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

- 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

- 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. Packaging Materials Unit 3 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

- 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

(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

(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 buttermilk and other fermented milk; bio-chemical changes occurring during manufacture of fermented milks; factors affecting these changes and effects of these changes on the quality of finished products

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 cookingstarch 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

- 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	Die tary Fibre Functional Products
TT . 4 0	Introduction; dietary nore- definition, source; processing dietary nore ingredients
Unit 9	UK and US Legislation and Functional Health Claims
	chime: disease specific aloging and labeling; numerit modification and specific numerit
	(DSUEA)
Unit 10	(DSILLA) Market for Functional Food Droducts
	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	
0	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

- 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.

- 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, 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.

- 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

- 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, 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
 - 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