

3-Year B.Tech FTBE Course:

FIRST YEAR FIRST SEMESTER						
Code No.	Subject	Pds / week			Marks	
		L	T	S	Exam	Sessional
FTBE/T/111	Biochemistry and Nutrition	5	0	0	100	
FTBE/T/112	Microbiology	3	0	0	100	
FTBE/Math/T/113	Mathematics-IH	4	0	0	100	
AM/ME/T/2	Solid Mechanics	4	0	0	100	
FTBE/T/115	Fluid Flow	3	0	0	100	
BM/ME/T/A	Basics of Mechanisms	4	0	0	100	
FTBE/S/111	Microbiology Lab	0	0	6		100
BED/ME/S/1	Basic Engineering Drawing	0	0	3		100
WS/ME/S/8A	Workshop Practice-VIII	0	0	3		100
	Sub - Total	23	0	12	600	300
	Total :		35			900

FIRST YEAR SECOND SEMESTER

Code No.	Subject	Pds / week			Marks	
		L	T	S	Exam	Sessional
FTBE/T/121	Chemistry of Foods	4	0	0	100	
FTBE/T/122	Heat transfer	3	0	0	100	
FTBE/T/123	Food Microbiology	3	0	0	100	
FTBE/Math/T/124	Mathematics-IIIH	4	0	0	100	
ETech/EE/T/B	Electrical Technology-B	4	0	0	100	

FTBE/T/126	Chemical Engineering Fundamentals	4	1	0	100	
FTBE/S/121	Chemistry of Food Lab	0	0	6		100
AED/ME/S/1	Advanced Engineering Drawing	0	0	3		100
WS/ME/S/11	Workshop Practice-XI	0	0	3		100
	Sub - Total	22	1	12	600	300
	Total :		35			900

First Year First Semester

FTBE/T/111 **BIOCHEMISTRY AND NUTRITION**

Introduction to biochemical sciences. Enzyme and coenzymes : Introduction, definition, nomenclature, classification, numbering, structure and functions of coenzyme energy-rich -compounds, active centre of enzymes, mechanisms of enzyme action, effect of temperature, pH, enzyme concentration and substrate concentration on the rate of enzyme reaction. Specificity of enzymes, enzyme inhibition, kinetics of enzyme action, activation of enzymes; regulatory enzymes , iso enzymes; enzymes involved in digestion. Metabolism of carbohydrates: Embden - Meyerhoff pathway, cori and corycycle, muscle contraction and relaxation, Neuberg second and third form of fermentation, Kreb's cycle, Glyxlnate by-pass, Hexosemonophosphate shunt pathway. Electron transport chain, oxidative phosphorylation and substrate linked phosphorylation, energy balances . Metabolism of lipids: Digestion and absorption of lipids , fatty liver, lipotropic agents, oxidation pathway, oxidation of odd- carbon- chain fatty acids, Ketone bodies, energy balance, Lipid biosyntehsis. Metabolism of proteins: Importance proteins, digestion and absorption of proteins, amino acid pool,

nitrogen balance, essential amino acids, evaluation of quality of proteins, general metabolism of proteins and amino acids. Nucleic acids and protein biosynthesis.

The functions of food. Fuel value of foods. Basal metabolism. Total energy need of individuals engaged in different activities. Determination of food energy.

Physiological fuel value of foods, calculation of energy value of foods. Methods of measuring or estimating caloric value of a diet. Physiological functions, role in metabolism and daily requirements of vitamin A, D, E, K, C, Thiamin, riboflavin, niacin, pyridoxin, cyanocobalamin, folic acid, choline, p-aminobenzoic acid, pantothenic acid. Minerals as structural and functional constituents in human metabolism. Specific role of iron, calcium, phosphorus, sodium, potassium, magnesium, chlorine, zinc, copper and iodine. Dietary interrelationship.

Functional foods. Nutraceuticals. Assessment of nutritional status of populations. Problems of under nutrition and effect of calorie over nutrition. Diet and dental health. Nutrition during pregnancy, lactation and aging. Nutrition of children. Selection of an adequate diet. New developments in foods and nutrition.

FTBE/T/112 MICROBIOLOGY

The importance of microbes in food and fermentation industries. The microscope.

Morphology of bacteria. Moulds and yeast. Dyes and staining techniques.

Nutrition of microbes. Techniques of pure culture. Bacterial genetics.

Differentiation and classification of bacteria. Bacterial viruses. Microbial respiration of proteins. Disinfection and disinfectants. Pasteurization, sterilisation and autoclaving. Energy metabolism of aerobic and anaerobic microbes.

Nitrogen fixation. Bacteriology of air, water, milk and milk products, fish, fruit and vegetable.

FTBE/Math/T/113 MATHEMATICS-IH

Functions of several variables. Taylor's theorem. Maxima and minima.
Lagrange's method of undetermined multipliers.
Fourier series in $()$ and $(-1, 1)$. Fourier half-range series. Applications. Laplace Transform and its inverse. Applications to ordinary linear differential equations and simultaneous ordinary linear differential equations with constant coefficients. Linear partial differential equations with constant coefficients. Solution of one dimensional wave and diffusion equations and two dimensional Laplace equation and Poisson's equation. Applications.
Series solution of ordinary linear differential equation. Bessel functions. Recurrence relations. Legendre polynomials. Recurrence relations and orthogonal property.

AM/ME/T/2 **SOLID MECHANICS**

Statics

Introduction, Idealisation of Mechanics, Fundamentals of Vector Algebra, Application of Vectors in Statics, Equivalent system, Equilibrium, FBD concept.

Strength of Materials

Uniaxial Stress field, Thin pressure vessels, Torsion, Shear force and Bending moment, Bending stress in beams, Deflection in beams, Buckling of columns (Euler's formula).

FTBE/T/115 **FLUID FLOW**

Introduction to the properties of different types of fluid. Fluid pressure and pressure measuring devices. Fluid Kinematics. Streamline flow, turbulent flow, unsteady flow. Equation of continuity, Navier - Stokes equation. Hagen Poiseuille equation. Fanning's equation, Euler equation, Bernoulli's equation, total energy balance equation. Flow of compressible fluid through nozzles. Fluidization. Flow measuring devices such as orificemeter, venturimeters, rotameter and weir. Energy losses in pipes, valves and fittings. Two phase flow

and flow through packed bed. Concept of boundary layer separation and vortex formation.

BM/ME/T/A **BASICS OF MECHANISMS**

Introduction: Mechanism and machine, pairs of element, linkages, degrees of freedom.

Velocity and acceleration analyses of simple mechanisms.

Power transmission devices: belt & pulley, gear, cam & cam follower, clutch, brake.

FTBE/S/111 **MICROBIOLOGY LABORATORY**

General procedures for aseptic work. Study of microscope. Staining of bacteria and observation of size, motility, meta-chromatic granules, flagella capsules and spore. Morphology of yeasts and moulds. *S. Cerevisiae*. *C. utilis*, preparation of nutrient broth and media with agar, gelation and special media for culture of microbes. Technique of pure culture, plating by pour plate and streak plate methods. Determination of bacterial species. Anaerobic cultures. Effect of temperature, UV light, osmotic pressure, desiccation, pH, surface tension and oligodynamic action on growth of bacteria. Determination of thermal death and Thermal death point of bacteria. Evaluation of growth modules and values of D_p . Growth constant for bacteria cells. Phenol coefficient, methylene blue reduction test. Hydrolysis of starch, liquefaction of gelatin, hydrolysis of casein and glycerides. Detection and accounting of coliform bacteria and Salmonella. Bacteriological examination of water, milk, dried fish and fish meal and canned foods.

BED/ME/S/1 **BASIC ENGINEERING DRAWING**

Drawing primitives: instruments, letters, lines, title block, geometric curves & shapes, scale and dimension.

Projection: orthographic and isometric, sectional views.

WS/ME/S/8A **WORKSHOP PRACTICE-VIII (Forging and Moulding)**

Forging: Introduction to forging tools, furnaces and forging machines; to practice basic forging operations- drawing out, upsetting, necking etc.; introduction to forge welding.

Introduction to moulding practice- preparation of moulding sand and use of moulder's tools; making of moulds by using selected pattern's; introduction to melting and pouring practice; experiments sand testing like permeability, moisture content, shutter index, mould strength, grain fineness number etc.; demonstration of injection moulding machine.

First Year Second Semester

FTBE/T/121 **CHEMISTRY OF FOODS**

Proximate composition of foods. Water in foods. Carbohydrate : Introduction.

Definition nomenclature, Classification general properties of sugar (Physical and chemical) : Identification of common monosaccharides, disaccharides and polysaccharides; determination of the amount of reducing and non-reducing sugars. Chemistry of starch, glycogen, cellulose, gums and mucilages crude fibre. Physiological functions of carbohydrates. Proteins : Physical and chemical properties of amino acids, chromatographic separation of amino acids, classification of proteins, amino acid sequence in proteins, pleatedsheet and helix structure of proteins, tertiary structure and conformation of proteins.

Physical and chemical properties of proteins, molecular weight of proteins and ultracentrifuge, preparation and purification of proteins, protein denaturation, food proteins and their characteristics. Lipids : Classification of lipids, fatty acid, soap and detergency, essential fatty acids, fats and oils saponification number, acid number, Iodine value, acetyl value, Reichert-Meissl number, oxidative and hydrolytic rancidity, reversion, waxes, phosphoglycerides, sphingo lipids, non-saponifiable lipids, cholesterol, prostaglandins, lipid bilayers, monolayers and micelles, structure of cell membrane. Natured pigments and flavouring agents :

Chlorophyll, carotenoids, Anthocyanins, Anthoxanthins, Flavonoids, Tannins, Natural flavour constituents. Vitamins : Occurrence, chemistry, loss during storage, transport and processing of foods of provitamin A & D, vitamin A, D, E, K, C, B, H niacin, pyridoxin, cyanocobalamine, folic acids p-aminobenzoic acid, biotin, choline.

FTBE/T/122 HEAT TRANSFER

Introduction to mode of heat transfer, Fourier's law. Steady state heat transfer through composite slabs, composite cylinders and spheres. Fundamentals of heat loss from pipe wall by conduction. Basic concept of individual and overall heat transfer co-efficients, log-mean temp. difference, different useful correlations in forced convection and natural convection. Basic concept of Reynold's analogy. Introduction to heat transfer during condensation and boiling liquids. Types and design characteristics of heat exchangers, condenser, reboiler and evaporators. Kirchoff's law and radiant heat transfer between surfaces and pyrometry. Basic concept of unsteady state heat transfer.

FTBE/T/123 FOOD MICROBIOLOGY

Development of microorganisms in Food. Taxonomy, Role and significance of microorganisms in Foods. Intrinsic and Extrinsic parameters of Foods that affect microbial growth. Microorganisms important in Food Microbiology. General principles underlying spoilage and chemical changes of foods caused by microorganisms. Contamination, Preservation and Spoilage of different kinds of foods namely- fruits & vegetables, fish, meat, egg and their products, Milk and milk products. Fermented foods. Determination of the presence of microorganisms and / or their products in Foods by different techniques. Food borne infection and intoxication. Food sanitation, control and inspection.

Books:

1. Modern Food Microbiology : James M. Jay.
2. Food Microbiology : W. C. Frazuir, D. C. West Hoff.

FTBE/Math/T/124 **MATHEMATICS-IIH**

Numerical methods : Graphical solution of a single non-linear equation and Newton's method of approximation to real roots. Numerical integration by trapezoidal rule and Simpson's one-third rule.

Statistical methods : Frequency distribution. Mean variance and standard deviation. Symmetrical and non-symmetrical distributions. Skewness. Principle of least squares. Application to linear and parabolic laws.

Rigid dynamics : Moments of inertia of symmetrical bodies. B'Alembert's principle. Equations of motion about fixed axis. Two dimensional motion.

Hydrostatics : Liquid pressure, density and specific gravity. Liquid at rest under gravity. Resultant and centre of pressure on a plane area. Principle of Archimedes. Floating bodies.

ETech/EE/T/B **ELECTRICAL TECHNOLOGY-B**

DC Circuits: Kirchhoff's Laws. Maxwell's Loop Current Methods of Analysis. Star-Delta Conversion. Superposition Theorem. Thevenin's Theorem. Maximum Power Transfer.

Magnetic Circuit: MMF, Flux, Reluctance. B-H Loop. Hysteresis and Eddy current loss. Magnetic circuit analysis with air gap.

AC 1 -phase: Periodic Waves and Sinusoids. Average and RMS Values, Form Factor, Peak Factor. Phasor concept of Sinusoids. Impedance and Admittance. Power, Power Factor, V A, V AR. Series R-L-C Circuit, Parallel R-L-C circuit. Resonance.

Balanced 3-phase: 3-phase AC balanced circuits. Phase-sequence. Star and Delta connections. Power, V A, V AR, Power Factor _or balanced 3-phase circuits.

Power Measurement: Wattmeter circuit connection. Power Measurement by two wattmeter methods in 3phase system.

DC Machines: Construction and general principle of operation. Generator EMF

Equation. Field connection ,shunt series and compound. Generator characteristics.

Motor-equation and general operation. starting and speed control, torque -speed curve.

1-Phase Transformer: Construction. EMF equation. Phasor diagram. Equivalent circuits. Losses and Efficiency. Open circuit and Short circuit test.

3-Phase Induction Machine: Types of induction machines. Rotating magnetic field, slip ,torque equation, torquespeed curve.DOL starting and reduced voltage starting.

3-Phase Synchronous Machines: Alternator, constructional features, EMF equation, synchronous reactance, power -angle characteristics.

Concept of synchronous motor.

Meters: DC and AC Ammeters and Voltmeters. Megger.Multiplier.

Books :

1. Electrical Science by Prof. S. Chowdhury, Prof. R. Chakraborty & Prof. P. K. Chatterjee.
2. Electrical Machines by Prof. P.K. Mukherjee & Prof. S. Chakravorti.

FTBE/T/126 CHEMICAL ENGINEERING FUNDAMENTALS

- i)a) Units and dimensions b) Mathematical techniques in process calculations
- ii) Physico Chemical properties of Gases, Liquids, Solids.
- iii) Material balance calculations : Without and with chemical reactions
- iv) Energy balance calculations : a) Principle of energy conversion and conservation b) Thermophysics c) Thermochemistry d) Energy balance Calculations : without and with chemical reactions.

FTBE/S/121 CHEMISTRY OF FOOD LABORATORY

Errors and accuracy in analysis food materials. Sampling not contents and preparation of samples for analysis. Determination of moisture, ash, lipids,

nitrogen (Protein and non protein) reducing and non-reducing sugar in samples of foods. Estimation of iodine value, saponification value, acid value, non-saponifiable matter, soluble and insoluble acids, neutralisation values, reichert value and Krischner value in fats and oils. Estimation of iron, phosphorus, copper, lead, arsenic and tin. Estimation of ascorbic acid, nicotinic acid, pyridoxin, thiamin, riboflavin vitamin A, choline and carotene, detection and estimation of amino acids, chlorophyll and carotenoids by paper and column chromatography. Estimation of activity of Papain, taka-diastase, pancreatin and phosphatase. Study on the effect of temperature pH and substrate concentration on enzyme activity.

AED/ME/S/1 ADVANCED ENGINEERING DRAWING

True length, development of surface of simple objects. Threaded joint & riveted joints, cotter/knuckle joint. Pulley, shaft coupling.

WS/ME/S/11 WORKSHOP PRACTICE-XI (Fitter Shop and Machine Shop)

Introduction to fitter's tools, gauges, measuring instruments etc.; marking of jobs; fitter's job involving chipping, filing, sawing, drilling; use of taps and dies; pipe fittings and plumbing.

Introduction to machine tools - lathes, drilling machines, shaping machines, planing machines, slotting machines, milling machines, grinding machines; machine shop work involving different operations by using the above mentioned machines through making of jobs.

Second Year First Semester

FTBE/T/211 PRINCIPLES OF FOOD PRESERVATION

General introduction to food technology. Construction of sanitary cans and testing of cans, can lacquers and can scaling compounds. Preservation by application of heat. Various canning techniques. Dehydration, water activity of food, intermediate moisture food. Preservation of food by removal of heat, cold

storage and freezing including cryogenic freezing of food. Curing oicklling. Preservation by ionization radiation use of chemical and preservatives in food preservation. Preservation by fermentation.

FTBE/T/212 **TECHNOLOGY OF FOODS-I (Technology of fish, meat and poultry)**

World production of fish, meat and poultry. Consideration of fish, as food assessment of quality of fish. Effect of method of catching and handling on the quality of fish. Handling of wet fish on board the catching vessel and on landing storage and transport of wet fish. Preservation of fish by different methods. Manufacture of fish protein concentrates, fish sauce and fish liver oil and other important by-products and quality control aspects of processed fish pisciculture and breeding. Processing of meat and meat products; curing, smoking, manufacture of sausage, ham bacon and other products. Meat analogues. Processing of poultry. Egg and egg products composition nutritive value. Preservation of egg by different methods. Egg quality assessment. By-product utilization.

FTBE/T/213 **TECHNOLOGY OF FOODS-II (Technology of Cereals, legumes and confectionaries)**

Storage of cereals, infestation control and use of pesticide Drying of grains. Processing of rice and rice products. Milling of wheat and production of wheat products including flour, bread, biscuits, cakes and other confectionery products. Milling of corn barley, oat, coarse grains including sorghum, ragi and millets. Toxic factors in cereals. In festation control. Proximate composition of legumes. Amino acid balance, inhibitors, toxic factors and processing methods : By products utilisation.

FTBE/T/214 **MECHANICAL OPERATION**

1. Size reduction, granulation, partials separation. Crushing and grinding; different types of equipment open-circuit and closed circuit grinding, power requirement. Granulation and other size enlargement operations. Particle separation; sampling and screening. Particle size measurement, cyclone separator, bag filter magnetic and electrostatic separator.
2. Hydraulic separation and concentration. Hydraulic separation, heavy media-separation. Digging, Froth-flotation elutriation, tabling.
3. Sedimentation flocculation : Free & hindered setting, thickening, counter current decantation flocculation and flocculating agents.
4. Filtration : Theory of filtration, filter equipment, filter medium filter aid. Filter auxiliaries, centrifuges.
5. Mixing of solids, liquids and slurries.
6. Material handling : handling of fluids, slurries and solids, pumps.

FTBE/T/215 MICROBIAL TECHNOLOGY

Economic activities of microorganisms. Propagation of food, food and bakery yeasts. Technology of production of alcohol, glycerol and beer. Mechanism of alcohol and glycerol fermentation. Production of wine and other alcoholic beverages (whiskey, rum etc.). Activities of lactic acid bacteria and industrial production of lactic acid. Activities of acetic acid bacteria and production of vinegar sorbose acid dihydroxy acetone. Production of dextrans. Amino acid fermentation. Metabolic controls in industrial fermentation. Saccharifying agents-methods of production and uses. Activities of molds. Microbial production of organic acids viz. Citric, gluconic, fumaric itaconic, gibberellic and kojic acids. Microbial production of vitamins B2 and B12. Production, isolation and use of microbial enzymes, immobilized enzymes and their applications. Production of glucose and fructose and starch by enzymatic methods. Production of mushroom mycelium by submerged culture process. Production of algal protein and recent advances. Microbiological transformation of steroids. Production and isolation of

antibacterial antibiotics like penicillin, streptomycin, chloromycetin, tetracyclines, semisynthetic penicillins. Antifungal antibiotics.

CHEMICAL ENGINEERING THERMODYNAMICS

Thermodynamic properties: Pressure, volume, temperature, internal energy and enthalpy. Thermodynamic process, state and path function. Reversible and irreversible processes. Equations of state. First and second law of thermodynamics applications to batch and flow systems. Carnot cycle. Clausius inequality theorem and entropy. Statistical concept of entropy. Work function thermodynamic potential fundamental differential equations. Fugacity and activity. Maximum work and availability. General Equations of Equilibrium: Chemical potential evaluation of chemical potentials and fugacities. Third law of thermodynamics: Thermodynamics of fluid flow, heat exchange and refrigeration cycle, compression refrigeration, absorption and expansion of fluids. Power cycle. Vapour liquid equilibrium introduction.

FTBE/S/211 MICROBIAL TECHNOLOGY LABORATORY

Production, recovery and control tests of the following fermentation production. Alcohols, bakers' yeast, food yeast, citric acid, enzymes (amylases, pectinases etc.) Vitamin B, amino acids (glutamic acid, valine etc.), antibiotics penicillin, streptomycin, neomycin etc.) Analysis of ferment gas including experiments of carbon balance. Methods of screening antibiotic producing organism. Determination of purity of the culture.

FTBE/EE/S/212 ELECTRICAL TECHNOLOGY LABORATORY

Experiments to supplement the theoretical course on "Electrical Technology-B".

MDR/ME/S/1 MACHINE DRAWING

Stuffing Box, Pipe Joints, Valves, Tool head of shaping machine, Plummer Block, Engine Parts.

Second Year Second Semester

FTBE/T/221 TECHNOLOGY OF FOODS-III (Dairy Technology)

Chemical composition and nutritive value and physical characteristic of milk and milk products. Handling of fresh milk. Pasteurization of milk. Homogenization of milk. Manufacture of milk products like condensed, evaporated and dried milk, creamed, butter ghee, ice cream. Fermented milk products. Technology of cheese. Fortification of milk products. Production of infant milk food. Imitation milk. Quality control in milk and milk products including various analytical techniques of determination of milk quality. Milk plant hygiene and sanitation. Plant of dairy waste.

FTBE/T/222 WASTE TREATMENT ENGINEERING

1. Environment and energy of nature.
2. Water for food and biochemical industries.
3. Stream pollution and measurement.
4. a) Physical treatment. b) Chemical treatment. c) Drying and incineration.
5. Industrial waste treatment : a) Vacuum treatment b) Sludge lagooning. c) Drying and incineration.
6. Treatment and disposal of sludge solids a) Vacuum treatment b) Sludge lagooning c) Drying and incineration.
7. Microbial flocculation and sedimentation, Design of biofilters and bioclarifiers. Ion exchange in biological fluids.
8. Biogas.

FTBE/T/223 SEPARATION PROCESS – I

Theory of diffusional processes – molecular and eddy diffusion in fluids, measurement of diffusivity. Theory of interphase mass – transfer, mass transfer coefficients and mass transfer theories. Analogy between heat mass and momentum transfer. Theory of absorption of a single component from gas mixtures wetted wall column. Design principles of absorption towers. Theory of

desorption operation. Fundamental principles of liquid-liquid extraction, selectivity and choice of solvent. Material balances in stage operations and principles of graphical methods in determination of number of equilibrium stages.

Fundamental principles of leaching operation and material balance calculations.

Theory of crystallisation, material and energy balance calculations, introduction to crystallizer design, introduction to the principles of adsorption.

FTBE/ME/T/224 THERMAL ENGINEERING

Study of properties of steam. Study of different types of boilers. Different types of heat engines (with descriptive study). Different heat transfer equipments.

Descriptive study of small power plant and water treatment plants.

FTBE/ET/T/225 ELEMENTARY ELECTRONICS

Energy band structure of metals, semi-conductors and insulators; Electron conduction in intrinsic and extrinsic semiconductors; P-Type and N-Type semiconductors; P-N junction; Metal-conductor junction

Junction diode, zenner and avalanche breakdown, rectifiers, filters and voltage regulators, BJT and its characteristics in CB and CE configurations; Bias stability, Low frequency, small signal analysis of BJT using simplified hybrid models; basic concepts of feedback amplifiers.

FET and MOSFET - Characteristics and applications

Digital System; Elements of Digital Circuits - AND, OR, NOT, NOR, NAND gates. Flip-flops (R-S, J-K, Master-Slave), ExOR, Half Adder & Full Adder.

FTBE/CSE/T/226 NUMERICAL METHODS & COMPUTER

PROGRAMMING

Introduction to computer system. Programme logic and flow charts. Fortran programming. Numerical Methods : Approximations and errors. Solution of linear system of equalitions. Matrix inversion. Interpolation. Numerical differentiation and integration curve fitting. Numerical solution of ordinary differential equations.

FTBE/S/221 MICROBIAL TECH. LABORATORY

Production, recovery and control tests of the following fermentation production.

Alcohols, bakers' yeast, food yeast, citric acid, enzymes (amylascs, pectinases

etc.), vitamin B12 amino acids (glutamic acid, lysine, valine etc.) antibiotics (penicillin, streptomycin, neomycin etc.). Analysis of ferment gas including experiments on carbon balance. Methods of screening antibiotic producing organism. Determination of purity of the culture.

FTBE/S/222 FOOD ANALYSIS LABORATORY

Extraction, separation and identification, water and oil soluble dyes. Detection and estimation of additives in food materials net as, boric acid, benzoates, sulphites, formaldehyde, formic acid, lactic acid, saccharine cyclamate, dulcin etc. Analysis of following food stuffs : with reference to the standards of quality fixed for these : milk, jam, jelly, squash, vinegar, cider, rice and wheat. Changes in the vitamins ascorbic acid and thiamin in canned vegetables during thermal treatment. Available lysine content in fish-meal.

FTBE/CSE/S/223 PROGRAMMING PRACTICE LABORATORY

To supplement the theoretical course on "Numerical Methods & Computer Programming".

MDD/ME/S/2 MACHINE DESIGN AND DRAWING

Basic idea of design, factor of safety, modes of failure, theories of failure, design under static and fatigue loading.

Design of Cotter/knuckle Joint, threaded and riveted joint, eccentric loading.

Shaft coupling (rigid / flexible). Belt-pulley drive. Pressure vessel.

Third Year First Semester

FTBE/T/311 TECHNOLOGY OF FOODS-IV (Tech. of fruits, vegetables food legislations, quality control and packaging)

Storage and handling of fresh fruits and vegetables. Preservation of fruits and vegetables by heat treatment. Processing and preservation of fruits and vegetable juices. Preparation of jam, jelly and marmalade, pickles chutneys and

vinegar, tomato products. Fermented fruit and vegetable products. Freezing and dehydration of fruits and vegetables. Concentration of fruits and vegetables. Food additives, physiology of ripening. Physical and chemical treatment to increase post harvest life of fruits and vegetables. Role of plant growth regulators in post harvest storage. Fermented foods, pickling and curing of food. Intermediate moisture foods. By product and their utilization. Preparation of spice powder in other miscellaneous spice and condiment products. Coconut and its derivatives. Preparation of non alcoholic beverage. Technology of tea, coffee, cacao. Food-laws the food rules and standards, quality control of food and food products. Sensory evaluation of food colour flavour, texture, shape etc. Instrumental methods of analysis of food statistical quality control. Operation research and plant organization and management packaging materials and their physicochemical characteristics. Various types of packaging including vacuum, gas pack. Different problems in packaging of food stuff, packaging equipment. Package design. Test procedures for packages.

FTBE/T/312 BIOCHEMICAL ENGINEERING AND BIOTECHNOLOGY

Improvement in processed food by the application of various biotechnological processes. Technology of conventional and non conventional fermentation based food products from cereals, legumes, fruits, vegetables, milk, fish, meat etc. Biotechnological process for manufacture of food staff and food etc. Fermentation production of modified carbohydrates, lipids and proteins and their purification techniques. Studies on changes in clour , flavour and organoleptic test during processing and storage of the fermented food and chances of spoilage of the products due to process defects. Evaluation and standardization of quality and safety of the fermented food products by the application of modern techniques. Production of microbial biomass and its economic aspects. Downstream processing of fermented products. Regulatory and social aspects of Biotechnology modified foods. Production of crude enzymes- their isolation and different purification processes kinetics of enzyme catalyzed reactions. Kinetics

of biological growth. Effects of other parameters like pH, temperature, fluid forces, chemical agents and irradiation on enzyme activity. Immobilization of enzymes and whole cells on insoluble supports, different techniques of immobilization, immobilized enzyme technology, industrial uses of the immobilized enzyme, enzyme reactors and analytical study of their performance. Introduction to genetic Engineering , tissue culture and immunology.

FTBE/T/313 **PROJECT ENGG. & PROCESS PLANT COSTING**

Introduction to plant design and project engineering. Process selection and evaluation. Pilot and semi-commercial plants scale-up techniques. Selection of materials of construction and specification of process equipments with special considerations for equipments and accessories of Food and Biochemical projects. Plant layout. Location of plant, raw materials and utilities. Objectives and business organization rules and procedures of process plant costing to man power, material, equipment and utilities. Analysis of production and productivity in joint products and by-products. Cost reduction techniques, optimization techniques and assessment of alternatives. Conceptual frame work on marginal costing and profitability. Application of PERT & CPM in project planning and monitoring. Techno-economic case studies in Food and Biochemical projects. Introduction of computer applications in project engineering and process plant costing.

FTBE/T/314 **SEPARATION PROCESSES – II**

Distillation : Vapor – Liquid equilibrium, relative volatility batch and equilibrium distillation, steam distillation, molecular distillation, azeotropic and extractive distillation, enthalpy-concentration diagram. Theory of rectification column design. Theory of sublimation Principles of humidification and dehumidification operations. Principles of construction and use of Psychrometric chart. Introduction to the design of humidifiers, dehumidifiers and cooling towers. Theory of drying of solids, liquids and gases. Introduction to dryer design.

FTBE/T/315 **PROCESS INSTRUMENTATION & CONTROL**

Process variables : Need for their measurement and control pressure measurement by mechanical and electrical transducers. Low pressure measurement by Mcleod Gage and Pirani gage. Temperature measurement by bi-metal thermometers, resistance thermometer thermistors, thermocouples. Radiation and optical pyrometers. Flow measurement by Hot – Wire ammeter and magnetic flow meters. Visualization by shadow-graph and interferometer. Liquid level measurement in open vessels and in pressure vessels. Thermal conductivity measurement of solids, liquids and gases. Measurement of diffusivity in gases. Block diagrams. Transfer function closed-loop and open-loop control systems. Response of first order systems and first order systems. Response of time constant. Different types of controllers. Final control elements. Closed loop transfer functions. Stability Root locus method. Frequency response. Level control. Flow control. Dynamics and control of heat exchangers and distillation columns.

CHEMICAL ENGINEERING KINETICS

Chemical Reaction Equilibria ; rate of chemical reaction; mechanism of reactions; collision and activated complex theories. Arrhenius equation. Interpretation of batch reactor data for simple and complex reactions. Homogeneous reactions. Design equations for batch; plug flow, semi- batch stirred tank, adiabatic and programmed reactions, concept of mixed reactors, thermal stability of reactors. Heterogeneous reactions. Introduction to noncatalytic and catalytic reactions, determination of rate controlling steps; Introduction to noncatalytic and catalytic reactions ; determination of rate controlling steps; Introduction to fluidized bed reactors; Preparation of catalyst; measurement of catalyst surface area and catalyst poisoning.

FTBE/S/311 **SEMINAR/GR. DISCUSSION**

Students will be required to carryout under the supervision of the staff members, a literature search and will prepare review papers on selected topics. Every student will do critical review of assigned subjects in Food Technology or Bio-chemical Engineering. Review of assigned subjects in food technology or Biochemical Engineering will be followed by discussions.

FTBE/S/312 **FOOD PROCESSING & QUALITY CONTROL LABORATORY**

Preparation of squash, jam, jellies, marmalade, preserved and candied fruit. Preparation of alcoholic beverages. Preparation of pickles, chutneys, sauces, fermented vegetables & tomato products. Fruit juice concentrate & powder. Preservation of fruits & vegetables, fish meat etc. by canning freezing, drying and quality assessment of the processed products. Testing of can preparation of ice cream & other frozen products. Preparation of confectionery products including bread, biscuits, cake etc. Preservation of milk by heat treatment. Preparation of various milk based products. Enumeration of faecal indicator organisms, salmonella & pathogenic organism in processed food. Detection and identification of food spoilage organisms. Quality assessment of processed food.

FTBE/S/313 **BIOCHEMICAL ENGINEERING & INSTRUMENTATION** **LABORATORY-I**

FTBE/S/322 **BIOCHEMICAL ENGINEERING & INSTRUMENTATION** **LABORATORY-II**

- i) Experiments on microbial engineering enzyme and genetic engineering, waste engineering and cellular genetics and tissue culture.
- ii) Also the following experiments in the instrumentation lab. of Chemical Engineering Dept. for four weeks.
 - a) Characteristics study of diode and triode.
 - b) Measurement of moisture in slabs.
 - c) Temperature control of a reactor/fermentor.

- d) Step response of thermocouple introduced in furnace/ovens.
- e) Pneumatic transmitter etc.

FTBE/ChE-ME/S/314

**FTBE/ChE-ME/S/323 CHEMICAL & MECHANICAL ENGINEERING
LABORATORY-I & II**

Flow of fluids through flow meters such as venturimeters, Orifice meters, rotameters, weirs, etc. Calibration of flow meters. Friction through bends, fittings, etc. Efficiency of pump. Measurement approximate critical velocity of liquid. Rate of filtration under different pressures. Drying rate under constant drying conditions. Running of vacuum drum drier water distillation plant. Concentration by forth floatation. Screen analysis of crushed products. Packed tower operations. Rectification of binary moisture. Also experiments in the mechanical laboratory.

Third Year Second Semester

FTBE/T/321 FOOD PROCESS ENGINEERING

Evaluation of process time in canning by different methods. Different types of sterilizers, seaming machine and other accessories used in canning industries. Engineering aspects of pasteurizer, homogenizer, evaporators and concentrators used in food industries. Construction of cold storage and different types of freezers including plate freezers, blast freezer cryogenic freezing. Vacuum freezing. Refrigerated vans and wagons. Equipment used for grading and sizing of food. Engineering aspect of various types of driers, including trays drier roller drier, spray drier, fluidized bed drier, freeze drier, solar drier. Extruder (Principles and method), Effect of extrusion parameter on product quality and optimization. Emulsifiers. Different equipment used for processing of food. Food Irradiation Technology.

FTBE/T/322 TECHNOLOGY OF FOODS-V (Tech. Of oils and fats):

Status of oils and fats and Indian economy. General chemistry, Analytical methods for characterization. Quality standards of edible oils and fats. Antioxidants and rancedity and fats indiet, nutrition and disease. Detection of adulteration.

Extraction and clarification of vegetable oil. Modifications of the properties of oils and fats incuding chemical and biotechnological processes. Confectionery plastic fats. Preparation of various products including different shortenings, margarine, salad dressing and mayonnaise, imitation of dairy products low calorie spreads. Animal fat, oil derivatives. Technology of oilseed protein isolate.

FTBE/T/323 BIOCHEMICAL ENGINEERING

Characteristic properties of biological fluids. Dynamics of microbial growth different growth models for microbial processes – Dynamics of continuous culture. Kinetics of thermal death of micro organisms – Mechanisms of thermal sterilization and sterilization by filteration – Design criteria and design guatious for sterilizations for sterilization processes, sterilization processes design for air. Materials of constructions for fermentation processes equipments. Differentt types of bio-reactors in use and their operation. Design and analysis of biological reactors. Aeration and agitation – oxygen supply and demand in microbial processes – Single and Multiple dubble reaction. Oxygen transfer in fermentation – Design of spargers and aeration equipment – Scale-up of biological reactors. Instrumentation and control operation; bio-reactors. Micro processors controlled fermentation.

MNG/ME/T/1 INDUSTRIAL MANAGEMENT

Growth of Industries, Management thoughts and scientific management, Taylorism; Factory system of production, Introduction to management problems, Types of manufacture, Planning analysis and control aspects in industries. Types of business ownership, means of finance and business combinations, organization structures, committee organization, authority and responsibility, duty

and span of control.

Plant location, factory buildings and physical facilities, plant layout, tools and techniques of plant layout, materials - handling arrangements. Product development, standardization, simplification and diversification.

Functions of production, planning and control, production forecasting, production scheduling and network techniques, Gantt chart, CPM, PERT etc.

Work study, job evaluation and merit rating; purchase system and inventory control. Inspection and quality control of systems, statistical quality control, maintenance and replacement policies for machine and equipments; decision making theories, breakeven analysis cost benefit analysis, evaluation of financial and managerial efficiencies. Introduction to operational research techniques.

Application of fuzzy logic in modern management concepts. Human relations in industry and labour compensation. Personnel management, provision of industrial legislations in India. Wage and salary administrations. Welfare and safety provisions, trade union acts. Study of environmental impacts and environmental laws.

Text Book:

Production and operations management: S.N.Chari

Reference books:

1. " Industrial Management" by: Basu & Majmundar (Birla Pub., Newdelhi)
2. " Quantitative techniques in management" by: N.D.Vohra (Tata Mcgraw Hill)
3. "Production systems analysis and control" by : Riggs
4. "Works organization and management by: Basu, Sahoo & Dutta.
5. Fuzzy logic with Engineering applications: Timothy J. Ross (Mcgraw Hill)

FTBE/T/325 ELECTIVE PAPER

1. COMPUTER APPLICATION FOR FERMENTATION PROCESS

2. PLANT OPERATION, MAINTENANCE AND SAFETY

3. NON-CONVENTIONAL ENERGY & POLLUTION CONTROL

FTBE/T/325A **COMPUTER APPLICATION FOR FERMENTATION PROCESS**

A. Computer : (1) Hardware (2) Software B. Instrumentation : i) Physical measurements, temperature, vessel pressure, volume/level weight, density, power input, agitation speed gas flow rate, liquid media feed rate, viscosity forming. ii) Chemical measurement : pH, biomass, gas oxygen and carbon dioxide concern dissolved oxygen, dissolved carbon dioxide, nitrogen source, ionic strength, redox potential, enzyme coupled sensors, microbe-coupled sensors, calorimeters, automatic sampling and inoculation, other methods. iii) Bio-chemical measurement : ATP/ADP, NAD/.NADH, Cytophotometry and cytofluorometry. iv) Biological measurement.

B. Sole estimation and parameter identification : Indirect measurement, microscope material/energy balances. On line estimation.

C. Modelling : Types of growth models, consideration in modelling and the use of models in computer control.

FTBE/T/325B **PLANT OPERATION, MAINTENANCE AND SAFETY**

Introduction to the structure of systems of plant operation, maintenance and safety. System interactions and degree of freedom with man, material and equipment. Factory rules and procedures with Indian and International specifications in operation, maintenance and safety. Effects of economic design criteria in optimum plant operation. Trouble shooting operation and maintenance in presence of uncertainty. Simulation for interpretation in difficult plant operation. Introduction to microprocessor based operations. Inspection, testing and analysis of tolerance limit and types of failure. Conditions based maintenance and its economical viability. Hazards and operative (HAZOP) analysis. Accidents and emergency preventive procedures. Insurance claim and loss analysis. Case studies on Food and Biochemical plants.

FTBE/T/325C **NON-CONVENTIONAL ENERGY & POLLUTION CONTROL**

- a) Fundamental concept of environmental system. Climatic aspects of pollution causes of Air pollution. Control of air pollution caused by industries and agriculture, viz. Sulfur dioxide removal from waste gases. Water quality, system for treating water and wastes, by physical, chemical and biological treatment processes. Processing of sludge Reuse of Water. Sensing, Instrumentation and measurement of air and water quality. Environmental education for creating awareness of pollution among people. Legal consideration. b) Energy forms and basic laws. Different types of solid gaseous fuels. World Energy Resources and consumption. The nature of Solar energy, Biological and chemical conversion of solar energy. Energy conservation in industries. Wind and tides and other forms of energy like geothermal energy etc. Renewable energy system for application in agriculture. Development of equipments based on the use of energy obtainable from non conventional sources.

b)

FTBE/T/326 **GENERAL VIVE-VOCE**

Based on all the theoretical and sessional subjects of all the semesters.

FTBE/S/321 **HOME DESIGN/PROJECT**

Students will be assigned Home design problem on selected designs of plant and equipment, related to Food Technological and Biochemical or similar industries. The design problem should be worked out by students under the guidance of teachers. Complete design with drawings should be submitted by the students within prescribed date. Alternatively, the students will be assigned one project work to carry out a particularly experiment and to find out experimental data under the guidance of departmental teachers. The Home design/project report along with vive will be considered as an examination paper, carrying 100 marks for the final examination.

FTBE/S/324 **FOOD ENGINEERING LABORATORY**

Evaluation of F & T values of two types of microorganisms encountered in spoilage of canned food. Determination of process time by graphical & formula method. Drying rate characteristics of different food materials. Studies on dehydration in spray drier. Spray drier, fluidized bed drier, freeze drier etc. Parboiling of paddy, wheat & other cereals & determination of their milling characteristics. Extraction and refining of oil from various oil seeds. Production of rice bran oil. Milling of spices & determination of oil & oleoresin. Evaluation of properties of different packaging material. Extrusion pro.

3-Year B.Tech FTBE Course:

SECOND YEAR FIRST SEMESTER						
Code No.	Subject	Pds / week			Marks	
		L	T	S	Exam	Sessional
FTBE/T/211	Principles of Food Preservation	4	0	0	100	
FTBE/T/212	Technology of Foods-I	3	0	0	100	
FTBE/T/213	Technology of Foods-II	3	0	0	100	
FTBE/T/214	Mechanical Operation	4	0	0	100	
FTBE/T/215	Microbial Technology	4	0	0	100	
	Chemical Engg. Thermodynamics	4	1	0	100	
FTBE/S/211	Microbial Technology Lab	0	0	5		100
FTBE/EE/S/212	Electrical Technology Lab	0	0	3		100
MDR/ME/S/1	Machine Drawing	0	0	4		100
	Sub - Total	22	1	12	600	300
	Total :		35			900

SECOND YEAR SECOND SEMESTER

Code No.	Subject	Pds / week			Marks	
		L	T	S	Exam	Sessional
FTBE/T/221	Technology of Foods-III	3	0	0	100	
FTBE/T/222	Waste Treatment Engg	4	0	0	100	
FTBE/T/223	Separation Process-I	3	0	0	100	

FTBE/ME/T/224	Thermal Engineering	3	0	0	100	
FTBE/ET/T/225	Elementary Electronics	3	0	0	100	
FTBE/CSE/T/226	Numerical Methods & Computer Programming	3	0	0	100	
FTBE/S/221	Microbial Tech. Lab	0	0	4		100
FTBE/S/222	Food Analysis Lab	0	0	5		100
FTBE/CSE/S/223	Programming Practice Laboratory	0	0	3		100
MDD/ME/S/2	Machine Design & Drawing	2	0	4		100
	Sub - Total	21	0	16	600	400
	Total :		37			1000

First Year First Semester

FTBE/T/111 BIOCHEMISTRY AND NUTRITION

Introduction to biochemical sciences. Enzyme and coenzymes : Introduction, definition, nomenclature, classification, numbering, structure and functions of coenzyme energy-rich -compounds, active centre of enzymes, mechanisms of enzyme action, effect of temperature, pH, enzyme concentration and substrate concentration on the rate of enzyme reaction. Specificity of enzymes, enzyme inhibition, kinetics of enzyme action, activation of enzymes; regulatory enzymes , iso enzymes; enzymes involved in digestion. Metabolism of carbohydrates: Embden - Meyerhoff pathway, cori and corycycle, muscle contraction and relaxation, Neuberg second and third form of fermentation, Kreb's cycle, Glyxlnate by-pass, Hexosemonophosphate shunt pathway. Electron transport

chain, oxidative phosphorylation and substrate linked phosphorylation, energy balances . Metabolism of lipids: Digestion and absorption of lipids , fatty liver, lipotropic agents, oxidation pathway, oxidation of odd- carbon- chain fatty acids, Ketone bodies, energy balance, Lipid biosynthesis. Metabolism of proteins: Importance proteins, digestion and absorption of proteins, amino acid pool, nitrogen balance, essential amino acids, evaluation of quality of proteins, general metabolism of proteins and amino acids. Nucleic acids and protein biosynthesis.

The functions of food. Fuel value of foods. Basal metabolism. Total energy need of individuals engaged in different activities. Determination of food energy. Physiological fuel value of foods, calculation of energy value of foods. Methods of measuring on estimating caloric value of a diet. Physiological functions, role in metabolism and daily requirements of vitamin A, D, E, K, C, Thiamin, riboflavin, niacin, pyridoxin, cyanocobalamin, folic acid, choline, p-aminobenzoic acid, pantothenic acid. Minerals as structural and functional constituents in human metabolism. Specific role of iron, calcium, phosphorus, sodium, potassium, magnesium, chlorine, zinc, copper and iodine. Dietary interrelationship. Functional foods. Nutraceuticals. Assessment of nutritional status of populations. Problems of under nutrition and effect of calorie over nutrition. Diet and dental health. Nutrition during pregnancy, lactation and aging. Nutrition of children. Selection of an adequate diet. New developments in foods and nutrition.

FTBE/T/112 MICROBIOLOGY

The importance of microbes in food and fermentation industries. The microscope. Morphology of bacteria. Moulds and yeast. Dyes and staining techniques. Nutrition of microbes. Techniques of pure culture. Bacterial genetics. Differentiation and classification of bacteria. Bacterial viruses. Microbial respiration of proteins. Disinfection and disinfectants. Pasteurization, sterilisation and autoclaving. Energy metabolism of aerobic and anaerobic microbes.

Nitrogen fixation. Bacteriology of air, water, milk and milk products, fish, fruit and vegetable.

FTBE/Math/T/113 **MATHEMATICS-IH**

Functions of several variables. Taylor's theorem. Maxima and minima.

Lagrange's method of undetermined multipliers.

Fourier series in $()$ and $(-1, 1)$. Fourier half-range series. Applications. Laplace Transform and its inverse. Applications to ordinary linear differential equations and simultaneous ordinary linear differential equations with constant coefficients. Linear partial differential equations with constant coefficients. Solution of one dimensional wave and diffusion equations and two dimensional Laplace equation and Poisson's equation. Applications.

Series solution of ordinary linear differential equation. Bessel functions.

Recurrence relations. Legendre polynomials. Recurrence relations and orthogonal property.

AM/ME/T/2 **SOLID MECHANICS**

Statics

Introduction, Idealisation of Mechanics, Fundamentals of Vector Algebra, Application of Vectors in Statics, Equivalent system, Equilibrium, FBD concept.

Strength of Materials

Uniaxial Stress field, Thin pressure vessels, Torsion, Shear force and Bending moment, Bending stress in beams, Deflection in beams, Buckling of columns (Euler's formula).

FTBE/T/115 **FLUID FLOW**

Introduction to the properties of different types of fluid. Fluid pressure and pressure measuring devices. Fluid Kinematics. Streamline flow, turbulent flow, unsteady flow. Equation of continuity, Navier - Stokes equation. Hagen Poiseuille equation. Fanning's equation, Euler equation, Bernoulli's equation,

total energy balance equation. Flow of compressible fluid through nozzles. Fluidization. Flow measuring devices such as orificemeter, venturimeters, rotameter and weir. Energy losses in pipes, valves and fittings. Two phase flow and flow through packed bed. Concept of boundary layer separation and vortex formation.

BM/ME/T/A **BASICS OF MECHANISMS**

Introduction: Mechanism and machine, pairs of element, linkages, degrees of freedom.

Velocity and acceleration analyses of simple mechanisms.

Power transmission devices: belt & pulley, gear, cam & cam follower, clutch, brake.

FTBE/S/111 **MICROBIOLOGY LABORATORY**

General procedures for aseptic work. Study of microscope. Staining of bacteria and observation of size, motility, meta-chromatic granules, flagella capsules and spore. Morphology of yeasts and moulds. *S. Cerevisiae*. *Cutilis*, preparation of nutrient broth and media with agar, gelation and special media for culture of microbes. Technique of pure culture, plating by pour plate and streak plate methods. Determination of bacterial species. Anaerobic cultures. Effect of temperature, UV light, osmotic pressure, desiccation, pH, surface tension and oligodynamic action on growth of bacteria. Determination of thermal death and Thermal death point of bacteria. Evaluation of growth modules and values of D_p . Growth constant for bacteria cells. Phenol coefficient, methylene blue reduction test. Hydrolysis of starch, liquefaction of gelatin, hydrolysis of casein and glycerides. Detection and accounting of coliform bacteria and *Salmonella*. Bacteriological examination of water, milk, dried fish and fish meal and canned foods.

BED/ME/S/1 **BASIC ENGINEERING DRAWING**

Drawing primitives: instruments, letters, lines, title block, geometric curves & shapes, scale and dimension.

Projection: orthographic and isometric, sectional views.

WS/ME/S/8A WORKSHOP PRACTICE-VIII (Forging and Moulding)

Forging: Introduction to forging tools, furnaces and forging machines; to practice basic forging operations- drawing out, upsetting, necking etc.; introduction to forge welding.

Introduction to moulding practice- preparation of moulding sand and use of moulder's tools; making of moulds by using selected pattern's; introduction to melting and pouring practice; experiments sand testing like permeability, moisture content, shutter index, mould strength, grain fineness number etc.; demonstration of injection moulding machine.

First Year Second Semester

FTBE/T/121 CHEMISTRY OF FOODS

Proximate composition of foods. Water in foods. Carbohydrate : Introduction.

Definition nomenclature, Classification general properties of sugar (Physical and chemical) : Identification of common monosaccharides, disaccharides and polysaccharides; determination of the amount of reducing and non-reducing sugars. Chemistry of starch, glycogen, cellulose, gums and mucilages crude fibre. Physiological functions of carbohydrates. Proteins : Physical and chemical properties of amino acids, chromatographic separation of amino acids, classification of proteins, amino acid sequence in proteins, pleated sheet and helix structure of proteins, tertiary structure and conformation of proteins.

Physical and chemical properties of proteins, molecular weight of proteins and ultracentrifuge, preparation and purification of proteins, protein denaturation, food proteins and their characteristics. Lipids : Classification of lipids, fatty acid, soap and detergency, essential fatty acids, fats and oils saponification number, acid number, Iodine value, acetyl value, Reichert-Meissl number, oxidative and

hydrolytic rancidity, reversion, waxes, phosphoglycerides, sphingo lipids, non-saponifiable lipids, cholesterol, prostaglandins, lipid bilayers, monolayers and micelles, structure of cell membrane. Natural pigments and flavouring agents : Chlorophyll, carotenoids, Anthocyanins, Anthoxanthins, Flavonoids, Tannins, Natural flavour constituents. Vitamins : Occurrence, chemistry, loss during storage, transport and processing of foods of provitamin A & D, vitamin A, D, E, K, C, B, H niacin, pyridoxin, cyanocobalamine, folic acids p-aminobenzoic acid, biotin, choline.

FTBE/T/122 **HEAT TRANSFER**

Introduction to mode of heat transfer, Fourier's law. Steady state heat transfer through composite slabs, composite cylinders and spheres. Fundamentals of heat loss from pipe wall by conduction. Basic concept of individual and overall heat transfer co-efficients, log-mean temp. difference, different useful correlations in forced convection and natural convection. Basic concept of Reynold's analogy. Introduction to heat transfer during condensation and boiling liquids. Types and design characteristics of heat exchangers, condenser, reboiler and evaporators. Kirchoff's law and radiant heat transfer between surfaces and pyrometry. Basic concept of unsteady state heat transfer.

FTBE/T/123 **FOOD MICROBIOLOGY**

Development of microorganisms in Food. Taxonomy, Role and significance of microorganisms in Foods. Intrinsic and Extrinsic parameters of Foods that affect microbial growth. Microorganisms important in Food Microbiology. General principles underlying spoilage and chemical changes of foods caused by microorganisms. Contamination, Preservation and Spoilage of different kinds of foods namely- fruits & vegetables, fish, meat, egg and their products, Milk and milk products. Fermented foods. Determination of the presence of microorganisms and / or their products in Foods by different techniques. Food borne infection and intoxication. Food sanitation, control and inspection.

Books:

1. Modern Food Microbiology : James M. Jay.
2. Food Microbiology : W. C. Frazuir, D. C. West Hoff.

FTBE/Math/T/124 MATHEMATICS-IIH

Numerical methods : Graphical solution of a single non-linear equation and Newton's method of approximation to real roots. Numerical integration by trapezoidal rule and simpson's one-third rule.

Statistical methods : Frequency distribution. Mean variance and standard deviation. Symetrical and non-symetrical distributions. Skewness. Principle of least squares. Application to linear and parabolic laws.

Rigid dynamics : Moments of inertia of symmetrical bodies. B'Alembert's principle. Equations of motion about fixed axis. Two dimensional motion.

Hydrostatics : Liquid pressure, density and specific gravity. Liquid at rest under gravity. Resultant and centre of pressure on a plane area. Principle of Archimedes. Floating bodies.

ETech/EE/T/B ELECTRICAL TECHNOLOGY-B

DC Circuits: Kirchhoff's Laws. Maxwell's Loop Current Methods of Analysis. Star-Delta Conversion. Superposition Theorem. Thevenin's Theorem. Maximum Power Transfer.

Magnetic Circuit: MMF, Flux ,Reluctance. B-H Loop. Hysteresis and Eddy current loss. Magnetic circuit analysis with air gap.

AC 1 -phase: Periodic Waves and Sinusoids. Average and RMS Values, Form Factor, Peak. Factor. Phasor concept of Sinusoids. Impedance and Admittance. Power, Power Factor, V A, V AR. Series R-L-C Circuit ,Parallel R-L-C circuit. Resonance.

Balanced 3-phase: 3-phase AC balanced circuits. Phase-sequence. Star and Delta connections. Power, V A, V AR, Power Factor _or balanced 3-phase circuits.

Power Measurement: Wattmeter circuit connection. Power Measurement by two wattmeter methods in 3phase system.

DC Machines: Construction and general principle of operation. Generator EMF Equation. Field connection ,shunt series and compound. Generator characteristics.

Motor-equation and general operation. starting and speed control, torque -speed curve.

1-Phase Transformer: Construction. EMF equation. Phasor diagram. Equivalent circuits. Losses and Efficiency. Open circuit and Short circuit test.

3-Phase Induction Machine: Types of induction machines. Rotating magnetic field, slip ,torque equation, torque speed curve.DOL starting and reduced voltage starting.

3-Phase Synchronous Machines: Alternator, constructional features, EMF equation, synchronous reactance, power -angle characteristics.

Concept of synchronous motor.

Meters: DC and AC Ammeters and Voltmeters. Megger.Multiplier.

Books :

1. Electrical Science by Prof. S. Chowdhury, Prof. R. Chakraborty & Prof. P. K. Chatterjee.
2. Electrical Machines by Prof. P.K. Mukherjee & Prof. S. Chakravorti.

FTBE/T/126 CHEMICAL ENGINEERING FUNDAMENTALS

- i)a) Units and dimensions b) Mathematical techniques in process calculations
- ii) Physico Chemical properties of Gases, Liquids, Solids.
- iii) Material balance calculations : Without and with chemical reactions
- iv) Energy balance calculations : a) Principle of energy conversion and conservation b) Thermophysics c) Thermochemistry d) Energy balance Calculations : without and with chemical reactions.

FTBE/S/121 **CHEMISTRY OF FOOD LABORATORY**

Errors and accuracy in analysis food materials. Sampling not contents and preparation of samples for analysis. Determination of moisture, ash, lipids, nitrogen (Protein and non protein) reducing and non-reducing sugar in samples of foods. Estimation of iodine value, saponification value, acid value, non-saponifiable matter, soluble and insoluble acids, neutralisation values, reichert value and Krischner value in fats and oils. Estimation of iron, phosphorus, copper, lead, arsenic and tin. Estimation of ascorbic acid, nicotinic acid, pyridoxin, thiamin, riboflavin vitamin A, choline and carotene, detection and estimation of amino acids, chlorophyll and carotenoids by paper and column chromatography. Estimation of activity of Papain, taka-diastrase, pancreatin and phosphatase. Study on the effect of temperature pH and substrate concentration on enzyme activity.

AED/ME/S/1 **ADVANCED ENGINEERING DRAWING**

True length, development of surface of simple objects. Threaded joint & riveted joints, cotter/knuckle joint. Pulley, shaft coupling.

WS/ME/S/11 **WORKSHOP PRACTICE-XI (Fitter Shop and Machine Shop)**

Introduction to fitter's tools, gauges, measuring instruments etc.; marking of jobs; fitter's job involving chipping, filing, sawing, drilling; use of taps and dies; pipe fittings and plumbing.

Introduction to machine tools - lathes, drilling machines, shaping machines, planing machines, slotting machines, milling machines, grinding machines; machine shop work involving different operations by using the above mentioned machines through making of jobs.

Second Year First Semester

FTBE/T/211 **PRINCIPLES OF FOOD PRESERVATION**

General introduction to food technology. Construction of sanitary cans and testing of cans, can lacquers and can scaling compounds. Preservation by application of heat. Various canning techniques. Dehydration, water activity of food, intermediate moisture food. Preservation of food by removal of heat, cold storage and freezing including cryogenic freezing of food. Curing oicklling. Preservation by ionization radiation use of chemical and preservatives in food preservation. Preservation by fermentation.

FTBE/T/212 **TECHNOLOGY OF FOODS-I (Technology of fish, meat and poultry)**

World production of fish, meat and poultry. Consideration of fish, as food assessment of quality of fish. Effect of method of catching and handling on the quality of fish. Handling of wet fish on board the catching vessel and on landing storage and transport of wet fish. Preservation of fish by different methods. Manufacture of fish protein concentrates, fish sauce and fish liver oil and other important by-products and quality control aspects of processed fish pisciculture and breeding. Processing of meat and meat products; curing, smoking, manufacture of sausage, ham bacon and other products. Meat analogues. Processing of poultry. Egg and egg products composition nutritive value. Preservation of egg by different methods. Egg quality assessment. By-product utilization.

FTBE/T/213 **TECHNOLOGY OF FOODS-II (Technology of Cereals, legumes and confectionaries)**

Storage of cereals, infestation control and use of pesticide Drying of grains. Processing of rice and rice products. Milling of wheat and production of wheat products including flour, bread, biscuits, cakes and other confectionery products. Milling of corn barley, oat, coarse grains including sorghum, ragi and millets. Toxic factors in cereals. In festation control. Proximate composition of legumes.

Amino acid balance, inhibitors, toxic factors and processing methods : By products utilisation.

FTBE/T/214 MECHANICAL OPERATION

1. Size reduction, granulation, partials separation. Crushing and grinding; different types of equipment open-circuit and closed circuit grinding, power requirement. Granulation and other size enlargement operations. Particle separation; sampling and screening. Particle size measurement, cyclone separator, bag filter magnetic and electrostatic separator.
2. Hydraulic separation and concentration. Hydraulic separation, heavy media-separation. Digging, Froth-flotation elutriation, tabling.
3. Sedimentation flocculation : Free & hindered setting, thickening, counter current decantation flocculation and flocculating agents.
4. Filtration : Theory of filtration, filter equipment, filter medium filter aid. Filter auxiliaries, centrifuges.
5. Mixing of solids, liquids and slurries.
6. Material handling : handling of fluids, slurries and solids, pumps.

FTBE/T/215 MICROBIAL TECHNOLOGY

Economic activities of microorganisms. Propagation of food, food and bakery yeasts. Technology of production of alcohol, glycerol and beer. Mechanism of alcohol and glycerol fermentation. Production of wine and other alcoholic beverages (whiskey, rum etc.). Activities of lactic acid bacteria and industrial production of lactic acid. Activities of acetic acid bacteria and production of vinegar sorbose acid dihydroxy acetone. Production of dextrans. Amino acid fermentation. Metabolic controls in industrial fermentation. Saccharifying agents-methods of production and uses. Activities of molds. Microbial production of organic acids viz. Citric, gluconic, fumaric itaconic, gibberellic and kojic acids. Microbial production of vitamins B2 and B12. Production, isolation and use of microbial enzymes, immobilized enzymes and their applications. Production of

glucose and fructose and starch by enzymatic methods. Production of mushroom mycelium by submerged culture process. Production of algal protein and recent advances. Microbiological transformation of steroids. Production and isolation of antibacterial antibiotics like penicillin, streptomycin, chloromycetin, tetracyclines, semisynthetic penicillins. Antifungal antibiotics.

CHEMICAL ENGINEERING THERMODYNAMICS

Thermodynamic properties: Pressure, volume, temperature, internal energy and enthalpy. Thermodynamic process, state and path function. Reversible and irreversible processes. Equations of state. First and second law of thermodynamics applications to batch and flow systems. Carnot cycle. Clausius inequality theorem and entropy. Statistical concept of entropy. Work function thermodynamic potential fundamental differential equations. Fugacity and activity. Maximum work and availability. General Equations of Equilibrium: Chemical potential evaluation of chemical potentials and fugacities. Third law of thermodynamics: Thermodynamics of fluid flow, heat exchange and refrigeration cycle, compression refrigeration, absorption and expansion of fluids. Power cycle. Vapour liquid equilibrium introduction.

FTBE/S/211 MICROBIAL TECHNOLOGY LABORATORY

Production, recovery and control tests of the following fermentation production. Alcohols, bakers' yeast, food yeast, citric acid, enzymes (amylases, pectinases etc.) Vitamin B, amino acids (glutamic acid, valine etc.), antibiotics penicillin, streptomycin, neomycin etc.) Analysis of ferment gas including experiments of carbon balance. Methods of screening antibiotic producing organism. Determination of purity of the culture.

FTBE/EE/S/212 ELECTRICAL TECHNOLOGY LABORATORY

Experiments to supplement the theoretical course on "Electrical Technology-B".

MDR/ME/S/1 MACHINE DRAWING

Stuffing Box, Pipe Joints, Valves, Tool head of shaping machine, Plummer Block, Engine Parts.

Second Year Second Semester

FTBE/T/221 TECHNOLOGY OF FOODS-III (Dairy Technology)

Chemical composition and nutritive value and physical characteristic of milk and milk products. Handling of fresh milk. Pasteurization of milk. Homogenization of milk. Manufacture of milk products like condensed, evaporated and dried milk, creamed, butter ghee, ice cream. Fermented milk products. Technology of cheese. Fortification of milk products. Production of infant milk food. Imitation milk. Quality control in milk and milk products including various analytical techniques of determination of milk quality. Milk plant hygiene and sanitation. Plant of dairy waste.

FTBE/T/222 WASTE TREATMENT ENGINEERING

1. Environment and energy of nature.
2. Water for food and biochemical industries.
3. Stream pollution and measurement.
4. a) Physical treatment. b) Chemical treatment. c) Drying and incineration.
5. Industrial waste treatment : a) Vacuum treatment b) Sludge lagooning. c) Drying and incineration.
6. Treatment and disposal of sludge solids a) Vacuum treatment b) Sludge lagooning c) Drying and incineration.
7. Microbial flocculation and sedimentation, Design of biofilters and bioclarifiers. Ion exchange in biological fluids.
8. Biogas.

FTBE/T/223 SEPARATION PROCESS – I

Theory of diffusional processes – molecular and eddy diffusion in fluids, measurement of diffusivity. Theory of interphase mass – transfer, mass transfer coefficients and mass transfer theories. Analogy between heat mass and momentum transfer. Theory of absorption of a single component from gas mixtures wetted wall column. Design principles of absorption towers. Theory of desorption operation. Fundamental principles of liquid-liquid extraction, selectivity and choice of solvent. Material balances in stage operations and principles of graphical methods in determination of number of equilibrium stages. Fundamental principles of leaching operation and material balance calculations. Theory of crystallisation, material and energy balance calculations, introduction to crystallizer design, introduction to the principles of adsorption.

FTBE/ME/T/224 THERMAL ENGINEERING

Study of properties of steam. Study of different types of boilers. Different types of heat engines (with descriptive study). Different heat transfer equipments. Descriptive study of small power plant and water treatment plants.

FTBE/ET/T/225 ELEMENTARY ELECTRONICS

Energy band structure of metals, semi-conductors and insulators; Electron conduction in intrinsic and extrinsic semiconductors; P-Type and N-Type semiconductors; P-N junction; Metal-conductor junction
Junction diode, zener and avalanche breakdown, rectifiers, filters and voltage regulators, BJT and its characteristics in CB and CE configurations; Bias stability, Low frequency, small signal analysis of BJT using simplified hybrid models; basic concepts of feedback amplifiers.
FET and MOSFET - Characteristics and applications
Digital System; Elements of Digital Circuits - AND, OR, NOT, NOR, NAND gates. Flip-flops (R-S, J-K, Master-Slave), ExOR, Half Adder & Full Adder.

FTBE/CSE/T/226 NUMERICAL METHODS & COMPUTER PROGRAMMING

Introduction to computer system. Programme logic and flow charts. Fortran programming. Numerical Methods : Approximations and errors. Solution of linear

system of equalities. Matrix inversion. Interpolation. Numerical differentiation and integration curve fitting. Numerical solution of ordinary differential equations.

FTBE/S/221 **MICROBIAL TECH. LABORATORY**

Production, recovery and control tests of the following fermentation production. Alcohols, bakers' yeast, food yeast, citric acid, enzymes (amylases, pectinases etc.), vitamin B12 amino acids (glutamic acid, lysine, valine etc.) antibiotics (penicillin, streptomycin, neomycin etc.). Analysis of ferment gas including experiments on carbon balance. Methods of screening antibiotic producing organism. Determination of purity of the culture.

FTBE/S/222 **FOOD ANALYSIS LABORATORY**

Extraction, separation and identification, water and oil soluble dyes. Detection and estimation of additives in food materials net as, boric acid, benzoates, sulphites, formaldehyde, formic acid, lactic acid, saccharine cyclamate, dulcin etc. Analysis of following food stuffs : with reference to the standards of quality fixed for these : milk, jam, jelly, squash, vinegar, cider, rice and wheat. Changes in the vitamins ascorbic acid and thiamin in canned vegetables during thermal treatment. Available lysine content in fish-meal.

FTBE/CSE/S/223 **PROGRAMMING PRACTICE LABORATORY**

To supplement the theoretical course on "Numerical Methods & Computer Programming".

MDD/ME/S/2 **MACHINE DESIGN AND DRAWING**

Basic idea of design, factor of safety, modes of failure, theories of failure, design under static and fatigue loading.

Design of Cotter/knuckle Joint, threaded and riveted joint, eccentric loading.

Shaft coupling (rigid / flexible). Belt-pulley drive. Pressure vessel.

Third Year First Semester

FTBE/T/311 **TECHNOLOGY OF FOODS-IV (Tech. of fruits, vegetables food legislations, quality control and packaging)**

Storage and handling of fresh fruits and vegetables. Preservation of fruits and vegetables by heat treatment. Processing and preservation of fruits and vegetable juices. Preparation of jam, jelly and marmalade, pickles chutneys and vinegar, tomato products. Fermented fruit and vegetable products. Freezing and dehydration of fruits and vegetables. Concentration of fruits and vegetables. Food additives, physiology of ripening. Physical and chemical treatment to increase post harvest life of fruits and vegetables. Role of plant growth regulators in post harvest storage. Fermented foods, pickling and curing of food. Intermediate moisture foods. By product and their utilization. Preparation of spice powder in other miscellaneous spice and condiment products. Coconut and its derivatives. Preparation of non alcoholic beverage. Technology of tea, coffee, cacao. Food-laws the food rules and standards, quality control of food and food products. Sensory evaluation of food colour flavour, texture, shape etc. Instrumental methods of analysis of food statistical quality control. Operation research and plant organization and management packaging materials and their physicochemical characteristics. Various types of packaging including vacuum, gas pack. Different problems in packaging of food stuff, packaging equipment. Package design. Test procedures for packages.

FTBE/T/312 **BIOCHEMICAL ENGINEERING AND BIOTECHNOLOGY**

Improvement in processed food by the application of various biotechnological processes. Technology of conventional and non conventional fermentation based food products from cereals, legumes, fruits, vegetables, milk, fish, meat etc. Biotechnological process for manufacture of food staff and food etc. Fermentation production of modified carbohydrates, lipids and proteins and their purification techniques. Studies on changes in clour , flavour and organoleptic test during processing and storage of the fermented food and chances of

spoilage of the products due to process defects. Evaluation and standardization of quality and safety of the fermented food products by the application of modern techniques. Production of microbial biomass and its economic aspects. Downstream processing of fermented products. Regulatory and social aspects of Biotechnology modified foods. Production of crude enzymes- their isolation and different purification processes kinetics of enzyme catalyzed reactions. Kinetics of biological growth. Effects of other parameters like pH, temperature, fluid forces, chemical agents and irradiation on enzyme activity. Immobilization of enzymes and whole cells on insoluble supports, different techniques of immobilization, immobilized enzyme technology, industrial uses of the immobilized enzyme, enzyme reactors and analytical study of their performance. Introduction to genetic Engineering , tissue culture and immunology.

FTBE/T/313 **PROJECT ENGG. & PROCESS PLANT COSTING**

Introduction to plant design and project engineering. Process selection and evaluation. Pilot and semi-commercial plants scale-up techniques. Selection of materials of construction and specification of process equipments with special considerations for equipments and accessories of Food and Biochemical projects. Plant layout. Location of plant, raw materials and utilities. Objectives and business organization rules and procedures of process plant costing to man power, material, equipment and utilities. Analysis of production and productivity in joint products and by-products. Cost reduction techniques, optimization techniques and assessment of alternatives. Conceptual frame work on marginal costing and profitability. Application of PERT & CPM in project planning and monitoring. Techno-economic case studies in Food and Biochemical projects. Introduction of computer applications in project engineering and process plant costing.

FTBE/T/314 **SEPARATION PROCESSES – II**

Distillation : Vapor – Liquid equilibrium, relative volatility batch and equilibrium distillation, steam distillation, molecular distillation, azeotropic and extractive distillation, enthalpy-concentration diagram. Theory of rectification column design. Theory of sublimation Principles of humidification and dehumidification operations. Principles of construction and use of Psychrometric chart. Introduction to the design of humidifiers, dehumidifiers and cooling towers. Theory of drying of solids, liquids and gases. Introduction to dryer design.

FTBE/T/315 PROCESS INSTRUMENTATION & CONTROL

Process variables : Need for their measurement and control pressure measurement by mechanical and electrical transducers. Low pressure measurement by McLeod Gage and Pirani gage. Temperature measurement by bi-metal thermometers, resistance thermometer thermistors, thermocouples. Radiation and optical pyrometers. Flow measurement by Hot – Wire ammeter and magnetic flow meters. Visualization by shadow-graph and interferometer. Liquid level measurement in open vessels and in pressure vessels. Thermal conductivity measurement of solids, liquids and gases. Measurement of diffusivity in gases. Block diagrams. Transfer function closed-loop and open-loop control systems. Response of first order systems and first order systems. Response of time constant. Different types of controllers. Final control elements. Closed loop transfer functions. Stability Root locus method. Frequency response. Level control. Flow control. Dynamics and control of heat exchangers and distillation columns.

CHEMICAL ENGINEERING KINETICS

Chemical Reaction Equilibria ; rate of chemical reaction; mechanism of reactions; collision and activated complex theories. Arrhenius equation. Interpretation of batch reactor data for simple and complex reactions. Homogeneous reactions. Design equations for batch; plug flow, semi- batch stirred tank, adiabatic and programmed reactions, concept of mixed reactors, thermal stability of reactors.

Heterogeneous reactions. Introduction to noncatalytic and catalytic reactions, determination of rate controlling steps; Introduction to noncatalytic and catalytic reactions ; determination of rate controlling steps; Introduction to fluidized bed reactors; Preparation of catalyst; measurement of catalyst surface area and catalyst poisoning.

FTBE/S/311 SEMINAR/GR. DISCUSSION

Students will be required to carryout under the supervision of the staff members, a literature search and will prepare review papers on selected topics. Every student will do critical review of assigned subjects in Food Technology or Bio-chemical Engineering. Review of assigned subjects in food technology or Biochemical Engineering will be followed by discussions.

FTBE/S/312 FOOD PROCESSING & QUALITY CONTROL LABORATORY

Preparation of squash, jam, jellies, marmalade, preserved and candied fruit. Preparation of alcoholic beverages. Preparation of pickles, chutneys, sauces, fermented vegetables & tomato products. Fruit juice concentrate & powder. Preservation of fruits & vegetables, fish meat etc. by canning freezing, drying and quality assessment of the processed products. Testing of can preparation of ice cream & other frozen products. Preparation of confectionery products including bread, biscuits, cake etc. Preservation of milk by heat treatment. Preparation of various milk based products. Enumeration of faecal indicator organisms, salmonella & pathogenic organism in processed food. Detection and identification of food spoilage organisms. Quality assessment of processed food.

**FTBE/S/313 BIOCHEMICAL ENGINEERING & INSTRUMENTATION
LABORATORY-I**

**FTBE/S/322 BIOCHEMICAL ENGINEERING & INSTRUMENTATION
LABORATORY-II**

- i) Experiments on microbial engineering enzyme and genetic engineering, waste engineering and cellular genetics and tissue culture.
- ii) Also the following experiments in the instrumentation lab. of Chemical Engineering Dept. for four weeks.
 - a) Characteristics study of diode and triode.
 - b) Measurement of moisture in slabs.
 - c) Temperature control of a reactor/fermentor.
 - d) Step response of thermocouple introduced in furnace/ovens.
 - e) Pneumatic transmitter etc.

FTBE/ChE-ME/S/314

FTBE/ChE-ME/S/323 CHEMICAL & MECHANICAL ENGINEERING LABORATORY-I & II

Flow of fluids through flow meters such as venturimeters, Orifice meters, rotameters, weirs, etc. Calibration of flow meters. Friction through bends, fittings, etc. Efficiency of pump. Measurement approximate critical velocity of liquid. Rate of filtration under different pressures. Drying rate under constant drying conditions. Running of vacuum drum drier water distillation plant. Concentration by forth floatation. Screen analysis of crushed products. Packed tower operations. Rectification of binary moisture. Also experiments in the mechanical laboratory.

Third Year Second Semester

FTBE/T/321 FOOD PROCESS ENGINEERING

Evaluation of process time in canning by different methods. Different types of sterilizers, seaming machine and other accessories used in canning industries. Engineering aspects of pasteurizer, homogenizer, evaporators and concentrators used in food industries. Construction of cold storage and different types of freezers including plate freezers, blast freezer cryogenic freezing. Vacuum

freezing. Refrigerated vans and wagons. Equipment used for grading and sizing of food. Engineering aspect of various types of driers, including trays drier roller drier, spray drier, fluidized bed drier, freeze drier, solar drier. Extruder (Principles and method), Effect of extrusion parameter on product quality and optimization. Emulsifiers. Different equipment used for processing of food. Food Irradiation Technology.

FTBE/T/322 **TECHNOLOGY OF FOODS-V (Tech. Of oils and fats):**

Status of oils and fats and Indian economy. General chemistry, Analytical methods for characterization. Quality standards of edible oils and fats.

Antioxidants and rancidity and fats indiet, nutrition and disease. Detection of adulteration.

Extraction and clarification of vegetable oil. Modifications of the properties of oils and fats including chemical and biotechnological processes. Confectionery plastic fats. Preparation of various products including different shortenings, margarine, salad dressing and mayonnaise, imitation of dairy products low calorie spreads. Animal fat, oil derivatives. Technology of oilseed protein isolate.

FTBE/T/323 **BIOCHEMICAL ENGINEERING**

Characteristic properties of biological fluids. Dynamics of microbial growth different growth models for microbial processes – Dynamics of continuous culture. Kinetics of thermal death of micro organisms – Mechanisms of thermal sterilization and sterilization by filtration – Design criteria and design guatious for sterilizations for sterilization processes, sterilization processes design for air. Materials of constructions for fermentation processes equipments. Differentt types of bio-reactors in use and their operation. Design and analysis of biological reactors. Aeration and agitation – oxygen supply and demand in microbial processes – Single and Multiple dubble reaction. Oxygen transfer in fermentation – Design of spargers and aeration equipment – Scale-up of biological reactors.

Instrumentation and control operation; bio-reactors. Micro processors controlled fermentation.

MNG/ME/T/1 **INDUSTRIAL MANAGEMENT**

Growth of Industries, Management thoughts and scientific management, Taylorism; Factory system of production, Introduction to management problems, Types of manufacture, Planning analysis and control aspects in industries. Types of business ownership, means of finance and business combinations, organization structures, committee organization, authority and responsibility, duty and span of control.

Plant location, factory buildings and physical facilities, plant layout, tools and techniques of plant layout, materials - handling arrangements. Product development, standardization, simplification and diversification.

Functions of production, planning and control, production forecasting, production scheduling and network techniques, Gantt chart, CPM, PERT etc.

Work study, job evaluation and merit rating; purchase system and inventory control. Inspection and quality control of systems, statistical quality control, maintenance and replacement policies for machine and equipments; decision making theories, breakeven analysis cost benefit analysis, evaluation of financial and managerial efficiencies. Introduction to operational research techniques.

Application of fuzzy logic in modern management concepts. Human relations in industry and labour compensation. Personnel management, provision of industrial legislations in India. Wage and salary administrations. Welfare and safety provisions, trade union acts. Study of environmental impacts and environmental laws.

Text Book:

Production and operations management: S.N.Chari

Reference books:

1. " Industrial Management" by: Basu & Majmundar (Birla Pub., Newdelhi)
2. " Quantitative techniques in management" by: N.D.Vohra (Tata Mcgraw Hill)
3. "Production systems analysis and control" by : Riggs
4. "Works organization and management by: Basu, Sahoo & Dutta.
5. Fuzzy logic with Engineering applications: Timothy J. Ross (Mcgraw Hill)

FTBE/T/325 ELECTIVE PAPER

1. COMPUTER APPLICATION FOR FERMENTATION PROCESS

2. PLANT OPERATION, MAINTENANCE AND SAFETY

3. NON-CONVENTIONAL ENERGY & POLLUTION CONTROL

FTBE/T/325A COMPUTER APPLICATION FOR FERMENTATION PROCESS

A. Computer : (1) Hardware (2) Software B. Instrumentation : i) Physical measurements, temperature, vessel pressure, volume/level weight, density, power input, agitation speed gas flow rate, liquid media feed rate, viscosity forming. ii) Chemical measurement : pH, biomass, gas oxygen and carbon dioxide concern dissolved oxygen, dissolved carbon dioxide, nitrogen source, ionic strength, redox potential, enzyme coupled sensors, microbe-coupled sensors, calorimeters, automatic sampling and inoculation, other methods. iii) Bio-chemical measurement : ATP/ADP, NAD/.NADH, Cytophotometry and cytofluorometry. iv) Biological measurement.

B. Sole estimation and parameter identification : Indirect measurement, microscope material/energy balances. On line estimation.

C. Modelling : Types of growth models, consideration in modelling and the use of models in computer control.

FTBE/T/325B PLANT OPERATION, MAINTENANCE AND SAFETY

Introduction to the structure of systems of plant operation, maintenance and safety. System interactions and degree of freedom with man, material and equipment. Factory rules and procedures with Indian and International

specifications in operation, maintenance and safety. Effects of economic design criteria in optimum plant operation. Trouble shooting operation and maintenance in presence of uncertainty. Simulation for interpretation in difficult plant operation. Introduction to microprocessor based operations. Inspection, testing and analysis of tolerance limit and types of failure. Contions based maintenance and its economical viability. Hazards and operative (HAZOP) analysis. Accidents and emergency preventive procedures. Insurance claim and loss analysis. Case studies on Food and Biochemical plants.

FTBE/T/325C NON-CONVENTIONAL ENERGY & POLLUTION CONTROL

- a) Fundamental concept of environmental system. Climatic aspects of pollution causes of Air pollution. Control of air pollution caused by industries and agriculture, viz. Sulfur dioxide removal from waste gases. Water quality, system for treating water and wastes, by physical, chemical and biological treatment processes. Processing of sludge Reuse of Water. Sensing, Instrumentation and measurement of air and water quality. Environmental education for creating awareness of pollution among people. Legal consideration. b) Energy forms and basic laws. Different types of solid gaseous fuels. World Energy Resources and consumption. The nature of Solar energy, Biological and chemical conversion of solar energy. Energy conservation in industries. Wind and tides and other forms of energy like geothermal energy etc. Renewable energy system for application in agriculture. Development of equipments based on the use of energy obtainable from non conventional sources.

b)

FTBE/T/326 GENERAL VIVE-VOCE

Based on all the theoretical and sessional subjects of all the semesters.

FTBE/S/321 HOME DESIGN/PROJECT

Students will be assigned Home design problem on selected designs of plant and equipment, related to Food Technological and Biochemical or similar industries. The design problem should be worked out by students under the guidance of teachers. Complete design with drawings should be submitted by the students within prescribed date. Alternatively, the students will be assigned one project work to carry out a particularly experiment and to find out experimental data under the guidance of departmental teachers. The Home design/project report along with viva will be considered as an examination paper, carrying 100 marks for the final examination.

FTBE/S/324 FOOD ENGINEERING LABORATORY

Evaluation of F & T values of two types of microorganisms encountered in spoilage of canned food. Determination of process time by graphical & formula method. Drying rate characteristics of different food materials. Studies on dehydration in spray drier. Spray drier, fluidized bed drier, freeze drier etc. Parboiling of paddy, wheat & other cereals & determination of their milling characteristics. Extraction and refining of oil from various oil seeds. Production of rice bran oil. Milling of spices & determination of oil & oleoresin. Evaluation of properties of different packaging material. Extrusion pro.

3-Year B.Tech FTBE Course:

THIRD YEAR FIRST SEMESTER						
Code No.	Subject	Pds / week			Marks	
		L	T	S	Exam	Sessional
FTBE/T/311	Technology of Foods-IV	3	0	0	100	
FTBE/T/312	Biochemical Engg & Biotechnology	4	0	0	100	
FTBE/T/313	Project Engg. & Process Plant Costing	3	0	0	100	
FTBE/T/314	Separation Process-II	3	0	0	100	
FTBE/T/315	Process Instrumentation & Control	3	0	0	100	
	Chemical Engg. Kinetics	3	1	0	100	
FTBE/S/311	Seminar/Gr. Discussion	0	0	3		100
FTBE/S/312	Food Processing & Quality Control Lab	0	0	4		100
FTBE/S/313	Biochemical Engg. & Instrumentation Lab-I	0	0	5		100
FTBE/ChE-ME/S/314	Chemical & Mechanical Engg. Lab-I	0	0	6		100
	Sub - Total	19	1	18	600	400
	Total :		38			1000

THIRD YEAR SECOND SEMESTER

Code No.	Subject	Pds / week			Marks	
		L	T	S	Exam	Sessional
FTBE/T/321	Food Process Engineering	4	0	0	100	
FTBE/T/322	Technology of Foods-V	3	0	0	100	
FTBE/T/323	Biochemical Engineering	4	0	0	100	
MNG/ME/T/1	Industrial Management	4	0	0	100	
FTBE/T/325	Elective Paper	3	0	0	100	
FTBE/T/326	General Viva-Voce	0	0	0	100	
FTBE/S/321	Home Design/Project Work	0	0	3		100
FTBE/S/322	Biochemical Engg. & Instrumentation Lab-II	0	0	5		100
FTBE/ChE-ME/S/323	Chemical & Mechanical Engg. Lab-II	0	0	6		100
FTBE/S/324	Food Engg. Lab	0	0	5		100
	Sub - Total	18	0	19	600	400
	Total :		37			1000

First Year First Semester

FTBE/T/111 BIOCHEMISTRY AND NUTRITION

Introduction to biochemical sciences. Enzyme and coenzymes : Introduction, definition, nomenclature, classification, numbering, structure and functions of coenzyme energy-rich -compounds, active centre of enzymes, mechanisms of enzyme action, effect of temperature, pH, enzyme concentration and substrate concentration on the rate of enzyme reaction. Specificity of enzymes, enzyme inhibition, kinetics of enzyme action, activation of enzymes; regulatory enzymes , iso enzymes; enzymes involved in digestion. Metabolism of carbohydrates: Embden - Meyerhoff pathway, cori and corycycle, muscle contraction and relaxation, Neuberg second and third form of fermentation, Kreb's cycle, Glyxlnate by-pass, Hexosemonophosphate shunt pathway. Electron transport chain, oxidative phosphorylation and substrate linked phosphorylation, energy balances . Metabolism of lipids: Digestion and absorption of lipids , fatty liver, lipotropic agents, oxidation pathway, oxidation of odd- carbon- chain fatty acids, Ketone bodies, energy balance, Lipid biosyntehsis. Metabolism of proteins: Importance proteins, digestion and absorption of proteins, amino acid pool, nitrogen balance, essential amino acids, evaluation of quality of proteins, general metabolism of proteins and amino acods. Nucleic acids and protein biosynthesis.

The functions of food. Fuel value of foods. Basal metabolism. Total energy need of individualas engaged in different activities. Determination of food energy. Physiological fuel value of foods, calculation of energy value of foods. Methods of measuring on estimating caloric value of a diet. Physiological functions, role in metabolism and daily requirements of vitamin A, D, E, K, C, Thiamin, riboflavin, niacin, pyridoxin, cyanocobalamine, folic acid, choline, p-aminobenzoic acid, pantothenic acid. Minerals as structural and functional constituents in human metabolism. Specific role of iron, calcium, phosphorous, sodium, potassium,

magnesium, chlorine, zinc, copper and iodine. Dietary interrelationship. Functional foods. Nutraceuticals. Assessment of nutritional status of populations. Problems of under nutrition and effect of calorie over nutrition. Diet and dental health. Nutrition during pregnancy, lactation and aging. Nutrition of children. Selection of an adequate diet. New developments in foods and nutrition.

FTBE/T/112 MICROBIOLOGY

The importance of microbes in food and fermentation industries. The microscope. Morphology of bacteria. Moulds and yeast. Dyes and staining techniques. Nutrition of microbes. Techniques of pure culture. Bacterial genetics. Differentiation and classification of bacteria. Bacterial viruses. Microbial respiration of proteins. Disinfection and disinfectants. Pasteurization, sterilisation and autoclaving. Energy metabolism of aerobic and anaerobic microbes. Nitrogen fixation. Bacteriology of air, water, milk and milk products, fish, fruit and vegetable.

FTBE/Math/T/113 MATHEMATICS-IH

Functions of several variables. Taylor's theorem. Maxima and minima. Lagrange's method of undetermined multipliers. Fourier series in $(0, \pi)$ and $(-1, 1)$. Fourier half-range series. Applications. Laplace Transform and its inverse. Applications to ordinary linear differential equations and simultaneous ordinary linear differential equations with constant coefficients. Linear partial differential equations with constant coefficients. Solution of one dimensional wave and diffusion equations and two dimensional Laplace equation and Poisson's equation. Applications. Series solution of ordinary linear differential equation. Bessel functions. Recurrence relations. Legendre polynomials. Recurrence relations and orthogonal property.

AM/ME/T/2 **SOLID MECHANICS**

Statics

Introduction, Idealisation of Mechanics, Fundamentals of Vector Algebra, Application of Vectors in Statics, Equivalent system, Equilibrium, FBD concept.

Strength of Materials

Uniaxial Stress field, Thin pressure vessels, Torsion, Shear force and Bending moment, Bending stress in beams, Deflection in beams, Buckling of columns (Euler's formula).

FTBE/T/115 **FLUID FLOW**

Introduction to the properties of different types of fluid. Fluid pressure and pressure measuring devices. Fluid Kinematics. Streamline flow, turbulent flow, unsteady flow. Equation of continuity, Navier - stockes equation. Hagen Posieuille equation. Fannings equation , Euler equation, Bernoulli,s equation, total energy balance equation. Flow of compressible fluid through nozzles. Fluidization. Flow measuring devices such as orificemeter, venturimeters, rotameter and weir. Energy losses in pipes, valves and fittings. Two phase flow and flow through packed bed. Concept of boundary layer separation and vortex formation.

BM/ME/T/A **BASICS OF MECHANISMS**

Introduction: Mechanism and machine, pairs of element, linkages, degrees of freedom.

Velocity and acceleration analyses of simple mechanisms.

Power transmission devices: belt & pulley, gear, cam & cam follower, clutch, brake.

FTBE/S/111 **MICROBIOLOGY LABORATORY**

General procedures for aseptic work. Study of microscope. Staining of bacteria and observation of size, motility, meta-chromatic granules, flagella capsules and

spore. Morphology of yeasts and moulds. *S. Cerevisiae*. Cutilis, preparation of nutrient broth and media with agar, gelation and special media for culture of microbes. Technique of pure culture, plating by pour plate and streak plate methods. Determination of bacterial species. Anaerobic cultures. Effect of temperature, UV light, osmotic pressure, desiccation, pH, surface tension and oligodynamic action on growth of bacteria. Determination of thermal death and Thermal death point of bacteria. Evaluation of growth modules and values of Dp. Growth constant for bacteria cells. Phenol coefficient, methylene blue reduction test. Hydrolysis of starch, liquefaction of gelatin, hydrolysis of casein and glycerides. Detection and accounting of coliform bacteria and Salmonella. Bacteriological examination of water, milk, dried fish and fish meal and canned foods.

BED/ME/S/1 BASIC ENGINEERING DRAWING

Drawing primitives: instruments, letters, lines, title block, geometric curves & shapes, scale and dimension.

Projection: orthographic and isometric, sectional views.

WS/ME/S/8A WORKSHOP PRACTICE-VIII (Forging and Moulding)

Forging: Introduction to forging tools, furnaces and forging machines; to practice basic forging operations- drawing out, upsetting, necking etc.; introduction to forge welding.

Introduction to moulding practice- preparation of moulding sand and use of moulder's tools; making of moulds by using selected pattern's; introduction to melting and pouring practice; experiments sand testing like permeability, moisture content, shutter index, mould strength, grain fineness number etc.; demonstration of injection moulding machine.

First Year Second Semester

FTBE/T/121 CHEMISTRY OF FOODS

Proximate composition of foods. Water in foods. Carbohydrate : Introduction. Definition nomenclature, Classification general properties of sugar (Physical and chemical) : Identification of common monosaccharides, disaccharides and polysaccharides; determination of the amount of reducing and non-reducing sugars. Chemistry of starch, glycogen, cellulose, gums and mucilages crude fibre. Physiological functions of carbohydrates. Proteins : Physical and chemical properties of amino acids, chromatographic separation of amino acids, classification of proteins, amino acid sequence in proteins, pleatedsheet and helix structure of proteins, tertiary structure and conformation of proteins. Physical and chemical properties of proteins, molecular weight of proteins and ultracentrifuge, preparation and purification of proteins, protein denaturation, food proteins and their characteristics. Lipids : Classification of lipids, fatty acid, soap and detergency, essential fatty acids, fats and oils saponification number, acid number, Iodine value, acetyl value, Reichert-Meissl number, oxidative and hydrolytic rancidity, reversion, waxes, phosphoglycerides, sphingo lipids, non-saponifiable lipids, cholesterol, prostaglandins, lipid bilayers, monolayers and micelles, structure of cell membrane. Natured pigments and flavouring agents : Chlorophyll, carotenoids, Anthocyanins, Anthoxanthins, Flavonoids, Tannins, Natural flavour constituents. Vitamins : Occurrence, chemistry, loss during storage, transport and processing of foods of provitamin A & D, vitamin A, D, E, K, C, B, H niacin, pyridoxin, cyanocobalamine, folic acids p-aminobenzoic acid, biotin, choline.

FTBE/T/122 **HEAT TRANSFER**

Introduction to mode of heat transfer, Fourier's law. Steady state heat transfer through composite slabs, composite cylinders and spheres. Fundamentals of heat loss from pipe wall by conduction. Basic concept of individual and overall heat transfer co-efficients, log-mean temp. difference, different useful correlations in forced convection and natural convection. Basic concept of Reynold's analogy. Introduction to heat transfer during condensation and boiling liquids. Types and

design characteristics of heat exchangers, condenser, reboiler and evaporators. Kirchoff's law and radiant heat transfer between surfaces and pyrometry. Basic concept of unsteady state heat transfer.

FTBE/T/123 **FOOD MICROBIOLOGY**

Development of microorganisms in Food. Taxonomy, Role and significance of microorganisms in Foods. Intrinsic and Extrinsic parameters of Foods that affect microbial growth. Microorganisms important in Food Microbiology. General principles underlying spoilage and chemical changes of foods caused by microorganisms. Contamination, Preservation and Spoilage of different kinds of foods namely- fruits & vegetables, fish, meat, egg and their products, Milk and milk products. Fermented foods. Determination of the presence of microorganisms and / or their products in Foods by different techniques. Food borne infection and intoxication. Food sanitation, control and inspection.

Books:

1. Modern Food Microbiology : James M. Jay.
2. Food Microbiology : W. C. Frazuir, D. C. West Hoff.

FTBE/Math/T/124 **MATHEMATICS-IIH**

Numerical methods : Graphical solution of a single non-linear equation and Newton's method of approximation to real roots. Numerical integration by trapezoidal rule and simpson's one-third rule.

Statistical methods : Frequency distribution. Mean variance and standard deviation. Symetrical and non-symetrical distributions. Skewness. Principle of least squares. Application to linear and parabolic laws.

Rigid dynamics : Moments of inertia of symmetrical bodies. B'Alembert's principle. Equations of motion about fixed axis. Two dimensional motion.

Hydrostatics : Liquid pressure, density and specific gravity. Liquid at rest under gravity. Resultant and centre of pressure on a plane area. Principle of Archimedes. Floating bodies.

ETech/EE/T/B **ELECTRICAL TECHNOLOGY-B**

DC Circuits: Kirchhoff's Laws. Maxwell's Loop Current Methods of Analysis. Star-Delta Conversion. Superposition Theorem. Thevenin's Theorem. Maximum Power Transfer.

Magnetic Circuit: MMF, Flux, Reluctance. B-H Loop. Hysteresis and Eddy current loss. Magnetic circuit analysis with air gap.

AC 1-phase: Periodic Waves and Sinusoids. Average and RMS Values, Form Factor, Peak Factor. Phasor concept of Sinusoids. Impedance and Admittance. Power, Power Factor, V A, V AR. Series R-L-C Circuit, Parallel R-L-C circuit. Resonance.

Balanced 3-phase: 3-phase AC balanced circuits. Phase-sequence. Star and Delta connections. Power, V A, V AR, Power Factor _or balanced 3-phase circuits.

Power Measurement: Wattmeter circuit connection. Power Measurement by two wattmeter methods in 3phase system.

DC Machines: Construction and general principle of operation. Generator EMF Equation. Field connection, shunt series and compound. Generator characteristics.

Motor-equation and general operation. starting and speed control, torque-speed curve.

1-Phase Transformer: Construction. EMF equation. Phasor diagram. Equivalent circuits. Losses and Efficiency. Open circuit and Short circuit test.

3-Phase Induction Machine: Types of induction machines. Rotating magnetic field, slip, torque equation, torque-speed curve. DOL starting and reduced voltage starting.

3-Phase Synchronous Machines: Alternator, constructional features, EMF equation, synchronous reactance, power-angle characteristics.

Concept of synchronous motor.

Meters: DC and AC Ammeters and Voltmeters. Megger. Multiplier.

Books :

1. Electrical Science by Prof. S. Chowdhury, Prof. R. Chakraborty & Prof. P. K. Chatterjee.
2. Electrical Machines by Prof. P.K. Mukherjee & Prof. S. Chakravorti.

FTBE/T/126 CHEMICAL ENGINEERING FUNDAMENTALS

- i) a) Units and dimensions b) Mathematical techniques in process calculations
- ii) Physico Chemical properties of Gases, Liquids, Solids.
- iii) Material balance calculations : Without and with chemical reactions
- iv) Energy balance calculations : a) Principle of energy conversion and conservation b) Thermophysics c) Thermochemistry d) Energy balance Calculations : without and with chemical reactions.

FTBE/S/121 CHEMISTRY OF FOOD LABORATORY

Errors and accuracy in analysis food materials. Sampling not contents and preparation of samples for analysis. Determination of moisture, ash, lipids, nitrogen (Protein and non protein) reducing and non-reducing sugar in samples of foods. Estimation of iodine value, saponification value, acid value, non-saponifiable matter, soluble and insoluble acids, neutralisation values, reichert value and Krischner value in fats and oils. Estimation of iron, phosphorus, copper, lead, arsenic and tin. Estimation of ascorbic acid, nicotinic acid, pyridoxin, thiamin, riboflavin vitamin A, choline and carotene, detection and estimation of amino acids, chlorophyll and carotenoids by paper and column chromatography. Estimation of activity of Papain, taka-diastrase, pancreatin and phosphatase. Study on the effect of temperature pH and substrate concentration on enzyme activity.

AED/ME/S/1 ADVANCED ENGINEERING DRAWING

True length, development of surface of simple objects. Threaded joint & riveted joints, cotter/knuckle joint. Pulley, shaft coupling.

WS/ME/S/11 WORKSHOP PRACTICE-XI (Fitter Shop and Machine Shop)

Introduction to fitter's tools, gauges, measuring instruments etc.; marking of jobs; fitter's job involving chipping, filing, sawing, drilling; use of taps and dies; pipe fittings and plumbing.

Introduction to machine tools - lathes, drilling machines, shaping machines, planing machines, slotting machines, milling machines, grinding machines; machine shop work involving different operations by using the above mentioned machines through making of jobs.

Second Year First Semester

FTBE/T/211 PRINCIPLES OF FOOD PRESERVATION

General introduction to food technology. Construction of sanitary cans and testing of cans, can lacquers and can scaling compounds. Preservation by application of heat. Various canning techniques. Dehydration, water activity of food, intermediate moisture food. Preservation of food by removal of heat, cold storage and freezing including cryogenic freezing of food. Curing oicklling. Preservation by ionization radiation use of chemical and preservatives in food preservation. Preservation by fermentation.

FTBE/T/212 TECHNOLOGY OF FOODS-I (Technology of fish, meat and poultry)

World production of fish, meat and poultry. Consideration of fish, as food assessment of quality of fish. Effect of method of catching and handling on the quality of fish. Handling of wet fish on board the catching vessel and on landing storage and transport of wet fish. Preservation of fish by different methods. Manufacture of fish protein concentrates, fish sauce and fish liver oil and other important by-products and quality control aspects of processed fish pisciculture and breeding. Processing of meat and meat products; curing, smoking, manufacture of sausage, ham bacon and other products. Meat analogues.

Processing of poultry. Egg and egg products composition nutritive value. Preservation of egg by different methods. Egg quality assessment. By-product utilization.

FTBE/T/213 **TECHNOLOGY OF FOODS-II (Technology of Cereals, legumes and confectionaries)**

Storage of cereals, infestation control and use of pesticide Drying of grains. Processing of rice and rice products. Milling of wheat and production of wheat products including flour, bread, biscuits, cakes and other confectionery products. Milling of corn barley, oat, coarse grains including sorghum, ragi and millets. Toxic factors in cereals. Infestation control. Proximate composition of legumes. Amino acid balance, inhibitors, toxic factors and processing methods : By products utilisation.

FTBE/T/214 **MECHANICAL OPERATION**

1. Size reduction, granulation, partials separation. Crushing and grinding; different types of equipment open-circuit and closed circuit grinding, power requirement. Granulation and other size enlargement operations. Particle separation; sampling and screening. Particle size measurement, cyclone separator, bag filter magnetic and electrostatic separator.
2. Hydraulic separation and concentration. Hydraulic separation, heavy media-separation. Digging, Froth-flotation elutriation, tabling.
3. Sedimentation flocculation : Free & hindered setting, thickening, counter current decantation flocculation and flocculating agents.
4. Filtration : Theory of filtration, filter equipment, filter medium filter aid. Filter auxiliaries, centrifuges.
5. Mixing of solids, liquids and slurries.
6. Material handling : handling of fluids, slurries and solids, pumps.

FTBE/T/215 **MICROBIAL TECHNOLOGY**

Economic activities of microorganisms. Propagation of food, food and bakers yeasts. Technology of production of alcohol, glycerol and beer. Mechanism of alcohol and glycerol fermentation. Production of wine and other alcoholic beverages (whiskey, rum etc.). Activities of lactic acid bacteria and industrial production of lactic acid. Activities of acetic acid bacteria and production of vinegar sorbose acid dihydroxy acetone. Production of dextrans. Amino acid fermentation. Metabolic controls in industrial fermentation. Saccharifying agents- methods of production and uses. Activities of molds. Microbial production of organic acids viv. Citric, gluconic, fumeric itaconic, gibberellic and kojic acids. Microbial production of vitamins B2 and B12. Production, isolation and use of microbial enzymes, immobilized enzymes and their applications. Production of glucose and fructose and starch by enzymatic methods. Production of mushroom mycelium by submerged culture process. Production of algal protein and recent advances. Microbiological transformation of steroids. Production and isolation of antibacterial antibiotics like penicillin, streptomycin, chloromycetin, tetracyclines, semisynthetic penicillins. Antifungal antibiotics.

CHEMICAL ENGINEERING THERMODYNAMICS

Thermodynamic properties: Pressure, volume, temperature, internal energy and enthalpy. Thermodynamic process, state and path function. Reversible and irreversible processes. Equations of state. First and second law of thermodynamics applications to batch and flow systems. Carnot cycle. Clausius inequality theorem and entropy. Statistical concept of entropy. Work function thermodynamic potential fundamental differential equations. Fugacity and activity. Maximum work and availability. General Equations of Equilibrium: Chemical potential evaluation of chemical potentials and fugacities. Third law of thermodynamics: Thermodynamics of fluid flow, heat exchange and refrigeration cycle, compression refrigeration, absorption and expansion of fluids. Power cycle. Vapour liquid equilibrium introduction.

Production, recovery and control tests of the following fermentation production. Alcohols, bakers' yeast, food yeast, citric acid, enzymes (amylases, pectinases etc.) Vitamin B, amino acids (glutamic acid, valine etc.), antibiotics penicillin, streptomycin, neomycin etc.) Analysis of ferment gas including experiments of carbon balance. Methods of screening antibiotic producing organism. Determination of purity of the culture.

FTBE/EE/S/212 ELECTRICAL TECHNOLOGY LABORATORY

Experiments to supplement the theoretical course on "Electrical Technology-B".

MDR/ME/S/1 MACHINE DRAWING

Stuffing Box, Pipe Joints, Valves, Tool head of shaping machine, Plummer Block, Engine Parts.

Second Year Second Semester

FTBE/T/221 TECHNOLOGY OF FOODS-III (Dairy Technology)

Chemical composition and nutritive value and physical characteristic of milk and milk products. Handling of fresh milk. Pasteurization of milk. Homogenization of milk. Manufacture of milk products like condensed, evaporated and dried milk, creamed, butter ghee, ice cream. Fermented milk products. Technology of cheese. Fortification of milk products. Production of infant milk food. Imitation milk. Quality control in milk and milk products including various analytical techniques of determination of milk quality. Milk plant hygiene and sanitation. Plant of dairy waste.

FTBE/T/222 WASTE TREATMENT ENGINEERING

1. Environment and energy of nature.
2. Water for food and biochemical industries.
3. Stream pollution and measurement.
4. a) Physical treatment. b) Chemical treatment. c) Drying and incineration.

5. Industrial waste treatment : a) Vacuum treatment b) Sludge lagooning. c) Drying and incineration.
6. Treatment and disposal of sludge solids a) Vacuum treatment b) Sludge lagooning c) Drying and incineration.
7. Microbial flocculation and sedimentation, Design of biofilters and bioclarifiers. Ion exchange in biological fluids.
8. Biogas.

FTBE/T/223 SEPARATION PROCESS – I

Theory of diffusional processes – molecular and eddy diffusion in fluids, measurement of diffusivity. Theory of interphase mass – transfer, mass transfer coefficients and mass transfer theories. Analogy between heat mass and momentum transfer. Theory of absorption of a single component from gas mixtures wetted wall column. Design principles of absorption towers. Theory of desorption operation. Fundamental principles of liquid-liquid extraction, selectivity and choice of solvent. Material balances in stage operations and principles of graphical methods in determination of number of equilibrium stages. Fundamental principles of leaching operation and material balance calculations. Theory of crystallisation, material and energy balance calculations, introduction to crystallizer design, introduction to the principles of adsorption.

FTBE/ME/T/224 THERMAL ENGINEERING

Study of properties of steam. Study of different types of boilers. Different types of heat engines (with descriptive study). Different heat transfer equipments. Descriptive study of small power plant and water treatment plants.

FTBE/ET/T/225 ELEMENTARY ELECTRONICS

Energy band structure of metals, semi-conductors and insulators; Electron conduction in intrinsic and extrinsic semiconductors; P-Type and N-Type semiconductors; P-N junction; Metal-conductor junction
Junction diode, zener and avalanche breakdown, rectifiers, filters and voltage regulators, BJT and its characteristics in CB and CE configurations; Bias stability, Low frequency,

small signal analysis of BJT using simplified hybrid models; basic concepts of feedback amplifiers.

FET and MOSFET - Characteristics and applications

Digital System; Elements of Digital Circuits - AND, OR, NOT, NOR, NAND gates. Flip-flops (R-S, J-K, Master-Slave), ExOR, Half Adder & Full Adder.

FTBE/CSE/T/226 NUMERICAL METHODS & COMPUTER

PROGRAMMING

Introduction to computer system. Programme logic and flow charts. Fortran programming. Numerical Methods : Approximations and errors. Solution of linear system of equalitions. Matrix inversion. Interpolation. Numerical differentiation and integration curve fitting. Numerical solution of ordinary differential equations.

FTBE/S/221 MICROBIAL TECH. LABORATORY

Production, recovery and control tests of the following fermentation production. Alcohols, bakers' yeast, food yeast, citric acid, enzymes (amylases, pectinases etc.), vitamin B12 amino acids (glutamic acid, lysine, valine etc.) antibiotics (penicillin, streptomycin, neomycin etc.). Analysis of ferment gas including experiments on carbon balance. Methods of screening antibiotic producing organism. Determination of purity of the culture.

FTBE/S/222 FOOD ANALYSIS LABORATORY

Extraction, separation and identification, water and oil soluble dyes. Detection and estimation of additives in food materials net as, boric acid, benzoates, sulphites, formaldehyde, formic acid, lactic acid, saccharine cyclamate, dulcin etc. Analysis of following food stuffs : with reference to the standards of quality fixed for these : milk, jam, jelly, squash, vinegar, cider, rice and wheat. Changes in the vitamins ascorbic acid and thiamin in canned vegetables during thermal treatment. Available lysine content in fish-meal.

FTBE/CSE/S/223 PROGRAMMING PRACTICE LABORATORY

To supplement the theoretical course on "Numerical Methods & Computer Programming".

MDD/ME/S/2 MACHINE DESIGN AND DRAWING

Basic idea of design, factor of safety, modes of failure, theories of failure, design under static and fatigue loading.

Design of Cotter/knuckle Joint, threaded and riveted joint, eccentric loading.

Shaft coupling (rigid / flexible). Belt-pulley drive. Pressure vessel.

Third Year First Semester

FTBE/T/311 TECHNOLOGY OF FOODS-IV (Tech. of fruits, vegetables food legislations, quality control and packaging)

Storage and handling of fresh fruits and vegetables. Preservation of fruits and vegetables by heat treatment. Processing and preservation of fruits and vegetable juices. Preparation of jam, jelly and marmalade, pickles chutneys and vinegar, tomato products. Fermented fruit and vegetable products. Freezing and dehydration of fruits and vegetables. Concentration of fruits and vegetables. Food additives, physiology of ripening. Physical and chemical treatment to increase post harvest life of fruits and vegetables. Role of plant growth regulators in post harvest storage. Fermented foods, pickling and curing of food. Intermediate moisture foods. By product and their utilization. Preparation of spice powder in other miscellaneous spice and condiment products. Coconut and its derivatives. Preparation of non alcoholic beverage. Technology of tea, coffee, cacao. Food-laws the food rules and standards, quality control of food and food products. Sensory evaluation of food colour flavour, texture, shape etc. Instrumental methods of analysis of food statistical quality control. Operation research and plant organization and management packaging materials and their physicochemical characteristics. Various types of packaging including vacuum, gas pack. Different problems in packaging of food stuff, packaging equipment. Package design. Test procedures for packages.

FTBE/T/312 BIOCHEMICAL ENGINEERING AND BIOTECHNOLOGY

Improvement in processed food by the application of various biotechnological processes. Technology of conventional and non conventional fermentation based food products from cereals, legumes, fruits, vegetables, milk, fish, meat etc.

Biotechnological process for manufacture of food staff and food etc.

Fermentation production of modified carbohydrates, lipids and proteins and their purification techniques. Studies on changes in colour , flavour and organoleptic test during processing and storage of the fermented food and chances of spoilage of the products due to process defects. Evaluation and standardization of quality and safety of the fermented food products by the application of modern techniques. Production of microbial biomass and its economic aspects.

Downstream processing of fermented products. Regulatory and social aspects of Biotechnology modified foods. Production of crude enzymes- their isolation and different purification processes kinetics of enzyme catalyzed reactions. Kinetics of biological growth. Effects of other parameters like pH, temperature, fluid forces, chemical agents and irradiation on enzyme activity. Immobilization of enzymes and whole cells on insoluble supports, different techniques of immobilization, immobilized enzyme technology, industrial uses of the immobilized enzyme, enzyme reactors and analytical study of their performance. Introduction to genetic Engineering , tissue culture and immunology.

FTBE/T/313 PROJECT ENGG. & PROCESS PLANT COSTING

Introduction to plant design and project engineering. Process selection and evaluation. Pilot and semi-commercial plants scale-up techniques. Selection of materials of construction and specification of process equipments with special considerations for equipments and accessories of Food and Biochemical projects. Plant layout. Location of plant, raw materials and utilities. Objectives and business organization rules and procedures of process plant costing to man power, material, equipment and utilities. Analysis of production and productivity in joint products and by-products. Cost reduction techniques, optimization

techniques and assessment of alternatives. Conceptual frame work on marginal costing and profitability. Application of PERT & CPM in project planning and monitoring. Techno-economic case studies in Food and Biochemical projects. Introduction of computer applications in project engineering and process plant costing.

FTBE/T/314 SEPARATION PROCESSES – II

Distillation : Vapor – Liquid equilibrium, relative volatility batch and equilibrium distillation, steam distillation, molecular distillation, azeotropic and extractive distillation, enthalpy-concentration diagram. Theory of rectification column design. Theory of sublimation Principles of humidification and dehumidification operations. Principles of construction and use of Psychrometric chart. Introduction to the design of humidifiers, dehumidifiers and cooling towers. Theory of drying of solids, liquids and gases. Introduction to dryer design.

FTBE/T/315 PROCESS INSTRUMENTATION & CONTROL

Process variables : Need for their measurement and control pressure measurement by mechanical and electrical transducers. Low pressure measurement by Mcleod Gage and Pirani gage. Temperature measurement by bi-metal thermometers, resistance thermometer thermistors, thermocouples. Radiation and optical pyrometers. Flow measurement by Hot – Wire ammeter and magnetic flow meters. Visualization by shadow-graph and interferometer. Liquid level measurement in open vessels and in pressure vessels. Thermal conductivity measurement of solids, liquids and gases. Measurement of diffusivity in gases. Block diagrams. Transfer function closed-loop and open-loop control systems. Response of first order systems and first order systems. Response of time constant. Different types of controllers. Final control elements. Closed loop transfer functions. Stability Root locus method. Frequency response. Level control. Flow control. Dynamics and control of heat exchangers and distillation columns.

CHEMICAL ENGINEERING KINETICS

Chemical Reaction Equilibria ; rate of chemical reaction; mechanism of reactions; collision and activated complex theories. Arrheius equation. Interpretation of batch reactor data for simple and complex reactions. Homogeneous reactions. Design equations for batch; plug flow, semi- batch stirred tank, adiabtic and programme reactions, concept of mixed reactors, thermal stability of reactors. Heterogeneous reactions. Introduction to noncatalytic and catalytic reactions, determination of rate controlling steps; Introduction to noncatalytic and catalytic reactions ; determination of rate controlling steps; Introduction to fluidized bed reactors; Preparation of catalyst; measurement of catalyst surface area and catalyst poisoning.

FTBE/S/311 SEMINAR/GR. DISCUSSION

Students will be required to carryout under the supervision of the staff members, a literature search and will prepare review papers on selected topics. Every student will do critical review of assigned subjects in Food Technology or Bio-chemical Engineering. Review of assigned subjects in food technology or Biochemical Engineering will be followed by discussions.

FTBE/S/312 FOOD PROCESSING & QUALITY CONTROL LABORATORY

Preparation of squash, jam, jellies, marmalade, preserved and candied fruit. Preparation of alcoholic beverages. Preparation of pickles, chutneys, sauces, fermented vegetables & tomato products. Fruit juice concentrate & powder. Preservation of fruits & vegetables, fish meat etc. by canning freezing, drying and quality assessment of the processed products. Testing of can preparation of ice cream & other frozen products. Preparation of confectionery products including bread, biscuits, cake etc. Preservation of milk by heat treatment. Preparation of various milk based products. Enumeration of faecal indicator organisms,

salmonella & pathogenic organism in processed food. Detection and identification of food spoilage organisms. Quality assessment of processed food.

FTBE/S/313 **BIOCHEMICAL ENGINEERING & INSTRUMENTATION**
LABORATORY-I

FTBE/S/322 **BIOCHEMICAL ENGINEERING & INSTRUMENTATION**
LABORATORY-II

- i) Experiments on microbial engineering enzyme and genetic engineering, waste engineering and cellular genetics and tissue culture.
- ii) Also the following experiments in the instrumentation lab. of Chemical Engineering Dept. for four weeks.
 - a) Characteristics study of diode and triode.
 - b) Measurement of moisture in slabs.
 - c) Temperature control of a reactor/fermentor.
 - d) Step response of thermocouple introduced in furnace/ovens.
 - e) Pneumatic transmitter etc.

FTBE/ChE-ME/S/314

FTBE/ChE-ME/S/323 **CHEMICAL & MECHANICAL ENGINEERING**
LABORATORY-I & II

Flow of fluids through flow meters such as venturimeters, Orifice meters, rotameters, weirs, etc. Calibration of flow meters. Friction through bends, fittings, etc. Efficiency of pump. Measurement approximate critical velocity of liquid. Rate of filtration under different pressures. Drying rate under constant drying conditions. Running of vacuum drum drier water distillation plant. Concentration by forth floatation. Screen analysis of crushed products. Packed tower operations. Rectification of binary moisture. Also experiments in the mechanical laboratory.

Third Year Second Semester

FTBE/T/321 FOOD PROCESS ENGINEERING

Evaluation of process time in canning by different methods. Different types of sterilizers, seaming machine and other accessories used in canning industries. Engineering aspects of pasteurizer, homogenizer, evaporators and concentrators used in food industries. Construction of cold storage and different types of freezers including plate freezers, blast freezer cryogenic freezing. Vacuum freezing. Refrigerated vans and wagons. Equipment used for grading and sizing of food. Engineering aspect of various types of driers, including trays drier roller drier, spray drier, fluidized bed drier, freeze drier, solar drier. Extruder (Principles and method), Effect of extrusion parameter on product quality and optimization. Emulsifiers. Different equipment used for processing of food. Food Irradiation Technology.

FTBE/T/322 TECHNOLOGY OF FOODS-V (Tech. Of oils and fats):

Status of oils and fats and Indian economy. General chemistry, Analytical methods for characterization. Quality standards of edible oils and fats. Antioxidants and rancidity and fats indiet, nutrition and disease. Detection of adulteration.

Extraction and clarification of vegetable oil. Modifications of the properties of oils and fats including chemical and biotechnological processes. Confectionery plastic fats. Preparation of various products including different shortenings, margarine, salad dressing and mayonnaise, imitation of dairy products low calorie spreads. Animal fat, oil derivatives. Technology of oilseed protein isolate.

FTBE/T/323 BIOCHEMICAL ENGINEERING

Characteristic properties of biological fluids. Dynamics of microbial growth different growth models for microbial processes – Dynamics of continuous culture. Kinetics of thermal death of micro organisms – Mechanisms of thermal sterilization and sterilization by filtration – Design criteria and design guatious for sterilizations for sterilization processes, sterilization processes design for air.

Materials of constructions for fermentation processes equipments. Different types of bio-reactors in use and their operation. Design and analysis of biological reactors. Aeration and agitation – oxygen supply and demand in microbial processes – Single and Multiple dubble reaction. Oxygen transfer in fermentation – Design of spargers and aeration equipment – Scale-up of biological reactors. Instrumentation and control operation; bio-reactors. Micro processors controlled fermentation.

MNG/ME/T/1 INDUSTRIAL MANAGEMENT

Growth of Industries, Management thoughts and scientific management, Taylorism; Factory system of production, Introduction to management problems, Types of manufacture, Planning analysis and control aspects in industries. Types of business ownership, means of finance and business combinations, organization structures, committee organization, authority and responsibility, duty and span of control.

Plant location, factory buildings and physical facilities, plant layout, tools and techniques of plant layout, materials - handling arrangements. Product development, standardization, simplification and diversification.

Functions of production, planning and control, production forecasting, production scheduling and network techniques, Gantt chart, CPM, PERT etc.

Work study, job evaluation and merit rating; purchase system and inventory control. Inspection and quality control of systems, statistical quality control, maintenance and replacement policies for machine and equipments; decision making theories, breakeven analysis cost benefit analysis, evaluation of financial and managerial efficiencies. Introduction to operational research techniques.

Application of fuzzy logic in modern management concepts. Human relations in industry and labour compensation. Personnel management, provision of industrial legislations in India. Wage and salary administrations. Welfare and safety provisions, trade union acts. Study of environmental impacts and environmental laws.

Text Book:

Production and operations management: S.N.Chari

Reference books:

1. " Industrial Management" by: Basu & Majmundar (Birla Pub., Newdelhi)
2. " Quantitative techniques in management" by: N.D.Vohra (Tata Mcgraw Hill)
3. "Production systems analysis and control" by : Riggs
4. "Works organization and management by: Basu, Sahoo & Dutta.
5. Fuzzy logic with Engineering applications: Timothy J. Ross (Mcgraw Hill)

FTBE/T/325 ELECTIVE PAPER

1. COMPUTER APPLICATION FOR FERMENTATION PROCESS

2. PLANT OPERATION, MAINTENANCE AND SAFETY

3. NON-CONVENTIONAL ENERGY & POLLUTION CONTROL

FTBE/T/325A COMPUTER APPLICATION FOR FERMENTATION PROCESS

- A. Computer : (1) Hardware (2) Software B. Instrumentation : i) Physical measurements, temperature, vessel pressure, volume/level weight, density, power input, agitation speed gas flow rate, liquid media feed rate, viscosity forming. ii) Chemical measurement : pH, biomass, gas oxygen and carbon dioxide concern dissolved oxygen, dissolved carbon dioxide, nitrogen source, ionic strength, redox potential, enzyme coupled sensors, microbe-coupled sensors, calorimeters, automatic sampling and inoculation, other methods. iii) Bio-chemical measurement : ATP/ADP, NAD/.NADH, Cytophotometry and cytofluorometry. iv) Biological measurement.
- B. Sole estimation and parameter identification : Indirect measurement, microscope material/energy balances. On line estimation.
- C. Modelling : Types of growth models, consideration in modelling and the use of models in computer control.

FTBE/T/325B PLANT OPERATION, MAINTENANCE AND SAFETY

Introduction to the structure of systems of plant operation, maintenance and safety. System interactions and degree of freedom with man, material and equipment. Factory rules and procedures with Indian and International specifications in operation, maintenance and safety. Effects of economic design criteria in optimum plant operation. Trouble shooting operation and maintenance in presence of uncertainty. Simulation for interpretation in difficult plant operation. Introduction to microprocessor based operations. Inspection, testing and analysis of tolerance limit and types of failure. Contions based maintenance and its economical viability. Hazards and operative (HAZOP) analysis. Accidents and emergency preventive procedures. Insurance claim and loss analysis. Case studies on Food and Biochemical plants.

FTBE/T/325C NON-CONVENTIONAL ENERGY & POLLUTION CONTROL

a) Fundamental concept of environmental system. Climatic aspects of pollution causes of Air pollution. Control of air pollution caused by industries and agriculture, viz. Sulfur dioxide removal from waste gases. Water quality, system for treating water and wastes, by physical, chemical and biological treatment processes. Processing of sludge Reuse of Water. Sensing, Instrumentation and measurement of air and water quality. Environmental education for creating awareness of pollution among people. Legal consideration. b) Energy forms and basic laws. Different types of solid gaseous fuels. World Energy Resources and consumption. The nature of Solar energy, Biological and chemical conversion of solar energy. Energy conservation in industries. Wind and tides and other forms of energy like geothermal energy etc. Renewable energy system for application in agriculture. Development of equipments based on the use of energy obtainable from non conventional sources.

b)

FTBE/T/326 **GENERAL VIVE-VOCE**

Based on all the theoretical and sessional subjects of all the semesters.

FTBE/S/321 **HOME DESIGN/PROJECT**

Students will be assigned Home design problem on selected designs of plant and equipment, related to Food Technological and Biochemical or similar industries.

The design problem should be worked out by students under the guidance of teachers. Complete design with drawings should be submitted by the students within prescribed date.

Alternatively, the students will be assigned one project work to carry out a particular experiment and to find out experimental data under the guidance of departmental teachers. The Home design/project report along with viva will be considered as an examination paper, carrying 100 marks for the final examination.

FTBE/S/324 **FOOD ENGINEERING LABORATORY**

Evaluation of F & T values of two types of microorganisms encountered in spoilage of canned food. Determination of process time by graphical & formula method. Drying rate characteristics of different food materials. Studies on dehydration in spray drier. Spray drier, fluidized bed drier, freeze drier etc. Parboiling of paddy, wheat & other cereals & determination of their milling characteristics. Extraction and refining of oil from various oil seeds. Production of rice bran oil. Milling of spices & determination of oil & oleoresin. Evaluation of properties of different packaging material. Extrusion pro.