixtures

Ideal and Perfect Gases

Differences between perfect, ideal and real gases, equation of state, evaluation of

properties of perfect and ideal gases.

Real Gases. Van der Waal's Equation of state, Van der Waal's constants in terms of critical properties, law of corresponding states, compressibility factor; compressibility chart and other equations of state (cubic and higher orders).

Unit 5 Pure Substances

Definition of a pure substance, phase of a substance, triple point and critical points, sub-cooled liquid, saturated liquid, vapor pressure, two-phase mixture of liquid and vapor, saturated vapor and superheated vapor states of a pure substance with water, dryness fraction, representation of pure substance properties on p-T and p-V diagrams, detailed treatment of properties of steam for industrial and scientific use (IAPWS-97, 95)

Unit 6 Basics of Energy Conservation Cycles

Heat - Work Conversion: Devices converting heat to work and vice versa in a thermodynamic cycle, thermal reservoirs.

Heat Engines and Heat Pumps, Heat engine and a heat pump, schematic representation and efficiency and coefficient of performance, Carnot cycle.

Unit 7 Second law of Thermodynamics

Identifications of directions of occurrences of natural processes, Offshoot of II law from the I, Kelvin-Planck statement of the Second law of Thermodynamics, Clasius's statement of Second law of Thermodynamics, equivalence of the two statements.

Definition of reversibility, examples of reversible and irreversible processes, factors that make a process irreversible, reversible heat engines, evolution of thermodynamics.

Unit 8 Entropy

Clasius inequality, statement, proof, application to a reversible cycle, entropy, definition of entropy, a property, principle of increase of entropy, entropy as a quantitative test for irreversibility, calculation of entropy, role of T-S diagrams, representation of heat, TdS relations, available and unavailable energy.

Unit 9 Availability and Irreversibility

Maximum work, maximum useful work for a system and a control volume, availability of a system and a steadily flowing stream, irreversibility, second law efficiency.

Unit 10 Boilers and Engines

Boilers: Classification of steam boilers, Vertical and Cross tube Cradley boiler, Cochran, Lancashire, Locomotive and Babcock-Wilcox boilers. Boiler mountings and accessories.

Engines: Two stroke and four stroke engines, engine efficiencies and performance.

Practical	Title
1.	Calorific value and its determination
2.	Study of various types of burners and firing of fuels
3.	To study properties of wet, dry saturated and superheated steam
4.	Use of steam tables and Molier charts, determination of dryness fraction of steam.
5.	Study of steam trap and streamline layouts
6.	Study of Boiler mountings and accessories
7.	Study of Vertical and Cross tube Cradley boiler
8.	Study of Babcock & Wilcox longitudinal drum water tube boiler (straight tube type)
9.	Study of Lancashire boiler
10.	Study of Cochran boiler
11.	Study of Locomotive boiler
12.	Study of Packaged boiler
13.	Study of two and for stroke engines
14.	Visit to food plant with steam utilization
15.	Problems on thermodynamic applications
16.	Problems on thermodynamic applications

Text books

1. Engineering Thermodynamics by P. K. Nag Publisher Tata McGraw Hill

2. Thermodynamics by Holman, J P, Publisher byTata McGraw Hill

Reference books

1. Thermodynamics and Heat Engines - Vol I by R. Yadav. Published by Central Publishing House, Allahabad)

FPE 123 4 (3+1)

Basic Electronics & Instrumentation Engineering

(48 Lectures + 16 Practical)

Unit 1 Semiconductor Devices

Introduction to various types of resisters, capacitors, etc. Structure of atom, energy band. N-type and P-type semiconductors. Intrinsic and Extrinsic semiconductors.

Unit 2 Diodes and Rectifiers

P.N. Junction diode and its characteristics, Zener diode and its characteristics. Half wave, full wave and bridge rectifiers, L & C filters, Silicon controlled rectifier (SCR)- characteristics, principle of operation as half wave and full wave controlled rectifier

Unit 3 Transistors

Transistor structure, transistor as a switch and as an amplifier, transistor input and output characteristics. Cut-off, active and saturation regions. Transistor biasing, OPAMP as amplifier.

THE Junction Transistor- Transistor current components, UNI Junction Transistor- Principle of operation, characteristics.

Unit 4 Controlled Switches

Operation of triggering circuits; GATE characteristics, circuit for GATE triggering, use of UJT as a triggering device. AC Voltage regulators-DIAC and TRIAC as AC voltage regulator. Basics of simple SMPS and DC/DC conversion circuits. Introduction to power MOSFETS;

Unit 5 Invertors

Various types of invertors and their principle of operation. Voltage and frequency controlling methods. Design of DC power supply.

Unit 6 Convertors

Line commuted circuits, input and output characteristics of bridge circuits. Effect of source ampedances, load impedance interphase, reactor control, commutation with capacitor, source impedance. Comparison of invertor and cyclo convertor. Principle of operation of chopper, voltage and current commutated choppers.

Unit 7 Digital Electronics

Digital systems, logic gates, flip flop number systems, A/D & D/A convertor circuit and its

principles.

Unit 8 Electronic Instrumentations

Instruments, absolute and secondary instruments, controller and recorder. Principles of measurement, static and dynamic characteristics of instruments, error analysis and its calibration, accuracy, sensitivity, reproducibility, static errors, dead zone, drift in measuring instrument. Essentials of indicating instruments, constructional details of indicating instruments.

Induction type instruments: Principles of induction type instruments, shaded pole method and two pole method, compensation for frequency and temperature errors.

Induction type voltmeter and ammeter, advantages and disadvantages, induction type single phase watt-hour meter, errors and remedies.

Analog and digital representation of signals, data loggers, RS-232 data transfer, USB data transfer.

Mechanical input transducers. Level, pressure, flow, velocity and humidity resistive transducers. Capacitive and inductive transducers, dielectric system for humidity measurements. Temperature transducers. Resistive, inductive, capacitive and thermoelectric transducers, magnetic transducers.

Cathode ray oscilloscope. Signal generator, transducers, piezoelectric transducer, capacitive transducer, velocity transducers. Sensors, strain gauges, thermisters and other data acquisition systems.

Practical	**Title**
1	Study of VI characteristics of PN-junction diode.
2	Study of LC filer circuits.
3	Study the diode as a clipper and clamper.
4	Study Zener diode as voltage regulator with variable load and variable input supply.
5	Study of half wave, full wave and bridge rectifiers.
6	Study SCR as full wave controlled rectifier with resistive and inductive load.
7	Study of transistor characteristics in CE configurations.
8	Study the fixed and self-bias transistors.
9	Study the potential divider bias transistor.
10	Study NAND & NOR gate IC as universal GATE.
11	Study of DIAC and TRIAC pair as an AC voltage controller.

12	Study of 741 IC as inverting and non-inverting amplifier.
13	Study a differential amplifier using two transistors.
14	To study various instrumentation symbols.
15	Study of CRO, function generator and power supply
16	Familiarize with various types of transducers, sensors, strain gauges, thermisters and other data acquisition systems.

Text book

1. Basic Electronics Engineering by RK Singh & A. Dixit (Laxmi Publications)
2. Power Electronics by P. C. Sen (Tata McGraw-Hill)

Reference Books:

1. Electronic Fundamentals and applications by J. D. Ryder (Prentice Hall of India)
2. Basic electronics and Linear Circuits by N. N. Bhargava (Tata McGraw-Hill).

FBM 121 3 (1+2)

Computer Programming and Data Structures

(16 lectures + 32 Practical)

Unit 1 Introduction and historical background: Review of computer technology; processor, memory, secondary storage, display devices and other peripheral devices; basic computer organisation; future trends. Brief review of present-day applications.

Unit 2 Programming. Introduction to systems software, applications software and programming language; algorithms and flow-charts: Input-processing-output model of a computer program. Role of the compiler and the integrated development environment.

Unit 3 Introduction to C: Structure of a C program. Simple data types. Declarations; operators and expressions. The assignment statement. Library functions.

Unit 4 Control Structures: Conditional and iterative execution of statements. Importance of documentation. Nesting of control structures and the use of indentation to indicate nesting levels. Labels and the "go to" statement.

Unit 5 Arrays; single and multi-dimensional arrays: Character strings and string functions.

Unit 6 Functions: Scope rules. Argument passing by reference and by value. Storage classes. Use of function prototypes. Structures, unions and user-defined types.

Unit 7 Operations on files: Concept of standard input and output files. Formatting of data on input and output. Use of include files.

Practical	**Title**
1-6	Familiarizing with Turbo C IDE; Building an executable version of C program; Debugging a C program;
7-14	Developing and executing simple programs;
15-17	Creating programs using decision making statements such as if, go to & switch; Developing program using loop statements while, do & for;
18-19	Using nested control structures;
20-23	Familiarizing with one and two dimensional arrays; Using string functions; Developing structures and union;
24-27	Creating user defined functions; Using local, global & external variables;
28-29	Using pointers;
30-32	Implementing Stacks; Implementing push/pop functions; Creating queues; Developing linked lists in C language; Insertion/Deletion in data structures

Text book

1. Fundamentals of Computers, by V Rajaraman, Prentice Hall of India

Reference Books

1 Programming with C (Schaum's Outline Series). Gottfried B S. Tata McGraw Hill
2. The Spirit of C - Introduction to Modern Programming, Mullish H & Cooper H L, Jaico

THIRD SEMESTER

FQA 231 3 (2+1)

Food Biochemistry and Human Nutrition

(32 lectures + 16 Practical)

Unit 1 Concepts of food and nutrition

Definition of terms – nutrition, malnutrition (undernutrition, overweight, obesity), health and nutritional status, functions of food, basic food groups – energy yielding, body building and protective, nutrients supplied by food, nutritional needs – requirements and recommended allowances of foods under normal conditions for all age groups

Unit 2 Mechanism of enzyme action

Introduction to enzymes, coenzymes, regulation of enzymatic activity, enzyme kinetics, inhibition effects of pH, allosteric enzymes, derivation of Michaelis-Menten Equation

Unit 3 Nucleic acids

Definition and composition of RNA and DNA, structure of various components, viz, bases and sugars, hydrolysis of nucleic acids, structure of RNA and double helical structure of DNA

Unit 4 Nutrients

Sources, functions, digestion, absorption, assimilation and transport of carbohydrates, proteins and fats in human beings

Unit 5 Metabolism of carbohydrates

Biological role of carbohydrates, glycolysis and respiration (TCA cycle), production of ATP- a brief description of electron transport chain, oxidative and substrate phosphorylation

Unit 6 Metabolism of lipids

Biological role of lipids, breakdown of triglycerides and phospholipids, β-oxidation of long chain fatty acids, ketosis, biosynthesis of fatty acids, triglycerides and phospholipids

Unit 7 Metabolism of proteins

Breakdown of proteins, transamination, deamination, decarboxylation, nitrogen fixation, urea cycle

Unit 8 Minerals

Functions, sources, factors affecting absorption of minerals, absorption promoters – Vit C for Fe, absorption inhibitors – phytates, tannins, oxalates, effect of deficiency – Calcium, phosphorus, iron, zinc, iodine, fluorine and copper

Unit 9 Vitamins and hormones

Classification, functions, sources, effects of deficiency , fat soluble vit (A,D,E,K), water soluble vitamin (thiamine, riboflavin, niacin, cyanocobalamin, folic acid, and ascorbic acid), relationship between vitamins and hormones in terms of their biological role

Unit 10 Physico chemical and nutritional changes during processing

Changes during food processing treatment – drying and dehydration, irradiation, freezing, fermentation, canning, restoration, enrichment, fortification and supplementation of foods

Practical	Title
1	Safety in biochemistry laboratory
2	Measurement of energy using bomb calorimeter
3	Determination of pka of acid
4	Determination of pI for casein
5	Estimation of sugars by Anthrone method
6	Estimation of protein by Lowry method
7	Estimation of amino acid using Biuret reaction
8	Separation of amino acids using paper chromatography
9	Separation of amino acids using Thin layer Chromatography
10	Separation of amino acids using electrophoresis
11	Estimation of phosphorus in food sample
12	Estimation of iron content in foods
13	Determination of calcium in food samples
14	Estimation of β – carotene using column chromatography
15	Estimation of ascorbic acid using dye method
16	Effects of acids and alkali on pigments

Text books

1 Principles of Biochemistry by A L Lehninger

2 Text book of Biochemistry by E S West, W R Todd, H S Mason and J T Van Bruggen

3 Nutrition and Dietetics, Tata McGraw-ill Co. Ltd by Shubhangini A Joshi

Reference books

1 General Biochemistry by J H Weil

2 Biochemistry of Foods, Academic Press by A M Eskin

3 Food Chemistry, Marcel Dekkar Inc by O R Fennema

4 Essentials of Nutrition, Ganesh and Co by M Swaminathan

5 Outlines of biochemistry by Eric E Conn and P K Stumpf

FPE 231 3 (2+1)

Fluid Mechanics

(32 Lectures + 16 Practical)

Unit 1 Introduction and Properties of Fluids

Properties of Fluids: Concept of fluid mechanics, definition of fluid, fluid continuum, density, specific weight

Viscosity: Newtonian and Non-Newtonian fluids, kinematic viscosity, dynamic viscosity, variation of temperature with viscosity

Surface tension, vapour pressure, incompressible and compressible fluids, ideal and real fluids

Unit 2 Fluid Mechanics

Pressure Measurement: Static pressure of liquids, absolute and gauge pressures, mechanical pressure gauges, pressure measurement by manometers

Forces on plane surfaces, forces on curved surfaces, Buoyant forces (Archimedes' Principle), stability of floating and submerged bodies.

Unit 3 Kinematics of Fluid Motion

Classification of Flow: Method of describing fluid motion, classification of flow: steady and unsteady; uniform and non-uniform; one, two and three dimensional flow

Laminar and turbulent flows, stramline, pathline and streakline

Acceleration equations, continuity equations, circulation and vorticity, flownet

Unit 4 Dynamics of Fluid Flow

Euler's equation of motion, application of Euler's equation

Bernoulli's equation, applications of Bernoulli's equation, cavitation, momentum

Unit 5 Navier-Stokes Equations of Motion

Navier-Stokes equations in cylindrical co-ordinates, boundry conditions

Simple application of Navier-Stokes equation: Laminar flow between two straight parallel boundries

Unit 6 Analysis of Flow Through Pipes

Energy losses in pipe lines, minor losses in pipe lines due to enlargement, contraction, bends and pipe fitting

Equivalent Length and Equivalent Pipes, Concept of equivalent length and equivalent pipes

Problems in Pipe Flow, Determination of pipe diameter, determination of discharge, determination of head loss

Other Systems for Flow, Hydraulic power transmission through a pipe, siphon, multiple pipe systems, water hammer

Unit 7 Flow Measurements

Measurement of Flow in Pipes, Venturimeter, flow nozzle, sharp edged concentric orifice meter, bend meter, rotameter. Measurement of Velocity, Pitot tube, hot wire anemometer, current meter. Flow through Orifices, Determination of hydraulic coefficient of orifice, large orifice, standard orifice, mouthpieces or short tubes. Measurement of Flow in Open Channels. Weirs: trianlgular weir, trapezoidal weir, Cipolletti weir, submerged weir, broad crested weir; flow under sluice gate.

Unit 8 Fluid Machines

Turbines and pumps: classification, centrifugal pumps, submersible pumps, reciprocating pumps, positive displacement pump.

Centrifugal pumps: Pumps in series and parallel, basic equations applied to centrifugal pump, loss of head due to changed discharge, static head, total head, manometric head, manometer efficiency, operating characteristics of centrifugal pumps.

Submersible pumps: Reciprocating pumps: working of reciprocating pump, double acting pump, instantaneous rate of discharge, acceleration of piston and water, gear pump.

Practical	Title
1	Study of different types of pipes, pipe fittings and tools
2	Study of different types of valves used in pipe lines
3	Plotting flow rate versus pressure drop with U-tube manometer
4	Verification of Bernoulli's theorem
5	Determination of discharge coefficient for Venturi
6	Determination of discharge coefficient for Orifice
7	Determination of discharge coefficient for V-Notch.
8	Determination of critical Reynold's number of laminar, transition and turbulent flow by Reynold's apparatus.
9	Calibration of Rota meter.
10	Determination of frictional coefficient of the pipe line
11	Determination of minor head losses in fluid flow

12	Study of reciprocating pump
13	Study of centrifugal pump and determination of performance characteristics
14	Study of submersible pumps
15	Study of gear pumps
16	Study of positive displacement pump

Text books

1. Fluid Mechanics by Jagdish Lal, Published by Metropolitan Book Co.

2. Fluid Mechanics, by Streeter V. L. and Wylie E. B. Published by McGraw Hill, SI Edition

Reference books

1. Hydraulics and Fluid Mechanics (SI Units), by Modi P. N. and Seth S. M. Published by Standard Book House

2. Fluid Mechanics. By Jain A. K., Published by Khanna Publication

FPE 232 3 (1+2)

Engineering Drawing and Graphics (16 Lectures + 32 Practical)

Unit 1 Introduction of drawing scales; Principles of orthographic projections; References planes;

Unit 2 Points and lines in space and traces of lines and planes; Auxiliary planes and true shapes of oblique plain surface; True length and inclination of lines;

Unit 3 Projections of solids (Change of position method, alteration of ground lines); Section of solids and Interpenetration of solid-surfaces; Development of surfaces of geometrical solids; Isometric projection of geometrical solids.

Unit 4 First and third angle methods of projection. Preparation of working drawing from models and isometric views. Drawing of missing views. Different methods of dimensioning. Concept of sectioning. Revolved and oblique section. Sectional drawing of simple machine parts.

Unit 5 Design process, application of computers for design, definition of CAD, benefits of CAD, CAD system components. Computer hardware for CAD.

Unit 6 Geometric modeling techniques. Introduction to solid modeling.

Practical

1 Familiarization with drawing instruments and their uses

2 Study of different type of scales and related terminology

3 Construction of different scales

4 Study of useful terminology of projections

5 Problems on projection of points lying in different quadrant with respect to two reference plains

6 Problems on projection of straight line lying in different quadrant with respect to two reference plains

7 Study of useful terminology of different types of planes and their traces

8 Problems on projection of planes lying in different quadrant with respect to two reference planes

9 Study of useful terminology of different types of solids

10 Problems on projection of solids lying in different quadrant with respect to two reference

planes

11 Study of useful terminology of section of solids

12 Problems on section of solids lying in different quadrant with respect to two reference planes

13 Problems on intersection of different solids with respect to two reference plane

14 Study of different methods of development and problem on development of surfaces of diff. solids

15 Study of useful terminology of isometric projection

16 Problems on isometric view. isometric projection of different solids with their diff. position with respect to two reference plane

Reference Books

1. Elementary Engineering Drawing , By: N.D. Bhatt ,
2. Engineering Drawing & Graphics , By: K. Venugopal
3. Engineering Drawing , By: D.N. Ghose
4. Geometrical Drawing , By: R. K. Dhawan,
5. Engineering Drawing , By: P. S. Gill

FPE 233 3 (2+1)

Food Process Engineering – I

(32 Lectures + 16 Practical)

Unit 1 Introduction to Food Process Engineering

Method of studying food process engineering, basic principles of food process engineering, conservation of mass and energy, overall view of an engineering process, molecular transport of momentum, energy and mass, air water mixtures-Mollier's psychometric diagram.

Dimensions, symbols, units, dimensional consistency, unit consistency and unit conversion, dimensionless ratios, precision of measurement.

Unit 2 Material and Energy Balance

Material Balance: Basic principles, material balances, basis and units total mass and composition concentrations. Types of process situations, continuous processes, blending, layout.

Energy Balance: Energy balances, heat balances, enthalpy, latent heat, sensible heat, energy balance equation in drying, freezing and canning. Other forms of energy, mechanical energy, electrical energy.

Unit 3 Heat – Transfer Theory

Introduction: Heat Conduction, thermal conductance, thermal conductivity.

Conduction: Conduction through a slab, Fourier equation, heat conductances, heat conductances in series. Heat conductances in parallel, surface-heat transfer, heat transfer coefficients. Newton's law of cooling, unsteady-state heat transfer, Biot number, Fourier number, charts.

Convection: Convection-heat transfer, Nusselt number, Prandtl number, Grashof number. Natural convection, natural convection equations, vertical cylinders and planes, horizontal cylinders & horizontal planes. Forced convection, forced-convection equations, inside tubes, over plane surfaces, outside tubes, overall heat-transfer coefficients, heat transfer to boiling liquids.

Radiation: Radiation-heat transfer, Stefan-Boltzmann law, black body, grey body, emissivity, absorbtivity, reflectivity. Radiation between two bodies, radiation to a small body from its surroundings.

Dielectric Heating: Microwave and RF heating, electromagnetic field, volumetric heat generation.

Unit 4 Heat-Transfer Applications

Thermal Processing: Thermal processing, thermal death time, F values, equivalent killing power at other temperatures, z value, sterilization, integration, time/temperature curves. In-can processing, thermal process calculations for canned foods, retorts,

pasteurization, milk pasteurization, high temperature short time HTST process, UHT process.

Heat Exchangers: Types of heat exchangers, continuous-flow heat exchangers, parallel flow, counter flow, cross flow heat exchanger. Heat transfer in heat exchangers, log mean temperature difference (LMTD). Jacketed pans, heating coils immersed in liquids, Scraped surface heat exchangers, plate heat exchangers, and shell and tube heat exchangers.

Unit 5 Evaporation

Evaporation Theory: Boiling point elevation, Raoult's law, Duhring's rule, Duhring plot, latent heats of vaporization. Evaporation of heat-sensitive materials, heat transfer in evaporators, vacuum evaporation.

Evaporation Equipment: Vacuum pans, horizontal-tube evaporators, vertical-tube evaporators, plate evaporators, long-tube evaporators, forced-circulation evaporators.

Falling film and rising film heat exchangers agitated film equipment, single-effect evaporator, agitated thin film evaporators. Multiple-effects evaporation, feeding of multiple-effect evaporators, advantages of multiple-effect evaporators, vapour recompression, condensers.

Unit 6 Drying

Drying Theory: Heat transfer in drying, dryer efficiencies Mass transfer in drying, mass transfer coefficient, drying rate curves, constant rate of drying, and falling-rate of drying, calculation of drying times.

Classification and Selection of Dryers: Classification based on heat transfer by conduction, convection and radiation, criteria of dryer selection for foods.

Dryers: Tray dryers, tunnel dryers, trough dryers, bin dryers, belt dryers, and roller or drum dryers. Vacuum dryers, osmotic dehydrators, fluidized bed dryers, spray dryers, pneumatic dryers, rotary dryers. Foam mat dryer, freeze dryers, moisture loss in freezers and chillers, microwave dryers, IR dryers, heat pump dryers.

Unit 7 Freezing

Food Freezing Theory: Frozen food properties: density, thermal conductivity enthalpy, apparent specific heat and thermal diffusivity. Plank's equation, shape factors, factors influencing freezing time, freezing rate and thawing time, freeze drying, spray freezing using liquid nitrogen.

Freezing and cooling Equipment/Systems: Indirect contact systems, plate freezers, air blast freezers, and freezers for liquid foods, direct contact systems, air blast immersion, and principles of cooling for preservation, pre-storage requirements, pre-cooling, and vacuum pre-cooling.

Practical Title

1. Practice on unit conversions problems and dimensional analysis in food processing
2. Problems on energy and mass balance
3. Heat transfer analysis during conduction and convection
4. Study of working principle and constructional details plate heat exchanger
5. Study of working principle and constructional details of shell and tube heat exchanger
6. Study of working principle open pan and vacuum evaporator
7. Study of single effect evaporator and estimation of heat/mass balance during concentration of liquid foods
8. Study of multiple effect evaporator and estimation of heat/mass balance during concentration of liquid foods
9. Study of operation and constructional details of vapour condensers
10. Study of hot air dryer and modelling drying kinetics
11. Study of vacuum dryer and modelling drying kinetics
12. Study of working principle of spray dryer and spray drying process
13. Study of microwave vacuum dryer and drying process
14. Study of drum dryer and liquid food dehydration using drum drying
15. Study of fluidized bed dryer and drying process
16. Study of freeze dryer and freeze drying process

Text books

1. Unit Operations in Food Processing by R.L.Earle, Published by NZIFST (Inc.)
2. Fundamentals of Food Process Engineering by R.T.Toledo, Published by Springer
3. Engineering Heat transfer by Karlekar and Dashmond

Reference Books

1. Food Processing Handbook, by J.G.Brennan, WILEY-VCH Verlag GmbH & Co. KGaA

2. Unit operations in Food Engineering by A. Ibarz and Gustavo V Barbosa-Canovas

3. Drying and Dehydration of Foods. Loesecke, Allied Scientific Publishers

4. Food Process Engineering and Technology by Zeki Berk, Published by ELSEVIER

4. Engineering Heat transfer by Gupta and Prakash,
5. Handbook of Industrial Drying by A.S. Mujumdar. Published by Taylor and Francis

Env 231 2(1+1)

Environmental Science

(16 Lectures + 16 Practical)

Unit 1 Introduction to Environment, Ecology and Ecosystem

Definition and Inter-relationships amongst and between them Components of environment, Relationship between different components Man-Environment relationship Impact of Technology on the environment Environmental Degradation:

Unit 2 Ecology & Ecosystems

Introduction: Ecology- Objectives and Classification Concepts of an ecosystem-structure & function of ecosystem Components of ecosystem- Producers, Consumers, Decomposers Bio-Geo- Chemical Cycles- Hydrological Cycle, carbon cycle, Oxygen Cycle, Nitrogen Cycle, Sulfur Cycle Energy Flow in cosystem, Food Chains: Grazing, Detritus, & Food webs, Ecological Pyramids, Major Ecosystems: Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem, Aquatic Ecosystem, Estuarine Ecosystem.

Unit 3 Population & Natural Resources

Development of Habitation patterns and Environmental factors governing human settlement Population & Pollution , Reasons for overpopulation ,Population growth, Demographic Projections and Population Structures ,Production of food

Unit 4 Renewable & Non-renewable Resources: Renewable Resources, Non-renewable

Resources, Destruction versus Conservation Water Resources: Water Resources-Indian Scenario, Water Sources- Surface & Ground Water Sources, Uses & overuses of water resources, problems due to Overexploitation of Water Resources

Unit 5 Forest Resources

Forest Resources- Indian Scenario, Importance of forests- Ecologically & Economically, Uses of forest products, Forest Types, Deforestations-Causes and effects, Forest Degradation in India Energy Resources: Energy Resources - Indian Scenario, Conventional Energy Sources & its problems, non-conventional energy sources-Advantages & its limitations, Problems due to Overexploitation of Energy Resources.

Unit 6 Environmental Pollution

Types of Environmental Pollution: Water Pollution: Introduction – Water Quality Standards, Sources of Water Pollution, Classification of water pollutants, Effects of water pollutants, Eutrophication. Air Pollution: Composition of air, Structure of atmosphere, Ambient Air Quality Standards, Classification of air pollutants, Sources of common air pollutants like SPM, SO2, NOX – Natural & Anthropogenic Sources, Effects of common air pollutants.

Land & Noise Pollution: Introduction- Lithosphere, Land Uses, Causes of land Degradation, Sources of Noise Pollution, Effects of noise pollution Current Environmental Global Issues : Global Warming & Green Houses Effects, Acid Rain , Depletion of Ozone Layer

Text Books

1. Environmental Science by Richard T Wright & Bernard J Nebel

2. Environmental Engineering & Management by Suresh K Dameja

3 Introduction to Environmental Engineering and Science by Master Gilbert M.

Reference Books

1 Environmental Studies: R. Rajagopalan,Oxford University Press

2 Environmental Pollution: Causes, Effects & Control by K.C Agrawal

3 Environmental Science by Daniel B Botkin & Edward A Keller

4 Environmental Management by Dr. Swapan C Deb

5 Environment & Ecology by Dr Gourkrishna Dasmohapatra

FPT 231 3 (2+1)

Food Processing Technology - I

(32 Lectures + 16 Practical)

Unit 1 Introduction

Food processing- historical development, status of food processing industry in India, Food processing policy of India, sources of food and their classification- plant foods, animal foods, sea foods. Mechanism and Techniques: Definition of preservation, scope, requirement and advantages of preservation, mechanism of food preservations. Techniques of food preservation- thermal/heat processing (microwave, dielectric), chilling, freezing, chemical, fermentation, irradiation.

Unit 2 Thermal Processing

Blanching- definition, advantages, equipment, effect of blanching on food nutrients, colour, texture and flavour. Pasteurization- definition, types, equipment, effect of pasteurization on food nutrients, colour, flavour and aroma. Sterilization- definition and type In container sterilization, ultra-high temperature sterilization, effect of sterilization on food nutrients, colour, flavour and aroma, aseptic processing

Unit 3 Cold Processing

Chilling- Theory, systems for chilling, chill injury; Chill storage conditions for fruits and vegetables. Freezing- Theory, crystal formation, quick and slow freezing, cryogenic freezing, thawing, application of freezing in food

Unit 4 Irradiation processing

Irradiation- mechanism and effect on ionizing radiation on food. Type of irradiation, advantage and limitations of irradiation. Food irradiation equipment, processing of spices, onion and potatoes using irradiation

Unit 5 Extrusion Processing

Extrusion- theory and advantages, rheological properties of the food and operating characteristics for extrusion. Equipment- single-screw extruders and twin-screw extruders, Applications of extrusion - cold extrusion and extrusion cooking, effect on foods-sensory characteristics and nutritional value, Extruded products- expanded snack products, pasta products, texturised vegetable protein

Unit 6 Baking and Roasting

Definition, food application- (Bread, biscuit, cakes), baking equipment, effect of baking and roasting on food nutrients, colour, flavour and aroma

Practical	Title
17.	Determination of adequacy of blanching of vegetables.
18.	Study the effect of blanching on nutritive quality
19.	Study the effect of blanching on colour of the food product
20.	Bottling of peas and to study the effect of heat processing
21.	Determination of adequacy of pasteurisation/sterilization
22.	Study the effect of pasteurisation/sterilization on nutritive quality
23.	Study the effect of pasteurization/sterilization on colour of the food product
24.	Study the freezing and thawing behaviour of the food product
25.	Visit to irradiation processing unit
10.	Study the effect moisture content of raw material on extruded food product
11.	Study the effect of machine parameter on extruded food product
13.	Study of various textural quality characteristics of the extruded products
13.	Development of cold extruded food products
14.	Study of the effect of baking on nutritive quality of the food
15.	Study of textural and sensory characteristics of baked product
16.	Visit to food processing technology industry

Text books

1. Principles of Food Science: Part-II Physical Principles of Food Preservation. Edited by O.R. Fennema Publisher-Marcel Dekker, New York.
2. Food Processing Technology: Principles and Practice. P. Fellows (Second Edition). Publisher-Woodhead Publishing Limited and CRC Press LLC.

Reference books

1. Fruit and Vegetable Preservation: Principles and Practices by RP Srivastava and S Kumar, (Second Edition), Publisher-International Book Distributing Co. Lucknow.
2. Food Science, (5^{th} Edition) by N N Potter, and JH Hotchkiss, Aspen Publishers, Inc., Gaithersburg, Maryland.
3. Managing Frozen Foods edited by Christopher J. Kennedy, Woodhead Publishing Limited, Abington, Cambridge, England

PHE 231 4 (3+1)

Post-Harvest Engineering

(48 lectures + 16 Practicals)

Unit 1 Introduction

Post-harvest technology of crops: An over view of concept and science, production and post-harvest losses, reasons for losses, importance of loss reduction, role in export, economy, and employment generation.

Unit 2 Decorticating & shelling

Principles of working, design and constructional details, operating parameters, maintenance etc of various decorticators /dehullers /shellers, description of groundnut decorticators, maize shellers etc

Unit 3 Psychometry

Psychometry, absolute humidity, relative humidity, dry bulb temperature, wet bulb temperature, dew point temperature, wet bulb depression, humid heat, specific volume, Lewis number, psychometric charts, equilibrium moisture content, heating, cooling, dehumidifying, sorption isotherms, three stages of water, phase diagram for water, vapour pressure-temperature curve for water, heat requirement for vaporization, equilibrium moisture content, (hysteresis, measurement of humidity, hygrometers

Unit 4 Field drying

Basic drying theory, types of drying (deep bed and thin layer drying, superheated steam drying, IR, RF and MW drying etc), types of dryers (flatbed dryer, continuous flow dryer, recirculating dryer, LSU dryer, rotary dryer, RF dryer, fluidised bed dryer, sprouted bed dryer, tray dryer, tunnel dryer), dryer performance, energy requirement in drying

Unit 5 Parboiling

Parboiling, changes during parboiling, advantages and disadvantages of parboiling, Traditional parboiling methods, modern parboiling methods, significance of glass transition temperature

Unit 6 Cleaning

Cleaning of grains, fruits and vegetables, types of cleaners, screens, types of screens, rotary screens, vibrating screens, machinery for cleaning of fruits and vegetables (air cleaners, washers), cleaning efficiency, care and maintenance

Unit 7 Sorting and Grading

Sorting, grading, methods of grading, grading- size grading, colour grading, specific gravity grading; screening, equipment for grading of fruits and vegetables, grading efficiency, care and maintenance.

Unit 8 Separation

Magnetic separator, destoners, electrostatic separators, pneumatic separator

Unit 9 Milling

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

Unit 10 Conveying

Introduction to different conveying equipments used for handling of grains, fruits and vegetables

Unit 11 Storage

Introduction to storage structures, bins, silos, bag and bulk storage

Practical	Title
1	Study of decorticators, principles and working
2	Study of a maize/sunflower sheller
3	To determine state of air using psychometric chart and hygrometer
4	Use of psychometric chart during drying process/ humidification process
5	Study of crop dryers, batch and continuous & LSU dryers
6	Study of a RF/MW/Fluidised bed/tray dryer
7	Study of cleaners for grains
8	Study of washers for fruits and vegetables
9	Study of graders for grains, grading efficiency
10	Study of graders for fruits and vegetables, grading efficiency
11	Study of rice milling machines
12	Study of pulse milling machines.
13	Study of different components of Flour mill.

14 Study of oil expeller.

15 Visits to rice mills, pulse mills, oil mills

Text Books

1. Post-harvest technology of cereals, pulses and oilseeds, Oxford Publishing by A. Chakraverty
2. Principles & Practices of Post-Harvest Technology, Kalyani Publishers by P. H. Pandey.
3. Principles of Agricultural Engineering, Volume – I, Jain Brothers by A. M. Michael & T. P. Ojha

Reference books

1. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed, Prentice Hall Ptr by Christie J. Geankoplis & Pamela R. Toliver.
2. Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices, Marcel Dekker, Inc., NY, CRC press by A. Chakraverty, and others.
3. Unit Operations in Chemical Engineering, 7th Ed, McGraw-Hill Professional by Mc Cabe, Smith & Harriott.
4. Rice: Chemistry and Technology, 3rd Ed, 2004, AACC by Elaine T. Champagne.
5. Wheat: Chemistry and Technology, 4th Ed, AACC by Khalil Khan & Peter R. Shewry.
6. Corn: Chemistry and Technology, 2nd Ed., AACC by Pamela J. White & Lawrence A. Johnson.

FOURTH SEMESTER

FPE 241 3 (2+1)
Food Process Engineering – II

(32 Lectures + 16 Practical)

Unit 1 Contact-Equilibrium Process

Introduction: Contact equilibrium separation phase distribution, distribution coefficients, concentrations, mole fraction, partial pressure, Avogadro's Law. Gas-Liquid equilibria, partial vapour pressure, Henry's law, solubility of gases in liquids, solid-liquid equiibria, saturated solution, supersaturated solution. Equilibrium - concentration relationships, deodorizing/ steam stripping McCabe/Thiele diagram, gas absorption.

Extraction: Extraction process, rate of extraction, stage-equilibrium extraction, solvent extraction, supercritical fluid extraction, extraction equipment, washing, washing equipment.

Crystallization: Crystallization process, mother liquor, growth, nucleation, metastable region, seed crystal, sheat of crystallization, rate of crystal growth, stage-equilibrium crystallization, crystallization equipment, evaporative crystallizer.

Membrane Separation: Membrane separations, osmotic pressure, ultra-filtration, reverse osmosis, rate of flow through membranes. Van't Hoff equation, diffusion equations, Sherwood number, Schmidt number, membrane equipment.

Distillation: Distillation process, equilibrium relationships, boiling temperature/concentration diagram azeotropes, steam distillation, vacuum distillation, batch distillation, fractional distillation, distillation equipment

Leaching: Principles of continuous leaching, counter current leaching , leaching equipment

Unit 2 Mechanical Separations

Introduction: The velocity of particles moving in a fluid, terminal velocity drags coefficient, terminal velocity magnitude.

Sedimentation: Sedimentation, Stokes' law, gravitational sedimentation of particles in liquid zones, velocity of rising fluid, sedimentation equipment, flotation, sedimentation of particles in a gas, settling under combined forces.

Centrifugal Separation: Centrifugal separations, centrifugal force, particle velocity, liquid separation, radial variation of pressure, radius of neutral zone, centrifuge equipment.

Filtration: Filtration, rates of filtration, filter cake resistance, equation for flow through the filter, constant-rate filtration, constant-pressure filtration, filtration graph, Filter-cake compressibility. Filtration equipment, plate and frame filter press, rotary filters, centrifugal filters, air filters.

Air Separators and Sieving: Cyclones-optimum shape efficiency, impingement separators, classifiers, rates of throughput, standard sieve sizes, cumulative analysis, particle size analysis, industrial sieves.

Unit 3 Size Reduction

Grinding and Cutting: Grinding and cutting, energy used in grinding, Kick's law, Rittinger's law, Bond’s law, new surface formed by grinding. Grinding equipment, crushers, hammer mills, fixed-head mills, plate mills, roller mills, miscellaneous milling equipment, and cutters.

Emulsification: Disperse/continuous phases, stability, emulsifying agents, preparation

of emulsions, shearing.

Homogenization: Definition, principles of homogenization, efficiency of homogenization.

Homogenizer construction, operation and maintenance.

Unit 4 Agitation and Mixing

Introduction, agitated vessels, characteristics of mixtures, measurement of mixing, particle mixing, random mixture, thorough mixture, mixing index, rates of mixing, mixing times, energy input in mixing, liquid mixing. Mixing equipment: liquid mixers, powder and particle mixers, and dough and paste mixers, agitators.

Unit 5 Absorption and Ionic Exchange

Introduction, equilibrium conditions, batch adsorption, adsorption in columns, ion exchange, basic principles. Properties of ion exchange, applications, water softening using ion exchange, reduction of acidity in fruit juices.

Unit 6 Extrusion

Extrusion Theory and Equipment: Introduction, extrusion, extrusion cooking, principles of extrusion cooking, single screw extruder, twin screw extruder, pasta making machines, effect of extrusion parameters on food.

Food Applications of Extrusion: Snacks, RTE foods, confectionery and chocolate, hot extrusion/pasta making.

Unit 7 Frying

Introduction, types of frying, heat and mass transfer in frying, fryers, frying equipment.

Unit 8 Baking and Roasting

Baking: Baking, principle of baking, baked foods, baking equipment.

Roasting: Roasting, principle of roasting, roasting equipment.

Unit 9 Puffing

Puffing, puffing methods, puffing equipment.

Unit 10 Ionizing Irradiation

Preservation by ionizing radiations: Ionizing radiations, electron beams, electromagnetic waves, preservation by ionizing radiations, radiation sources, interaction with matter, radiation dose, chemical and biological effects of ionizing irradiation, industrial applications.

Unit 11 Non-Thermal Preservation Processes

Pulsed Electric Field and Pulsed Intense Light: Dielectric heating, PEF sterilization of liquid foods, PEF equipment, principle of pulsed intense light preservation, PIL equipment.

High Pressure Processing and Ultrasound: Principle, micro-organism inactivation by high pressure processing, equipment, speed of sound, acoustic impedance, attenuation.

Practical Title

1. Study of solvent extraction plant
2. Study of super critical fluid (SCF) extraction system
3. Study of crystallization process
4. Study of working principle and constructional details of reverse osmosis plant
5. Study of distillation process and distillation equipment
6. Determination of sedimentation time of solids in liquid food
7. Study of centrifugal separator and separation process
8. Study of filtration equipment
9. Sieve analysis of powder mixtures and separation in to different fractions

10. Study of various grinders and cutting equipment and determination of power requirement in grinding and cutting of foods
11. Study of constructional and working details of homogenizer
12. Study of various agitators and mixing equipments
13. Study of constructional details and working principle of extruder and extrusion cooking
14. Study of frying, baking and roasting processes
15. Study of HTST puffing process
16. Kinetics of microorganism inactivation by high pressure processing

Text Books

1. Unit Operations in Food Processing by R.L.Earle, Published by NZIFST (Inc.)
2. Unit operations in Food Engineering by A. Ibarz and Gustavo V Barbosa-Canovas
3. Fundamentals of Food Process Engineering by R.T.Toledo, Published by Springer
4. Food Process Engineering and Technology by Zeki Berk, Published by ELSEVIER

Reference Books

1. Food Processing Handbook, by J.G.Brennan, Published by WILEY-VCH Verlag GmbH & Co. KGaA
2. Unit operations of chemical engineering by McCabe and Smith. Published by McGraw-Hill
3. Dairy plant engineering and management by Tufail Ahmad. Published by Kitab Mahal Publications
4. Engineering for dairy and food product by Farrall A.W. Published by John Wiley and Sons

FPE 242 3 (2+1)

Material Science and Engineering

(32 Lectures + 16 Practical)

Unit 1 Crystal Structures and Bonding

Crystals: Introduction : Crystal geometry and structure; space lattice; unit cell; crystal systems; atomic packing; coordination number; crystal structure for metallic elements (BCC, FCC, HCP).

Bonding: Bonds in solids; types of bond and mechanisms of bond formation; ionic, covalent and metallic bonds and their comparison; secondary and mixed bonds; bonding and the properties of materials

Unit 2 Polymers, Plastics and Ceramics

Polymers: Mechanisms of polymerisation; additions in polymers; polymer structures.

Plastics and Rubbers: Plastics, elastomers and rubbers, fibres and filaments, composite materials.

Crystal and Ceramics: Single crystals, agglomerated structures, Ceramics and ceramic-metal alloys.

Unit 3 Material Properties

Thermo-Physical and Mechanical Properties: Thermo-physical and mechanical properties of materials such as ferrous metals, alloys, polymers, composites and ceramics; their structural behaviour in regard to axial, flexural, stiffness, torsional, shear, hardness, impact and fatigue strengths, creep phenomenon, corrosion, principal stresses and strains.

Structural Properties.

Structural properties of materials under load and their suitability in various applications.

Unit 4 Design of Moulds

Design of mould and Plastics, Design concepts for mould design and fibre-reinforced plastics.

Unit 5 Corrosion

Corrosion and its effect on material properties.

Unit 6 Stress

Concept of stress, a short review of the methods of statics, stresses in the members of a structure, analysis and design

Axial loading, normal stress, shearing stress, bearing stress in connections, application to the analysis and design of simple structures, method of problem solution, numerical accuracy

Stress on an oblique plane under axial loading, stress under general loading conditions, components of stress, design considerations

Unit 7 Stress and Strain – Axial Loading

Introduction, normal strain under axial loading, stress-strain diagram, Hooke's law; modulus of elasticity, elastic versus plastic behaviour of a material, repeated loadings, fatigue, deformations of members under axial loading.

Statically indeterminate problems, problems involving temperature changes, Poisson's ratio, multiaxial loading; generalized Hooke's law, dilatation, bulk modulus, shearing strain, further discussion of deformations under axial loading, relation among e, ν , and g, stress and strain distribution, Saint-Venant's principle, stress concentrations.

Unit 8 **Tortion**

Introduction, preliminary discussion of the stresses in a shaft, deformations in a circular shaft, stresses in the elastic range. Angle of twist in the elastic range, statically indeterminate shafts, stress concentrations in circular shafts.

Unit 9 **Pure Bending**

Introduction, symmetric member in pure bending, deformations in a symmetric member in pure bending, stresses and deformations in the elastic range, deformations in a transverse cross section, bending of members made of several materials, stress concentrations, eccentric axial loading in a plane of symmetry

Unit 10 **Analysis and Design of Beams for Bending**

Introduction, shear and bending-moment diagrams, relations among load, shear, bending moment, design of prismatic beams for bending, nonprismatic beams

Unit 11 **Shearing Stresses in Beams and Thin Walled Members**

Introduction, shear on the horizontal face of a beam element, determination of the shearing stresses in a beam, shearing stresses in common types of beams, further discussion of the distribution of stresses in a narrow, rectangular beam, longitudinal shear on a beam element of arbitrary shape, shearing stresses in thin-walled members, unsymmetric loading of thin-walled members, shear centre

Unit 12 **Transformations of Stress and Strain**

Introduction, transformation of plane stress, principal stresses, maximum shearing stress

Mohr's circle for plane stress

General state of stress, application of Mohr's circle to the three-dimensional analysis of stress

Stresses in thin-walled pressure vessels

Transformation of plane strain, Mohr's circle for plane strain, three-dimensional analysis of strain, measurements of strain, strain rosette

Unit 13 **Principal Stresses Under a given Loading**

Introduction, principal stresses in a beam, stresses under combined loadings

Practical	**Title**
1.	Study on crystal geometry and structure
2.	Study of various types of bonds in solids
3.	Study of various types of materials and quantification of microstructure
4.	Determination of mechanical properties of modern materials
5.	Tensile testing of metals and polymers
6.	Compressive testing of wood, bone and fiberglass
7.	To study changes in steel microstructure by various heat treatments
8.	To study temperature dependence of stiffness of polymers
9.	Determination of coefficient of friction of modern materials on various surfaces.
10.	Determination of hardness of plastic block
11.	Determination of impact and fatigue strength of plastic block
12.	Installation of strain gauge in the material.
13.	To determine axial properties using extensometers and crossheads
14.	To study the torsion behaviour and beam bending
15.	To determine Poisson's ratio of material

16. Design of beam and column

Text books

1. Material Science and Engineering: an Introduction by Callister W.D. Published by John Wiley and Sons
2. Mechanics of materials by Beer FP, Johnston ER Jr, DeWolf JT. Published by McGraw Hill
3. Materials Science, by Narula, Narula and Gupta. Published by Tata McGraw Hill

Reference books

1. Elements of Materials Science, by Lawrence H van Vlack. Published by Addison Wesley
2. Mechanics of Structures vol. I, by Junnarkar and Shah. Published by Charotar Publishing House

FPE 243 4 (3+1)

Food Refrigeration and Air Conditioning

(48 Lectures + 16 Practical)

Unit 1 Fundamentals

Definition of refrigeration and air conditioning, general gas law, Dalton's law, necessity of refrigeration and air conditioning, unit of refrigeration.

Unit 2 Refrigerating Machine and Reversed Carnot-Cycle

Refrigerating Machine: The second law interpretation, heat engine, heat pump and refrigerating machine.

Carnot Cycle: Carnot principle, vapour as refrigerant in reverse Carnot cycle, limitations of reversed Carnot cycle.

Unit 3 Methods of Producing Low Temperatures

Types of Refrigeration Systems: Air cycle refrigeration systems, vapour compression refrigeration systems, vapour absorption refrigeration systems.

Unit 4 Vapour Compression System

Vapour Compression System: Components of vapour compression refrigeration system, coefficient of performance, evaporator, compressor, condenser and expansion valve.

Cycle Diagrams and Simple Saturated Cycles: Cycle diagram, pressure enthalpy diagram, simple saturated refrigerating cycle, expansion process, vaporizing process, compression process, condensing process.

Unit 5 Refrigerants

Types and Properties of Refrigerants: Different types of refrigerants, desirable properties of refrigerants: physical, chemical, thermodynamic, safety and economical aspects.

Unit 6 Air Conditioning

Mixing process, basic processes in conditioning of air, psychrometric processes in air conditioning. Air conditioning system, state and mass rate of supply air.

Unit 7 Applications of Refrigeration in Food Processing and Preservation

Cold Store

Design of cold storage, size and shape, construction and material, insulation, vapour barriers, floors, frost-heave, interior finish and fitting, evaporators, automated cold stores, security of operations, cold storage for fruits and vegetables, cold storage of apples and pears.

Refrigeration of Meat, Poultry, Marine Products: Refrigeration of boned, boxed and processed meats, pork and bacon, poultry, fish and seafood.

Refrigeration for Dairy, Brewing and Soft Drink Industries: Refrigeration of milk and milk products, ice-cream, ice lollies, brewing, wines and spirits, soft drinks.

Refrigeration for Bakery and Other Foods, Cooling of bakery products, cook/chill process, chocolate enrobing.

Refrigerated Transport, Handling and Distribution, Cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display.

Unit 8 Refrigeration Load Estimation

Load sources, product cooling, conducted heat, convected heat, internal heat sources, heat of respiration, peak load.

Practical	Title
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.	To study refrigeration system of dairy plant
11.	Estimation of refrigeration load for ice-cream
12.	To study cooling system for bakery and estimation of refrigeration loads
13.	To estimate refrigeration load during chocolate enrobing process.
14.	Study of refrigerated van
15.	To study deep freezing and thawing of foods
16.	To study refrigerated display of foods and estimation of cooling load

Text books

1. Refrigeration and Air-conditioning by CP Arora. Published by Tata McGraw Hill
2. Principles of Refrigeration by Dossat RJ. Published by John Wiley
3. Advances in food refrigeration by Da Wen Sun. Published by Woodhead Publishing Limited, UK

Reference books

1. Refrigeration and Air-conditioning by Manohar Prasad. Published by New Age publications.
2. Commercial Cooling of Fruits and Vegetables by Thompson. Published by Univ. of California

FPT 241 3 (2+1)

Food Processing Technology – II

(32 Lectures + 16 Practical)

Unit 1 Extraction

Leaching, solvent extraction and super critical extraction - basic concept and definition; effect of various parameters on solvent extraction; extraction equipment, type of solvents used in food industry and their application-flavours and essential oils, coffee, tea

Unit 2 Crystallization

Theory an principle, equipment for crystallization, Crystallization in food processing

Unit 3 Frying

Frying- Theory and principle, shallow or contact frying and deep fat frying, frying equipment, effect of heat on fried food, Fried food products- chips, snacks

Unit 4 Membrane processing

Osmosis, reverse osmosis and ultrafiltration- basic definition, concept and mechanism; types of membranes and their limitations; Application of membrane processing in food

Unit 5 Minimal Processing

Minimal processing- basic concept and principle, Application of minimal processing in food

Unit 6 Pulsed electric field processing

Theory and principle, effect of PEF on food, effect on microbe, Application in food processing

Unit 7 High pressure processing

Theory and principle, effect of high pressure processing on food, effect on microbe, Application of high pressure processing in food

Unit 8 Hurdle Technology

Hurdle technology- concept and mechanism, Application of hurdle technology in food

Unit 9 Ultrasound Processing

Theory and principle of ultrasound processing, application in food industry

Practical Title

1. Effect of sample particle size and time on solvent extraction process
2. Effect of temperature on crystallization rate of sugar
3. To visit sugar processing industry
4. Determination of oil uptake by the food product during frying
5. Study the qualitative changes in the fried food product
6. To study the osmosis in fruits
7. Determination of solid gain and moisture loss during osmosis
8. To study reverse osmosis process
9. To study ultra-filtration/membrane separation process
10. To study the effect of high pressure on microbe
11. To study the effect of pulse electric field on food
12. To prepare minimally processed fruit/vegetable
13. To study the effect of various hurdles (pH, temperature, salt concentration, water activity) in food
14. Development of high-moisture ambient stable fruit products using hurdle technology

15. To visit solvent extraction unit
16. To visit food processing industry/ organisation using advance processing techniques

Text books

1. Principles of Food Science: Part-II Physical Principles of Food Preservation. Edited by O.R. Fennema Publisher-Marcel Dekker, New York.
2. Food Processing Technology: Principles and Practice. P. Fellows (Second Edition). Publisher-Woodhead Publishing Limited and CRC Press LLC.
3. Food Processing Handbook, by J. G. Brennan, WILEY-VCH Verlag GmbH & Co. KGaA

Reference books

1. Unit Operations in Food Processing by R. L. Earle, Published by NZIFST (Inc.)
2. Fundamentals of Food Process Engineering by R. T. Toledo, Published by Springer
3. Minimal Processing Technologies in the Food Industry. Edited by T Ohlsson and N Bengtsson, Publisher-Woodhead Publishing Limited.

FPT 242 4 (3+1)

Processing Technology of Food Grains

(48 Lectures + 16 Practical)

Unit 1 Structure and Properties of Grains

Status of food grain production and its supply chain in India; Food grain (rice, wheat, corn, pulses and oil seeds) - structure, physico-chemical properties, thermal properties, biochemical properties; effect of different factors on the physical, thermal and biochemical properties of grains.

Unit 2 Paddy Processing

Parboiling- various methods of parboiling (CFTRI, RPEC, High pressure etc.); effect of parboiling on milling, nutritional and cooking quality of rice; paddy milling operations- cleaning, dehusking, separation, whitening, grading; quality characteristics influencing final rice- milling outturn, kernel chalkiness, translucency and cooking, processed rice products

Unit 3 Wheat Processing

Wheat milling- break system, purification system and reduction system; extraction rate and its effect on flour composition; quality characteristics of flour and their suitability for baking into- bread, biscuits and cakes, processed product of flour mill

Unit 4 Pulse Processing

Traditional dry milling and wet milling of pulses, CFTRI method, Pantnagar process, CIAE process; milling process of tur, blackgram etc

Unit 5 Corn and Millets Processing

Dry milling of corn and wet milling of corn, starch and gluten separation; malting and milling of barley, milling of millets

Unit 6 Oil Seed Processing

Processing of oil seeds for direct use and consumption, oil expression and extraction, mechanical oil expression, solvent extraction; processing of extracted oil- refining, hydrogenation, fractionation, transesterification, and interesterification; processing of deoiled cakes; textured protein products from oil cake

Practical	**Title**
1.	Physical properties of cereals and pulses
2.	Chemical properties of cereals
3.	Study of temperature and time on parboiling of rice
4.	Effect of parboiling on nutrient content of paddy.
5.	Determination of cooking quality of rice
6.	Determination of gelatinization temperature of rice
7.	Effect of time and roller distance on dehusking and milling of rice in laboratory dehusker
8.	Water absorption capacity, stability index of wheat flour using doughlab
9.	Determination of gluten content in wheat flour
10.	Determination of falling number and amylase activity
11.	Production of popcorn and study the expansion characteristics
12.	Study on cooking quality of dhals
13.	Effect of oil and red earth slurry application on milling of dhal
14.	Determination of trypsin inhibitor in soybean

15. Solvent extraction of oil from rice bran
16. Production and processing of malt from barley/sorghum

Text books

1. Post-harvest technology of Cereals, Pulses and Oil Seeds by A Chakravarti Oxford Publishing.
2. Unit Operations in Agricultural Processing by KM Sahay and KK Singh, Vikas Publishing House, Pvt. Ltd.

Reference books

1. Manuals on Rice and its processing by CFTRI Mysore and IIT Kharagpur
2. Cereals Technology by NN Potter AVI Publication
3. Bakery Technology and engineering by SA Matz CBS Publication
4. Corn, Chemistry and Technology by A Watson and P Ramsted, American Association of Cereal Chemists, St. Paul, Minnesota, USA.
5. Technology of Cereals by N L Kent and A D Evers, Elsevier Science Ltd. Kidlington, Oxford, U.K.

FPT 243 3 (2+1)

Design and Formulation of Foods

(32 Lectures + 16 Practical)

Unit 1 Fundamental Concepts of Nutrition

Nutrient and their role in human metabolism;- carbohydrates; proteins; fat; vitamins and minerals and their importance for human

Unit 2 Nutritional Requirement

Nutritional requirements of human being; recommended daily allowance (RDA) for preschool and school children; adult male and female; lactating and pregnant women; anti-nutritional factors present in food- cereals; pulses; oil seeds; fruits and vegetables; fish, meat and eggs; acid-base balance in food

Unit 3 Infant food

Infant foods- Definition and need; formulation of weaning foods- for babies, preschool going (2-5 years)

Unit 4 Traditional sweet and snacks

Production, formulation, preparation and processing of Indian traditional sweet and snack food products; formulation and preparation of sweets- Rasgolla, Gulabjamun; formulation and preparation of namkeen, papads and samosa etc.

Unit 5 Formulation of Probiotic and Prebiotic Food

Probiotic and prebiotics- definition and their health promoting effects; preparation and maintenance of bacterial, yeast and mould cultures for probiotic and prebiotic food; Lactic acid bacteria as prebiotic; formulation and preparation of probiotic and prebiotic products

Unit 6 Therapeutic Foods

Therapeutic foods- definition and need; concept and formulation of foods for special demographic groups- undernourished children and lactating mothers; geriatric food; foods for persons suffering from various ailments- osteoporosis, cardiac problem, diabetes

Unit 7 Functional and Nutraceuticals Foods

Functional foods- definition and concepts; design of functional foods; Nutraceuticals food- definition and concepts, design of nutraceutical foods

Unit 8 Recent Trends

Recent trends in food formulation; antioxidant rich food products; concepts for formulation of foods for drought and disaster afflicted; defence services, sportsmen, space food

Practical	**Title**
1.	Determination of vitamin C content of given food product
2.	Determination of mineral content in a given food product
3.	Design of diet on the basis of daily nutritional requirement for young adult
4.	Development of protein rich weaning food for infants
5.	Preparation and formulation of traditional sweet product- Rasogolla/ Gulabjamun
6.	Preparation and formulation of traditional salty product- Namkeen/ Papad/ Samosa
7.	Preparation and formulation of fermented food –Idli/ Dosa
8.	Preparation and formulation of food for- Cardiac patient
9.	Preparation and formulation of food for- Diabetic patient

10. Isolation of phytochemical/ bio active agent from plant sources
11. Determination of antioxidants in foods.
12. Determination of Thiobarbituric acid (TBA) value
13. Development and formulation of antioxidant rich food
14. Determination of dietary fiber in given food product
15. Development of prebiotic/ probiotic food product
16. Preparation and formulation of high fiber food product

Text books

1. Nutritive Value of Indian Foods by C Gopalan, BV Ramshastri, S C Balasubramaniam, National Institute of Nutrition, Hyderabad
2. Essentials of Nutrition by M Swaminathan, Ganesh Co.
3. Handbook of Indigenous Fermented Foods by K.H. Steinkrauss, Marcel Dekker.

Reference Books

1. 'Proceedings of Technical Session of IFCON-98' AFTS (I), CFTRI, Mysore.
2. Antioxidants in Food by J Pokorny, N Yanishlieva, and M Gordon, Published by Woodhead Publishing Limited, Abington Hall, Abington
3. Food Science, (5^{th} Edition) by N N Potter, and J H Hotchkiss, Aspen Publishers, Inc., Gaithersburg, Maryland.
4. Food and Nutrition Bulletin, Vol. 23, 24, 25 and 26. The United Nations University, Press.
5. Functional Foods. Biochemical and Processing Aspects by G Mazza, Technomic Publ. Co.
6. Nutrition in Health and Disease by Corrine Robinson.
7. Clinical Dietetics and Nutrition by F.P. Antia
8. Human Nutrition and Dietetics by Davidson and Passmore

PHE 241 3 (2+1)

Engineering Properties of Biological Materials

(32 lectures + 16 Practical)

Unit 1 Introduction & Physical properties

Introduction to engineering properties of biomaterials and their importance in the food process technology.

Structure and chemical composition of grain, physical characteristics (size, shape, roundness, sphericity, geometric mean diameter, surface area, projected surface area, resemblance to geometric bodies, volume, bulk density, true density, specific gravity, porosity) and their measurement

Unit 2 Mechanical properties

Contact stress between bodies, Hertz problems, hardness, impact resistance, coefficient of restitution, fragility factor

Unit 3 Rheological properties

Stress, strain, elastic limit, modulus of elasticity, poisson's ratio, shear strength, compressive strength, tensile strength, yield point, yield strength, deformation, bio yield point, rupture point, stiffness, elasticity, plasticity, degree of plasticity, toughness, resilience, mechanical hysteresis, viscoelasticity, stress relaxation, relaxation time, creep, retardation time, kinematic viscosity, apparent viscosity, Newtonian and non-Newtonian fluid, thixotropic fluid, rheopectic fluid, ideal elastic behaviour (Hookean body), ideal plastic body (St. Venant body), ideal viscous behaviour (Newtonian liquid), time effects (viscoelasticity), Maxwell model, Kelvin model, Burgers model, texture profile (firmness/ hardness, cohesiveness, adhesiveness, etc)

Unit 4 Mechanical damage

Abrasion, bruising, crack, cut, puncture, shatter load, skin break, split, skinning and feathering, stem end tearing, swell cracking

Unit 5 Aerodynamic properties

Terminal velocity, drag coefficient, Reynold's number, application of aerodynamic properties to agricultural products

Unit 6 Frictional properties

Static and dynamic coefficient of friction, angle of repose, coefficient of internal friction, pressure ratio, asperity contact, rolling resistance, cohesion of granular materials, definition of deep and shallow bins, application of frictional properties in grain handling, processing and conveying

Unit 7 Optical properties

Colour, reflectance, diffraction, absorption, radiation, lightness, hue, chroma, saturation, value, gloss, tristimulus values of colour, CIE and Lab colour system, application of optical properties in food processing

Unit 8 Thermal properties

Heat capacity, specific heat, latent heat, eutectic point, sensible heat, heat of absorption, heat of respiration, thermal conductivity, thermal diffusivity, modes of heat transfer, coefficient of thermal expansion, application of thermal properties in food processing operations

Unit 9 Electrical and Electromagnetic properties

Electrical capacitance, resistance, spectrum of electromagnetic radiation, frequency of radiation, energy of radiation, black body, grey body, dielectric constant, dielectric loss, power factor, dielectric heating, dielectric loss tangent, electromagnetic properties application to processing of food

Practical	Title
1	Measurement of grain and fruit dimensions, surface area, projected surface area, volume
2-3	Determination of bulk density and true density, specific gravity, porosity
4	Measurement of (grain, fruit) hardness (Moh's hardness test), compressive strength
5	Determine flow parameters of Newtonian, Non Newtonian food products by: Capillary tube, viscometer, Hakke's viscometer, Rotational viscometer and Falling ball viscometer.
6	Viscosity measurement using (RVA, Brookfield viscometer)
7	Texture Profile Analysis of different food samples
8	To study the separating behaviour of a grain sample in a vertical wind tunnel (aspirator column)
9	Angle of repose measurement of different grains
10	To find out the co-efficient of external and internal friction of different crops
11	Optical properties measurement using hunter Lab/CIE colour system
12	Optical properties measurement using Spectrophotometer
13	Optical properties measurement using Tintometer
14	To determine specific heat of some food grains

15 To find the thermal conductivity of different grains.

16 To find the electrical impendence of the grain

Text Books

1 Physical Properties of Plant and Animal Materials, 2nd Ed, Gordon & Breach Science Publisher by N.N. Mohsenin

2 Thermal properties of food and agricultural materials, Gordon & Breach Science Publisher by N.N. Mohsenin

3 Electromagnetic radiation properties of food and agricultural materials, Gordon & Breach Science Publisher by N.N. Mohsenin

4 Engineering Properties of Foods,3rd Ed, CRC Press by Rao, Rizvi & Dutta

Reference books

1 Texture and Viscosity: Concept and Measurement, 2nd Ed, Academic Press, London by Malcome C. Bourne

2 Physico Chemical Constituents and Engineering Properties of Food, Scientific Publishers (India) by R.P. Kachru

FIFTH SEMESTER

FQA 351 3 (2+1)

Food Plant Sanitation

(32 lectures + 16 practical)

Unit 1 Sanitation and food industry

Sanitation, importance of sanitation in food plants, sanitation laws and guidelines, establishment of sanitary practices

Unit 2 Food contamination sources

Sources of contamination, contamination of foods, protection against contamination

Unit 3 Personal hygiene and sanitary food handling

Personal hygiene, employee hygiene, sanitary food handling, role of employee supervision, employee responsibility

Unit 4 Cleaning compounds and sanitizers

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

Unit 5 Pest and Rodent Control

Insect infestation, cockroaches, rodents, birds, use of pesticides, integrated pest management

Unit 6 Sanitary design and construction for food processing plant

Site selection, site preparation, building construction considerations, pest control design, construction materials

Unit 7 Water quality and treatment

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

Unit 8 Role of HACCP in sanitation

HACCP, HACCP development, interface with GMP and SSOPs, HACCP principles, organization, implementation and maintenance

Practical	**Title**
1	Sampling plans and microbial guidelines

2	Microbiological testing of water for coliform and faecal streptococci
3	Detection and enumeration of coliforms enterococci as indicator organism in foods
4	To determine hardness of water sample
5	To determine residual chlorine in water
6	To determine total dissolved solids and electrical conductivity in given water sample
7	To determine acidity of waste water
8	To determine alkalinity of waste water
9	Determination of biological oxygen demand of waste water
10	Determination of chemical oxygen demand of waste water
11	Assessing cleanliness and sterility of food equipments by swab method
12	To evaluate cleanliness of food equipments by rinse method
13	To assess cleanliness and sterility of food equipments by agar roll method
14	Visit to restaurants/hotels and microbial examination of plates, cups and other eating utensils
15	Testing the efficiency of detergents used in food plant

Text books

1 Principles of food sanitation, Springer by Norman G Marriott, Robert B Gravani

2 Food Plant Sanitation, Marcell Dekker Inc by Bernard L Bruinsma, J Richard Gorham

FPE 351 3 (2+1)

Process Equipment Design

(32 Lectures and 16 Practical)

Unit 1 Materials and Properties

Materials for fabrication, mechanical properties, ductility, hardness, corrosion, protective coatings, corrosion prevention linings equipment, choice of materials, material codes.

Unit 2 Design Considerations

Stresses created due to static and dynamic loads, combined stresses, design stresses and theories of failure, safety factor, temperature effects, radiation effects, effects of fabrication method, economic considerations.

Unit 3 Design of Pressure and Storage Vessels

Operating conditions, design conditions and stress. Design of shell and its component, stresses from local load and thermal gradient, mountings and accessories.

Unit 4 Design of Heat Exchangers

Design of shell and tube heat exchanger, plate heat exchanger, scraped surface heat exchanger, sterilizer and retort.

Unit 5 Design of Evaporators and Crystallizers

Design of single effect and multiple effect evaporators and its components.

Design of rising film and falling film evaporators and feeding arrangements for evaporators. Design of crystalliser and entrainment separator.

Unit 6 Design of Agitators Separators

Design of agitators and baffles. Design of agitation system components and drive for agitation. Design of centrifuge separator.

Unit 7 Design of Equipment Components

Design of shafts, pulleys, bearings, belts, springs, drives, speed reduction systems.

Unit 8 Design of Freezing Equipment

Design of ice-ream freezers and refrigerated display system.

Unit 9 Design of Dryers

Design of tray dryer, tunnel dryer, fluidized dryer, spray dryer, vacuum dryer, freeze dryer and microwave dryer.

Unit 10 Design of Conveyors and Elevators

Design of belt, chain and screw conveyor, design of bucket elevator and pneumatic conveyor.

Unit 11 Design of Extruders

Cold and hot extruder design, design of screw and barrel, design of twin screw extruder.

Unit 12 Design of Fermenters

Design of fermenter vessel, design problems.

Unit 13 Hazards and Safety Considerations

Hazards in process industries, analysis of hazards, safety measures, safety measures in equipment design, pressure relief devices.

Practical	Title
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

Text books

1. Process equipment design by Joshi MV and Mahajan VV. Published by Macmillan India Ltd
2. Process equipment design by Brownell and Young. Published by John Willey

Reference books

1. Process equipment design by Bhattacharya BC. Published by Macmillan India Ltd
2. Strength and elasticity of materials by Brooks WH. Published by Asia Publishing House

FPE 352 3 (2+1)

Bio Process Engineering

(32 Lectures + 16 Practical)

Unit 1 Introduction

Introduction of bio-processing of foods, industrial fermentations in food processing, basis and principles of fermentation and operations.

Unit 2 Biological Reactors

Process considerations, oxygen transfer, sparger systems, scale up, sterilization, cell culture, product recovery

Unit 3 Fermentation

Introduction to Fermentation: Rate of microbial growth and death, fermentation kinetics, mass transfer diffusion, membrane transport, dialysis, nutrient uptake. Types of fermentation: sub-merged and solid state solid state, batch and continuous fermentation, scale up in ermentation. Fermenter construction, operation, measurement and control in fermentation.

Aeration and Agitation in Fermentation

Oxygen requirement, bubble aeration, mechanical agitation.

Unit 4 Sterilization

Air sterilization, media sterilization

Product Recovery and Waste Utilization, Product recovery, biological waste treatment and inplant sanitation. Principle and use of biosensor. Production of vitamins, amino acids, organic acids, enzymes and antibiotics, alcohols

Unit 5 Process Modelling

Structured models, continuous culture, mathematical analysis, computer aids for analysis and design

Unit 6 Enzyme Engineering

Enzymatic reaction kinetics, immobilized enzymes, enzymatic reactors

Practical Title

1. To study the bacterial growth in batch culture.
2. To study the enumeration of microorganism by striking and pore plate method
3. To study food spoilage and calculate thermal resistance of microorganisms.

4. To measurement B.O.D. of effluent
5. To measurement C.O.D. of effluent
6. To study the fermenter operation and measure end products
7. To produce starter
8. To produce baker's yeast culture
9. To produce citric acid
10. To produce alcohol and alcoholic beverages
11. To produce beer
12. To produce wine
13. To produce enzymes
14. To produce amino acids
15. Visit to brewery
16. Visit to effluent treatment plant

Text books

1. Bioprocess Engineering Principles by Pauline,M. Doran. Published by Academic Press.
2. Biochemical Engineering Fundamentals by Olson, J. E. Bailey and David F. Ollis. Published by McGraw-Hill Book Co. Inc., New York
3. Chemical Engineering Handbook by Perry R.H. Published by McGraw-Hill

Reference books

1. Thermobacteriology in Food Processing by Stumbo. Published by Academic Press, New York
2. Biochemical Engineering by Blanch, H. W. and Clark, D. S. Published by Marcel Dekker Inc., NewYork.
3. Food Canning Technology by Larousse, Jean and Brown, B. E., Published by Wiley-VCH,

FPE 353 3 (2+1)

Food Plant Utilities & Services

(32 Lectures + 16 Practical)

Unit 1 Introduction

Classification of various utilities and services in food industry

Unit 2 Water use in Food Processing Industry

Water supply system : Pumps of different types, operational aspects, piping system for fresh water, chilled water etc., fittings and control, water requirement for cleaning and processing, water quality, water purification and softening

Water use in food processing: Different types of water requirements in food processing plants, types of water use, waste water sources, water wastage minimization, water loadings per unit mass of raw material.

Water conservation: Water and waste water management, economic use of water, water filtration and recirculation.

Unit 3 Steam uses in Food Industry

Steam uses in food industry :Food processing operations in which steam is used, temperature, pressure and quantity of steam required in various food processing operations

Steam generation system: Components of a boiler system, fuels used in boilers, energy analysis for a steam generation system, heat loss from boiler system, boiler design consideration.

Energy conservation technologies for steam generation system, Energy saving through optimal design and operation of boiler, energy recovery from flue gas, energy recovery from blow down water, maintenance of boiler.

Steam distribution system: Components of steam distribution, heat loss and energy efficiency of a steam distribution system.

Energy conservation technologies for steam distribution system: Steam trap maintenance, condensate recovery, repairing of steam leaks, insulation improvements. Economical analysis of energy efficiency improvement, cogeneration.

Unit 4 Electric Energy uses in Food Industry

Power and Electrical System: Types of electrical loads, electric loads, sources of energy losses in power and electrical systems, low power factor, improper motor load, poor control.

Power management for demand control, power factor improvement, replacement with high efficiency motors, replacement with electronic adjustable motors.

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

Unit 5 Waste-Heat Recovery in Food Processing Facilities

Quantity and quality of waste heat in food processing facilities, waste heat utilization, heat exchangers for waste heat recovery, and heat pumps for waste heat recovery.

Unit 6 Thermal Energy Storage in Food Processing Facilities

Thermal energy storage system and materials, hot thermal energy storage, cooling energy storage.

Unit 7 Compressed Air System

Main components of compressed air systems sources of energy losses from a compressed air system. Energy conservation technologies for compressed air systems, high efficiency motors, repairing of air leaks. Reduced air pressure reduced air inlet temperature, localized air delivery system.

Unit 8 Waste Disposal and its Utilization

Industrial waste, sewage, influent, effluent, sludge, dissolved oxygen, biological oxygen demand, chemical oxygen demand.

Unit 9 Planning and Design of Service Facilities in Food Industry

Estimation of utilities requirements : Lighting, ventilation, drainage, CIP system, dust removal, fire protection etc.

Maintenance of facilities : Design and installation of piping system, codes for building, electricity, boiler room, plumbing and pipe colouring, maintenance of the service facilities.

Services required in offices, laboratories, locker and toilet facilities, canteen, parking lots and roads, loading docks, garage, repair and maintenance shop, ware houses etc.

Practical Title

1. To study operational aspects of water supply system and measures to conserve water in food processing plant
2. To study the sizing and maintenance of various pumps used in food industry
3. To estimate water requirement in food processing plant
4. To study the waste disposal and management process in the food processing plants
5. To study different types piping layout, fittings and control and process of regular checkups

and maintenance

6. To study different types of steam generation systems and its maintenance
7. To study different types steam distribution systems, its maintenance and safety measures
8. To study regular checkups and maintenance of electricity distribution system, wires, cables, switches, fuses and controls in food processing plant
9. To study process of regular checkups and maintenance of process equipment
10. To study the air compression and distribution system in processing plant
11. To study the fire control operations and use of fire extinguisher
12. To measure electrical power and energy used in the processing plants.
13. To study the CIP system of dairy plant
14. Study the various heat recovery systems in a processing plant.
15. To study the effluent treatment plant
16. To study thermal energy storage system

Text books

1. Energy Efficiency and Management in Food Processing Facilities, by Lijun Wang. Published by CRC Press, 2008

2. Energy-saving Techniques for the Food Industry by M. E. Casper. Published by Noyes Data Corp., 1977

3. Chilton's Food Engineering. Published by Chilton Co., 1979

Reference book

1. A Survey of Water Use in the Food Industry by W. E. Whitman, S. D. Holdsworth. Published by British Food Manufacturing Industries Research Association.

FPT 351 4 (3+1)

Processing Technology of Fruits and Vegetables

(48 Lectures + 16 Practical)

Unit 1 Production and Processing Status of Fruits and Vegetable

Importance of fruit and vegetable in world agriculture; nutritive value of fruits and vegetable and their role in human diet; production status of fruits and vegetables in India; export potential of processed and raw fruits and vegetable produce

Unit 2 Unit Operations in Canning

Raw material procurement, washing, blanching, peeling of fruits and vegetables; canning of fruits and vegetables-washing, peeling, filling, brining, liding, exhausting, sealing, processing, cooling etc.; types of container glass container, tin container; acid resistant, sulphur resistant can; canning equipment

Unit 3 Freezing of Fruits and Vegetables

Freezing of fruits and vegetables- purpose of freezing, pre freezing methods, quick freezing, individual quick freezing; freezing temperatures for fruits and vegetables; frozen storage of fruits and vegetables

Unit 4 Factors Affecting Quality of Fruits and Vegetable

Various environmental and cultural factors affecting fruits and vegetable quality; Post harvest factors affecting the quality; controlled atmosphere storage (CAS) and modified atmosphere storage (MAS), effect of controlled atmosphere packaging (CAP) and modified atmosphere packaging on shelf-life of fresh fruits and vegetables

Unit 5 Fruits and Vegetables Processing – Liquid Products

Methods of preparation of juices, squashes, syrups, sherbet and cordials; extraction, deaeration and filtration; FPO specification for juices, squashes, syrups sherbet, cordials etc.; equipment for juice processing, Aseptic processing

Unit 6 Fruits and Vegetables Processing – Solid and semi solid Products

Jam, jelly and marmalade- theory and ingredients; crystallized fruits and fruit preserves; FPO specifications for jam, jelly and marmalades; chutney, pickles, sauce, puree, paste, ketchup and tomato products

Unit 7 Process Technologies and Quality Control

Technology of processing fruit/vegetable- processing of selected fruits (mango and banana) and vegetables (tomato and curried vegetable); determination of various quality parameters of processed fruits and vegetable products- salt content, sulphur dioxide content, acidity etc

Practical Title

1. To study the respiration rate of fruits/ vegetable at different storage conditions using head space analyser
2. To study the effect of ascorbic acid, potassium meta bisulphite on inhibition of enzymatic browning
3. Canning of fruits-Mango/Guava/Papaya
4. Canning of vegetables- Peas/Mushroom
5. Preparation of fruit jam from Apple/ Mango/ Aonla /Strawberry
6. Preparation of fruit jelly: Sweet orange/mandarin/Guava
7. Qualitative determination of pectin content by alcohol test / jelmeter test in fruit extract
8. Quantitative determination of pectin content by jelmeter test in fruit extract
9. Preparation of fruit preserve – aonla
10. Preparation of ready to serve (RTS) from mango/ litchi/ lemon
11. Preparation of squash- lemon/ mandarin/ litchi and sherbet
12. Determination of SO_2 content in preserved fruit pulp sample
13. Determination of salt content in canned vegetable product
14. Preparation of fruit leather -mango leather
15. Preparation and preservation of tomato puree and ketchup
16. Determination of lycopene content in given tomato product (spectrophotometric method)

Text books

1. Preservation of Fruits and Vegetables, by Girdhari Lal, G L Siddappa and G L Tandon Publisher-Indian Council of Agricultural Research, New Delhi.
2. Fruit and Vegetable Preservation: Principles and Practices by RP Srivastava and S Kumar (Second Edition), Publisher-International Book Distributing Co. Lucknow.

Reference books

1. Post harvest physiology of Perishable plant Products. By Stanley J. Kays. C B S.
2. Commercial Fruits and Vegetable Products by W.V. Cruess. AVI Publishers
3. Post harvest technology of Fruits and Vegetables by P.H. Pandey, Saroj Prakasham
4. Managing frozen foods Edited by C J. Kennedy, Woodhead Publishing Limited, Abington, Cambridge, England
5. Fruit and Vegetable Processing by M E Dauthy, FAO Agricultural Services Bulletin No.119, 1995.

FPT 352 4 (3+1)

Processing Technology of Milk and Milk Products

(48 Lectures + 16 Practical)

Unit 1 Production and Processing Status

Historical development of dairy in India; development of milk co-operatives- Amul; National Dairy Development Board (NDDB); operation flood/ white revolution; production and utilization of milk; milk consumption pattern; basis for pricing of milk; marketing channel for milk in India and abroad

Unit 2 Composition and Properties of Milk

Definition of milk, milk composition, factors affecting composition of milk; milk fat; milk sugar; milk proteins; vitamins, minerals; physico-chemical properties of milk

Unit 3 Processing of Milk

Milk – procurement and purchase; grading and quality testing; milk processing and packaging; defects in milk- causes and prevention; standardized milk, skim milk; sterilized milk; reconstituted/ rehydrated milk; recombined milk

Unit 4 Butter

Introduction, definition, composition; processing and production steps; overrun; continuous butter manufacturing; quality testing of table butter; butter- defects, causes and their prevention; packaging and storage

Unit 5 Ice cream

Introduction, definition; composition; types; processing steps and flow diagram; overrun; ice-cream-quality parameters and testing; ice-cream defects causes and prevention; packaging and storage

Unit 6 Cheese

Introduction, definition, composition, types; processing steps for cheese manufacturing; process flow diagram for cheddar cheese; cheese-defects, causes and prevention; quality control for cheese

Unit 7 Dried milk

Introduction, definition; composition; types of dried milk; processing steps; process flow diagram for dried milk; dried milk- defects, causes and prevention; malted milk and beverages

Unit 8 Traditional Indian Dairy Products

Acid coagulated products ; fermented products-dahi, processing conditions, defects etc.; shrikhand; lassi; mattha/Chhas); fat rich products- ghee and its processing; milk based puddings/ desserts- kheer;

payasam; gajar-ka-halwa

Practical	Title
1.	Platform tests of milk (clot on boiling COB test, alcohol test)
2.	Determination of specific gravity and total solids of milk using lactometer.
3.	Determination of titrable acidity and pH of milk sample
4.	Determination of moisture and fat content of milk powder
5.	Determination of fat using gerber method
6.	Detection of adulterants in milk like water, urea, neutralizers, preservatives, Sucrose, starch
7.	Preparing standardized milk as per requirement.
8.	Separation of fat from milk
9.	Direct microscopic clump count (DMC) of milk
10.	Determination of hygienic quality of sterilization (i.e. MBRT/ Alkaline phosphatase test / rezaurin test)
11.	Determination of protein content in milk
12.	Determination of moisture content and salt content of butter
13.	Preparation of ice-cream and its textural study using texture analyser
14.	Preparation of mozzarella cheese/ processed paneer
15.	Preparation of Dahi/ Yoghurt
16.	Preparation of Lassi/ Chhans related beverage
17.	Preparation of paneer/channa

Text books

1. Outlines of dairy technology by Sukumar De. Oxford University Press
2. Dairy Plant System and Layout by Tufail Ahmed, Kitab Mahal, Allahabad

Reference Books

1. Indian dairy products by K S Rangappa Asia Publishing House
2. Engineering for dairy and food products by A W Farrall John Wiley and Sons
3. Cheese and Butter by V. Cheke and A. Sheeprd, Agrobios (India)
4. Dairy chemistry and biochemistry by P F Fox and PLH McSweeney, Blackie Academic and Professional, An Imprint of Chapman & Hall, London.
5. Milk and Milk Products by Eckles and Eckles

PHE 351 3 (2+1)

Storage Structures and Environment Control

(32 lectures + 16 Practical)

Unit 1 Storage

Importance of scientific storage systems, post harvest physiology of semi-perishables and perishables, climacteric and non-climacteric fruits, respiration , ripening, changes during ripening, ethylene biosysnthesis

Unit 2 Damages

Direct damages; indirect damages; causes of spoilage in storage (moisture, temperature, humidity, respiration loss, heat of respiration, sprouting), destructive agents (rodents, birds, insects etc), sources of infestation and control.

Unit 3 Storage structures

Traditional storage structures (bukhari, morai etc); improved storage structures; modern storage structures, farm silos-horizontal silos, tower silos, pit silos, trench silos, size and capacity of silos

Unit 4 Storage of grains

Storage of cereal grains and their products, respiration of grains, moisture and temperature changes in stored grains; conditioning of environment inside storage through ventilation.

Unit 5 Aeration & Stored Grain Management

Introduction, purposes of aeration, aeration theory, aeration system design, aeration system operation,

Unit 6 Storage pests and control

Damage due to storage insects and pests, its control, seed coating, fumigations, etc. Damage caused by rodents and its control.

Unit 7 Storage of perishables

Storage of agricultural perishables, cold storage, controlled and modified atmospheric storage, hypoboric storage, evaporative cooling storage, conditions for storage of perishable products, control of temperature and relative humidity inside storage

Unit 8 Design of storage structures

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

Practical	Title
1	Visits to traditional storage structures
2-3	Layout design, sizing, capacity and drawing of traditional storage structures
4	Visits to FCI godowns
5	Design of FCI godowns for particular capacity and commodity
6	Drawing and layout of FCI godown for particular commodity and capacity
7	Visits to cold storage
8	Design of cold storage for particular capacity and commodity
9	Drawing and layout of cold storage for particular commodity and capacity
10	Visits to CA storage
11	Design of CA storage for particular capacity and commodity
12	Drawing and layout of CA storage for particular commodity and capacity
13	Measurement of respiration of fruits/grains in the laboratory
14	Study on fumigation
15	Visits to evaporative cooling system for storage
16	Storage study in the MAP

Text Books

1. Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices, Marcel Dekker, Inc., NY by A. Chakraverty, A. S. Mujumdar, G.S.V. Raghavan, H.S. Ramaswamy.
2. Grain Storage Engineering and Technology, Batra Book Services by Vijayaraghavan, S.

Reference books

1. Storage of Cereal Grains and Their Products, 4th Edition, AACC by David B. Saucer.
2. Post Harvest Technology of Horticultural Crops, New India Publishing by Sudheer, K.P. and V.Indira, V Indira.
3. Principles of Agricultural Engineering, Volume – II, Jain Brothers by A. M. Michael and T. P. Ojha.
4. Handling and Storage of Food Grains in Tropical and Subtropical Area by FAO Pub.

5. Silos, Theory and Practice: Vertical Silos, Horizontal Silos (retaining Walls), 2nd Ed, Lavoisier Pub. By André M. Reimbert

6. Fruit and Vegetables: Harvesting, Handling and Storage, 2nd Ed, Iowa State Press by Keith Thompson

7. Advanced Data Warehouse Design, Springer by Malinowski, Elzbieta, Zimányi, and Esteban.

SIXTH SEMESTER

FQA 361 3 (2+1)
Food Regulations & Quality Assurance

(32 lectures + 16 Practical)

Unit 1 Quality Attributes of Foods

Introduction to appearance, flavour, textural factors and additional quality factors.

Taste: Introduction, organs involved in taste perception- tongue, papillae, taste buds, salivary glands, mechanism of taste perception, chemicals responsible for sweet, salt, sour, and bitter taste their structure and chemical dimensions. Factors affecting taste quality, reaction time and factors affecting it, absolute and recognition threshold, taste abnormalities.

Olfaction: Introduction and definition, anatomy of nose, mechanism of odour perception. Prerequisites for odour perception, odour classification, chemical specificity of odour. Classification of odour, measurement of odour using different techniques – primitive, double tube olfactometer, Elseberg techniques, Wenzel's olfactometer, sniffing, merits and demerits of each methods, olfactory abnormalities.

Colour: Introduction to natural and synthetic colours, functions of colour in foods. Optical aspect of colour, perception of colour, objective evaluation, colour measurement using different systems- Munsell colour system, CIE colour system, qualitative and quantitative analysis of colour, reflectance spectrophotometry and colorimetry.

Texture: Introduction, definition, classification of texture profile, subjective evaluation, phases of oral processing, objective analysis, rheological methods of texture measurement including rheological models. Measurement of texture in various food groups viz. cereals, dairy, fruits and vegetables, bakery and confectionary products

Unit 2 Sensory assessment in Quality Control

Introduction, facilities , lab set up, equipment, panel selection and training, judging quality, test design and methods – difference tests, triangle tests, paired comparison test, hedonic rating test

Unit 3 Quality Control

Definition – Quality, quality control, principles of quality control – raw material control, process control, finished product inspection, process control, quality problems and quality improvement techniques- mechanization, future of quality control, Total quality management.

Unit 4 Quality Standards and Specifications

Quality control specifications, processed food products (bakery, canned foods, dairy products), fresh fruits and vegetables, training of food technologists for quality control, implementation of standards and specifications

Unit 5 National and International food laws and regulations

National- Essential Commodity Act, mandatory and voluntary food laws- Prevention of Food Adulteration Act (PFA), Fruit Products Order (FPO), Meat Food Products Order (MFPO), Vegetable Oil Control Order, Agricultural Marketing and Grading Standards (AGMARK), Bureau of Indian Standards(BIS) and their certification, Food Safety and Standards Act, International – Codex laws, Food and Drug Administration (FDA), International Organization for Standardization (ISO), standards of fill of the containers, standards of identity, standards of minimum quality, Good Manufacturing Practices (GMP), Good Agricultural Practices (GAP), Generally Recognized as Safe (GRAS).

Unit 6 Food Adulteration

Definition of food adulteration, misbranding, common adulterants in foods

Unit 7 Food Safety Management System

ISO 22000 - Food safety management systems - Requirements for any organization in the food chain

Practical	Title
1	Training of sensory panel for flavor perception
2	To perform sensitivity tests for four basic tastes
3	To perform difference tests, triangle test, paired comparison test, duo trio test.
4	Sensory evaluation of milk and detection of flavour defects in milk
5	Sensory evaluation of biscuit samples for textural properties
6	Simple tests for detection of common adulterants- formaldehyde, starch, cane sugar, hydrogen peroxide, sodium bicarbonate in milk.
7	Test for the presence of sesame oil in given oil sample
8	Colour estimation of food samples by tintometer
9	Examination of fruit jams for FPO specifications
10	Examination of Butter / oil samples for AGMARK specifications
11	Examination of food / milk products for BIS specifications
12	To determine BAR (Brix acid ratio) in beverages
13	Visit to units with ISO 22000:2005 certified company
14	Evaluation of food labels of products from market for PFA standards
15	Determination of total residual chlorine in water sample.
16	Cut out analysis of Canned Product samples

Text books

1 Quality Control for Food Industry. Vol I and II AVI Publications by A Krammer

2 Food Quality Control by Manoranjan Kalia

Reference books

1 Food Quality Assurance AVI Publications. by W A Gould

2 ISI Specifications for Various Food Products

3 Handbook of Analysis and Quality Control of fruits & Vegetables Products Tata Mc Grow Hill Publications. by S Ranganna

FPE 361 3 (2+1)

Process Control in Food Industry

(32 Lectures and 16 Practical)

Unit 1 Temperature Measurement

Mercury thermometers, bimetal thermometers, capillary type thermometers, recording thermometers, thermocouples, resistance thermometers, thermistors.

Unit 2 Pressure Measurement

Pressure gauge, elastic deformation elements, basic concept of pneumatic pressure transmitter, pressure current and pressure resistance transducers.

Unit 3 Flow Measurement

Positive displacement meter, turbine type, float type, timed flow and magnetic meters.

Unit 4 Miscellaneous Measurements

Weight measurement- mechanical scale, electronic tank scale, conveyor scale, measurement of specific gravity, measurement of humidity, measurement of viscosity, measurement of density, automatic valves.

Unit 5 Process Control

Definition of process control, simple system analysis, dynamic behaviour of simple process, Laplace transform, process control hardware. Frequency response analysis, frequency response characteristics, Bode diagram and Nyquist plots and stability analysis.

Unit 6 Instrumentation and Sensors for the Food Industry

Sorting by colour in the food industry

Sorting machine, assessment of food particles for colour sorting, the optical inspection system, completing the sorting system, computer vision systems, colour sorter.

Food compositional analysis using near infra-red absorption technology

Principles of measurement, instrumentation, applications in the food industry, the power of process monitoring and trending, practical considerations for implementing on-line measurement.

Practical aspects of infra-red remote thermometry. Radiation thermometers, measurement principles, practical situations, miscellaneous techniques.

In-line and off-line FTIR measurements. Food applications, calibration and general aspects of routine use.

Microwave measurements of product variables. Overview of microwave techniques, microwave leakage detector, fiber optic sensors.

Ultrasonic instrumentation in the food industry Low-frequency techniques, high-frequency techniques.

Unit 7 Instrumental Techniques in the Quality Control Laboratory

Conductance/impedance techniques for microbial assay. Rapid microbiological methods: an overview, principles of electrical conductance methods, capacitance versus conductance measurement, the evaluation of conductance data.

Unit 8 Chemosensors, Biosensors, Immunosensors, Electronic Noses and Tongues

Sensors for food flavour and freshness: electronic noses, tongues and testers

Introduction to flavour assessment, modelling the human nose, electronic nose, electronic tongue, marker chemical approach, in situ freshness monitor for frying oil using resonant viscosity probe, knife-type meat freshness tester using glucose profiling biosensor.

Chemosensors

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	Title
1	Measurement of temperature by different thermometers and calibration
2	Measurement of variation in intensity of solar radiation with time
3	To study the various types of pressure measuring instruments and calibration
4	To study and measure the flow through pipe and open channels using various types of flow measuring instruments and devices.
5-6	To study the data logging system and collect data.
7	To study the principle of operation of optical vision system for colour sorting.
8-9	To analyse the food sample for proximate composition using NIR.
10	To analyse the food sample using UV spectrophometer.
11	To measure the microwave power leakage in the microwave oven.
12	To study the principles of operation of electronic nose.
13	To study the marker chemical approach for food analysis during heating process.
14	To study the instrumentation system in the dairy industry.
15	To study the instrumentation system in food processing plant.
16	To study the instrumentation system in food testing laboratory.

Text books

1. Process system analysis and control by Donald R. C. Published by Mc-Graw Hill
2. Instrumentation and sensors for the food industry by Erika Kress-Rogers, Christopher J. B. Brimelow, Published by Woodhead Publishing
3. Process Instrumentation by Patranobish. Published by Tata Mc-Graw Hill

Reference books

1. Transducers and Instrumentation by Murty DVS. Published by Prentice Hall of India
2. Process Control Instrumentation Technology by Johnson C. Published by Prentice Hall of India

FPT 361 4 (3+1)

Processing Technology of Meat, Fish & Poultry

(48 Lectures + 16 Practical)

Unit 1 Introduction

Sources of meat fish and poultry in India; development of meat, fish and poultry industries in India; importance of fish, meat and poultry industries in national economy and their export potential.

Unit 2 Muscle Structure and Composition

Muscle- definition and structure; chemical composition and physico-chemical properties

Unit 3 Conversion of Muscle to Meat Processing and Preservation

Conversion of muscle to meat- pre-slaughter handling, death of the animal; conditioning; factors affecting the growth of meat-spoilage micro-organisms

Unit 4 Processing and Preservation of Meat

Preservation of meat- dehydration, freezing, pickling, curing, cooking and smoking; dehydration; curing; preservation of meat using ionizing radiation; preservation of meats using- antibiotics and chemical preservatives

Unit 5 Quality of Meat

Eating quality of meat and discoloration; water-holding capacity and juiciness in cooked and uncooked meat; texture and tenderness- definition and measurement, factors affecting texture and tenderness, artificial tenderizing

Unit 6 Abattoir Design

Abattoir design and layout, meat plant sanitation and safety, by-products utilization

Unit 7 Egg- Composition and Processing

Egg- structure, composition, nutritive value and quality characteristics; processing and preservation of eggs, production of egg yolk and egg yellow powder.

Unit 8 Poultry and Fish Processing

Poultry processing; quality evaluation of poultry meat; fish processing; quality of fresh fish; manufacture of fish products

Practical Title

1. Pre-slaughter operations of meat and poultry
2. Visit to abbatoir
3. Meat cutting and handling
4. Evaluation of animal carcasses
5. Evaluation of meat and study post rigor changes
6. Preparation of smoked meat and preservation of meat
7. Preparation and evaluation of dehydrated meat products
8. Study the effect of preservatives/antibiotic on shelf life of meat
9. Preparation and evaluation of pickled meat
10. Preparation and evaluation of meat sausages
11. Preparation and evaluation of meat/ chicken patties
12. Evaluation of quality and grading of eggs
13. Evaluation of quality of fish (in terms of freshness)
14. Preparation of egg/fish pickle
15. Visit to meat processing industry
16. Experiments on by-products utilization of meat

Text Books

1. Meat Science by R.A. Lawrie, 2nd Edition, Pergamon Press, Oxford UK.
2. Meat Handbook by A. Lavie, 4th Edition, AVI, Westport.

3. Egg Science and Technology by W.J. Stadelmen, and O. J. Cotterill, 1977. 2nd Edition. AVI, Westport.
4. Muscle as Food. By PJ Bechtel, Orlando, FL, Academic Press.

FPT 362 3 (2+1)

Processing Technology of Spices and Plantation Crops

(32 Lectures + 16 Practical)

Unit 1 Structure and Composition

Spices- Classification, composition, structure and characteristics;
production status of spices in India, major spice producing area in India and worldwide, export potential of processed and raw spice product

Unit 2 Processing of major and minor spices

Preservation and processing of major and minor spices of India; Processing of whole spice, spice powder, paste and extracts; production and processing of spice mixtures; spice oils and oleoresins, functional role of spices, quality specification for spices

Unit 3 Tea Processing

Composition and production of tea leaves; processing of tea leaves; CTC tea, black tea, green tea and Oolong tea, grading and packaging; processing of instant tea

Unit 4 Coffee Processing

Production and processing of coffee cherries by wet and dry method; processing technology for coffee; preparation of brew; processing technology for instant coffee and decaffeinated coffee

Unit 5 Cocoa processing

Cocoa bean- introduction, history and composition; processing of cocoa bean; processed products of cocoa

Practical	Title
1.	Spice for classification and acquaintance
2.	Formulation and preparation of powder spice from turmeric and cumin
3.	Formulation and preparation of spice mixture for sambhar
4.	Formulation and preparation of spice mixture for tea
5.	Extraction of volatile oil from clove
6.	Visit to spice processing industry
7.	Determination of volatile oil in spice
8.	Extraction of piperine in black pepper and its determination
9.	Extraction of capsaicin in capsicum and its determination
10.	Determination of curcumin content in turmeric
11.	Extraction of eugenol from tulsi, cinnamon, and clove
12.	Extraction gingerol in ginger and its determination
13.	Determination of iodine value of selected essential oils from spices
14.	Detection of adulteration in cumin, tea and pepper
15.	Detection of adulteration in clove oil
16.	Visit to tea processing industry

Text Books

1. Major spices of India-Crop Management – Post Harvest Technology by J S Pruthi, Indian Council of Agricultural Research, New Delhi.
2. Coffee processing technology By M Sivetz and H. E. Foote, AVI Publishing, Co.
3. Chemistry and Applications of Green Tea by T Yamamoto, L R Juneja, D-chi Chu ad M. Kim, CRC Press

Reference Book

1. Quality Assurance in Spices and Spice Products – Modern Methods of Analysis by J S Pruthi, Allied Publishers Limited, New Delhi.

BE 361 4 (3+1)

Bio Energy

(48 Lectures + 16 Practical)

Unit 1 Classification of energy sources;

Unit 2 Introduction to renewable energy sources; characterization of biomass;

Unit 3 Types, construction, working principle, uses and safety/environmental aspects of different renewable energy devices like gasifiers,

Unit 4 Types, construction, working principle, uses of biogas plants,

Unit 5 Types, construction, working principle, uses of solar passive heating devices,

Unit 6 Types, construction, working principle, uses of photovoltaic cells and arrays;

Unit 7 Brief introduction to wind energy, hydroelectric energy, ocean energy, briquetting and baling of biomass, biomass combustion, biodiesel preparation and energy conservation in agriculture.

Practical	**Title**
1	Determination of calorific value
2	Estimation of ash content of biomass
3	Estimation of moisture content of biomass
4	Estimation of fixed carbon and volatile matter of biomass
5	Demonstration of down draft throatless rice husk gasifier
6	Demonstration of down draft gasifier with throat
7	Demonstration of rice husk gasifier for thermal use
8	Demonstration of working of a fixed dome type biogas plants
9	Demonstration of working of a floating drum type biogas plants
10-11	Demonstration of biodiesel preparation
12	Measurement of basic solar parameters
13	Demonstration of solar water heater
14	Demonstration of PVC
15	Demonstration of solar cooker.
16	Determination of fuel properties

Text books

1. Energy Technology Non-conventional, Renewable and Conventional ,By: S.S. Rao and B.B. Parulekar,
2. Solar Energy Fundamentals and Applications, By: H.P. Garg and J. Prakash
3. Hand book of biogas technology, By: N.S. Grewal, S. Ahluwalia, S. Singh and G. Singh

Reference Books

1. Handbook of Biomass Downdraft Gasifier Engine System,By: Thomas B Reed and Aqua Das.
2. Small scale producer gas engine systems,,By: A Kaupp & J.R.Goss.
3. Biogas Systems (Principles & Applications) ,By: K.M. Mittal
4. Solar energy, By: S.P. Sukhatme,
5. Principles of Solar Energy. ,By: D. Yogi Goswami
6. Renewable Energy,By: P.D. Dunn.

FBM 361 3(2+1)

Project Management & Entrepreneurship Development

(32 Lectures + 16 Practical)

Unit 1 Introduction and definitions related with project, management and entrepreneurship. Fundamentals of project management and entrepreneurship development.

Unit 2 Project formulation: market survey techniques, project identification, project selection, project proposal, work breakdown structure

Unit 3 Network scheduling: activity, networks, use of CPM, PERT in project scheduling.

Unit 4 Resource planning, resource allocation, project scheduling with limited resources.

Unit 5 Estimation of project costs, earned value analysis, project techno-economic viability, break-even analysis.

Unit 6 Identification of business opportunity in food processing sector, Government policies for promotion of entrepreneurship in food processing.

Unit 7 Launching and organizing an enterprise, enterprise selection, market assessment, feasibility study, SWOT analysis, resource mobilization

Practical	**Title**
1-2	Date collection from market on various projects on food processing.
3	Writing work break down structure for different projects.
4-5	Solving various problems using an assignment model and job sequencing.
6	Drawing network charts for different projects.
7-9	Formulation of CPM scheduling for a specific project.
10-12	Formulation of PERT scheduling for a specific project.
13-14	Calculation of project cost and break even analysis for a specific food product enterprise.
15-16	SWOT analysis of a specific enterprise.

Text Books

1. Management and Engineering by Gail Freeman Bell and James Balkwill. Printice Hall International
2. Entrepreneurship and Management inputs for entrepreneurs in Food Processing Sector by Dinesh Awasthi and Rama Jaggi

Reference Books

1. Elementary Economics by Dewetl and Verma. S. Chand & Company.
2. Entrepreneur's Guidebook on Food Processing Industries Arunachal Pradesh SISI 1983
   World of KAIZEN: by Shyam Talawadekar. Quality management system, Mumbai.

Stat 361 3 (2+1)
Statistics and Optimization

(32 Lectures + 16 Practical)

Unit 1 Introduction: Definition of Statistics and its use and limitations; Frequency Distribution and Frequency Curves; Measures of Central Tendency: Characteristics of Ideal Average, Arithmetic Mean; Median, Mode, Merits and Demerits of Arithmetic Mean; Measures of Dispersion: Standard Deviation, Variance and Coefficient of Variation;

Unit 2 Probability: Definition and concept of probability; Normal Distribution and its properties;

Unit 3 Introduction to Sampling: Random Sampling; the concept of Standard Error; Tests of Significance- Types of Errors, Null Hypothesis, Level of Significance and Degrees of Freedom, Steps involved in testing of hypothesis; Large Sample Test- SND test for Means, Single Sample and Two Samples (all types); Small Sample Test for Means, Student's t-test for Single Sample, Two Samples and Paired t test.

Unit 4 F test; Chi-Square Test in 2x2 Contingency Table, Yates' Correction for continuity; Correlation: Types of Correlation and identification through Scatter Diagram, Computation of Correlation Coefficient 'r' and its testing. Linear Regression: of Y on X and X on Y. Inter-relation between 'r' and the regression coefficients, fitting of regression equations.

Unit 5 Experimental Designs: Basic Designs, Completely Randomized Design (CRD), Layout and analysis with equal and unequal number of observations, Randomized Block Design (RBD), Layout and analysis, Latin Square Design (LSD), Layout and analysis.

Practical	**Title**
1	Construction of frequency distribution table and its graphical representation,
2	histogram, frequency polygon, frequency curve,
3	bar chart, simple, multiple, component and percentage bar charts,
4	pie chart, mean, mode for row and grouped data, percentiles, quadrille, and median for row and grouped data,
5	coefficient of variation, 't' test for independent, will equal and unequal variants,
6	paired 't' test, chi-square test for contingency tables and theoretical ratios,
7	Correlation and linear regression.
8	Use of CRD; RBD and LSD; missing plot technique;;

Text books

1. Statistical Methods by Snedecor; G. W. and Cochran, W.G. 1968; Oxford and IBH Publishing Co., New Delhi
2. Sampling Techniques. by Cochran, W. G. 1972; Wiley Eastern Pvt. Ltd., New York

Reference Books

1 Experimental Designs by Cochran, W. G. and G.M. Cox 1962; Asia Publishing House, Bombay
2. Statistical Quality Control, by Grant and Leavenworth 1972; McGraw Hill, New Delhi
3. Handbook on Statistical Quality Control by Indian Standards Institute 1986 New Delhi

SEVENTH SEMESTER

FPE 471 3 (2+1)

Food Plant Design and Layout

(32 Lectures and 16 Practical)

Unit 1 Introduction

Classification of food processing plants, perishable nature of foods, food plant design concepts, situations giving rise to plant design problems and general design considerations (technical, economic, legal, safety and hygiene).

Unit 2 Feasibility Study

Steps involved in feasibility study, collection of the information, information flow diagrams, market analysis, technical analysis and preparation of feasibility report.

Unit 3 Plant Location

Factors affecting plant location, their interaction with plant location, location theory models for evaluation of alternate locations.

Unit 4 Plant Size

Economic plant size, factors affecting the plant size (technical and economical), raw material availability, market demand, competition in the market, return on investment etc.

Procedures for estimation of economic plant size (breakeven analysis and optimization), estimation of volume of production for each product.

Unit 5 Product and Process Design

Design of product, product specifications, least cost mix of raw materials, process design, process selection considering technical, economic and social aspects.

Process planning and scheduling, flow sheeting, flow diagrams and process flow charts including their design and computer aided development of flow charts.

Unit 6 Selection of Equipment

Process equipments, material handling equipment, service equipment, instruments and controls, considerations involved in equipment selection, economic analysis of equipment alternatives using optimization techniques and cash flows, economic decision on spare equipment, prediction of service life of the equipment.

Unit 7 Plant Layout

Types of layouts, considerations involved in planning an efficient layout, preparation and development of layout, evaluation of alternate layouts, use of computers in development and evaluation of layouts, equipment symbols, flow sheet symbols, electric symbols, graphic symbols for piping systems, standards for space requirement and dimensions, distances between critical plant areas and for different plant facilities.

Unit 8 Planning and Design of Service Facilities and Plant Surroundings

Requirements of the steam, refrigeration, water, electricity, waste disposal, lighting, ventilation, drainage, CIP system, dust removal, fire protection etc.

Design and installation of piping system, codes for building, electricity, boiler room, plumbing and pipe colouring.

Planning of offices, laboratories, lockers and toilet facilities, canteen, parking lots and roads, loading docks, garage, repair and maintenance shop, ware houses etc.

Unit 9 Workers Safety and Health Aspects

Falling hazards and safeguards, electric hazards, heat exposure, dust protection, noise control, protection against chemicals, fire safety, fumes, moist conditions, personnel

hygiene, sanitary requirements and standards, insect, rodent and bird control.

Unit 10 Building and Building Materials

Requirements in respect of building type, wall, ceiling and floor construction, building height and building materials.

Practical	Title
1	To prepare a feasibility report
2	To prepare a plant location report
3	To study design and layout of milk processing plant
4	To study design and layout of fruit processing plant
5	To study design and layout of beverage plant
6	To study design and layout of meat and meat products plant
7	To study design and layout of bakery and confectionery plant
8	To study design and layout of grain processing plant
9	To study design and layout of cold storage and warehouse
10	Design and layout of milk processing plant
11	Design and layout of fruit processing plant
12	Design and layout of beverage plant
13	Design and layout of meat and meat products plant
14	Design and layout of bakery and confectionery plant
15	Design and layout of grain processing plant
16	Design and layout of cold storages and warehouses

Text books

1. Food Plant Economics by Z.B. Maroulis and G.D. Sarvacos. Published by CRC press
2. Chemical Engineering Plant Design by Villbrandt F.C. and Dryden C.E. Published by McGraw-Hill
3. Plant Layout and Design by J.M. Moore Published by The Mcmillan company
4. Chemical Engineering Handbook by Perry R.H. Published by McGraw-Hill

Reference books

1. Project Feasibility Analysis by Clifton D.S. and D.E. Fyfee. Published by John Willey and Sons, New York
2. Process Plant Design by Backhusrt J.R. and J.H. Barker. Published by Heimann Educational Books, London
3. Plant Design and Economics for Chemical Engineers by Peters M.S. and K.D.Timmerhaus. Published by McGraw-Hill
4. Computer Aided Process Plant Design by Leesley M.E. Published by Gulf Publishing Company, Houston
5. Project Management for Engineers by M.D. Rosenau Published by Van Nostrand Reinhold Co., New York
6. Engineering Economic Analysis by W.T. Morris. Published by Reston Publishing Company, Inc., New York.

FPE 472 2 (1+1)

IT Applications in Food Industry

(16 Lectures + 16 Practical)

Unit 1 Introduction

Importance of computerization in food industry, operating environments and information systems for various types of food industries, principles of communication.

Unit 2 Supervisory Contro; and Data Acquision (SCADA)

Introduction to SCADA,

SCADA systems hardware and firmware

SCADA systems software and protocols

Landlines, local area network systems, modems, central site computer facilities

Unit 3 Spreadsheet Applications

Data Interpretation and Solving Problems

Cells, cell reference, functions, preparation of charts, use of macros to solve engineering problems, use of add-ins, use of solver

Unit 4 Web hosting and Webpage Design

Domain registration, web hosting, webpage design using web publishing software

Introduction to File Transfer Protocol (FTP)

Online food process control from centralized server system in processing plant

Unit 5 Use of Latlabs in Food Industry

Introduction to MATLAB

MATLAB interactive sessions, menus and toolbars, computing with MATLAB

Script files and editor/debugger, MATLAB help system, problem solving methodologies

Numeric, cell and structure array

Arrays, multidimensional arrays, element by element operations

Matrix operations, polynomial operations using arrays, cell arrays, structure arrays

Functions and Files in MATLAB

Elementary mathematical functions, user defined functions

Advanced function programming, working with data files

Programming using MATLAB, Program design and development, Relational operators and logical variables, Logical operators and functions, Conditional statements, loops, the switch structure, debugging MATLAB programs, applications to simulations.

Plotting and Model Building in MATLAB

XY plotting functions, subplots and overlay plots, special plot types, interactive plotting in MATLAB, function discovery, regression, the basic fitting interface, three dimensional plots

Introduction to Toolboxes useful to Food Industry

Curve fitting toolbox, Fuzzy logic toolbox, Neural Network toolbox, Image processing toolbox, statistical toolbox

Unit 6 Introduction to CFD Applications in Food Industry

Introduction to Computational Fluid Dynamics (CFD), governing equations of fluid dynamics. Models of flow, substantial derivative, divergence of velocity, continuity, momentum and energy equations. Physical boundary conditions, discretization. Applications of CFD in Food and beverage industry. Introduction to CFD softwares, GAMBIT and Fluent softwares

Practical	Title
1.	Introduction to various features in spreadsheet
2.	Solving problems using functions in spreadsheets
3.	To use Add-Ins in spread sheet and statistical data analysis using Analysis Tool pak
4.	To solve problems on regression analysis using Analysis Tool pak in spreadsheet
5.	To solve problems on optimization using solver package in spreadsheet
6.	Introduction to MATLAB
7.	Writing code using MATLAB programming
8.	To solve problems using Curve fitting toolbox in MATLAB
9.	To solve problems using Fuzzy logic toolbox in MATLAB
10.	To solve problems using Neural Network toolbox in MATLAB
11.	To solve problems using Image processing toolbox in MATLAB
12.	Introduction to GAMBIT software
13.	Creation of Geometry for laminar flow through pipe using GAMBIT
14.	Introduction to FLUENT software
15.	Import of geometry and application of boundary conditions
16.	To solve a problem on laminar flow using FLUENT

Text books

1. Computer Applications in Food Technology: Use of Spreadsheets in Graphical, Statistical and Process Analysis by R. Paul Singh, AP. Published by Academic Press
2. Practical SCADA for Industry by David Bailey and Edwin Wright. Published by Elsevier
3. Introduction to MATLAB 7 for engineers by William J. Palm. Published by McGraw Hill Professional
4. Computation Fluid Dynamics in Food Processing by Da Wen Sun. Published by CRC press
5. Web Design: A Complete Introduction by Jenny Chapman. Published by John Wiley & Sons

Reference books

1. Fundamentals of Food Process Engineering by R.T.Toledo. Published by Springer
2. Introduction to Web Design Using Microsoft FrontPage by Glencoe/McGraw-Hill Published by Glencoe/McGraw Hill

FPT 471 3 (2+1)

Food Packaging Technology & Equipment

(32 Lectures + 16 Practical)

Unit 1 Function and Types of Packaging

Introduction, functions of package, marketing consideration for a package; types of packaging

Unit 2 Basic Concept and Terminology

Barrier properties of packaging material, gas permeation rates- oxygen transmission rate (OTR), water vapour transmission rate (WVTR), bursting strength, tensile strength, tearing strength, drop test, puncture test, etc.

Unit 3 Packaging Materials

Metal container; glass jars; films- cellulose films, polyethylene, LDPE, HDPE, laminated films, co-extruded films, multi-layer films, edible and biodegradable films; rigid, semi rigid plastic containers and their manufacturing

Unit 4 Advantages and Limitations of Packaging Materials

Rigid packaging materials- wooden boxes and crates glass, metal container, rigid plastic; flexible packaging materials- plastics films, woven jute, paper, aluminium foils, laminates, paper board, corrugated fibre boards, cartons

Unit 5 Packaging Material for Raw and Processed Food Products

Selection criteria of packaging materials for raw and processed fruits and vegetables, milk and dairy products, meat and meat products

Unit 6 Machinery for Packaging

Bottle fillers, fillers for dry mixers, ice-cream fillers, Form fill and seal machines, vacuum packaging machine, shrink wrap packaging machine, tetra pack system

Unit 6 Labelling of Package and Shelf Life

Package labelling – functions, nutrition labelling, ingredient characterization handling instruction, and regulations; Shelf life of packaged food

Practical	**Title**
1.	Classification of various packages based on material and rigidity.
2.	Measurement of thickness of paper, film, paper boards.
3.	Determination of wax weight in paper packaging
4.	Measurement of grammage and water absorption of paper of paper boards.
5.	Measurement of bursting strength of paper of paper boards.
6.	Measurement of tear resistance of packaging material.
7.	Measurement of puncture resistance of packaging material.
8.	Measurement of tensile strength of packaging material.
9.	Measurement of grease resistance of papers.
10.	Determination of gas transmission rate of package films.
11.	Determination of coating on package materials.
12.	Identification of plastic films.
13.	Study of packaging film for their labelling characteristics and specifications
14.	Pre-packaging practices followed for packing fruits, vegetables
15.	Demonstration of can-seaming operation
16.	Determination of shelf life of food product

Text books

1. Hand Book of Packaging by Indian Institute of Packaging
2. Food Packaging and Preservation by M. Mathlouthi. Blackie Academic & Professional

Reference books

1. Hermeticity of Electronic Packages by Hal Greenhouse, William Andrew Publishing, LLC, Norwich, New York, U.S.A.
2. Fundamentals of Food packaging by F.A. Payne
3. Food Packaging by S. Stanley

FPT 472 4 (3+1)

Elective I - Bakery and Confectionery Products

(48 Lectures + 16 Practical)

Unit 1 Introduction to Bakery Technology

Historical development and status of bakery industry in India; introduction and definition of bakery products-bread, biscuit, cake, pastries, rusk, crackers, bun- PFA specifications of bakery products

Unit 2 Bread and Biscuit Processing

Bread- types; role of major and minor ingredients; processes of bread making; problems associated with bread; equipment for bread manufacturing; processing steps for biscuit, cookies, cracker, cakes and their major and minor ingredients

Unit 3 Nutrition and Quality of Bakery Products

Nutritional aspect of bakery products; quality evaluation of baked products

Unit 4 Confectionary

Confectionary- historical development; classification of confectionary products; basic technical considerations for confectionary products- TS, TSS, pH, acidity, ERH, RH etc. raw materials and their role in confectionary product; traditional confectionary products

Unit 5 Cocoa, Chocolate Processing

Cocoa bean- introduction, history and composition; processing of cocoa bean; processed product of cocoa; historical development in chocolate processing; ingredients and their role in chocolate; processing steps of chocolate processing- mixing, refining, conching, tempering, molding, cooling, coating, enrobing etc.

Unit 6 Candy and Toffee Processing

High boiled sweets/candy - composition, production and preparation of high boiled sweets- traditional, batch and continuous method; toffee- composition, types, ingredient and their role, batch and continuous method of toffee manufacturing;

Practical	**Title**
1.	Particle size analysis of flour
2.	Determination of protein content of flour and its characterisation
3.	Determination of moisture content of bread
4.	Effect of improver (potassium chloride) and preservative (propionate) on bread
5.	Dough extensibility test using dough extension rig
6.	Preparation and evaluation of bread
7.	Preparation and sensory evaluation of biscuits
8.	Determination of expansion ratio in biscuit
9.	Effect of various leavening agent (baking soda, ammonium carbonate) on biscuit characteristics
10.	Determination of crispiness of biscuit using texture analyzer
11.	Preparation and sensory evaluation of fruit/ sponge cakes
12.	Preparation and sensory evaluation of buns
13.	Determination of firmness of bread using texture analyser
14.	Preparation and sensory evaluation of pizza
15.	Preparation of high boiled sweets
16.	Determination of quality of sugar

Text Books

1. Biscuit, cracker and cookie recipes for the food industry by Duncan Manley, Woodhead Publishing Ltd and CRC Press LLC
2. Biscuit, cookie and cracker manufacturing manuals- Manual 1. Ingredients, by Duncan Manley, Woodhead Publishing Ltd and CRC Press LLC
3. Biscuit, cookie and cracker manufacturing manuals- Manual 2. Biscuit doughs by Duncan Manley, Woodhead Publishing Ltd and CRC Press LLC
4. Biscuit, cookie and cracker manufacturing manuals- Manual 3. Biscuit dough piece forming, by Duncan Manley, Woodhead Publishing Ltd and CRC Press LLC
5. Biscuit, cookie and cracker manufacturing manuals- Manual 4. Baking and cooling of biscuits, by Duncan Manley, Woodhead Publishing Ltd and CRC Press LLC
6. Biscuit, cookie and cracker manufacturing manuals- Manual 5. Secondary processing in biscuit manufacturing, by Duncan Manley, Woodhead Publishing Ltd and CRC Press LLC
7. Biscuit, cookie and cracker manufacturing manuals- Manual 6. Biscuit packaging and storage, by Duncan Manley, Woodhead Publishing Ltd and CRC Press LLC
8. Baking problems solved by S Cauvain and L Young, Woodhead Publishing Ltd and CRC Press LLC

FPT 472 4 (3+1)

Elective I – Fermented Food Products

(48 Lectures + 16 Practical)

Unit 1 Introduction

Fermentation- historical development; fermented food products of India; worldwide fermented food products; classification of fermented food products

Unit 2 Fermentation- Basic Concepts

Basic principles involved in fermentation; types of fermentation; starter culture; preparation and maintenance of bacterial, yeast and mold cultures for food fermentations

Unit 3 Fermented Milk Products

Processing, manufacture, storage and packaging of acidophilus milk, cultured butter-milk and other fermented milk; bio-chemical changes occurring during manufacture of fermented milks; factors affecting these changes and effects of these changes on the quality of finished products

Unit 4 Fermented Vegetable Products

Technological aspects of pickled vegetables, sauerkraut, cucumbers; mushrooms-cultivation and preservation;

Unit 5 Fermented Cereal and Pulse Products

Fermented soy sauce; microbiology and biochemistry; soy sauce manufacturing methods; miso fermentation - raw materials and microorganism for fermentation; comparison of indigenous and modern processing; spoilage microbes; tempeh-production and consumption, raw material used, essential steps of fermentation; indigenous fermented product-idli, dosa, dhokla etc

Unit 6 Fermented Fish and Meats Product

Fermented fish and fish products- fish sauces, fermented fish pastes;
fermented sausages- process for manufacture of fermented sausage
biochemical and microbiological changes during sausage ripening

Unit 7 Alcoholic Fermentation Products

Technology for processing of wine, cider, beer etc; microbiological and biochemical aspects

Unit 8 Other Fermented Products

Methods of manufacture for acetic acid/vinegar, baker's yeast, microbial protein, lactic acid etc

Practical	**Title**
1	Preparation and maintenance of bacterial, yeast and mold cultures for fermented food products
2	Preparation of media for different kinds of fermentations
3	Constructional and operational details of different fermentors
4	Study of various probiotics and their characteristics
5	Preparation and evaluation of cultured butter-milk
6	Preparation and evaluation of pickled vegetable and isolation of micro- organism involved
7	To study the preparation of sauerkraut
8	To visit to mushrooms processing unit
9	To prepare fermented soy sauce and its quality evaluation
10	Preparation and evaluation of tofu

11	Preparation and evaluation of idli
12	Preparation and evaluation of dhokla
13	To study the production of baker's yeast
14	To study malting/ brewing of barley
15	Estimation of alcohol content in fermented product
16	Visit to brewery/ winery

Text books

1. Industrialization of indigenous fermented foods by K.H. Steinkrauss, CRC Press
2. Handbook of Indigenous Fermented Foods by K.H. Steinkrauss, CRC Press
3. Outlines of Dairy Technology by Sukumar De, Oxford University Press

Reference books

1. Microbiology of fermented foods by B. J. B. Wood, Springer

FPT 472 4 (3+1)

Elective I – Processing Technology of Extruded and Expanded Foods

(48 Lectures + 16 Practical)

Unit 1 Introduction

Basic concepts, types-cold, hot; function and advantage of extruder; rheology and raw material characteristics for extrusion cooking-
starch based, protein based, soluble solids, nucleating substances, colouring, flavouring

Unit 2 Extruder Types and Selection

Types- single screw, twin screw; operating data for different types of extruder; ancillary equipment; selection of an extruder

Unit 3 Process Control in Extrusion

Introduction; key control points; instrumentation; process control

Unit 4 Extrusion and Nutritional Quality

Extrusion and nutritionla quality- macro nutrient, vitamin, minerals, non-nutrient healthful component of food;

Unit 5 Breakfast Cereals

Range of products, unit operations and technologies, process issues related to product range

Unit 6 Snack Foods

Formed dough products- potato; formed dough products- maize and other materials; pellet snacks, directly expanded snacks, co extruded snacks

Unit 7 Pet and Fish Foods

Various extruded pet foods; fish foods- floating type products

Unit 8 Puffed Food Products

Puffed products; oven puffed rice; gun puffed rice; puffed wheat products; continuous puffing

Text books

1. Technology of Cereals: An Introduction for Students of Food Science and Agriculture By Norman Leslie Kent, A. D. Evers, 4th Edition, Woodhead Publishing
2. Convenience and Fast Food Handbook by Marvin Edward Thorner, AVI Pub. Co.,
3. Extrusion cooking: technologies and applications By Robin Guy By Woodhead Publishing

Reference book

1. Handbook of Cereal Science and Technology By K Kulp and J. G. Ponte 2nd Edition, CRC
2. Shelf-life evaluation of foods By C. M. D. Man, Adrian A. Jones 2nd Edition, Springer

FPT 473 4 (3+1)

Elective II - Functional Foods and Nutraceuticals (48 Lectures + 16 Practical)

Unit 1 Introduction

Functional foods- concept and definition; nutraceutical concept and definition

Unit 2 Colonic Functional Foods and Nutraceuticals

Health aspects of functional colonic foods; probiotics, prebiotics, synbiotics as colonic functional food

Unit 3 Probiotics and Gastrointestinal Disorders

Probiotics and the immune system; probiotic functional foods and the treatment of gastrointestinal disorders

Unit 4 Functional Food and Nutraceuticals for Coronary Heart Disease

Coronary heart disease and risk factors; relevant lipid, effects of probiotics, prebiotics, synbiotics on blood lipids

Unit 5 Role of Functional Food and Nutraceuticals in Tumor

Nature of tumour growth; models of carcinogenesis; the role of functional food in tumor- mechanism of nutrient, phytochemicals

Unit6 Functional Fats and Spreads

Functional ingredients and chronic diseases- applications in fats and spreads; spreads containing fish oil; modified fats and oils; phytosterols; low fat spreads

Unit 7 Functional Confectionery

Types of functional confectionery; development and manufacture of functional confectionery products

Unit 8 Dietary Fibre Functional Products

Introduction; dietary fibre- definition, source; processing dietary fibre ingredients

Unit 9 UK and US Legislation and Functional Health Claims

Functional claims; packaging and labeling; nutrient modification and specific nutrient claims; disease-specific claims; Dietary Supplement Health and Education Act (DSHEA)

Unit 10 Market for Functional Food Products

Functional foods and consumers; the role of health in food choice; drivers of the functional foods market; the growth of the functional foods market in the US and other countries; regulatory context of functional food in various countries

Practical	Title
1	Study of various prebiotics and their characteristics
2	Study of various probiotic organisms and their characteristics
3	Method of propagation and maintenance of probiotic culture
4	Extraction and determination of phytochemicals
5	Extraction and determination of phenolics
6	Extraction and determination of flavanoids
7	Extraction and determination of tocopherols
8	Determination of saponin content
9	Compositional and nutritional analysis of functional food
10	Preparation of liquid, semi-solid and dried functional foods in laboratory

11 Study of viability of probiotic organisms in functional foods
12 Microbiological analysis of market functional foods.
13 Preparation of iced tea
14 Preparation of symbiotic yoghurt
15 Preparation of sports drink
16 Visit to nutraceuticals producing industry.

Text books

1. **Functional foods: Principles and technology by M Guo, Woodhead Publishing Limited, Abington Hall, Abington, Cambridge**
2. **Functional Foods Concept to Product by Glenn R. Gibson and Christine M. Williams, Woodhead Publishing Limited and CRC Press LLC**

Reference books

1. Functional Dairy Products by T Mattila-Sandholm and M. Saarela, Woodhead Publishing Limited and CRC Press LLC
2. Report on Functional Foods by Muriel Subirade, Food Quality and Standards Service (AGNS), Food and Agriculture Organization of the United Nations (FAO)
3. **Handbook of Nutraceuticals and Functional Foods by Robert E. C. Wildman, CRC Press**

FPT-473 4(3+1)

Elective II – Sugar and Jaggery Products

(48 Lectures + 16 Practical)

Unit 1 Introduction

Production and consumption status of sugar in India and worldwide, source and classification of sugar

Unit 2 Physico-chemical Properties of Sugar

Monosaccharide , disaccharide, dextrose, fructose, sucrose, physical and chemical properties of sucrose and reducing sugars- density, solubility, boiling point, heat of solution,

Unit 3 Cane Sugar

History, composition, harvest, respiration; maturation and use of ripeners; production of raw sugar; specialty products from sugarcane

Unit 4 Beet Sugar

History, composition, harvest; effect of ambient temperature and storage; production of raw sugar

Unit 5 Sugar from Palms and Maples

Palm and maple as sucrose sources; production and utilization of palm sucrose; production of maple syrup

Unit 6 Sugar Processing Technology

Cleaning; milling and extraction of juice from cane and beet; comparison of beet sugar juice and cane sugar juice/liquor; purification of cane and beet juice; evaporation of cane and beet juice; crystallization; centrifugation; drying; cane sugar recovery; storage and packaging; handling techniques of sugar, molasses.

Unit 7 Jaggery Processing Technology

Jaggery- introduction, history and classification; jaggery processing- cleaning, juice extraction; clarification of cane juice; boiling of cane juice; setting of jaggery; drying and storage; jaggery products- liquid jaggery, jaggery powder, jaggery chocolate

Unit 8 Quality Control and Standards

Quality control and standards for white sugar, brown sugar, jaggery

Practical	**Title**
1	Extraction of cane juice and evaluation of its quality
2	Study the effect of nautral clarification agent on clarification of cane juice
3	Study of chemical agents on clarification of cane juice
4	Study of centrifugal clarification of cane juice
5	Formulation and preparation of granulated sugar
6	Determination of sucrose using saccharimeter
7	Determination of concentration of unknown sugar solution
8	Processing and preparation of liquid jaggery
9	Processing and formulation of powdered jaggery
10	Processing and preparation of jaggery chocolate
11	Visit to sugar mill
12	Constructional and operational details of sugarcane crushers and allied equipments
13	Constructional & operational details of juice purification equipments
14	Constructional & operational details of juice concentration equipments
15	Constructional & operational details of juice crystallizer

16 Visit to jaggery processing unit

Text books

1. Introduction to Cane Sugar Technology By G. H. Jenkins, 2nd Edition, Elsevier
2. Sugar Technology: Beet and Cane Manufacture By P W van der Poel, H Schiweck, and T K. Schwartz, Verlag Dr Albert Bartens KG
3. Beet-sugar Technology By Richard A. McGinnis, 2nd edition, Beet Sugar Development Foundation
4. Principles of sugar technology By Pieter Honig, Elsevier Pub.

Reference books

1. Glossary of Sugar Technology: In Eight Languages, By C. A. Müller, Elsevier
2. Spencer-Meade Cane Sugar Handbook: A Manual for Cane Sugar Manufacturers and Their Chemists by G P Meade and G L Spencer, 9th Edition, J. Wiley

FPE 473 4 (3+1)

Elective III - Dairy Engineering

(48 Lectures + 16 Practicals)

Unit 1 Hygienic design concepts, sanitary pipes and fittings, CIP system, corrosion process and their control milking machine, bulk milk coolers, milk collecting center milk chilling units.

Unit 2 Milk reception equipments, milk tanks, stirrers and mixers, pasteurizers, sterilizers, centrifugation, homogenizer, packaging and filling machines.

Unit 3 Equipments for cheese, ice-cream, butter manufacture, special milk products, casein, whey, evaporators, dryers, cyclone separators, fluidized bed dryer.

Unit 4 Ultra-filtration and reverse osmosis, thermo compressor, MVR, drum dryers, tray dryers, and spray dryer, butter churn.

Unit 5 Equipment for indigenous milk product manufacturing. Small capacity milk processing equipment, village level sterilization and ascetic packaging.

Unit 6 Dairy plant Maintenance: Elements of preventive maintenance program: Equipment data collection, reporting and recording, principles of lubrication, lubricants and preparation of lubrication schedule. Maintenance organization, development of optimum organization Planned overhaul and PERT planning, engineering and general stores, workshop facilities in relation to the size and types of dairy plants.

Practical	**Title**
1.	Identification of hygienic characteristics of pipes and fittings in dairy plant
2.	To study CIP system for dairy plant
3.	To study technical specifications of milking and storage equipment
4.	To study technical specifications of equipment for chilling & pasteurization
5.	To study features of centrifuges and operation
6.	To study working principle of ice-cream freezers & packing machine
7.	To study design and principle of working of cheese vat
8.	To study working principle of milking machine
9.	To study working principle of press & packing machine
10.	To study butter manufacturing equipment
11.	To study different types of evaporators used in dairy industry
12.	To study different types of dryers used in dairy industry
13.	To study operation of spray dryers used in dairy industry
14.	To study operation of drum an vacuum dryers used in dairy industry
15.	To design milk collecting and chilling unit
16.	Visit to dairy industry

Text books

1. Ahmad T. 1995. Dairy Plant Engineering and Management. Kitab Mahal, Allahabad.
2. Kessler HG. 1981. Food Engineering and Dairy Technology. Verlag.

Reference books

1. Newcomer JL. 1981. Preventive Maintenance Manual for Dairy Industry.
2. Venus Trading Co., Anand.

FPE 473 4 (3+1)

Elective III – Principles of Maintenance of Equipment

(48 Lectures + 16 Practical)

Unit 1 Maintenance systems: Maintenance objectives and scopes; Maintenance strategies & organizations; Maintenance works; life cycle costs

Unit 2 Preventive Maintenance: Principles of preventive maintenance, procedures & selection; Preventive Maintenance planning, scheduling and control; Forms & resources; Maintenance work measurement; Modeling and analysis techniques in PM and inspections; Predictive maintenance.

Unit 3 Computerized Maintenance Management systems: Benefits and applications; Work order systems & plant registers; Maintenance reports, analysis and monitoring; Introduction to commercial packages

Unit 4 Equipment maintenance: Installation, commissioning and testing of plant equipment, checking for alignment, lubrication and lubrication schedule; maintenance of typical rotating and process equipment systems like turbines, pumps and fans, centrifuges, heat exchangers, boilers and pressure vessels etc.

Unit 5 Case studies interfacing areas with maintenance planning and scheduling of process equipment into PM & Predictive Maintenance.

Unit 6 Reliability Concepts: Basic concepts of probability theory and distributions, definition of reliability, , failure probability, reliability and hazard rate function, MTBF and MTTR, System reliability , series and parallel system, redundancy.

Unit 7 Introduction to advance topics: RCM: Seven basic questions for RCM, RCM procedures, Benefits of RCM, TPM: Goals of TPM and methodology, TPM improvement plan & procedures.

Practical	**Title**
1.	To study the maintenance schedules and systems in food processing plant
2.	To study the preventive maintenance systems
3.	To study the computerized maintenance management systems in food processing plant
4.	To study the lubrication of equipment and develop lubrication schedules
5.	To study maintenance of rotating type of equipment
6.	To study maintenance of heat transfer equipment
7.	Case study of equipment maintenance of dairy equipment
8.	Case study of equipment maintenance of fruit and vegetable processing equipment
9.	Case study of equipment maintenance of grain processing equipment
10.	Case study of equipment maintenance of cold storage equipment
11.	Case study of equipment maintenance of beverage industry equipment
12.	Case study of equipment maintenance of drying industry equipment
13.	To study the advanced maintenance software packages
14.	To study advanced maintenance systems like RCM and TMP
15.	To study the maintenance manuals of dairy processing equipment
16.	To study the maintenance manuals of fruits, vegetable and grain processing equipment

Text books

1. Maintenance Planning and scheduling hand book, Doc Palmer, McGraw Hill
2. Reliability Centred Maintenance, S Moughbray, Butterworth and Heinemann

3. Introduction to Total Productive Maintenance, S Nakajima, Productivity Press
4. The TPM Experience, P Willmott, Conference Communications

Reference books

1. Chemical Engineering Handbook by Perry R.H. Published by McGraw-Hill
2. Maintenance Strategy, Antony Kelly, Butterworth and Heinemann

FPE 473 4(3+1)

Elective III -Advanced Food Processing Machinery

(48 Lectures + 16 Practical)

Unit 1 Classification of food processing equipment and machinery based on thermal and non-thermal processing, wet and dry processing. Classification on the basis of processing steps and products

Unit 2 Advanced machinery for fruits and vegetable processing

Ascetic processing, automated plants of large scale processing of fruits and vegetable with raw material cleaning, sorting, grading, blanching and peeling equipment

Thermal processing equipment like continuous heat exchangers, tunnel (spray) pasteurisers, in container processing, UHT processing

Unit 3 Advanced machinery for evaporation and dehydration

Multiple effect evaporators, vapour recompression equipment, automated evaporators, and flash dryers, automated continuous and batch systems of tunnel, fluidized bed, vacuum and dielectric drying. Spray freezing equipment

Unit 4 Commercial food irradiation machinery, high pressure processing (HPP) equipment, HPP continuous and HPP Batch systems

Unit 5 Pulsed electric field (PEF) equipment, power ultra sound applicators, pulsed light equipment.

Equipment for High Voltage Arc Discharge , Oscillating Magnetic Fields and Plasma Processing

Equipment for pasteurization using carbon dioxide

Unit 6 Advanced bakery, extrusion and fermentation equipment

Practical	**Title**
1.	To study operation and working principle of multiple effect evaporator
2.	To study vapour recompression equipment
3.	To study electronic cleaning, grading and sorting machinery
4.	To study working of in-container processing equipment
5.	To study UHT equipment
6.	To study working principle of multiple effect evaporator
7.	To study working principle of dielectric dryers
8.	To study working principle of spray freezing equipment
9.	To study working principle of HPP equipment
10.	To study working principle of power ultrasound applicator
11.	To study working principle of pulsed light equipment
12.	To study working principle of pulsed electric field equipment
13.	To study working principle of equipment for pasteurization using carbon dioxide
14.	Visit to fruits processing industry
15.	Visit to cereal processing industry
16.	Visit to bakery industry

Text books

1. Food Processing Handbook, by J.G.Brennan, Published by WILEY-VCH Verlag GmbH & Co. KGaA

2. Handbook of Industrial Drying by A.S. Mujumdar. Published by Taylor and Francis

Reference books

1. Handbook of Food Engineering Practice by K.J. Valentas, Enrique Rostein and R.P. Singh. Published by CRC press

FBM 471 3 (3+0)
Marketing Management & International Trade

(48 Lectures)

Unit 1 Concept of marketing, functions of marketing, concepts of marketing management, scope of marketing management, marketing management. Process, concepts of marketing- mix, elements of marketing- mix.

Unit 2 Market structure and consumer buying behaviour: concept of market structure, marketing environment, micro and macro environments.

Unit 3 Consumers buying behaviour, consumerism. Marketing opportunities analysis: marketing research and marketing information systems.

Unit 4 Market measurement- present and future demand, market forecasting, market segmentation, targeting and positioning. Allocation and marketing resources.

Unit 5 Marketing planning process. Product policy and planning: product-mix, product line, product life cycle. New product development process. Product brand, packaging, services decisions. Marketing channel decisions. Retailing, wholesaling and distribution.

Unit 6 Pricing decisions. Price determination and pricing policy of food products in organized and unorganized sectors of food industry. Promotion-mix decisions.

Unit 7 Advertising, how advertising works, deciding advertising objectives, advertising budget and advertising message, media planning, personal selling, publicity, sales promotion. Food and dairy products marketing.

Unit 8 International marketing and international trade. Salient features of international marketing. composition & direction of Indian exports, international marketing environment, deciding which & how to enter international market

Unit 9 Exports- direct exports, indirect exports, licensing, joint ventures, direct investment & internationalization process

Unit 10 Deciding marketing programme, product, promotion, price, distribution channels. Deciding the market organization, World Trade Organization (WTO)

Text Books

1. Marketing Managemant by Phillip Kotler. Published by Prentice Hall of India, New Delhi
2. Marketing in the International Environment by Cundiff and Higler. Published by Prentice Hall of India, New delhi

Reference books

Marketing management by P.K. Srivastava,. Published by Himalaya Publishing House, New Delhi.
Advertising Management by David A Aamar, Rajiv batra and Mayers,. Published by Prentice Hall of India, New delhi

EIGHTH SEMESTER

FIE 481 23(0+23)

Food Process Plant Experience

FIE 482 2 (0+2*)

Educational Tour

*indicates non-credit course