## Syllabus for B.Tech (Food Technology)

**Revised Syllabus of B.Tech FT (for the students who were admitted in Academic Session 2010-2011)**

### 2nd Year, 3rd Semester

#### A: THEORY:

<table>
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<tr>
<th>Code</th>
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<td>FT303 Chemistry of food</td>
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### 3rd Year: 6th Semester

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<td>Bakery, confectionary and extruded foods</td>
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### Syllabus for B.Tech (Food Technology)

**Revised Syllabus of B.Tech FT (for the students who were admitted in Academic Session 2010-2011)**

#### 4th Year, 7th SEMESTER

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<td>Waste Management of Food Industries</td>
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Total practical and sessional: 15 12

Total 5th Semester: 32 29

#### 4th Year: 8th SEMESTER

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Total Theory: 8 8

**B. PRACTICAL & SESSIONAL:**

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Total sessional: 18 15

Total 6th semester: 26 23
VALUES & ETHICS IN PROFESSION

Science, Technology and Engineering as knowledge and as Social and Professional Activities

**Effects of Technological Growth:**

Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development
Energy Crisis: Renewable Energy Resources
Environmental degradation and pollution. Eco-friendly Technologies. Environmental Regulations, Environmental Ethics
Appropriate Technology Movement of Schumacher; later developments
Technology and developing notions. Problems of Technology transfer, Technology assessment impact analysis.

**Ethics of Profession:**

Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals. Social and ethical responsibilities of Technologists. Codes of professional ethics. Whistle blowing and beyond, Case studies.

**Profession and Human Values:**

Values Crisis in contemporary society
Nature of values: Value Spectrum of a good life
Psychological values: Integrated personality; mental health
Societal values: The modern search for a good society, justice, democracy, secularism, rule of law, values in Indian Constitution.
Aesthetic values: Perception and enjoyment of beauty, simplicity, clarity
Moral and ethical values: Nature of moral judgements; canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility.

**Books:**

CHEMISTRY-2

Module I: Dilute solutions – Colligative properties
Lowering of vapor pressure of solution, elevation of boiling point, freezing point depression, definition, principles, and laws of osmotic pressure
 Ionic equilibrium: Solubility and solubility product, common ion effect, determination of solubility product by EMF method, ionic product of water, pH, pOH, hydrolysis of salt solutions: Strong acid and weak base, weak acid and strong base, weak acid and weak base, concepts of buffer

Module II: Instrumental methods of spectral analyses
**UV Spectra**: Electronic transition (σ-σ*, n-σ*, π-π* and n-π*), steric effect, solvent effect, hyperchromic effect, hypochromic effect (typical examples).
**IR Spectra**: Modes of molecular vibrations, characteristic stretching frequencies of O-H, C-H, C=C, C=O functions
**NMR Spectra**: Nuclear spin, NMR active nuclei, principle of proton magnetic resonance, equivalent and non-equivalent protons
**Photochemistry**: Lambert’s law and Beer’s Law, Laws of photochemistry, Photochemical processes

Module III: Coordination chemistry
Structures of coordination compounds corresponding to coordination number 6; types of ligands; isomerism (geometrical, optical, ionization, linkage and coordination)
Colloid chemistry: Definition of colloid, principle of colloid formation, types of colloid, colloid preparation, stability of colloid, association of colloid and emulsion

Module IV:
**General treatment of reaction mechanisms**: Ionic and radical reactions; heterolytic and, homolytic bond cleavage; Reactive intermediates: carbocations (cabenium and carbonium ions), carbanions, carbon radicals, carbenes – structure using orbital picture, electrophilic/nucleophilic behaviour, stability, generation and fate. Reaction kinetics: transition state theory, rate const and free energy of activation, free energy profiles for one step and two step reactions
**Nucleophilic substitution reactions**: SN1, SN2, SNi mechanisms. Effect of substrate structure, nucleophiles and medium on reactivity and mechanism; neighboring group participations.
**Elimination Reactions**: E1, E2, and E1cB mechanisms. Saytzeff and Hofmann rules. Elimination vs substitution reaction. Electrophilic and Activated Nucleophilic substitution reactions of Benzene (Nitration, sulphonation, Halogenation and Friedel Craft reactions)

**BASIC ENVIRONMENTAL ENGINEERING & ELEMENTARY BIOLOGY**

CH(FT) 301
L-T-P = 3-0-0

**Introduction**: Basic ideas of environment, basic concepts, man, society & environment, their interrelationship. 1L
Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-a-vis population growth, sustainable development. 2L
Materials balance: Steady state conservation system, steady state system with non conservative pollutants, step function. 1L
Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of environmental science and engineering. 2L
Ecology: Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem- components types and function. 1L

At least 30 Hrs/Sem
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Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundarban); Food chain: definition and one example of each food chain, Food web. 2L

Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. 1L

Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity. 2L

Air pollution and control: Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. 1L

Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems. 1L

Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth’s heat budget. 1L

Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). 2L

Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes. 2L

Water Pollution and Control: Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. 2L

River/Lake/ground water pollution: River: DO, 5 day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river[deoxygenation, reaeration], COD, Oil, Greases, pH. 2L

Lake: Eutrophication [Definition, source and effect]. 1L

Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only) 1L

Standards and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. 2L

Noise Pollution: Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise] 1L

Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L10 (18hr Index), Ld. Noise pollution control. 1L
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Environmental Management: Environmental impact assessment, Environmental audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol.  2L

References/Books

THERMODYNAMICS AND KINETICS
FT301: L-T-P = 3-1-0  At least 45 hrs/sem

Module I: 10L

Module II: 10L
Simple model’s for vapour/liquid Equilibrium, Roult’s Law, Henry’s law, Modified Raoult’s Law, Vapour Liquid Equilibrium, K-value correlations; VLE from Cubic Equations of State; Equilibrium and Stability; Liquid/liquid equilibrium; Solid/liquid equilibrium, Solid/vapour equilibrium.

Module III: 10L
Thermodynamics and its Applications: The Chemical Potential and Phase Equilibria Fugacity and Fugacity, Coefficient: for pure species and solution; Generalised correlations for Fugacity, the Ideal Solution, Property Changes and Heat Effects of Mixing Processes. The Vapour-Compression Cycle, the Choice of Refrigerant, Absorption, Refrigeration and liquefaction: Low temperature cycle: Linde and Claude.

Module IV: 10L
Kinetics: Rate of chemical reaction; Effect of Temperature on Rate Constant, Arrehnius equation, Collision Theory, Transition State Theory, Order and Molecularity of a Chemical reaction, Elementary Reactions, First, Second and Third order reactions, Non Elementary Reactions, Pseudo-first order reaction, Determination of rate constant and order of reaction, Half life method, Fractional order reactions

Revision: 5L
Textbook:
1. Smith & Vanness, Thermodynamics for Chemical Engineers, MGH
Reference books:
1. Richardson, J.F., Peacock, D.G.Coulson & Richardson’s Chemical Engineering- Volume 3
5. Physical Chemistry ; Moore, PHI

FOOD MICROBIOLOGY
FT 302: L-T-P = 3-1-0  At least 45 hrs/Sem

Module I: 10L
Introduction – definition, historical development and significance of food microbiology; Microscope; Classification & morphology of microbes; Techniques of pure culture; Bacteriology of air & water; Antimicrobial agents – physical & chemical – mechanism & action.
Module II: 10L
Disinfection & disinfectants; Energy metabolism of aerobic & anaerobic microbes; Thermal inactivation of microbes; Concept, determination & importance of TDT, F, Z & D values; Factors affecting heat resistance; Pasteurization and sterilization.

Module III: 10L
Microbiology of milk & milk products like cheese, butter, ice-cream, milk powder; Microbiology of meat, fish, poultry & egg and their products.

Module IV: 10L
Microbiology of fruits & vegetable and products like jam, jelly, sauce, juice; Microbiology of cereal and cereal products like bread, biscuits, confectionary

Revision: 5L
Text Books / References :
1. Essentials of Microbiology; K. S. Bilgrami; CBS Publishers, Delhi
2. Food Microbiology; WC Frazier; Tata McGraw Hill, Delhi
3. Modern Food Microbiology; James M Jay; CBS Publishers, Delhi
4. Microbiology; Pelczar, Chan and Krieg; Tata McGraw Hill, Delhi
5. Basic Food Microbiology; Bannett, Chapman and Hall
6. Food Microbiology; M. R. Adams
7. Hand Book of Microbiology; Bisen

CHEMISTRY OF FOOD

FT 303: L-T-P = 3-1-0 At least 45 hrs/sem

Module I: 10L
Introduction to different food groups and importance of food chemistry; Water in foods and its properties. Carbohydrate: Sources of food carbohydrates; Physico-chemical and functional properties; chemistry and structure of homosachharides and heterosachharides.

Module II: 10L
Proteins: Sources and physico-chemical and functional properties; Purification of proteins; Common food proteins.

Module III: 10L
Fats: Sources and physico chemical and functional properties; PUFA [Poly-unsaturated Fatty Acids] hydrogenation and rancidity; Saponification number, iodine value, Reichert-Meissl number, Polenske value; Lipids of biological importance like cholesterol and phospholipids.

Module IV: 10L
Minerals and Vitamins: Sources and structures of minerals & vitamins; Effect of processing and storage of vitamins; Pro vitamins A & D; Vitamins as antioxidants. Food Pigments & Flavouring Agents : Importance, types and sources of pigments – their changes during processing and storages.

Revision: 5L
Text Books / References:
1. Essentials of Food & Nutrition by Swaminathan, Vol. 1 & 2
2. Food Chemistry by L. H. Muyer
3. Hand Book of Analysis of fruits & vegetables by S. Ranganna
4. Food Chemistry by Linhinger
5. Chemical changes in food during processing by Richardson
6. Nutrition and Dietetics by Rose

**Practical**

**ENVIRONMENTAL ENGINEERING LAB**

**CH-391: L-T-P = 0-0-3**
1. Physical examination of Sewage/Water:
   a. Total Solid
   b. Total dissolve solid
   c. Total suspended solid
   d. pH, color and odor
2. Chemical estimation of Sewage/Water and soil
   a. Determination of Chlorides
   b. Estimation of Chemical oxygen Demand
3. Microbial examination of Sewage/Water
   a. Confirmation of coliforms
   b. Biological oxygen demand
5. Examination of different bacteria, algae, fungi, plants and animals by microscopic or morphological examination

**CHEMISTRY-2 LAB**

**CH(FT) 392: L-T-P = 0-0-3**
1. Amino Acid Analysis: pH measurements and Buffer Preparation
2. Amino Acid Analysis: Isoelectric Point Determination
3. Estimation of proteins by Lowry’s method / Buret method
4. Estimation of proteins by Bradford Assay
5. Determination of N, P, K, organic C from soil samples
6. Lipid/sugar: TLC/Paper Chromatography
7. Study on kinetics of iodine / ester hydrolysis
8. Detection of aldehyde / aliphatic or aromatic alcohol / carboxylic / ester / amino group(s)

**CHEMISTRY OF FOOD LAB – I**

**FT 391: L-T-P = 0-0-3**
1. Determination of Moisture in food sample
2. Determination of Protein in food sample
3. Determination of Ash in food sample
4. Determination of Crude Fat in food sample
5. Determination of Acidity and pH in food sample/beverages
6. Determination of total, non-reducing and reducing sugars
7. Determination of Vitamin C in food sample

**FOOD MICROBIOLOGY LAB**

**FT 392: L-T-P = 0-0-3**
1. Study of a compound microscope.
2. Gram Staining and Study of morphology of bacterial cells.
3. Study of autoclave, Preparation and sterilization of nutrient broth and agar.
4. Subculturing of a bacterial strain in liquid and solid medium.
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5. Study of growth of *E. coli* by a spectrophotometer.
7. Preparation of synthetic medium for yeast and mould and inoculation with standard strains of yeasts and moulds.
8. Isolation of starch-hydrolyzing organism from soil.
10. Isolation of pure culture.
11. Estimation of microbial count of air.

**Semester IV**

**Theory**

**NUMERICAL METHODS**

**Mi(CS) 401: L-T-P = 2-1-0**

Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors. (4)

Interpolation: Newton forward/backward interpolation, Lagrange’s and Newton’s divided difference Interpolation. (5)

Numerical integration: Trapezoidal rule, Simpson’s 1/3 rule, Expression for corresponding error terms. (3)

Numerical solution of a system of linear equations: Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method. (6)

Numerical solution of Algebraic equation: Bisection method, Regula-Falsi method, Newton-Raphson method. (4)

Numerical solution of ordinary differential equation: Euler’s method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference method. (6)

**Text Books:**

**References:**
2. Baburam: Numerical Methods, Pearson Education.
4. Soumen Guha & Rajesh Srivastava: Numerical Methods, OUP.
5. Srimanta Pal: Numerical Methods, OUP.

**INDUSTRIAL STOICHIOMETRY**

**CH 401: L-T-P = 3-1-0**

At least 45 hrs/Sem

Module I (10L): Small units and dimensions: Buckingham Pi-theorem. Dimensionless groups, Conversion of equations, Solution of simultaneous equations, use of log-log and semi-log graph paper, triangular diagram, Graphical differentiation and graphical integration, Treatment and Interpretation of data, Error analysis in connection with computation.


Module IV (10L): Combined Material and Energy Balances: Simultaneous material and energy balances, selected industrial process calculations for bioprocesses.

Revision: 5L

Reference books:

UNIT OPERATIONS OF CHEMICAL ENGINEERING – I

CHE 414: L-T-P = 3-1-0


Module II (10L): Flow measurements and machineries: Flow through pipes and open channels, Orifice and Venturimeters, Pitot Tube, Weirs, Rotameters and other types of meters, Transportation of fluids, Pipe Fittings and valves, Pumps – classification, centrifugal and positive displacement type – peristaltic. Blowers and compressors (oil-free).


Revision: 5L

Books:
1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
3. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
4. Heat Transfer: D.Q. Kern, MGH
5. Badger, W.L., Banchero, J.T., Introduction to Chemical Engineering, MGH
7. Perry, Chilton & Green, Chemical Engineers’ Handbook, MGH
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8. Unit operations and unit processes for Engineers and Biologists; B. C. Bhattacharya and C. M. Narayanan; Khanna Publications, Delhi
9. Mechanical Operations for Chemical Engineers; C. M. Narayanan and B. C. Bhattacharya; Khanna Publishers, Delhi

BIOCHEMISTRY & NUTRITION

FT 401: L-T-P = 3-1-0 At least 45 hrs/Sem
Module I (10L): Introduction to Biochemistry. Proteins and protein structures; Essential amino acids. Metabolism of proteins (digestion and absorption); Nitrogen balance and nitrogen pool; Evaluation of quality of proteins
Module II (10L): Enzymes; Definition, function, classification, nomenclature & structure; Co-enzymes and its function; Mechanism of enzyme action, enzyme kinetics & environmental effects; Enzyme inhibition.
Module III (10L): Carbohydrates; Definition & classification; General chemistry of carbohydrates; Metabolic pathways for breakdown of carbohydrates: glycolytic pathway, pentose phosphate pathway, citric acid cycle, electron transport chain, ATP balance, gluconeogenesis; General chemistry of lipids; Essential fatty acids; Digestion & absorption of lipids.
Module IV (10L): Vitamins & minerals: occurrence, physiological function of vitamins and minerals. Introduction to human nutrition; Nutritive values of foods; Basal metabolic rate; Techniques for assessment of human nutrition, Dietary requirements and deficiency diseases of different nutrients
Revision: 5L
Text Books / References :
1. Lehninger, Nelson & Cox, Principle of Biochemistry, CBS Publication
2. Modern Experimental Biochemistry, Boyer, Pearson Education
3. Lubert stryer, Biochemistry, Freeman & Co, N.Y.
4. Voet & Voet, Fundamentals of Biochemistry, Jonh Willey & Sons
5. HamesNutrition and dietetics by Rose

PRINCIPLES OF FOOD PRESERVATION

FT 402: L-T-P = 3-1-0 At least 45 hrs/Sem
Module I (10L): Introduction to food preservation – Objectives and techniques of food preservation
Canning: Preservation principle of canning of food items, thermal process time calculations for canned foods, spoilage in canned foods
Module II (10L): Water activity of food and its significance in food preservation; dehydration and drying of food items; IMF; Low temperature preservation: cold storage, cold chain, freezing (including cryogenic freezing)
Module III (10L): Preservation by fermentation: curing and pickling; Hurdle technology, Non-thermal (e.g. high pressure processing) and minimal processing technologies
Module IV (10L): Ionization radiation; Use of preservative in foods: chemical preservative, biopreservatives, antibiotics, lactic acid bacteria
Revision: 5L
Text Books / References :
1. Technology of Food Preservation by Desrosier
2. Food Science by Potter
3. Fruits and vegetable processing by Cruss
4. Preservation of Fruits & Vegetables by IRRI
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Practical

Technical Report Writing & Language Lab Practice

HU 481: L-T-P = 0-0-3 Cr-2

Guidelines for Course Execution:
Objectives of this Course: This course has been designed:
1. To inculcate a sense of confidence in the students.
2. To help them become good communicators both socially and professionally.
3. To assist them to enhance their power of Technical Communication.

Detailed Course Outlines:
A. Technical Report Writing: 2L+6P
   1. Report Types (Organizational / Commercial / Business / Project )
   2. Report Format & Organization of Writing Materials
   3. Report Writing (Practice Sessions & Workshops)
B. Language Laboratory Practice
   I. Introductory Lecture to help the students get a clear idea of Technical Communication and the need of Language Laboratory Practice Sessions 2L
   2. Conversation Practice Sessions: (To be done as real life interactions) 2L+4P
      a) Training the students by using Language Lab Device/Recommended Texts/cassettes /cd’s to get their Listening Skill & Speaking Skill honed
      b) Introducing Role Play & honing over all Communicative Competence
   3. Group Discussion Sessions: 2L+6P
      a) Teaching Strategies of Group Discussion
      b) Introducing Different Models & Topics of Group Discussion
      c) Exploring Live /Recorded GD Sessions for mending students’ attitude/approach & for taking remedial measure
   Interview Sessions; 2L+6P
      a) Training students to face Job Interviews confidently and successfully
      b) Arranging Mock Interviews and Practice Sessions for integrating Listening Skill with Speaking Skill in a formal situation for effective communication
   4. Presentation: 2L+6P
      a) Teaching Presentation as a skill
      b) Strategies and Standard Practices of Individual /Group Presentation
      c) Media & Means of Presentation: OHP/POWER POINT/ Other Audio-Visual Aids
   5. Competitive Examination: 2L+2P
      a) Making the students aware of Provincial /National/International Competitive Examinations
      b) Strategies/Tactics for success in Competitive Examinations
      c) SWOT Analysis and its Application in fixing Target

Books – Recommended:

References:
1. Adrian Duff et. al. (ed.): Cambridge Skills for Fluency
   A) Speaking (Levels 1-4 Audio Cassettes/Handbooks)
   B) Listening (Levels 1-4 Audio Cassettes/Handbooks)
   Cambridge University Press 1998
2. Mark Hancock: English Pronunciation in Use
   4 Audio Cassettes/CD’S OUP 2004
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NUMERICAL METHODS LAB

M(CS)-491: L-T-P = 0-0-2
1. Assignments on Newton forward /backward, Lagrange’s interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson’s 1/3 rule, Weddle’s rule.
3. Assignments on numerical solution of a system of linear equations using Gauss elimination and Gauss-Seidel iterations.
4. Assignments on numerical solution of Algebraic Equation by Regular-falsi and Newton Raphson methods.
5. Assignments on ordinary differential equation: Euler’s and Runga-Kutta methods.
6. Introduction to Software Packages: Matlab / Scilab / Labview / Mathematica.

BIOCHEMISTRY LAB

FT491: L-T-P = 0-0-3
1. Separation of amino acids/sugars by Ascending Paper Chromatography.
2. Separation of sugars/amino acids by Thin Layer Chromatography.
4. Determination of BOD5 and COD of a sample of waste water.
5. Preparation of cell-free extract: Bacterial cell by sonication, Chicken liver by homogenization.
6. Assay of enzyme activity – (a) Phosphatase assay [Chicken liver] (b) Protease assay
7. Study of an enzymatic reaction.

UNIT OPERATION LAB – I

CHE 484: L-T-P = 0-0-3
1. Experiments on Reynolds’s Apparatus – Determination of flow regime and construction of friction factor against NRE.
2. Experiments on flow measuring device — in closed conduit using (a) Venturimeter, (b) Orifice meter, (c) Rotameter.
3. Determination of Pressure drop for flow through packed bed & verification of Ergun Equation, Kozeny-Karman equation, Blake-Plummer Equation.
4. To study the working characteristics of a Jaw Crusher, calculate the energy consumption as a function of size reduction and compare it with the actual energy requirements.
5. To study the working characteristics of a Ball Mill, calculate the energy consumption as a function of size reduction and determine the critical speed.
6. To Determine the Overall heat transfer coefficient of a concentric pipe heat exchanger based on the inside diameter of the tube.
7. To study the characteristics of film-wise/drop-wise condensation.

CHEMISTRY OF FOOD LAB – II

FT 492: L-T-P = 0-0-3 Credit – 2
1. Determination of pigments in food sample.
2. Estimation of calcium in food sample
3. Estimation of iron in food products
4. Estimation of zinc in food sample
5. Estimation of tin in canned foods
6. Estimation of crude fiber in food sample
7. Estimation of antioxidant(s) / polyphenol(s) in food sample
8. Analysis of lysine content in animal / vegetable sources
Semester V

Theory

ECONOMICS OF ENGINEERING

HU 501

Contracts: 3L Credits- 3

9. Inflation And Price Change – Definition, Effects, Causes, Price Change With Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates.

Readings

2. Donald Newnan, Ted Eschembach, Jerome Lavelle : Engineering Economics Analysis, OUP
5. R.Paneer Seelvan: Engineering Economics, PHI

FOOD PROCESS TECHNOLOGY – I (cereals, fruits and vegetables, beverages)

FT 501

Contracts: 3L + 1T Credits- 4

Module I: Storage of cereals, Infestation control; Drying of grains, Processing of rice and rice products. Milling of wheat, corn, barley, oat; Production of wheat products, including flour and semolina. Puffed cereals from broken rice.
Module II: Feed for livestock from wheat bran and germ, Production of starch, modified starch, Extraction of prolamins (Zein & kafirin); Potato processing (potato chips, flakes, powder) and storage
Module III: Storage and handling of fresh fruits and vegetables, Production of fruits and vegetable juices, Preparation of jam, jelly, marmalade, and tomato products (sauce and ketchup), Production of pectin, vitamins from apple pomace; Production of citrus oil from peels of citrus fruits, candied peel
Module IV: Non-alcoholic beverages, Processing of tea, coffee and cocoa, Tea-waste utilization as feed for livestock and poultry; Coloring agents, Humectants, anti-caking agents, Low calorie sweeteners, pH control agents, thickeners.

Books:

1. Food Science by Potter
2. Fruit and Vegetable Preservation by Srivastava and Sanjeev Kumar
3. Principles of Food Science, Vol-I by Femina Karrel
4. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon
5. Post Harvest Technology of cereal pulse and oil seeds by Chakraborty, AC
6. Food Science by Mudambi
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FOOD PROCESS TECHNOLOGY – II (fish, meat, poultry)

FT 502
Contracts: 3L + 1T Credits- 4
Module I: Classification of fresh water fish and marine fish; Commercial handling, storage and transport of raw fish; Average composition of fish; Freshness criteria and quality assessment of fish; Spoilage of fish; Methods of Preservation of fish: Canning, Freezing, Drying, Salting, smoking, curing, fermentation (fish sauce).
Module II: Fish byproducts - production of fish meal, fish protein concentrate, fish protein hydrolysate fish liver oil and fish silage; Production of chitin, chitosan; Production of non-food items from fish processing wastes.
Module III: Slaughtering of animals; Meat cuts and portions of meat, muscle; Classification, composition and nutritional value of poultry meat; Color of meat; Post mortem changes of meat; Meat processing - curing and smoking; Fermented meat products (sausages and sauces); Frozen meat & meat storage; By-products from meat industries and their utilization.
Module IV: Structure, composition and nutritional values of eggs; Egg processing, Byproduct Utilization – commercial processing of lecithin and other egg solids, Utilization of egg-derived products as food ingredients; Fertilizer from shells

Books:
3. Egg and poultry meat processing; Stadelman WJ, Olson VM, Sherwell GA & Pasch S; 1988, Elliswood Ltd.
6. Fish as Food; Vol 1 & 2; Bremner HA; 2002, CRC Press.
7. Fish & Fisheries of India; Jhingram VG; 1983, Hindustan Pub Corp
9. Fish Processing Technology , Rogestein & Rogestein

FOOD PROCESS ENGINEERING

FT503
Contracts: 3L + 1T Credits- 4
Module I: Process time calculations; Sterilizers and accessories used in canning industries; Engineering aspects of pasteurizer: homogenizer, evaporators (basic principle and single-effect evaporator) and concentrators used in food industries; Seaming machine.
Module II: Construction of cold storage; Different types of freezers including plate contact freezer, air blast freezer, cryogenic freezing and refrigerated vans.
Module III: Various types of driers (basic principle and drying time) – Tray drier, roller drier, spray drier, fluidized bed drier, freeze drier and solar drier.
Module IV: Heat exchangers (including paraflow HEs); Extruders – Basic principles and types, Difference between single- and twin-screw extruders; Kneader; Oil expeller

Book:
1. The Fundamentals of Food Engineering; Charm SE; 1963, AVI Pub.
2. Bakery Technology & Engineering; Matz SA; 1960, AVI Pub.
3. Dictionary of Food Science & Technology, Blackwell Publishing
4. Engineering Properties of Foods; Rao MA & Rizvi SSH; 1986, Marcel Dekker Inc.
6. Food process engineering, D.R.Heldman and R.P.Singh

UNIT OPERATIONS OF CHEMICAL ENGINEERING – II

CHE514
Contracts: 3L + 1T Credits- 4
Module I: 10L
Introduction to mass transfer: Molecular diffusion in fluids, diffusivity, mass transfer coefficients, interphase mass transfer, gas absorption, countercurrent multistage operation, packed tower.
Module II: 10L
Distillation: Vapor-liquid equilibrium, Rayleigh’s equation, flash and differential distillation, continuous rectification, McCabe-Thiele method, bubble cap and sieve distillation column.
Module III: 10L
Extraction, Drying and Crystallization: Liquid-liquid equilibrium, liquid extraction, stage-wise contact, liquid-solid equilibria, leaching, batch drying and mechanism of batch drying, principle and operation of a spray drier, preliminary idea of crystallization.
Module IV: 10L
Advanced separation processes: Dialysis, ultrafiltration, reverse osmosis, pervaporation, electro dialysis and membrane separation.
Revision: 5L

Books:
1. Unit Operations of Chemical Engineering; McCabe, Smith & Harriot; 6th ed, TMH.
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2. Transport Processes & Unit operations; Geankopolis; 3rd ed, PHI.
4. Chemical Engineer’s Handbook; Perry, Chilton & Green; MGH.

Practical

FOOD PROCESSING LAB – I
FT 591
L-T-P = 0-0-4
1. Preparation of orange squash.
2. Preparation of mango jam.
3. Preparation of guava jelly.
4. Preparation of tomato ketchup.
5. Preparation of canned peas / pine apple.
6. Preparation of mango pickle.
7. Preparation of dried carrot.
8. Preparation of frozen prawn.

FOOD ANALYSIS AND QUALITY CONTROL LAB
FT 592
L-T-P = 0-0-4
1. Analysis of jam
2. Analysis of spices
3. Analysis of milk, sweetened condensed milk (SCM)
4. Determination of adulterants in milk and milk products
5. Analysis of tea and coffee
6. Analysis of wheat flour, bread, biscuits
7. Analysis of non-alcoholic beverages
8. Estimation of a) iodine value, (b) Saponification value (c) acid value (d) peroxide value, (e) RM value (f) P value, (g) K value of fats and oils

UNIT OPERATION LAB – II
CHE 584
L-T-P = 0-0-4
1. Separation: Filtration, centrifugation
2. Vacuum evaporation
3. Drying and freeze drying
4. Freezing
5. Mass transfer coefficient / kLa determination

Semester VI

Theory

PRINCIPLES OF MANAGEMENT
HU 601
Contracts: 3L + 0T
Credits- 3

1. Basic concepts of management: Definition – Essence, Functions, Roles, Level.
5. Managerial Competencies – Communication, Motivation, Team Effectiveness, Conflict Management, Creativity, Entrepreneurship


Readings


FOOD PROCESS TECHNOLOGY – III (Milk and milk products)

FT 601
Contracts: 3L + 1T Credits- 4
Module I (10L): Composition of milk; Varieties of milk; Checks for purity of milk; Handling of freshly produced milk; Cleaning and sanitization.
Module II (10L): Thermal processing of fluid milk – Pasteurization (LTLT and HTST), sterilization and UHT techniques; Packaging of fluid milk; Fermentation of milk and fermented milk products – Cheese, yogurt, etc including probiotic dairy products.
Module IV (10L): Traditional Indian sweets; Dairy processing by-products – Fermented, condensed and dried products from whey, Production of lactose and protein from whey.
Revision: 5L
Books:
4. Developments in Dairy Chemistry – Vol 1 & 2; Fox PF; Applied Science Pub Ltd.

FOOD PROCESS TECHNOLOGY – IV (edible fats and oils)

FT 602
Contracts: 3L + 0T Credits- 3
Module I (8L): Importance of fats and oils in foods; Sources, composition and properties of fats and oils (plant and animal origin); Reversion and rancidity of fats and oils; Extraction of fats and oils – Rendering, pressing, solvent extraction, supercritical fluid extraction, enzyme-derived oil extraction.
Module II (8L): Processing of oils – Degumming, refining, bleaching, deodorization, fractionation; Pyrolysis of fats, toxicity of frying oil.
Module III (8L): Plastic fat – Winterization, hydrogenation, esterification, inter-esterification and emulsification; Application of plastic fat in bakery, confectionary (including cocoa butter replacers), shortenings, margarine processing.
Module IV (8L): By-products of fat/oil processing industries – Oil seed protein isolates; Quality standards of fats and fatty foods; Antioxidants and its mechanism of application.
Revision: 4L
Books:
3. Food Oils and their Uses; Weiss T; 1983, AVI.
4. Edible Oils & Fats: Developments since 1978 (Food Technology Review # 57); Torrey S; 1983, NDC.

BAKERY, CONFECTIONARY AND EXTRUDED FOODS

FT 603
Contracts: 3L + 0T Credits- 3
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Module I (8L): Introduction to baking; Bakery ingredients and their functions; Machines and equipment for batch and continuous processing of bakery products.
Module II (8L): Testing of flour; Manufacture of bread, cake and biscuits; Analysis of bakery products; Cake icing techniques, wafer manufacture, cookies, crackers, dusting or breading.
Module III (8L): Manufacture of bread rolls, sweet yeast dough products, cake specialties, pies, pastries, doughnuts, chocolates and candies; Coating or enrobing of chocolate (including pan-coating); Maintenance, safety and hygiene of bakery plants.
Module IV (8L): Importance and applications of extrusion in food processing; Pre and post extrusion treatments; Manufacturing process of extruded products; Change of functional properties of food components during extrusion.
Revision: 4L
Books:
2. Bakery Technology & Engineering; Matz SA; 1960; AVI Pub.
3. Up to-date Bread Making; Fance WJ & Wrogg BH; 1968, Maclaren & Sons Ltd.

MICROBIAL TECHNOLOGY & FOOD BIOTECHNOLOGY

FT 604
Contracts: 3L + 1T                  Credits- 4
Module I (10L): Methods for the microbiological examination of water and foods; Control of Microbiological quality and safety; Food borne illnesses and diseases
Module II (10L): Microbial cultures for food fermentation, their maintenance, strain development; Production of organic acids (vinegar, lactic acid), alcoholic beverages (beer, wine, and distilled alcoholic beverages such as whiskey, rum, vodka), glycerol
Module III (10L): Propagation of baker’s yeasts; Microbial production of vitamins (B1 and B12), antibiotics (penicillin, streptomycin, tetracycline); Enzymatic production of glucose, fructose, starch, SCP and mushrooms
Module IV (10L): Basics of microbial genetics – Gene, DNA, RNA; Replication, transcription, transformation, transduction, conjugation; Regulation of gene expression; Application in GM foods.
Revision: 5L
Books:
1. Industrial Microbiology Prescott & Dunn, CBS Publishers
2. Modern Food Microbiology by Jay JM, CBS Publishers
3. Comprehensive Biotechnology by Murray & Mooyoung, Academic press
4. Industrial Microbiology by Cassida L.R., New Age International Pvt. Ltd.
5. Food Microbiology; Frazier WC; 4th ed, Tata-McGowhill Pub.
6. Microbiology by Pelczar, Chan, and Krieg, TMH

DATA STRUCTURE AND ALGORITHM

CS 615
Contracts: 3L + 1T                  Credits- 4
Module I (10L): Linear Data Structures – Sequential representations, Arrays and Lists, Stacks, Queues and Dqueues, String and their applications.
Module II (10L): Algorithms for creating and manipulating different linear data structures; Non-linear data structure – Trees including Binary Trees, Binary Search Trees, Insertion and Deletion algorithms, Height-balanced and Weight-balanced trees, B-trees.
Module III (10L): Graph Representations, Breadth first search (BFS) and Depth first search (DFS); Graph Theoretic Algorithms – Incidence Matrix, Adjacency Matrix, Algorithms for Minimal Spanning Tree (Prim’s and Kruskal’s Algorithm).
Module IV (10L): Sorting and Searching Algorithms – Bubble sort, Insertion sort, Quick sort, Merge sort; File Structures – Record and Table Structures, Sequential and Direct access, Indexed Files, Inverted Files, Hashed Files.
Revision: 5L
Books:
2. Berman, Data Structure Via C++, OUP
References:
3. Graph Theory – N. Deo, PHI

Practical

FOOD PROCESSING LAB – II

FT 691
L-T-P = 0-0-4
1. Preparation of dry onion/ chilli/ garlic.
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2. Preparation of bread
3. Manufacture of macaroni by extruder.
4. Manufacture of potato powder.
5. Manufacture of ice cream.
7. Manufacture of candied fruits.
8. Production of dried milk by drum drying
9. Production of milk powder by spray drying
10. Preparation of sponge cake

MICROBIAL TECHNOLOGY LAB
L-T-P = 0-0-4
1. Alcohol fermentation
2. Organic acid fermentation – Vinegar / citric / lactic acid production
3. Propagation of baker’s yeast
4. Fermented dairy products
5. Production of antibiotics
6. Enzyme preparation
7. Amino acid production
8. Vitamin B₁₂ production

DATA STRUCTURE & ALGORITHM LAB
CS 685 L-T-P = 0-0-3
Implementation of Array Operations: (using C/C++ languages)
Stacks and Queues: Adding, Deleting elements, Circular Queue: Adding and Deleting elements, Merging Problem.
Implementation of linked lists: Inserting, Deleting, Inverting a Linked List
Sorting and Searching Algorithms
Prim’s, Kruskal’s
And Dijkstra’s Algorithm

Semester VII
Theory

Semester VII
Theory

FOOD PACKAGING TECHNOLOGY
FT 701 L-T-P: 3-0-0 Credits: 3
Module 1: 9L
Functions of packaging; Type of packaging materials; Selection of packaging material for different foods; Selective properties of packaging film; Methods of packaging and packaging equipment.
Module 2: 9L
Mechanical strength of different packaging materials; Printing of packages; Barcodes & other marking; Interactions between packaging material and foods; Environmental and cost consideration in selecting packaging materials.
Module 3: 9L
Manufacture of packaging materials; Potential of biocomposite materials for food packaging; Packaging regulations; Packaging and food preservation; Disposal of packaging materials.
Module 4: 9L
Testing of packaging; Rigid and semi rigid containers; Flexible containers; Sealing equipment; Labelling; Asceptic and shrink packaging; Secondary and transport packaging.
Text books and references:
Syllabus for B.Tech(Food Technology)

Revised Syllabus of B.Tech FT (for the students who were admitted in Academic Session 2010-2011)

6. Plastics in Packaging by A.S Athlye, TMGH, New Delhi.
8. Plastics in packaging by forwarded by H.B Ajmera & M.R Subramaniam – Indian institute of packaging. Published by A.P.Vaidya, Secretary IIP, E2, MIDC, Industrial Area (Andheri (East), Bombay–400093.

WASTE MANAGEMENT OF FOOD INDUSTRIES

FT 702
L-T-P: 3-1-0
Module 1: 10L
Introduction: Classification and characterization of food industrial wastes from fruit and vegetable processing industry, beverage industry, fish, meat and poultry industry, sugar industry and dairy industry; Waste disposal methods – physical, chemical and biological; Economical aspects of waste treatment and disposal.
Module 2: 10L
Treatment methods for liquid wastes from food process industries; Design of activated sludge process, Rotating biological contactors, Trickling filters, UASB, Biogas plant.
Module 3: 10L
Treatment methods of solid wastes: Biological composting, drying and incineration; Design of solid waste management system: Landfill digester, Vermicomposting pit.
Module 4: 10L
Biofilters and bioclarifiers, Ion exchange treatment of waste water, Drinking-water treatment, Recovery of useful materials from effluents by different methods.
Revision: 5L
Text books and references:
3. Wastewater Treatment; Bartlett RE; Applied Science Pub Ltd.
5. Food Processing Waste Management; Green JH & Kramer A; 1979, AVI.
7. Environmental Biotechnology; Bhattacharyya B C & Banerjee R; Oxford University Press.

ENZYME TECHNOLOGY

FT 703 A
L-T-P: 3-0-0
Module 1: 9L
Introduction to enzyme technology; Industrial enzymes – present status and opportunities with special reference to food industries; Catalytic properties of enzymes; Intracellular and extra-cellular enzymes.
Module 2: 9L
Enzyme production technology; Enzyme reactors and process design; Application of recombinant DNA technique to enzyme technology.
Module 3: 9L
Cell disintegration by physical, chemical and biological methods; Enzyme purification methods.
Module 4: 9L
Application of enzymes for production in biochemical and food processing industries; Application of immobilized enzymes and cells.
Text books and references:
1. Methods of Enzymology
2. Biochemical Engg Fundamentals-Baily, Ollis. MGH
3. Prescott & Dunn’s Industrial Microbiology Macmiller
4. Principles of Fermentation Technology-Wittaker and Stanby

RENEWABLE ENERGY TECHNOLOGY

**FT 703 B**

**L-T-P: 3-0-0**

**Cr edits: 3**

Module 1: 9L

- Biological fuel generation; Biomass as a renewable energy source; Types of biomass: forest, agricultural and animal residues;
- Industrial and domestic organic wastes; Conversion of biomass to clean fuels and petrochemical substitutes by physicochemical and/or fermentation processes.

Module 2: 9L

- Biogas from anaerobic digestion; Thermal energy from biomass combustion; Ethanol from biomass.

Module 3: 9L

- Hydrogen production by photosynthetic bacteria, biophotolysis of water and by fermentation; Microbial recovery of petroleum by biopolymers (Xanthum gum), biosurfactants.

Module 4: 9L

- Solar energy; Solar collectors, solar pond, photovoltaic cells, chemical storage; Geothermal energy and wind energy; Use of geothermal energy; Operating principles of different types of wind energy mills; Nuclear energy; Nuclear reactions and power generation; Tidal wave energy.

Text books and references:

PLANT MAINTENANCE, SAFETY & HYGIENE

**FT 703 C**

**L-T-P: 3-0-0**

**Cr edits: 3**

Module 1: 9L

- Plant maintenance program; Role of maintenance staff and plant operators; Preventive maintenance; Guidelines for good maintenance & safety precautions; Lubrication & lubricants; Work place improvement through ‘5S’.

Module 2: 9L

- The objective of safety, health & environment; Cost of safety; Accident investigation report; Safety promotional activity; Environmental pollution and its control.

Module 3: 9L

- Indian Factories Act on safety; HACCP; Desirable safety features of some food processing equipment; Personal protective equipment; Safety from adulteration of food.

Module 4: 9L

- Hygiene and sanitation requirement in food processing and fermentation industries; Cleaning, sanitizing & pest control in food processing; storage and service areas.

Text and reference books:
1. Basic Concepts of Industrial Hygiene, Ronald M Scott, CRC Press.
2. Safety design criteria for industrial plants. Maurizio Cumo & Antonio Naviglia. CRC Press.
3. Industrial Hygiene & Toxicology by Josef Brozek-1948.

MODELING AND SIMULATION OF FOOD PROCESSES

**FT 704 A**

**L-T-P: 3-0-0**

**Cr edits: 3**

Module 1: 9L

- Introduction to mathematical modeling; Process analysis and simulation; Model building; Classification and uses of mathematical models; Formulation of mathematical model and fundamental laws.

Module 2: 9L
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Batch processes in food industry; Equilibriation in batch processes; Steady state flow processes of non reacting systems; Mixing in flow processes.
Module 3: 9L
Simultaneous heat and mass transfer in packed tower and immobilized enzyme system.
Module 4: 9L
Modelling, simulation and optimization of fermentation processes.

Text and reference books:
1. Process modeling, simulation and control: William L Luyben, TMH

PROTEIN TECHNOLOGY

FT 704 B
L-T-P: 3-0-0
Credits: 3
Module 1: 9L
Determination of protein structure; Nutritional and commercial importance of proteins; Physical, chemical and functional properties of proteins; Folding of proteins; Commercial sources of proteins; Creation of new proteins by bio-composite synthesis technique.
Module 2: 9L
Process of making protein isolates and concentrates; Factors affecting quality of isolates and concentrates; Treatment to isolate and concentrate; Packaging of protein isolates and concentrates; Food and non food uses of isolates and concentrates.
Module 3: 9L
Methods of manufacturing protein hydrolysates; Factors affecting quality of hydrolysates; Food uses of hydrolysates; Fibre spinning process of proteins; Textured protein gels and expanded products; Simulated milk products; Restructured protein; Non-conventional sources of protein.
Module 4: 9L
Centrifugation; Cell disruption; Protein precipitation and its recovery; Aqueous two-phase separation; Ion exchange chromatography; Gel filtration; Affinity chromatography; Electrophoresis; Cross filtration; Ultra filtration.

Text and reference books:
8. Protein Biotechnology, Franks, F.; Humana Press

QUALITY CONTROL & MANAGEMENT

FT 704 C
L-T-P: 3-0-0
Credits: 3
Module 1: 9L
Definition of quality, Quality specifications and quality attributes of different foods, Statistical quality control
Module 2: 9L
Quality control programs: History and development, Total quality control and management, Quality assurance, ISO 9000 series
Module 3: 9L
Food laws and regulations: PFA, FPO, MFPO, Essential Commodities Act, Sugarcane (control) Order, FSSA
Module 4: 9L
Food Safety Management Systems: Pre-requisites of HACCP, HACCP, ISO 22000

Text and reference books:
2. The Essentials of Quality Control Management, Peter N T Pang, Trafford publishing
3. Guide to Quality Management system for the food industry. Ralph Early
Syllabus for B.Tech(Food Technology)
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PROCESS INSTRUMENTATION & CONTROL
ET 701
L-T-P: 3-1-0
Credits: 4
Module 1: 10L
Operational aspect of instrument system, control and requisites; Analytical balance and spring balance, load cell, moisture measurement cells for granular material, infrared, transmission measurement of moisture
Module 2: 10L
Low pressure measurement by McLeod Gage and Pirani Gage; Temperature measurement by bi-metal thermometers – resistance thermometers, thermistors and thermocouples. Radiation and optical pyrometers; Flow measurement by magnetic flow meters
Module 3: 10L
Control system, Open and closed loop system, transfer function of open loop and closed loop control systems; Block diagrams; Laplace transform; Response of a control system; Stability; Feedback;
Module 4: 10L
Controller mode, Root locus plot, Modulation, Final control, Controllers, Control valve, Application of control in heat exchangers, distillation column
Text and reference books:
1. Instrumentation, Measurement and Analysis; Nakra BC & Chaudhury KK; TMH
2. Process System Analysis & Control; Coughanowr DR ; MGH
3. Chemical Process Control; Stephanopoulis G; PHI

Practical

GROUP DISCUSSION
HU 791
L-T-P: 0-0-3
Credit: 2

FOOD ENGINEERING LAB
FT 791
L-T-P: 0-0-3
Credit: 2
1. Determination of thermal destruction parameters of canning processing – F value, D value, z value
2. Oil
3. extraction from oils seeds
4. Crude oil
4. refining
5. Drying
5. efficiency – spray drier, tray drier, drum drier
6. Fruit juice
6. concentration
7. efficiency

INSTRUMENTATION AND CONTROL LAB

ET 791
L-T-P: 0-0-3
Credit: 2
1. Temperature measurements: (i) Thermocouple, (ii) Resistance Temperature Detector (RTD)
2. Pressure calibration
3. Load cell
4. Moisture measurement
5. Viscometer
REPORT & SEMINAR ON INDUSTRIAL TRAINING

FT 792
Credit: 2
The Industrial Training will be undertaken by each student during the summer recess after the completion of the 6th semester examination and prior to commencement of the 7th semester. A report on the training which is required to be submitted shall consist of:
1. A general overview of the plant.
2. The products & raw material sources of the plant.
3. Detail description of different processing and other equipment.
4. Scheduling of plant operations.
5. Conclusion.
A viva will be conducted after submission of the report and presentation of a seminar.

PROJECT PART 1

FT 793
L-T-P: 0-0-6
Credit: 4
Each student shall undertake project work assigned to him related to design or R&D or industrial problem solving in the area of food science and technology under the supervision of a faculty member or faculty members. In principle, the research / design work has to be carried out by the student himself taking advice from his supervisor when problem arises. The work will be allotted at the beginning of the seventh semester specifying the different aspects to be carried out by the student. At the end of the semester the student will submit a typed Interim Report on his work. Evaluation shall include an oral presentation followed by a brief viva. The same project may be extended for the 8th semester also depending on the nature of the project.

Semester VIII

Theory

HU 801A
L-T-P: 2-0-0
Credits: 2

Organisational Behaviour

1. Organizational Behaviour: Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities for OB. [2]
2. Personality and Attitudes: Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes, Job Satisfaction. [2]
7. Leadership: Definition, Importance, Theories of Leadership Styles. [2]
8. Organizational Politics: Definition, Factors contributing to Political Behaviour. [2]

References:
3. Shukla, Madhukar: Understanding Organizations – Organizational Theory & Practice in India, PHI

PROJECT ENGINEERING AND FOOD PLANT LAYOUT

FT 801
L-T-P: 3-0-0 Credits: 3
Module 1: 9L
Basic concepts of plant layout and design including basic understanding of equipment layout ventilation; Reference to bakery and biscuit, fruits, vegetable and beverage processing, and dairy industries; Miscellaneous aspects of plant layout and design like provision for waste disposal, and safety arrangements
Module 2: 9L
Design consideration for location of food plants; ISO, FPO, MPO requirements in food plant layout and design; Preparation of flow sheets for material movement and utility consumption in food plants
Module 3: 9L
Layout and designing aspects of pilot and semi-commercial food processing plants; Scale-up; Application of Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM) in project planning and monitoring
Module 4: 9L
Introduction to project engineering; Selection of construction materials; Specifications of processing equipments and accessories

Text and reference books:

PRINCIPLES BIOCHEMICAL ENGINEERING

FT 802 A
L-T-P: 3-0-0 Credits: 3
Module 1: 9L
Introduction to biochemical process industries; Industrial alcohols, antibiotics, acids, alcoholic beverages, vitamins, enzymes, single cell protein, Enzymatic immobilization and Kinetics of immobilized systems with diffusion
Module 2: 9L
Bioreactor design: Mechanisms and kinetics (Monod model), Fermentation - types of fermenters, chemostat, chemostat with recycle, turbidostat, PFR, fluidized bed reactor, air lift fermenter, Mass transfer in microbial reactors; scale-up of bioprocess
Module 3: 9L
Bioproduct recovery: Downstream processing - separation process for cell mass and product, filtration, centrifuging, membrane processes (reverse osmosis, ultrafiltration, chromatographic separation)
Module 4: 9L
Bioprocess economics, Cost analysis of alcohol production plant, Fermentation plant design project, Bio-product regulation

Text and reference books:
1. Biochemical Engineering Fundamentals: J.E Bailey, D F Olli, MGH
2. Biochemical Engineering: Aiba S; Academia press, NY
ENTREPRENEURSHIP DEVELOPMENT FOR FOOD TECHNOLOGISTS

FT 802 B
L-T-P: 3-0-0
Credits: 3
Module I: 9L
Entrepreneur and entrepreneurial flair; Classification of small, medium and large scale manufacturing industries; Opportunities of food processing industries in West Bengal
Module II: 9L
Trade license and registration marks; Sources of finance; Selection of land and factory sheds
Module III: 9L
Agencies for promotion of food processing industries; Source of machine and equipment
Module IV: 9L
Preparation of project report; Market feasibility reports; Techno-economic feasibility report on fruits and vegetable processing, bakery and confectionary, mushroom manufacture and soybean processing
Text books/References:
1. Entrepreneurial Development by Sarwate (Everest Publication)

FUNCTIONAL FOODS & NUTRACEUTICALS

FT 802 C
L-T-P: 3-0-0
Credits: 3
Module 1: 9L
Introduction: Relevant terminologies – Enrichment, value addition, fortification, supplementation, Sources, Significance, Fortification and Enrichment in different foods (MSG; Bakery and confectionary products e.g. bread, biscuit and cookies; Breakfast and ready to eat cereals; Infant formulas; Protein mixes; Vegetable Mixes; Dairy product e.g. ice cream; Beverages including diet beverages), Value addition in processed food products e.g. pasta, ice cream, pizza, wafers, rolls, buns, jam, jelly, sauce, pickles, waffles etc
Module 2: 9L
Types of functional foods: Concepts of Probiotic, Nutraceuticals, Spiceuticals, Regulatory and labeling issues, CODEX
Module 3: 9L
Functional ingredients: Extraction / purification of lycopene, isoflavonoids, prebiotics and probiotics glucosamine, phytosterols, and their stability in processing conditions; Manufacturing of dietary supplements in the form of liquid, rehydration powder, tablet, pill, capsule or mix
Module 4: 9L
Nutritional significance: Role of nutraceutical / functional foods in cardiovascular health, diabetes, obesity, immunity, age related muscular degeneration, stress management; Dosage levels; Adverse effects and toxicity of nutraceuticals
Text and reference books:

PROJECT PART 2

FT 891
L-T-P: 0-0-12
Credit: 8
Student shall continue to carry out project works under the supervision of a faculty member or faculty members, as assigned at the beginning of the 7th Semester. At the end of the semester, the work shall yield some meaningful results that facilitate advancement of food science and technology. Each student shall submit a typed, hard-bound Final Project Report on his work and its findings. Evaluation of Project Part 2 shall include an oral presentation followed by a brief viva. Project Defense should be carried out in presence of all the faculty members in the Department, and preferably in presence of External Examiner.

PRODUCT DEVELOPMENT & QUALITY ASSURANCE LAB

FT 892
L-T-P: 0-0-6
Credit: 4
- Development of a food product prototype including product formulation and specifications
- Selection and analysis of raw materials
- Establishment of suitable process flow-diagram for the developed protocol
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- Development of HACCP plan for the processing line
- Establishment of quality assurance protocol
- Product testing (including sensory analyses) and shelf-life study

GRAND VIVA

FT 893
Credit: 4
The Comprehensive Viva-voce Examination evaluates student’s overall grasp on basic principles and their applications in food science and technology.