

## Syllabus for B.Tech(Food Technology)

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



### 2<sup>nd</sup> Year, 3<sup>rd</sup> SEMESTER

#### A.THEORY:

	Code	Subjects	Contacts (Periods/ week)				Credit points
			L	T	P	Total	
1	HU301	Values and ethics in profession	3	0	0	3	3
2	CH(FT) 302	Chemistry-2	3	1	0	4	4
3	CH(FT) 301	Basic Environmental Engineering & Elementary Biology	3	0	0	3	3
4	FT301	Thermodynamics & Kinetics	3	1	0	4	4
5	FT302	Food Microbiology	3	1	0	4	4
6	FT303	Chemistry of food	3	1	0	4	4
Total Theory						22	22

#### B.PRACTICAL:

	Code	Subjects	Contacts (Periods/ week)				Credit points
			L	T	P	Total	
1	CH(FT)392	Chemistry-2 Lab	0	0	3	3	2
2	CH391	Environmental Engineering Lab	0	0	3	3	2
3	FT391	Chemistry of Food Lab – I	0	0	3	3	2
4	FT392	Food Microbiology Lab	0	0	3	3	2
Total practical						12	8
Total 3 <sup>rd</sup> Semester						34	30

### 2<sup>nd</sup> Year: 4<sup>th</sup> SEMESTER

#### A: THEORY:

	Code	Subjects	Contacts (Periods/ week)				Credit points
			L	T	P	Total	
1	M(CS) 401	Numerical Methods	2	1	0	3	2
2	FT 401	Biochemistry & Nutrition	3	1	0	4	4
3	CH 401	Industrial Stoichiometry	3	1	0	4	4
4	FT 402	Principles of Food Preservation	3	1	0	4	4
5	CHE 414	Unit Operation of Chemical Engineering-I	3	1	0	4	4
Total Theory						19	18

#### B.PRACTICAL:

	Code	Subjects	Contacts (Periods/ week)				Credit points
			L	T	P	Total	
1	FT 491	Biochemistry Lab	0	0	3	3	2
2	FT 492	Chemistry of Food Lab - II	0	0	3	3	2
3	CHE 484	Unit operation Lab - I	0	0	3	3	2
4	M(CS) 491	Numerical methods lab	0	0	2	2	1
5	HU 481	Technical Report Writing & Language Lab Practice	0	0	3	3	2
Total practical						14	9
Total 4 <sup>th</sup> semester						33	27

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### 3<sup>rd</sup> Year, 5<sup>th</sup> SEMESTER

#### A.THEORY:

Sl. no.	Field	Code	Subjects	Contact hours/week				Credit points
				L	T	P	Total	
1	HU	HU501	Economics of engineering	3	0	0	3	3
2	PC	FT 501	Food process technology – I (cereals, fruits, vegetables, beverages)	3	1	0	4	4
3	PC	FT 502	Food process technology – II (fish, meat, poultry)	3	1	0	4	4
4	PC	FT 503	Food process engineering	3	1	0	4	4
5	FE	CHE 514	Unit operations of chemical engineering – II	3	1	0	4	4
Total Theory							19	19

#### B.PRACTICAL:

Sl. no.	Field	Code	Subjects	Contact hours/week				Credit points
				L	T	P	Total	
1	PC	FT 591	Food processing lab – I	0	0	4	4	2
2	PC	FT 592	Food analysis & quality control lab	0	0	4	4	3
3	FE	CHE 584	Unit operation lab – II	0	0	4	4	3
Total practical							12	8
Total 5 <sup>th</sup> Semester							31	27

### 3<sup>rd</sup> Year: 6<sup>th</sup> SEMESTER

#### A: THEORY:

Sl. no.	Field	Code	Subjects	Contact hours/week				Credit points
				L	T	P	Total	
1	HU	HU 601	Principles of management	2	0	0	2	2
2	PC	FT 601	Food process technology – III (milk and milk products)	3	1	0	4	4
3	PC	FT 602	Food process technology – IV (edible fats and oils)	3	0	0	3	3
4	PC	FT 603	Bakery, confectionary and extruded foods	3	0	0	3	3
5	PE	FT 604	Microbial technology & food biotechnology	3	1	0	4	4
6	FE	CS 615	Data structure and algorithm	3	1	0	4	3
Total Theory							20	19

#### B.PRACTICAL:

Sl. no.	Field	Code	Subjects	Contact hours/week				Credit points
				L	T	P	Total	
1	PC	FT 691	Food processing lab – II	0	0	3	3	2
2	PC	FT 692	Microbial technology lab	0	0	4	4	2
3	PE	CS 685	Data structure & algorithm lab	0	0	3	3	2
4		FT 693	Seminar	0	0	3	3	2
Total practical							13	8
Total 6 <sup>th</sup> semester							33	27

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4<sup>th</sup> Year, 7<sup>th</sup> SEMESTER

### A.THEORY:

Sl. no.	Field	Code	Subjects	Contact hours/week				Credit points
				L	T	P	Total	
1	PC	FT 701	Food Packaging Technology	3	0	0	3	3
2	PC	FT 702	Waste Management of Food Industries	3	1	0	4	4
3	PE	FT 703 (A/B/C)	Elective – I (Enzyme Technology / Renewable Energy Technology / Plant Maintenance, Safety & Hygiene)	3	0	0	3	3
4	PE	FT 704 (A/B/C)	Elective – II (Modeling & Simulation of Food Processes / Protein Technology / Quality Control & Management)	3	0	0	3	3
5	FE	ET 701	Process Instrumentation and Control	3	1	0	4	4
Total Theory							17	17

### B. PRACTICAL & SESSIONAL:

Sl. no.	Field	Code	Subjects	Contact hours/week				Credit points
				L	T	P	Total	
1	HU	HU 781	Group Discussion	0	0	3	3	2
2	PC	FT 791	Food Engineering lab	0	0	3	3	2
3	PE	FT 792	Report and Seminar on Industrial Training	-	-	-	-	2
4	FE	ET 791	Instrumentation & Control Lab	0	0	3	3	2
5	Sessional	FT 793	Project part 1	0	0	6	6	4
Total practical and sessional							15	12
Total 5 <sup>th</sup> Semester							32	29

4<sup>th</sup> Year: 8<sup>th</sup> SEMESTER

### A. THEORY:

Sl. no.	Field	Code	Subjects	Contact hours/week				Credit points
				L	T	P	Total	
1	HU	HU 801A	Organizational Behavior	2	0	0	2	2
2	PE	FT 801	Project Engineering & Food Plant Layout	3	0	0	3	3
3	FE	FT 802 (A/B/C)	Elective – III (Principles of Biochemical Engineering / Entrepreneurship Development for Food Technologists / Functional Foods & Nutraceuticals)	3	0	0	3	3
Total Theory							8	8

### B. PRACTICAL & SESSIONAL:

Sl. no.	Field	Code	Subjects	Contact hours/week				Credit points
				L	T	P	Total	
1	Sessional	FT 891	Project part 2	0	0	12	12	8
2	Practical	FT 892	Product Development & Quality Assurance Lab	0	0	6	6	4
3	Sessional	FT 893	Grand Viva	-	-	-	-	3
Total sessional							18	15
Total 6 <sup>th</sup> semester							26	23

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## Semester III Theory

### VALUES & ETHICS IN PROFESSION

**HU 301**

**Contracts: 3L**

**Credits- 3**

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.

Human Operator in Engineering projects and industries. Problems of man, machine, interaction, Impact of assembly line and automation. Human centered Technology.

#### *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:**

1. Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994 (2<sup>nd</sup> Ed)
2. Deborah Johnson, Ethical Issues in Engineering, Prentice Hall, Englewood Cliffs, New Jersey 1991.
3. A N Tripathi, Human values in the Engineering Profession, Monograph published by IIM, Calcutta 1996.

### CHEMISTRY-2

**CH(FT) 302**

Contracts: 3L + 1T

Credits- 4

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

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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 ( $\sigma\text{-}\sigma^*$ ,  $n\text{-}\sigma^*$ ,  $\pi\text{-}\pi^*$  and  $n\text{-}\pi^*$ ), 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 (carbenium 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 & EELMENTARY BIOOLOGY

### CH(FT) 301

L-T-P = 3-0-0

At least 30 Hrs/Sem

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

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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

Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. 2L

Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification. 1L

Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference). 1L

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

Standard 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

Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic 1L

Land Pollution: Lithosphere; Internal structure of earth, rock and soil. Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes; Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling. Solid waste management and control (hazardous and biomedical waste). 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,  $L_{10}$  (18hr Index),  $L_{dn}$ . 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

1. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.
2. De, A. K., "Environmental Chemistry", New Age International.

## THERMODYNAMICS AND KINETICS

**FT301:** L-T-P = 3-1-0

At least 45 hrs/sem

### Module I: 10L

Basic Concepts of Thermodynamics: The Ideal Gas, Review of first and second laws of thermodynamics, PVT behaviour of Pure Substances, Virial Equation of State, Application of the Virial Equations, Cubic Equations of State, Generalized Correlations for Gases and Liquids. The Nature of Equilibrium, the Phase Rule, Duhem's Theorem

### Module II: 10L

Simple model's for vapour/liquid Equilibrium, Rault'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, Arrhenius 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 ed., First Indian ed. Asian Books Pvt. Ltd. 1998
2. Levenspiel.O., Chemical Reaction Engineering, Wiley Eastern Ltd.
3. Bailey & Olis, Biochemical Engg. Fundamentals, MGH, 1990
4. Physical Chemistry: Castellan, Narosa Publishing.
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.

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## 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. Moyer
3. Hand Book of Analysis of fruits & vegetables by S. Ranganna
4. Food Chemistry by Linhinger



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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
4. Determination of soil microbial biomass carbon.
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 / Biuret 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.
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.

## Semester IV

### Theory

#### NUMERICAL METHODS

**M(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:

1. C.Xavier: C Language and Numerical Methods.
2. Dutta & Jana: Introductory Numerical Analysis.
3. J.B.Scarborough: Numerical Mathematical Analysis.
4. Jain, Iyengar, & Jain: Numerical Methods (Problems and Solution).

#### References:

1. Balagurusamy: Numerical Methods, Scitech.
2. Baburam: Numerical Methods, Pearson Education.
3. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.
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.

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Module II (10L): Material balance: Introductory Concepts, Simplification of the general mass balance equation for steady and unsteady state processes, Procedure for material balance calculations, Material balance without chemical reactions, humidification such as continuous filtration, batch mixing, crystallizer, distillation column. Material balance with chemical reaction: Stoichiometry of growth and product formation: growth stoichiometry and elemental balances. Material Balance with recycle, bypass and purge streams.

Module III (10L): Energy Balance: General energy balance equation for steady and unsteady state processes, Without Chemical Reaction, With Chemical Reaction, Enthalpy calculation procedures, Special cases e.g., spray dryer, Distillation Column, Enthalpy change due to reaction: Heat of combustion, Heat of reaction for processes with biomass production, Energy-balance equation for cell culture, for fermentation processes.

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

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Reference books:

1. Hougen and Watson, Chemical Process Principles (Part one): 2nd Ed, John Wiley.
2. Basic Principles and Calculations in Chemical Engineering: Himmelblau, 6th Ed. Prentice Hall
3. Bhatt & Vora, Stoichiometry, 4th Ed., TM

## UNIT OPERATIONS OF CHEMICAL ENGINEERING – I

**CHE 414:** 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 Poiseuille 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 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).

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.

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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

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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. Hames Nutrition 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 IRR

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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:

1. Nira Konar: English Language Laboratory: A Comprehensive Manual  
PHI Learning, 2011

2. D. Sudharani: Advanced Manual for Communication Laboratories &  
Technical Report Writing, Pearson Education (W.B. edition), 2011

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 Runge-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.
3. Separation and isolation of proteins/amino acids by Paper Electrophoresis.
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

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Semester V

Theory

## ECONOMICS OF ENGINEERING

**HU 501**

Contracts: 3L

Credits- 3

1. Economic Decisions Making – Overview, Problems, Role, Decision making process.
2. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.
3. Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value Of Money, Debt repayment, Nominal & Effective Interest.
4. Present Worth Analysis : End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives.
5. Cash Flow & Rate Of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate Of Return, Calculating Rate Of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis. Economic Analysis In The Public Sector - Quantifying And Valuing Benefits & drawbacks.
6. Uncertainty In Future Events - Estimates And Their Use In Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic Decision Trees, Risk, Risk vs Return, Simulation, Real Options.
7. Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances.
8. Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life Of A New Asset, Marginal Cost, Minimum Cost Life Problems.
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.
10. Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.

### **Readings**

1. James L.Riggs,David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , Tata McGraw-Hill
2. Donald Newnan, Ted Eschembach, Jerome Lavelle : Engineering Economics Analysis, OUP
3. John A. White, Kenneth E.Case,David B.Pratt : Principle of Engineering Economic Analysis, John Wiley
4. Sullivan and Wicks: Engineering Economy, Pearson
5. R.Paneer Seelvan: Engineering Economics, PHI
6. Michael R Lindeburg : Engineering Economics Analysis, Professional Pub

## **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 prolamin (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 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

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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 hydrolyzate 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:

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
8. Fish as Food, Vol. I-IV; George Borgstrom, Academic Press
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.
5. Fundamentals of Food Process Engineering; Toledo RT; 2nd ed, 2000, CBS Publishers.
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.
3. Chemical Engineering, Vol-I & II, Colson & Richardson; Butterworth Heinemann.
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.
9. Cultivation of oyster mushrooms.

### 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.
2. Functions of Management : Planning – Concept, Nature, Types, Analysis, Management by objectives; Organisation Structure – Concept, Structure, Principles, Centralization, Decentralization, Span of Management; Organisational Effectiveness.
3. Management and Society – Concept, External Environment, CSR, Corporate Governance, Ethical Standards.
4. People Management – Overview, Job design, Recruitment & Selection, Training & Development, Stress Management.
5. Managerial Competencies – Communication, Motivation, Team Effectiveness, Conflict Management, Creativity, Entrepreneurship

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- Leadership: Concept, Nature, Styles.
- Decision making: Concept, Nature, Process, Tools & techniques.
- Economic, Financial & Quantitative Analysis – Production, Markets, National Income Accounting, Financial Function & Goals, Financial Statement & Ratio Analysis, Quantitative Methods – Statistical Interference, Forecasting, Regression Analysis, Statistical Quality Control.
- Customer Management – Market Planning & Research, Marketing Mix, Advertising & Brand Management.
- Operations & Technology Management – Production & Operations Management, Logistics & Supply Chain Management, TQM, Kaizen & Six Sigma, MIS.

## Readings

- Management : Principles, Processes & Practices – Bhat, A & Kumar, A (OUP).
- Essentials for Management – Koontz , Revised edition, Tata McGraw Hill(TMh)
- Management – Stoner, James A. F. (Pearson)
- Management - Ghuman, Tata McGraw Hill(TMh)

### 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 III (10L): Processing of evaporated and dried milk products – Milk powder, SCM, etc.; Cream, butter, ghee, Ice-cream, Infant formulae, Stabilizers and emulsifiers as additives in milk 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:

- Robinson RK; 1996; Modern Dairy Technology, Vol 1 & 2; Elsevier Applied Science Pub.
- Milk & Milk Processing; Herrington BL; 1948, McGraw-Hill Book Company.
- Modern Dairy Products, Lampert LH; 1970, Chemical Publishing Company.
- Developments in Dairy Chemistry – Vol 1 & 2; Fox PF; Applied Science Pub Ltd.
- Outlines of Dairy Technology, De S; Oxford.

### 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 :

- Bailey's Industrial Oil and Fat Products, Vol 1 & 2; Swern D; 4th ed, 1982, John Wiley & Sons.
- The Chemistry & Technology of Edible Oils and Fats; Devine J & Williams PN; 1961, Pergamon Press.
- Food Oils and their Uses; Weiss TJ; 1983, AVI.
- 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 and 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:

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.

## 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 (B<sub>2</sub> and B<sub>12</sub>), 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 Casida L.R., New Age International Pvt. Ltd.
5. Food Microbiology; Frazier WC; 4th ed, Tata-McGrawhill Pub.
6. Microbiology by Pelczar, Chan, and Krieg, TMH
7. Fermentation Biotechnology, Principles, Processed Products by Ward OP, Open University Press.

## 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.

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 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:

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

### 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.
6. Manufacture of Rosogolla and Sandesh.
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

**FT 692**

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 B<sub>12</sub> 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; Aseptic and shrink packaging; Secondary and transport packaging.

Text books and references:

1. Food and Packaging Interactions by Joseph H. Hotchkiss, (ACS symposium series -365, April 5-10, 1987, American chemical society, Washington DC, 1988.)

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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).

### WASTE MANAGEMENT OF FOOD INDUSTRIES

#### FT 702

L-T-P: 3-1-0

Credits: 4

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:

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.

### ENZYME TECHNOLOGY

#### FT 703 A

L-T-P: 3-0-0

Credits: 3

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:

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1. Methods of Enzymology
2. Biochemical Engg Fundamentals-Baily, Ollis. MGH
3. Prescott & Dunn's Industrial Microbiology Macmillan
4. Principles of Fermentation Technology-Wittaker and Stanby

## RENEWABLE ENERGY TECHNOLOGY

### FT 703 B

L-T-P: 3-0-0

Credits: 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:

1. J.E.Smith – Biotechnology, 3rd edn. Cambridge Univ Press.
2. S.Sarkar – fuels and combustion, 2nd edn., University Press.

## PLANT MAINTENANCE, SAFETY & HYGIENE

### FT 703 C

L-T-P: 3-0-0

Credits: 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.
4. Food Hygiene, Microbiology & HACCP. S J Forsythe, P R Hayes. Springer.

## MODELING AND SIMULATION OF FOOD PROCESSES

### FT 704 A

L-T-P: 3-0-0

Credits: 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; Equilibration 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
2. Process analysis & simulation : Himmelblau, Kenneth & Birchoff, John Wills.

## 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:

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

## 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:

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

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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; Stephanopoulos 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. | tion of thermal destruction parameters of canning processing – F value, D value, z value | Determina   |
| 2. | extraction from oils seeds   | Oil         |
| 3. | refining   | Crude oil   |
| 4. | efficiency – spray drier, tray drier, drum drier   | Drying      |
| 5. | concentration  | Fruit juice |
| 6. | efficiency   | Freezing    |

## 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



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Sessional

## 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

## ORGANIZATIONAL BEHAVIOR

**HU 801A**

L-T-P: 2-0-0

Credits: 2

### **Organisational Behaviour**

**HU801A**

**Contracts: 2L**

**Credits- 2**

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]
3. Perception: Definition, Nature and Importance, Factors influencing Perception, Perceptual Selectivity, Link between Perception and Decision Making. [2]
4. Motivation: Definition, Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory, McClelland's Theory of Needs, Vroom's Expectancy Theory. [4]
5. Group Behaviour: Characteristics of Group, Types of Groups, Stages of Group Development, Group Decision Making. [2]
6. Communication: Communication Process, Direction of Communication, Barriers to Effective Communication. [2]
7. Leadership: Definition, Importance, Theories of Leadership Styles. [2]
8. Organizational Politics: Definition, Factors contributing to Political Behaviour. [2]

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9. Conflict Management: Traditional vis-a-vis Modern View of Conflict, Functional and Dysfunctional Conflict, Conflict Process, Negotiation – Bargaining Strategies, Negotiation Process. [2]
10. Organizational Design: Various Organizational Structures and their Effects on Human Behaviour, Concepts of Organizational Climate and Organizational Culture. [4]

### References:

1. Robbins, S. P. & Judge, T.A.: Organizational Behavior, Pearson Education, 15<sup>th</sup> Edn.
2. Luthans, Fred: Organizational Behavior, McGraw Hill, 12<sup>th</sup> Edn.
3. Shukla, Madhukar: Understanding Organizations – Organizational Theory & Practice in India, PHI
4. Fincham, R. & Rhodes, P.: Principles of Organizational Behaviour, OUP, 4<sup>th</sup> Edn.
5. Hersey, P., Blanchard, K.H., Johnson, D.E.- Management of Organizational Behavior Leading Human Resources, PHI, 10<sup>th</sup> Edn.

### 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:

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)

### 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

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## 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:

### Sessional

## PROJECT PART 2

### FT 891

L-T-P: 0-0-12

Credit: 8

Student shall continue to be carry out project works under the supervision of a faculty member or faculty members, as assigned at the beginning of the 7<sup>th</sup> 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.