West Bengal University of Technology
BF-142, Salt Lake City, Kolkata-700064
Structure & Detailed Syllabus of B.Tech in Food Technology

2ND YEAR: 3RD SEMESTER (JULY-DEC)

A. THEORY:

A. THEORY							
	Code	Subjects	Contacts (periods/week)				Credit points
			L	T	P	Total	
1.	M-315	Mathematics	3	1	0	4	4
2.	FT-301	Food Microbiology	3	1	0	4	4
3.	FT-302	Bio Chemistry & Nutrition	3	1	0	4	4
4.	FT-303	Process Calculations, Thermodynamics & Food Science	3	1	0	4	4
5.	FT-304	Mechanical Design of Process Equipment	3	1	0	4	4
Total of Theory						**20**	**20**

B. PRACTICAL:

B. PRACTICAL							
	Code	Subjects	Contacts (periods/week)				Credit points
			L	T	P	Total	
1.	FT-391	Food Microbiology Lab	0	0	6	6	2
2.	FT-392	Bio Chemistry Lab	0	0	6	6	2
3.	FT-393	Process Equipment Drawing	0	0	4	4	2
Total of Practical						**16**	**6**
Total of 3rd Semester						**36**	**26**

2ND YEAR: 4TH SEMESTER (JAN-JUNE)

A. THEORY:

A. THEORY							
	Code	Subjects	Contacts (periods/week)				Credit points
			L	T	P	Total	
1.	FT-401	Chemistry of Food	3	1	0	4	4
2.	FT-402	Principles of Food Preservation	3	1	0	4	4
3.	FT-403	Food Process Technology-I (Cereals, Fruits, Vegetables &Beverages)	3	1	0	4	4
4.	CHE-414	Unit Operations of Chemical Engineering – I	3	1	0	4	4
5.	CS-415	Data Structure & Algorithm	3	1	0	4	4
Total of Theory						**20**	**20**

B. PRACTICAL:

B. PRACTICAL							
	Code	Subjects	Contacts (periods/week)				Credit points
			L	T	P	Total	
1.	FT-491	Chemistry of Food Lab	0	0	6	6	2
2.	CHE-484	Unit Operation Lab-I	0	0	3	3	2
3.	CS-485	Data Structure & Algorithm Lab	0	0	3	3	2
Total of Practical						**12**	**6**

C. SESSIONAL:

C. SESSIONAL							
	Code	Subjects	Contact (periods/week)				Credit points
			L	T	P	Total	
	HU-481	Report Writing & Technical Language Practice Lab	0	0	3	3	2
						3	**2**
Total of 4th Semester						**35**	**28**

3RD YEAR: 5TH SEMESTER (JULY-DEC)

A. THEORY

	Code	Subjects	Contacts (periods/week)				Credit points
			L	T	P	Total	
1.	FT 501	Food Process Technology II (Fish, Meat & Poultry)	3	1	0	4	4
2.	FT 502	Food Process Technology III (Dairy products)	3	1	0	4	4
3.	FT 503	Food Process Engineering	3	1	0	4	4
4.	FT 504	Waste Management of Food Industries	3	1	0	4	4
5.	CHE 514	Unit Operations of Chemical Engineering II	3	1	0	4	4
Total of Theory						**20**	**20**

B. PRACTICAL

	Code	Subjects	Contacts (periods/week)				Credit points
			L	T	P	Total	
1.	FT 591	Food Processing Lab I	0	0	6	6	4
2.	FT 592	Food Analysis & Quality Control Lab I	0	0	6	6	4
Total of Practical						**12**	**8**
Total of 5th Semester						**32**	**28**

3RD YEAR: 6TH SEMESTER (JAN-JUNE)

A. THEORY							
	Code	**Subjects**	**Contacts (periods/week)**				**Credit points**
			L	T	P	Total	
1.	FT 601	Food Process Technology IV (Fats & Oils)	3	0	0	3	3
2.	FT 602	Advanced Food Microbiology & Biotechnology	3	1	0	4	4
3.	FT 603	Bakery, Confectionary and Extruded foods	3	0	0	3	3
4.	FT 604	Food Process Equipment Design	3	0	0	3	3
5.	ET 601	Process Instrumentation and Control	3	1	0	4	4
Total of Theory						**17**	**17**

B. PRACTICAL							
	Code	**Subjects**	**Contacts (periods/week)**				**Credit points**
			L	T	P	Total	
1.	FT 691	Food Processing Lab II	0	0	6	6	4
2.	FT 692	Food Analysis and Quality Control Lab II	0	0	6	6	4
3	FT 693	Food Biotechnology Lab	0	0	3	3	2
4	FT694	Seminar	0	0	3	3	2
Total of Practical						**18**	**12**
Total of 6th Semester						**35**	**29**

4TH YEAR: 7TH SEMESTER (JULY-DEC)

A. THEORY

	Code	Subjects	Contacts (periods/week)				Credit points
			L	T	P	Total	
1.	FT 701	Food Packaging Technology	3	0	0	3	3
2.	FT 702	Food Additives and Post Process Handling	3	0	0	3	3
3.	FT703 (A/B/C/D)	Elective I (Subject)	3	0	0	3	3
4.	HU 701	Industrial Management	3	0	0	3	3
5.	HU 702	Engineering Economics	3	0	0	3	3
Total of Theory						**15**	**15**

B. SESSIONALS

	Code	Subjects	Contacts (periods/week)				Credit points
			L	T	P	Total	
1.	FT 791	Project	0	0	12	12	8
2.	FT 792	Report & Presentation on Practical Training	-	-	-	-	3
3	FT 793	Seminar	0	0	3	3	2
Total of Practical						**15**	**13**
Total of 7th Semester						**30**	**28**

4TH YEAR: 8TH SEMESTER (JAN-JUNE)

A. THEORY

	Code	Subjects	Contacts (periods/week)				Credit points
			L	T	P	Total	
1.	FT 801	Food Plant Layout & Design	3	0	0	3	3
2.	FT 802 (A/B/C/D)	Elective II (Subject)	3	0	0	3	3
3.	ID 801	Ethics and IPR	2	0	0	2	2
4.	ID 802 (A/B/C/D)	Elective III (Interdisciplinary)	3	0	0	3	3
Total of Theory						**11**	**11**

B. SESSIONALS

	Code	Subjects	Contacts (periods/week)				Credit points
			L	T	P	Total	
1.	FT 891	Project	0	0	18	18	12
2.	FT 892	Project Defence	-	-	-	-	4
3	FT 893	Comprehensive Viva Voce	-	-	-	-	8
Total of Practical						**18**	**24**
Total of 8th Semester						**29**	**35**

Elective I (Subject)	Elective II (Subject)	Elective III (Inter-disciplinary)
FT 703A: Enzyme Technology	**FT 802A:** Plant Maintenance, Safety & Hygiene	**ID 802A:** Marketing and Distribution Logistic
FT 703B: Fermented Food Products	**FT 802B:** Principles of Biochemical Engineering	**ID 802B:** Food informatics
FT 703C: Utilization of Food Industry Wastes	**FT 802C:** Modeling and Simulation of Food Processes	**ID 802C:** Quality Control and Management
FT 703D: Entrepreneurship Development for Food Technologists	**FT 802D:** Protein Technology	**ID 802D:** Renewable Energy Technology

DETAILED SYLLABUS

SEMESTER – III

M 315 : Mathematics – III   **L-T-P = 3-1-0**

At least 45 hrs/Sem

Module I : 10L

Fourier Series : Introduction; Euler's formula; problem of general Fourier series; conditions for Fourier expansion; functions having points of discontinuity; change of interval; Even and odd functional half range series; typical waveforms (square, saw-toothed, triangular, half wave rectifier, full wave rectifier).

Module II : 10L

Series solution of differential equations and special functions : Introduction, validity of series solution of an equation, general method to solve equation type : $P_0 y'' + P_1 y' + P_2 y = 0$; problems; Bessel's equation; properties of Bessel's function; equation reducible to Bessel's equation; Legendre's equation, Legendre function, recurrence formula for Legendre function, orthogonality.

Module III : 10L

Partial differential equations and its applications : Introduction, linear and nonlinear equation of first order; examples; homogeneous linear equations with constant coefficients; nonlinear equation of second order, Separation of variables, formulation and solution of wave equation; one dimensional heat flow equation and solution; two dimensional heat flow equation and solution.

Module IV : 10L

Statistics : Mean, median, mode; standard deviation, variance, random variable; discrete and continuous probability distributions : distribution and density function, mathematical expectancy; standard probability models — Binomials, Poisson and Normal; Correlation and regression; curve fitting — least square method.

Revision : 5L

Text Books / References :

1. Advanced Engineering Mathematics : E. Kreyszig, Wily, 5th Edn.
2. Higher Engineering Mathematics : B. S. Grewal, 1977
3. Jordon & Smith, Mathematical techniques, OUP
4. Fundamental Concepts of Mathematical Statistics : Gupta and Kapoor, S. Chand
5. Statistical Methods : N. G. Das

6.   Elements of partial Differential Equation : Sneddon, MGH

FT 301 : Food Microbiology   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; Anti-microbial 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 & 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

FT 302 : Biochemistry & Nutrition   **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 & 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. Hames, B. D. (Ed), Biochemistry, Viva Books
6. Essentials of Food and Nutrition, Swaminathan, Vol 1 & 2
7. Fundamentals of Food and Nutrition by Sumati. R. Muldambi
8. Nutrition and dietetics by Rose
9. Nutrition and dietetics by Joshi

FT 303 : Process Calculations, Thermodynamics & Food Science   L-T-P = 3-1-0

At least 45 hrs/Sem

Module I : 10L

Process Calculations, Material & Energy Balances : Mathematical requisites – use of log-log and semi-log graph papers, triangular diagram, graphical differentiation and graphical integration. Material balance without & with chemical reaction. Energy balance: enthalpy changes, heat of reaction and its temperature dependence, heats of solution and mixing, adiabatic flame temperature, use of psychometric charts.

Module II : 10L

Thermodynamics

Basic Concepts : The Ideal Gas; Review of first and second laws of thermodynamics; PVT behavior of pure substances; Virial equation of state; Application of the virial equations; Cubic equations of state; Generalized correlations for gases and liquids.

Vapour /Liquid, Liquid/Liquid, Solid/Liquid and Solid/Vapour Equilibria :   Nature of equilibrium; Phase Rule; Duhem's theorem; Simple model's for vapour/liquid equilibrium; Rault's Law; Henry's Law; Modified Rault's Law; K-value correlations; VLE from Cubic Equations of State;   Equilibrium and Stability;   Liquid/liquid equilibrium;   Solid/liquid equilibrium, Solid/vapour equilibrium.

Module III : 10L

Application of Thermodynamics : Chemical Potential and Phase Equilibria; Fugacity and fugacity coefficient for pure species and solution; Generalized 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

Food Science :

Introduction & definition of Food Science; Palatability of food and measurement of acceptance by :I)testing ii)appearance iii)smell iv)test; General structure and composition of cereals like wheat & rice, nutritive value & various products like whole wheat flour, maida, puffed rice etc; Food additives; classification, composition and nutritive value of fruits & vegetables; Milk & milk products; Classification & properties of sugar; fats, oil & nuts; Spice & beverages & their roles.

Revision : 5L

Text Books / References:

1. Chemical Process Principles (Part one and two), Hougen, Watson & Ragatz, Asian Student Edition, Asia Publishing House
2. Basic Principles and Calculations in Chemical Engineering, Himmelblau, Prentice Hall (I) 6th Ed.

3. Coulson & Richardson's Chemical Engineering – Volume 3 (Chemical and Biochemical Reactors and Process Controls) ed. Richardson, J.F., Peacock, D.G., First Indian ed. Asian Books Pvt. Ltd. 1998
4. Levenspiel, O., Chemical Reaction Engineering, Willey Eastern Ltd.
5. Smith & Vanness, Thermodynamics for Chemical Engineers, MGH
6. Food Science by Potter
7. Principles of Food Science Vol. I by Fennema, Karrel
8. Food Science by Mudambi

FT 304 : Mechanical Design of Process Equipment   L-T-P = 3-1-0

At least 45 hrs/Sem

Module I : 10L

Material of construction : Introduction to material selection; Material properties; Environmental effects on material selection; Mechanical properties & strength of materials.

Design basis : Design code; Design pressure; Design temperature; Design stress & factor of safety; Design & actual thickness; Corrosion allowance; Weld joint efficiency factor; Design loadings; Criteria of failure.

Module II : 10L

Design of thin walled process vessels : Cylindrical & spherical vessels under internal and external pressure; Design of attachments and closures; Compensation for openings; Design of flange connections & threaded fasteners; Design of supports.

Module III : 10L

Design of thick walled high pressure vessels; Design of piping; Methods of fabrication of ferrous & non-ferrous metals; Concrete, wood and other non-metallic construction.

Module IV : 10L

Design of belt and chain drives; Toothed gearing; shafting & bearing; specification of handling equipment.

Revision : 5L

Text Books / References :

1. Introduction to Chemical Equipment Design — Mechanical Aspects; B. C. Bhattacharya; CBS Publishers, Delhi
2. Process Equipment Design; H. C. Hesse and J. H. Rushton; Van Nostrand, East West Press
3. Selection of Material and Fabrication for Chemical Process Equipment; B. C. Bhattacharya; Chem. Engg. Education Dev. Centre; I.I.T Madras
4. Process Equipment Design; L. E. Brownell and E. H. Young; John Wiley and Sons, Inc. N.Y.

5. Computer Aided Design of Chemical Process Equipment; B. C. Bhattacharya; and C. M. Narayanan; New Central Book Agency, Kolkata
6. Mechanical Design and Fabrication of Process Equipment; B. C. Bhattacharya; Khanna Publishers, Delhi

FT 391 : Food Microbiology Lab   L-T-P = 0-0-6

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.
5. Study of growth of *E.coli* by a spectrophotometer.
6. Study of microbiological quality of milk by MBRT test.
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.
9. Dilution and Plating by spread –plate and pour –plate techniques.
10. Isolation of pure culture.
11. Estimation of microbial count of air.

FT 392 : Bio-chemistry Lab   L-T-P = 0-0-6

1. Separation of amino acids/sugars by Ascending Paper Chromatography.
2. Separation of sugars/amino acids by Thin Layer Chromatography.
3. Separation and isolation of proteins/amino acids by Paper Electrophoresis.
4. Determination of BOD_5 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.

FT 393 : Process Equipment Drawing   L-T-P = 0-0-4

Mechanical design and drawing of process equipment : Storage vessels, Pressure Vessels, Reactors, Heat exchanger, evaporator, distillation and fractionation column, agitators, filters.

SEMESTER - IV

FT 401 : Chemistry of Food   **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 & 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

FT 402 : Principles of Food Preservation   L-T-P = 3-1-0

At least 45 hrs/Sem

Module I : 10L

Objectives and techniques of food preservation; Canning: classification of cans, can specification, structure of cans, lacquering, 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 and freezing including cryogenic freezing.

Module III : 10L

Preservation by fermentation: curing and pickling; Hurdle technology.

Module IV : 10L

Ionization radiation; Use of preservative in foods: chemical preservative, biopreservative including antibiotics.

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

FT 403 : Food Process Technology – I   L-T-P = 3-1-0

(Cereals, Fruits, Vegetables & Beverages)

At least 45 hrs/Sem

Module I : 10L

Storage of cereals, Infestation control; Drying of grains, Processing of rice and rice products. Milling of wheat and production of wheat products, including flour and semolina.

Module II : 10L

Milling of corn, barley, oat, coarse grains including sorghum, ragi and millets; Processing of tea, coffee and cocoa.

Module III : 10L

Storage and handling of fresh fruits and vegetables, Preservation of fruits and vegetable by heat treatment. Production and preservation of fruits and vegetable juices, preservation of fruit juice by hurdle technology. Preparation of Jam, Jelly and marmalade, pickles, vinegar and tomato product.

Module IV : 10L

Non-alcoholic beverages; Food Laws, food rules and standards, Statistical Quality Control ; Various types of packaging.

Revision : 5L

Text Books / References :

1. Food Science by Potter
2. Technology of Food Preservation by Desrosier
3. Principles of Food Science, Vol-I by Fennma 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.

CHE 414 : Unit Operations of Chemical Engineering – I   L-T-P = 3-1-0

At least 45 hrs/Sem

Module I : 10L

Basic Concepts of Fluid Mechanics : Dimensional Analysis: Buckingham Pi-theorem, Dimensionless groups, Conversion of equations. Basic equations of Fluid Flow, Hagen Poiseille equation, Bernoulli Equation, Fluid Friction. Friction in flow through packed beds, fundamentals of fluidization.

Module II : 10L

Flow measurements and machineries : Flow through pipes and open channels, Orifice and Venturi meters, 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).

Module III : 10L

Heat transfer : Classification of heat flow processes, conduction, Thermal conductivity. Heat flow in fluids by conduction and convection. Countercurrent and parallel flow. Enthalpy balance in heat exchange equipment. Individual heat transfer coefficients, overall coefficient, Heating and cooling of fluids, Heat transfer equipment. Unsteady state heat transfer, Radiation.

Module IV : 10L

Mechanical Operations : Principles of comminution, Types of comminuting equipment. Energy and power requirement, Crushers, Grinders, Mixing and Agitations, Power consumption in mixing, Mechanical separation, Screening, Types of screen, Filtration, Principle of Constant pressure and constant rate filtration, Settling classifiers, Floatation, Centrifugal Separations.

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
6. Foust, A.S., Wenzel, L.A., et.al. Principles of Unit Operations, 2nd edition, JWS
7. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH
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

CS 415 : Data Structure and Algorithm   **L-T-P = 3-1-0**

At least 45 hrs/Sem

Module I : 10L

Linear Data Structures : Sequential representations, Arrays and Lists, Stacks, Queues and D-queues, String and their applications.

Link Representation : Linearly linked lists, Circularly linked lists, Doubly linked lists and applications.

Module II : 10L

Algorithms for creating and manipulating different linear data structures.

Non-linear Data Structure : Trees – 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 & Table Structures, Sequential and Direct access, Indexed Files, Inverted Files, Hashed Files.

Revision : 5L

Text Books :

1. Aho Alfred V., Hopperoft John E., Ullman Jeffrey D., "Data Structures and algorithms", Pearson Education
2. Berman, Data Structure Via C++, OUP

References :

1. Horowitz Ellix & Sartaj Sahani, "Fundamentals of Data Structures", Galgotria Pub.
2. Tenenbaum A. S., "Data Structures using C", Pearson Education/PHI
3. Graph Theory – N. Deo, PHI

FT 491 : Chemistry of Food Lab   **L-T-P = 0-0-6**

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 & pH in food sample/beverages.
6. Determination of total, non-reducing and reducing sugars.
7. Determination of Vitamin C in food sample.
8. Determination of Pigments in food sample.
10. Estimation of calcium, iron and zinc in food products.

CHE 484 : Unit Operation Lab – I   **L-T-P = 0-0-3**

1. Experiments on Reynolds's Apparatus –Determination of flow regime and construction of friction factor against N_{RE}.
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.

CS 485 : Data Structure Lab   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

HU 481 : Report Writing & Technical Language Practice Lab   L-T-P = 0-0-3

Topics to be covered and number of hours required for it

1. Introductory lecture is to be given to the students so that they get a clear idea of the syllabus and understand the need for having such a practice lab in the first place (3 hours).

2. Conversion practice is done on given situation topics. The students are also made to listen to pre-recorded cassettes produced by British Council and also by the Universities of Oxford and Cambridge (6 hours).

3. Group Discussion : The students are made to understand the difference between the language of conversion and group discussion. Strategies of such discussions are to teach to them. It is also helpful to use video cassettes produced by the U.G.C. on topics like group-discussion. After wards the class is divided into groups and the students have to discuss on given topics on current socio-economic-political-educational importance (12 hours).

4. Interview sessions-students are taught the do's and don'ts of facing a successful interview. They then have to face rigorous practices of mock-interviews. There

simulations of real life interview sessions where students have to face an interview panel (12 hours).

5. Presentations : The secrets of an effective presentation are taught to the students. Then each and every student has to make lab presentations with the help of the Overhead projector/using power point presentation and other audio-visual aids in the laboratory. They also have to face the question answer sessions at the end of their presentation (12 hours).

6. Classes are also allotted to prepare the students for competitive examinations like the T.O.E.F.L. by making the students listen to specially produced C.D. cassettes of such examinations (3 hours).

The overall aim of this course is to inculcate a sense of confidence in the students and help them to become good communicators in their social as well as professional lives.

Text :

Sharma   —   Business Correspondence & Report Writing, TMH

Prasad   —   Group Discussion & Interview (With Audio Cassette), TMH

Reference : Sashi Kumar   —   Spoken English (With Cassette), TMH

SEMESTER - V

FT 501: Food Process Technology II – Fish, Meat & Poultry   **L-T-P = 3-1-0**

At least 45 h/ Sem

Module I: 10L
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 and Curing.

Module II: 10L
Fish products - production of fish meal, fish protein concentrate, fish liver oil and fish sauce and other important byproducts; Quality control of processed fish; Fish processing industries in India.

Module III: 10L
Slaughtering technique of animal; Meat cuts and portions of meat, muscle; Color of meat; Post mortem changes of meat; Meat processing - curing and smoking; Fermented meat products (meat sausages & sauces); Frozen meat & meat storage; By-products from meat industries and their utilization; Meat industries in India.

Module IV: 10L
Classification of poultry meat; Composition and nutritional value of poultry meat & eggs ; Processing of poultry meat and eggs; Spoilage and control; Byproduct utilization and future prospects; Poultry farms in India.

Revision: 5L
Text books/ References:
1. Processed Meats; Pearson AM & Gillett TA; 1996, CBS Publishers.
2. Meat; Cole DJA & Lawrie RA; 1975, AVI Pub.
3. Egg and poultry meat processing; Stadelman WJ, Olson VM, Shemwell GA & Pasch S; 1988, Elliswood Ltd.
4. Developments in Meat Science – I & II, Lawrie R; Applied Science Pub. Ltd.
5. Egg Science & Technology; Stadelman WJ & Cotterill OJ; 1973, AVI Pub.
6. Fish as Food; Vol 1 & 2; Bremner HA; 2002, CRC Press.
7. Fish & Fisheries of India; Jhingram VG; 1983, Hindustan Pub Corp.

FT 502: Food Process Technology III – Milk and Dairy products   L-T-P = 3-1-0

At least 45 h/ Sem

Module I: 10L
Composition of milk; Varieties of milk; Checks for purity of milk; Handling of fresh milk.

Module II: 10L
Pasteurization of milk; HTST and UHT techniques; Packaging of milk; Fermentation of milk and fermented milk products.

Module III: 10L
Manufacture of milk products like evaporated milk, powder milk, condensed milk, cream butter, cheese, yogurt, ice cream, ghee, baby food and sweet meat.

Module IV: 10L
Quality control of milk and milk products; Milk plant hygiene and sanitation.

Revision: 5L
Text books/ References:
1. Robinson RK; 1996; Modern Dairy Technology, Vol 1 & 2; Elsevier Applied Science Pub.

2. Milk & Milk Processing; Herrington BL; 1948, McGraw-Hill Book Company.
3. Modern Dairy Products, Lampert LH; 1970, Chemical Publishing Company.
4. Developments in Dairy Chemistry – Vol 1 & 2; Fox PF; Applied Science Pub Ltd.
5. Outlines of Dairy Chemistry, De S; Oxford.

FT 503: Food Process Engineering

L-T-P = 3-1-0

At least 45 h/ Sem

Module I: 10L
Seaming machine; Sterilizers & other accessories used in canning industries; Engineering aspects of pasteurizer; homogenizer, evaporators and concentrators used in food industries.

Module II: 10L
Construction of cold storage; Different types of freezers including plate contact freezer, air blast freezer, cryogenic freezing and refrigerated vans.

Module III: 10L
Various types of driers including tray drier, roller drier, spray drier, fluidized bed drier, freeze drier and solar drier.

Module IV: 10L
Bakery machines and equipment; Heat exchangers; Extruders.

Revision: 5L
Text books/ References:
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.
5. Fundamentals of Food Process Engineering; Toledo RT; 2nd ed, 2000, CBS Publishers.

Reference:
1.Cambridge World History of Food(2 Volume Set),Cambridge University Press

FT 504: Waste Management of Food Industries   **L-T-P = 3-1-0**

At least 45 h/ Sem

Module I: 10L
Introduction: Classification and characterization of food industrial wastes from Fruit and Vegetable processing industry, Beverage industry; Fish, Meat & Poultry industry, Sugar industry and Dairy industry; Waste disposal methods – Physical, Chemical & Biological; Economical aspects of waste treatment and disposal.

Module II: 10L
Treatment methods for liquid wastes from food process industries; Design of Activated Sludge Process, Rotating Biological Contactors, Trickling Filters, UASB, Biogas Plant.

Module III: 10L
Treatment methods of solid wastes: Biological composting, drying and incineration; Design of Solid Waste Management System: Landfill Digester, Vermicomposting Pit.

Module IV: 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/ References:
1. Food Industry Wastes: Disposal and Recovery; Herzka A & Booth RG; 1981, Applied Science Pub Ltd.
2. Water & Wastewater Engineering; Fair GM, Geyer JC & Okun DA; 1986, John Wiley & Sons, Inc.
3. Wastewater Treatment; Bartlett RE; Applied Science Pub Ltd.
4. Symposium: Processing Agricultural & Municipal Wastes; Inglett GE; 1973, AVI.
5. Food Processing Waste Management; Green JH & Kramer A; 1979, AVI.
6. Environmental Biotechnology: Principles and Applications; Rittmann BE & McCarty PL; 2001, Mc-Grow-Hill International editions.
7. Environmental Biotechnology; Bhattacharyya B C & Banerjee R; Oxford University Press.

CHE 514: Unit Operations of Chemical Engineering -II   **L-T-P = 3-1-0**

At least 45 h/ Sem
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
Text books/ References:
1. Unit Operations of Chemical Engineering; McCabe, Smith & Harriot; 6th ed, TMH.
2. Transport Processes & Unit operations; Geankopolis; 3rd ed, PHI.
3. Chemical Engineering, Vol-I & II, Colson & Richardson; Butterworth Heinemann.
4. Chemical Engineer's Handbook; Perry, Chilton & Green; MGH.

FT 591: Food Processing Lab - I   **L-T-P = 0-0-6**

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.
9. Preparation of sponge cake.
10. Preparation of bread.

FT 592: Food Analysis and Quality Control Lab – I   **L-T-P = 0-0-6**

1. Analysis of jam.
2. Analysis of spices.
3. Analysis of milk.
4. Analysis of tea and coffee.
5. Analysis of wheat flour and bread.
6. Analysis of non alcoholic beverages.

SEMESTER- VI

FT 601: Food Process Technology IV – Fats and Oils   L-T-P = 3-1-0
                                                                                At least 45 h/ Sem

Module I: 10L
Importance of fats and oils in foods; Sources of fats and oils; Extraction of fats and oils – rendering, pressing, solvent extraction; Processing of oils – degumming, refining, bleaching, deodorization, fractionation; Reversion and rancidity of fats and oils.

Module II: 10L
Natural vegetable oil and animal fat: source, composition, properties and industrial applications; Plastic fat in bakery and confectionary; Preparation of shortenings and margarine.

Module III: 10L
Manufacture of different types of fat/oil derived products: winterization, hydrogenation, esterification, inter-esterification & emulsification
.

Module IV: 10L
Production technology of oilseed protein isolates; Standard and quality control of fats and fatty foods; By-products of fat/oil processing industries.

Revision: 5L

Text books/ References:
1. Bailey's Industrial Oil and Fat Products, Vol 1 & 2; Swern D; 4th ed, 1982, John Wiley & Sons.
2. The Chemistry & Technology of Edible Oils and Fats; Devine J & Williams PN; 1961, Pergamon Press.
3. Food Oils and their Uses; Weiss TJ; 1983, AVI.
4. Edible Oils & Fats: Developments since 1978 (Food Technology Review # 57); Torrey S; 1983, NDC.

FT 602: Advanced Food Microbiology and Biotechnology   L-T-P = 3-1-0

At least 45 h/ Sem

Module I: 10L
Important microorganisms and the factors affecting their growth and survival in foods; Changes caused by spoilage; Spoilage of processed foods and their control.

Module II: 10L
Methods for the microbiological examination of water and foods; Control of microbiological quality; Bacterial and non-bacterial agents of food borne illnesses;

Module III: 10L
Microbial cultures for food fermentation and their maintenance; Production of vinegar, fermented foods, alcoholic beverages, SCP and mushrooms..

Module IV: 10L
Principles of genetic engineering and its application.
Revision: 5L
Text books/ References:
1. Food Microbiology; Frazier WC; 4th ed, Tata-McGrowhill Pub.
2. Modern Food Microbiology; Jay JM; 4th ed, CBS Publishers.
3. Microbiology; Pelczar, Chan & Krieg; Tata-McGrawHill Pub.
4. Food Microbiology; Adams MR & Moss MD; New Age International (P) Ltd Pub.
5. Food Biotechnology, Vol 1 & 2; King RD & Cheetham PSJ; 1988, Elsevier App. Sci.
6. Food Biotechnology; Angold R, Buch G & Taggart J; 1989, Cambridge University Press.
7. Fermentation Biotechnology: Principles, Processes & Products; Ward OP; Open University press.
8. Fundamental Principles of Bacteriology; Salle AJ; 7th ed, 1985, Tata-McGraw-Hill.

FT 603: Bakery, Confectionary and Extruded Foods   **L-T-P = 3-1-0**

At least 45 h/ Sem

Module I: 10L
Introduction to baking; Bakery ingredients and their functions; Machines & equipment for batch and continuous processing of bakery products.
Module II: 10L
Testing of flour; Manufacture of bread, cake and biscuits; Analysis of bakery products; Cake icing techniques, wafer manufacture, cookies and crackers

Module III: 10L

Manufacture of bread rolls, sweet yeast dough products, cake specialties, pies and pastries, doughnuts, chocolates and candies; Maintenance, safety and hygiene of bakery plants.

Module IV: 10L
Objectives and importance of extrusion in food product development; Components and functions of an extruder; Classification of extruder; Advantages and disadvantages of different types of extrusion; Change of functional properties of food components during extrusion; Pre and post extrusion treatments; Use of extruder as bioreactor; Manufacturing process of extruded products; Application of extrusion technologies in food industries.

Revision: 5L

Text books/ References:
1. Extrusion of Food, Vol 2; Harper JM; 1981, CRC Press.
2. Bakery Technology & Engineering; Matz SA; 1960; AVI Pub.
3. Up to-date Bread Making; Fance WJ & Wrogg BH; 1968, Maclasen & Sons Ltd.
4. Modern Cereal Chemistry; Kent-Jones DW & Amos AJ; 1967, Food Trade Press Ltd.

FT 604: Food Process Equipment Design   **L-T-P = 3-1-0**

At least 45 h/ Sem

Module I: 10L
Design of autoclave, Pasteurizer, Continuous Sterilizer, Steam Jacketed Pan and Vacuum Concentrator.

Module II: 10L
Design of Basket Press, Screw type Juice Extractor, Solid Mixer, Kneader; Oil Expeller, filters and extruder.

Module III: 10L
Design of Tray Drier, Drum Drier, Spray Drier, Fluidized Bed Drier and Rotary Roaster.

Module IV: 10L
Design of Homogenizer, Pulping Machine, Plate Type Freezer and Freeze Drier.

Revision: 5L

Text books/ References:
1. Chemical Engineer's Handbook; Perry, Chilton & Green; MGH.
2. Fundamentals of Food Process Engineering, 2nd ed; Toledo Romeo T; CBS Publishers.
3. Preservation of Fruits & Vegetables; Lal G, Sidhapa GS & Tandon GL; ICAR.
4. Introduction to Chemical Equipment Design – Mechanical Aspects; Bhattacharyya BC; CBS Publishers.

5. Process Equipment Design; Hesse HC & Rushton JH; Van Nostrand, East West Press
6. Selection of Material and Fabrication for Chemical Process Equipment; Bhattacharyya BC; Chemical engineering Education Development Centre, IIT Madras.
7. Process Equipment Design; Brownell LE & Young EH; John Wiley and Sons, Inc.
8. Computer Aided Design of Chemical Process Equipment; Bhattacharyya BC & Narayanan CM; New Central Book Agency.
9. Mechanical Design and Fabrication of Process Equipment; Bhattacharyya BC; Khanna Publishers.

ET 601: Process Instrumentation and Control   **L-T-P = 3-1-0**

At least 45 h/ Sem

Module I: 10L
Operational aspect of instrument system, control and requisites; Analytical balance & spring balance, load cell, moisture measurement cells for granular material, infra-red transmission measurement of moisture.

Module II: 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 III: 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; Final control; Electronic circuit components.

Module IV: 10L

Controller mode, Root locus plot, Modulation, Electronic circuit components, Final control.

Revision: 5L
Text books/ References:
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.

Practicals

FT 692: Food Analysis and Quality Control Lab – II   L-T-P = 0-0-3

1. Analysis of lysine content in animal /vegetable sources.
2. Estimation of tin in canned foods.
3. Analysis of biscuits.
4. Analysis of fruit juice.
5. Analysis of sweetened condensed milk.
6. Estimation of a) Iodine value, (b) Saponification value (c) acid value (d) RM value (e) K value of fats and oils.
7. Qualitative identification of adulteration in dairy products.

FT 691: Food Processing Lab - II   L-T-P = 0-0-6

1. Preparation of dry onion/ chilli/ garlic.
2.   Cultivation of oyster mushrooms.
3. Manufacture of macaroni by extruder.
4. Manufacture of potato powder.
5. Manufacture of ice cream.
6. Manufacture of Rosogolla and Sandesh.
7. Manufacture of candid fruits.
8. Production of dried milk by drum drying
9. Production of milk powder by spray drying

FT 693: Food Biotechnology Lab   L-T-P = 0-0-6

1. Determination of microbiological quality of water by MPN method.
2. Presumptive and confirmatory tests for coliform bacteria in water.
3. Microbiological quality of processed milk.
4. Microbiological quality of dehydrated foods.
5. Microbiological examination of spoiled food.
6. Production of alcohol by fermentation.
7. Production of Dahi and examination of its microbiological study.

SEMESTER - VII

FT 701:   Food Packaging Technology.   L-T-P = 3-0-0
                    At Least 36 L/Sem

Module I: 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 II : 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 III : 9L

Manufacture of packaging materials; Potential of biocomposite materials for food packaging; Packaging regulations; Packaging and food preservation; Disposal of packaging materials.

Module IV : 9L

Testing of packaging; Rigid and semi rigid containers; Flexible containers; Sealing equipment; Labelling; Asceptic and shrink packaging; Secondary and transport packaging.

Text Books/References.
1. Food and Packaging Interactions by Joseph H. Hotchkiss, (ACS symposium series -365, April 5-10, 1987, American chemical society, Washington DC, 1988.)
2. Packaging foods with plastics by winter A. Jenkins & James P Harrington – Technomic publishing co. Inc, Lancaster. Basel.
3. Flexible food packaging (Question & Answers) by Arthur Hirsch VNB – Van Nostrand Reinhold, New York (An AVI Book), ISBN 0-442-00609-8.
4. Food Packaging and Preservation (theory & practice) by M.Mathlouthi- Elsevier Applied science publisher, London and New york.
5. Food Packaging Materials (Aspect of Analysis & Migration of contaminants) by N.T.crosby applied science publishers LTD. London.
6. Plastics in Packaging by A.S Athlye, TMGH, New Delhi.
7. Packaging (specifications, purchasing & Quality Control) 3rd edition by Edmond A Leonard- Marcel Dekker, INC- Newyork & Basel.
8. Plastics in packaging by forwarded by H.B Ajmera & M.R Subramanium – Indian institute of packaging. Published by A.P.Vaidya, Secretary IIP, E2, MIDC, Industrial Area (Andheri (East), Bombay-400093.
9. Food Packaging- Stanley Sacharois & Roger C. Griffin- The AVI Publishing company Inc. 1970.
10. Principles of packaging development- Griffin & Sacharow. (The AVI Publishing company, Inc. 1972).

FT 702 Food Additives and Post Process Operations.   L-T-P = 3-0-0
                                                                           At Least 36 L/Sem

Module I : 9L

Need for food additives; Antioxidants; Chelating agents; Colouring agents; Curing agents and emulsifiers.

Module II : 9L

Flavour and flavour enhancers; Flour improvers; Humectants and anticaking agents; Leavening agents.

Module III : 9L

Low calorie sweeteners; pH control agents ; Preservatives; Stabilizers and other additives; Nutrient supplements & thickeners.

Module IV : 9L

Coating or enrobing; Coating materials; Enrobers; Dusting or breading; Pan coating (hard, soft, chocolate coating)

Text Books/References.
   1. Food Science (5th Edn.) by Potter & Hotchkiss, CBS Publishers & Distributors.
   2. Food process Technology by Fellows (Woodhead Publishing Ltd).

FT 703A Enzyme technology.

                                                                           L-T-P = 3-0-0
                                                                     At Least 36 L/Sem

Module I : 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 II : 9L
       Enzyme production technology; Enzyme reactors and process design; Application of recombinant DNA technique to enzyme technology.

Module III : 9L
       Cell disintegration by physical, chemical and biological methods; Enzyme purification methods.

Module IV : 9L

Application of enzymes for production of biochemicals and in food processing industries; Application of immobilized enzymes and cells.

Text Books/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.

FT 703 B Fermented Food Products.   **L-T-P = 3-0-0**
                                                                              At least 36 L/Sem

Module I : 9L

Importance of fermented foods; Organisms used for production of fermented food products; Environmental parameters for fermentation process; Classification of fermentation processes for fermented foods; safety criteria of fermented foods.

Module II : 9L.

Cereal and legume based fermented products like Bread, Soya Sauce, Koji, Tempeh, Miso, Natto, Tofu, Angkkak; Indian products like Idly, Dosa, Bada, Bori. Alcoholic beverages and vinegar.

Module III : 9L

Vegetables, fish and meat based fermented products; Different types of pickles like olive cucumber, salt stock and dill pickles, Fish sauce, sausages and Surimi.

Module IV : 9L.

Dairy based fermented products like cheese, Butter, Yoghurt, Kefir, Koumiss, Srikhand, Cultured butter milk; Whey based fermented products.

Text Books/ References.

1. Fermented Foods of the world. (A Dictionary & Guide) –by Geoffrey Champbell, Platt, Butterworths, London.
2. Industrial Microbiology by Brinton M miller & Warren Litsky. MGH.
3. Pickle & Sauce Making, Binsted, Devey & & Dakin (2nd edn), Food Trade Press Ltd, London.

4. Outlines of Food Technology- Harry W VonLoesecke (ab)- Agrabios (India) 2nd edition, 2001.

FT 703C Utilization of Food Industry Refuse.   L-T-P = 3-0-0

                                                                                             At least 36 L/Sem

Module I : 9L

Fruits & Vegetables:
        Production of pectin, ethanol, natural gas, citric acid, activated charcoal, fibre extract from apple pomace, vitamins
        Production of citrus oil from peels of citrus fruits; Manufacture of candied peel and pectin from albedo of citrus fruits.
        Production of single cell protein by the use of potato wastes; Recovery of Protein from potato starch plant waste.

Module II : 9L

Fish, Meat, Poultry.
        Production of fish meal; Fish protein concentrate; Animal feed; Shell product; Glue from seafood processing waste.
        Texturised fish protein concentrate (marine beef); Utilization of organs and glands of animal as human food.
        Production of human food from animal blood and blood protein; Marketable products like chitin, chitosan, fertilizer, nutritional enhancer animal feed from shells.

Module III : 9L

Cereals
        Feed for livestock from wheat and corn bran and germ.
        Extraction of oil & wax from rice bran, Puffed cereals from broken rice; Starch, modified starch and industrial alcohol from nonusable cereals; Silica from rice husk; Extraction of plolamin (Zein & katirin); Protein from sorghum; Beer spent graining.
Module IV : 9L

Dairy industry and tea, coffee.
        Fermentation products from whey. Condensed & dried products from whey; Production of lactose and protein from whey; Utilization of tea waste as feed for live stock & poultry.

Text Books/ References.
    1. The potato in the human diet-Jennifer A Woolfe
    2. Edible meat by products- A M Pearson & T R Dutson
    3. By products from milk- Webb & Whitier.

4. Fish & Krill protein processing technology- Taneko Suzuki.
5. Processed apple products-Downing
6. Citrus fruits and their products- Ting & Rouseft.
7. Cocoa- Wood & Lass
8. Wheat- Peterson
9. Sweetness & Sweetener- Birch, Green & Coulson.
10. Outlines of Food Technology- Hanx W. VonLoesecke (ab)- Agrabios (India) 2nd Edition, 2001

FT 703D: Entrepreneurship development for Food Technologists.

L-T-P = 3-0-0
At least 36L/ Sem

Module I: 9L
Entrepreneur & 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)

HU 701 Industrial Management.   **L-T-P = 3-0-0**
                                                                          At Least 30L/Sem

1. Introduction:
   History of Management Development, Management as Science and Art, Management as a Profession, Functions of Management, Levels of Management. [2L]

2. Forms of Business Organisations:
   Forms of Business Organisations, Advantages and Disadvantages of Private Ownership and Public Ownership; Distinction between Sole Proprietary Firm and Partnership Firm; Distinction between Partnership Firm and Joint Stock Company; Distinction between Private and Public Company; Types of Organisations – Concepts, merits and demerits of Line, Line and Staff, Functional Organisations.   [3L]

3. Elementary Economics:
   Concepts of Basic terms in Economics – Goods, Utility, Value, Price, Wealth, Money, Wants; Demand and Demand Analysis – Factors influencing demand, Law of Demand, Demand Curve, Variations in Demand, Change in Demand, Elasticity of Demand; Equilibrium and Price Determination; Indifference Curve Analysis;[4L]

4. The Manufacturing (Production) Function:
   Objectives of Production Management, Operation Concept, Production as Conversion Process, Productivity, Qualities and Responsibilities of a Production Manager; Meaning of Product Development, Factors Influencing Choice of Manufacturing Systems, Classification of Manufacturing Systems; Factors Governing Plant Location, Basic Procedure of Method Study (Work Study) and Time Study; Concepts, Objectives and functions of Production Planning and Control (PPC); [4L]

5. Quality Management:
   Definitions of Quality, Historical Development of Quality Management, Quality Standards, Quality Control, Concept of Zero Defect, Quality Circles – Meaning, Benefits and Operation of Quality Circles, Quality Audit – Meaning, Terminology, Stages of an Audit; Quality Management Systems – ISO-9000 Series, Benefits of Quality Management Systems, Total Quality Management –Meaning and Key Principles. [3L]

6. Materials Management:
   Importance, Objectives and Functions of Materials Management, Scientific Purchasing, Functions of Purchase Department, Methods of Buying, Centralised versus Decentralised Buying, Functions of Scientific Store Management, Inventory Management, Standard Inventory Models - EOQ, Logistics Management.[3L]

7. Personnel Management:
   Human Resource Planning – Steps in Manpower Planning, Recruitment and Selection – Difference between Recruitment and Selection, Steps in the Selection Procedure; Training and Development – Need for Training, Steps in Training, Training Methods; Performance Appraisal, Difference between Merit Rating and Performance Appraisal, Wage and Salary Administration – Concept of Wage, Factors affecting Wage; Motivation Theories – Maslow's, Herzberg's; Worker's Participation in Management; Collective Bargaining.[4L]

8. Financial Management:

Capital Structure - Need for Finance, Types of Capital, Methods of Raising Funds, Financial Institutions; Depreciation Methods – Straight Line Method, Reducing Balance Method; Break Even Analysis; Cost Accounting – Elements of Costs, Cost Sheet. [4L]

9. Marketing Management:

Marketing Concepts – Need, Want, Demand, 4 P-s, Production Concept, Product Concept, Selling Concept, Marketing Concept, Societal Marketing Concept, Difference between Selling and Marketing; Market Segmentation – STP Concept, Need for Segmentation, Bases of Segmentation, Types of Segmentation. Marketing Research – Need for and Steps of Marketing Research, Questionnaires; Promotion Mix.[3L]

Text Books/References:

1. Industrial Management - S C Jain, W S Bawa, Dhanpat Rai & Co. (P) Ltd.
2. Industrial Management, Vol.1 L.C. Jhamb, EPH,
3. Industrial Engineering & Production Management - Martand Telsang, S. Chand
4. Industrial & Business Management - Martand T. Telsang, S. Chand
5. Introduction to Materials Management - J Tony Arnold & Stephen N. Chapman, Pearson Education Asia
6. Production & Operations Management – Adam, Pearson Education /PHI
7. Industrial Relations, Trade Unions & Labour Legislation - Sinha, Pearson Education Asia
8. Business Organisation & Management - Tulsian, Pearson Education Asia.

HU 702 Engineering Economics.

Introduction to economics: Meaning, scope, and contribution to business decisions.
Analysis of Demand: Law of demand, Utility function, Rate of commodity substitution, Maximization of utility, Demand functions, Indifference curve analysis, Substitution and income effects.
Market demand and demand elasticities: concept of market demand, price and income elasticities of demand, importance of elasticity.
Demand forecasting: causes and techniques of demand forecasting.
Analysis of supply and market equilibrium: Law of supply, price elasticity of supply, equilibrium of demand and supply.
Theory of the Farm: Production function, returns to scale, Optimizing behavior, Input demands, Cost functions, Profit maximization, economics & diseconomies of scale, break even analysis.
MARKET STRUCTURES.
    A) Perfect competition: Profit maximization and equilibrium of firm and industry, Short run and long run supply curves; Price and output determination, practical applications.

B) Monopoly: Determination of price under monopoly; Equilibrium of a farm; Comparison between perfect competition and monopoly; Price discrimination; Practical applications.

C) Monopolistic Competition: Meaning and characteristics; Price and output determination under monopolistic competition; Product differentiations; Selling costs; Comparison with perfect competition.

D) Oligopoly: Characteristics; Indeterminate pricing and output; classical models of oligopoly; Collusive oligopoly; Kinked demand curve; non-price competition.

Profitability Analysis: Application of capital budgeting techniques for decision making.
National Income: Concepts & measurements.
Bank & Financial Institutions: Concepts, roles in the economy.
New Economic Environment: Economic Liberalization of industry & Foreign trade; Privatization; Globalization.

Text Books/References:

1. A. Koutsoyianni : Modern Micro Economics, Macmillan.
2. R Dutta & K P M Sundaran : Indian Economy. S.Chand.
3. A N Agarwal : Indian Economy, Vikas.
4. D N Dwivedi : Engineering Economics, Vikas.
5. P A Samuelson & W D Nordhans : Economics: TMH.
6. D N Dwivedi : Managerial Economics , Vikas.

Sessionals

FT 791   Project   **L-T-P = 0-0-12**

Each student shall undertake project work assigned to him related to design or R&D in the area of food technology under the supervision of a faculty member. 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 an interim report on his work in typed form. Evaluation shall include oral presentation. (the same project may be extended for the 8th semester also depending on the nature of the project.)

FT 792 Report & Presentation on Practical Training.

The in plant 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 should 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.

FT 793 Seminar   L-T-P = 0-0-3

A seminar topic will be allotted to individual student according to his/her area of interest (students are also suggested to propose topics with relevant published information during the time of allotment), on which a report should be prepared and submitted after presentation as per schedule.

SEMESTER - VIII

FT 801 Food Plant Layout & Design.   L-T-P = 3-0-0
                                                            At least 36 L/Sem

Module I: (9L)

Basic concepts of plant layout and design with special reference to food process industries. Application of HACCP concept, ISO, FPO & MPO requirements in food plant layout and design.

Module II: (9L)

Design consideration for location of food plants. Basic understanding of equipment layout and ventilation in food process plants. Preparation of flow sheets for material movement and utility consumption in food plants.

Module III: (9L)

Plant layout and design of bakery and biscuit industries. Plant layout and design of fruits and vegetables processing industries including beverages.

Module IV: (9L)

Plant layout and design of milk and milk products. Miscellaneous aspects of plant layout and design like provision for waste disposal, safety arrangements etc.

Text Books/ References.

1. Manufacturing Facilities Design and Material Handling by Fred E. Meyers, and Matthew P. Stephens, 3rd Edition, Pearson Prentice Hall, 2000.
2. James M Moore, "Plant Layout and Design", Mcmillan & Co., (1959)
3. Bolz, Harold A George E., " Material Handling Handbook.
4. J M Apple, " Plant layout and Material Handling", John Willey & Sons, (1977)
5. Various Indian Standards.

FT 802A : Plant maintenance, Safety and Hygiene   L-T-P = 3-0-0
                                                            At least 36 h/ Sem

Module I: 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 II: 9L
The objective of safety, health & environment; Cost of safety; Accident investigation report; Safety promotional activity; Environmental pollution and its control.

Module III: 9L
Indian Factories Act on safety; HACCP; Desirable safety features of some food processing equipment; Personal protective equipment; Safety from adulteration of food.

Module IV: 9L
Hygiene and sanitation requirement in food processing and fermentation industries; Cleaning, sanitizing & pest control in food processing; storage and service areas.

Text books/ References:
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.
4. Food Hygiene, Microbiology & HACCP. S J Forsythe, P R Hayes. Springer.

FT 802B Principles of Biochemical Engineering   L-T-P = 3-0-0
                                                            At least 36 h/ Sem

Module I. (9L)

Introduction to biochemical process industries; Industrial alcohols, antibiotics, acids, alcoholic beverages, Vitamins, enzymes, single cell protein, food processing.

Module II (9L)

Bioreactor Design.

Module III. (9L)

Bioproduct Recovery.

Module IV. (9L)
Bioprocess Economics.

Text Books/ References.

1. Biochemical Engg Fundamentals: J.E Bailey, D F Olli, MGH.
2. Biochemical Engineering: Aiba S; Academia press, NY

FT 802C   Modelling and Simulation of Food Processes.   L-T-P = 3-0-0
At Least 36L/Sem

Module I. (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 II (9L)
Batch processes in food industry; Equilibriation in batch processes; Steady state flow processes of non reacting systems; Mixing in flow processes.
Module III (9L)
Simultaneous heat and mass transfer in packed tower and immobilized enzyme system.
Module IV. (9L)
Modelling, simulation and optimization of fermentation processes.

Text Books/ References.
1. Process modeling, simulation and control: William L Luyben, TMH
2. Process analysis & simulation : Himmelblau, Kenneth & Birchoff, John Wills.

FT 802D Protein Technology.   L-T-P = 3-0-0
                                            At Least 36L/Sem

Module I. (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 II. (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 III. (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 IV (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 Books/ References:

1. Altschul, A.M and Wilcke, , H.L Ed 1978. new protein Foods. Vol III. Academic Press, New York.
2. Bodwell, C.E.Ed. 1977. evaluation of proteins for Humans. AVI, Westport.
3. Milner,M., Scrimshaw, N.S and Wang, D.I.C.Ed. 1978. Protein Resources and Technology. AVI, Westport.
4. Salunkhe, O.K and Kadam, S.S Eds. 1999. Handbook of world legumes; Nutritional Chemistry, Processing Technology and Utilization. Volume I to III. CRC Press, Florida.
5. Salunkhe, D.K. Chavan, J.K.,Adsule, R.N Kadam, S.S 1992. World Oilseeds: Chemistry, Technology and Utilization, Van Nostrand Reinhold, New York.
6. Bioseparation Engineering: Principles, Practise and Economics, M.Ladish; Wiley Inter science.

7. Proteolytic enzymes: a practical approach, Beynon, R.J and Bond, J.S; IRL Press, Oxford.
8. Protein Biotechnology, Franks, F.; Humana Press

ID 801 Ethics and IPR.   L-T-P = 2-0-0
                                                             At least 24 hrs/Sem

Module I : 6L
The importance and the needs of ethics; Ethical business practices; Laws and ethics; Environmental protection; Creating awareness and safeguarding health of consumers; Fair trade practices.

Module II : 6L
Concept of property, rights, duties and their correlation; History and evaluation of IPR; Copyrights and related rights. Distinction among various forms of IPR.

Module III: 6L
Patent rights/protection and procedure; Infringement or violation; Remedies against infringement; Indian Patent Act 1970 and TRIPS; Geographical indication and Industrial design.

Module IV: 6L
International Registration systems; WIPO treaties; Unfair competition; Protection of new plant varieties; Legal implications and public concerns in genetic modification of foods; National policies on food security.

Text Books/ References;

1. Santaniello, Evenson, Ziberman, Carlson – Agriculture and Intellectual Property Rights, Univ. Press, 1998
2. S. K. Chakraborty : Values and Ethics in Organization, OUP
3. A. N. Tripathi : Human Values, New Age International
4. Economic Reforms And Food Security: The Impact of Trade and Technology in South Asia by Suresh Chandra Babu, Haworth Press
5. Intellectual property rights in Agricultural Biotechnology; Edited by Erbisch, Maredia; CABI

ID 802A Marketing and Distribution Logistic   L-T-P = 3-0-0
                                                         At Least 36 L/Sem

Marketing Management:

1. Understanding Marketing Management
Definitions of Marketing Management, Types of Market, Evolving Views of Marketing's Role in an Organisation.

Core Marketing Concepts – Marketers and Prospects, Marketing Environment, Exchange and Transactions, Needs, Wants and Demands, Product or Offering , Brand, Brand Image, Brand Strength and Brand Equity, Competition, Relationships and Networks, Marketing Channels, Supply Chain, Value and Satisfaction, Target Markets and Segmentation, Marketing Mix;

Company Orientations towards the Market Place - Production Concept, Product Concept, Selling Concept, Marketing Concept, Societal Marketing Concept, Difference between Selling and Marketing;

2. Product and New Product
    Product – Levels of Product, Product Classification, Product Mix, Product Life Cycle.
    New Product – What is a New Product, Steps of New Product Development.

3. Price
    Concept of Pricing, Pricing Methods, Pricing Strategies;

4. Promotion
    Advertising   - Steps Of Developing an Advertising Program (5 M-s);
    Sales Promotion – Sales Promotion Tools Targeting the Customers, Trade and Sales Force;
    Public Relations & Publicity – Functions of PR Dept., Role of MPR;
    Personal Selling – Steps of Personal Selling, Qualities of a Successful Salesperson;
    Direct Marketing – Benefits, Major Channels of Direct Marketing;

5. Market Segmentation
    STP Concept, Need for Segmentation, Bases of Segmentation, Types of Segmentation.

6. Marketing Research
    Need for and Steps of Marketing Research, Questionnaires;

Distribution Logistics:

7. Roles of Intermediaries, Functions of Channels, Channel Levels, Channel Flows, Channel Design Decisions, Channel Management Decisions.

Text Books /References

1. Phillip Kotler : Marketing Management : Prentice Hall/ Pearson Education
2. Mahua Dutta, Debraj Dutta: Marketing Management: Vrinda Publication
3. Rajan Saxena : Marketing Management : Tata McGraw Hill
4. Palmer, Principles of marketing, OUP
5. Czinkota, Marketing Management,Vikas
6. B.K. Chatterjee, Marketing Management , Jaico
7. Hoffman, Marketing Best Practices,2nd Ed, Thomson Learning

ID 802B   Food informatics   **L-T-P = 3-0-0**
                                                                                   At least 36L/Sem

Module I. (9L)
        PFA, Agmark, BIS, EIC, etc.

Module II. (9L)
   Adulteration detection procedure.

Module III. (9L)
   Application of biotechnology in GM food production.

Module IV. (9L)
   Organic cultivation of raw materials for food process industries.

Text Books /References.
   1. Bioinformatics: a practical approach, D Higgins, W Taylor. Oxford University Press.
   2. Bioinformatics: Principles & Basic Internet Applications, by Hassan A Sadek. Trafford Publishing.
   3. Mendel in the Kitchen: A scientist's view of Genetically Modified Food. Nina Pedoroff, Nancy Brown. Joseph Henry Press.
   4. Prevention and Food Adulteration Act of India (As amended till 2004)

ID 802C Quality control and management.   **L-T-P = 3-0-0**
                                                                    At least 36L/Sem.

Module 1 (9L)
      Definition of quality. Quality specifications, Quality attributes of different foods. Food laws and regulations.

Module II. (9L)
      Quality control in the food industries, Microbial quality of foods; Application of chemical analysis in quality control. Implementation of quality control program.

Module III. (9L)
      HACCP concept, quality systems. BS 5750 an ISO 9000 series. Instrumental methods for quality control.

Module IV. (9L)
      Statistical quality control, cleaning and disinfection in food processing industries.

Text Books /References.
   1. Management and control of quality. James R Evans, William M Lindsey. Thomson South-western.

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

ID 802D Renewable Energy Technology.   **L-T-P = 3-0-0**
At least 36L/Sem.

Module I (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 II (9L)
Biogas from anaerobic digestion; Thermal energy from biomass combustion; Ethanol from biomass.

Module III (9L)
Hydrogen production by photosynthetic bacteria, biophotolysis of water and by fermentation; Microbial recovery of petroleum by biopolymers (Xanthum gum), biosurfactants.

Module IV (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/ References:
1. J.E.Smith – Biotechnology, 3rd edn. Cambridge Univ Press.
2. S.Sarkar – fuels and combustion, 2nd edn., University Press.

FT 891 Project (Same as in 7th semester)   **L-T-P = 0-0-18**
FT 892 Project Defence.

The project undertaken by the student at the commencement of the 7th semester will be continued till the end of the 8th semester. At the end of the semester the student will submit a report on his work in typed and bound form. Evaluation shall include oral presentation and a viva voce. Defence of the project viva on the project should be done in presence of external examiner along with internal faculties.

FT 893 Comprehensive Viva-Voce

This is a grand viva voce examination to ascertain the student's overall grasp of the principles of Food Technology and allied subjects.