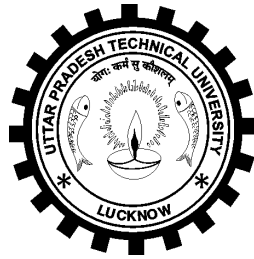


U.P. TECHNICAL UNIVERSITY, LUCKNOW



Syllabus

of

B.TECH. FOOD TECHNOLOGY

2nd, 3rd and 4th Year

[Effective from Session 2009-10]

U.P. TECHNICAL UNIVERSITY, LUCKNOW
Study & Evaluation scheme
[Effective from the session 2009-10]
B.Tech (Chemical Technology) [FOOD TECHNOLOGY]

YEAR 2ND, SEMESTER III

S.No	Course Code	Subject	PERIODS			Evaluation Scheme				Subject Total	Credit
			L	T	P	SESSIONAL EXAM					
						CT	TA	Total	ESE		
THEORY SUBJECTS											
1	ECY 301	Applied Engineering Chemistry	3	1	0	30	20	50	100	150	4
2	EAS 301/ EOE 031- EOE 038	Mathematics III/ Science Based Open Elective**	3	1	0	30	20	50	100	150	4
3	EHU 301/ EHU302	Industrial Psychology/ Industrial Sociology	2	0	0	15	10	25	50	75	2
4	EFT 301	Composition, Quality & Safety of Foods	3	1	0	30	20	50	100	150	4
5	ECH 301	Process Calculations	3	1	0	30	20	50	100	150	4
6	ECH 307	Fluid Flow & Solid Handling	2	1	0	15	10	25	50	75	3
7	EHU 111	*Human Values & Professional Ethics	2	2	0	15	10	25	50	75	
PRACTICAL /DESIGN/DRAWING											
8	ECY 351	Applied Chemistry Lab	0	0	3	10	10	20	30	50	1
9	EFT 351	Analysis of Food Constituents Lab	0	0	4	10	10	20	30	50	1
10	ECH 357	Fluid Flow & Solid Handling Lab	0	0	3	10	10	20	30	50	1
11	EFT 352	Group Discussion & Seminar	0	0	2			50		50	1
12	GP 301	General Proficiency						50		50	1
		TOTAL	16	5	12					1000	26

*Human Values & Professional Ethics will be offered as compulsory Audit Course for which passing marks are 40% in theory & 50% in aggregate. Student will be required to audit it within the period of their study. There will not be carry over facility for this course and a failed student will be required to repeat this course

****Science Based Open Elective**

EOE031/EOE041: Introduction to Soft Computing,
EOE032/EOE042: Nano Sciences
EOE033/EOE043: Laser Systems and Applications
EOE034/EOE044: Space Sciences

EOE035/EOE045: Polymer Science & Technology
EOE036/EOE046: Nuclear Science
EOE037/EOE047: Material Science
EOE038/EOE048: Discrete Mathematics

U.P. TECHNICAL UNIVERSITY, LUCKNOW
Study & Evaluation scheme
[Effective from the session 2009-10]
B.Tech (Chemical Technology) [FOOD TECHNOLOGY]

YEAR 2ND, SEMESTER IV

S.No	Course Code	Subject	PERIODS			Evaluation Scheme				Subject Total	Credit
			L	T	P	SESSIONAL EXAM					
						CT	TA	Total	ESE		
THEORY SUBJECTS											
1	EHU402/ EHU 401	Industrial Sociology/ Industrial Psychology	2	0	0	15	10	25	50	75	2
2	EOE041- EOE048/ EAS 401	Science Based Open Elective** / Mathematics III	3	1	0	30	20	50	100	150	4
3	ECH 401	Chemical Engineering Thermodynamics	3	1	0	30	20	50	100	150	4
4	ECH 402	Heat Transfer	3	1	0	30	20	50	100	150	4
5	EFT 401	Basic Food Microbiology	3	1	0	30	20	50	100	150	4
6	EFT 402	Food Additives	2	1	0	15	10	25	50	75	2
7	EHU 111	*Human Values & Professional Ethics	2	2	0	15	10	25	50	75	
PRACTICAL /DESIGN/DRAWING											
8	EFT 451	Basic Food Microbiology Lab	0	0	3	15	10	25	50	75	
9	ECH 452	Heat Transfer lab	0	0	3	15	10	25	50	75	
10	EFT 452	Group Discussion & Seminar	0	0	3			50		50	
11	GP 401	General Proficiency						50		50	
		TOTAL	16	05	09					1000	

** See the note on previous page

U.P. TECHNICAL UNIVERSITY, LUCKNOW
Study & Evaluation scheme
[Effective from the session 2010-11]
B.Tech (Chemical Technology) [FOOD TECHNOLOGY]

YEAR 3RD , SEMESTER V

S.No	Course Code	Subject	PERIODS			Evaluation Scheme				Subject Total	Credit
			L	T	P	SESSIONAL EXAM					
						CT	TA	Total	ESE		
THEORY SUBJECTS											
1	EHU 501	Engineering & Managerial Economics	3	1	0	30	20	50	100	150	4
2	EAS 501	Computer Based Numerical Methods.	3	1	0	30	20	50	100	150	4
3	EME509	Machine Design	2	0	0	15	10	25	50	75	2
4	EFT 501	Food Chemistry	3	1	0	30	20	50	100	150	4
5	EFT 502	Food Biochemistry & Biotechnology	3	1	0	30	20	50	100	150	4
6	ECH 507	Instrumentation and Process Control	2	1	0	15	10	25	50	75	2
7	EHU 111	*Human Values & Professional Ethics	2	2	0	15	10	25	50	75	
PRACTICAL /DESIGN/DRAWING											
8	EFT 551	Food Chemistry Lab	0	0	3	10	10	20	30	50	2
9	EFT 552	Food Biochemistry & Biotechnology Lab	0	0	3	20	20	40	60	100	2
10	EAS 551	Computer Based Numerical Methods Lab	0	0	3	10	10	20	30	50	1
11	GP 501	General Proficiency						50		50	1
		TOTAL	16	5	9					1000	26

U.P. TECHNICAL UNIVERSITY, LUCKNOW
Study & Evaluation scheme
[Effective from the session 2010-11]
B.Tech (Chemical Technology) [FOOD TECHNOLOGY]

YEAR 3RD , SEMESTER VI

S.No	Course Code	Subject	PERIODS			Evaluation Scheme				Subject Total	Credit
			L	T	P	SESSIONAL EXAM					
						CT	TA	Total	ESE		
THEORY SUBJECTS											
1	EHU 601	Industrial Management	3	0	0	30	20	50	100	150	4
2	EFT 601	Food Preservation & Processing Principles	3	1	0	30	20	50	100	150	4
3	EFT 602	Fruits, Vegetables & Plantation Products	3	1	0	30	20	50	100	150	4
4	ECH 607	Chemical Reaction Engineering	2	1	0	15	10	25	50	75	2
5	ECH 608	Introduction to Modeling & Simulation	2	1	0	15	10	25	50	75	2
6	ECH 609	Mass Transfer Operations	3	1	0	30	20	50	100	150	4
7	EHU 111	*Human Values & Professional Ethics	2	0	0	15	10	25	50	75	
PRACTICAL /DESIGN/DRAWING											
8	EFT 651	Food Preservation & Processing Lab- I	0	0	6	20	20	40	60	100	2
9	ECH 655	Mass Transfer Operations Lab	0	0	3	10	10	20	30	50	2
10	EFT 652	Seminar	0	0	2			50		50	1
11	GP 601	General Proficiency						50		50	1
		TOTAL	16	5	11					1000	26

U.P. TECHNICAL UNIVERSITY, LUCKNOW
Study & Evaluation scheme
[Effective from the session 2011-12]
B.Tech (Chemical Technology) [FOOD TECHNOLOGY]

YEAR 4TH , SEMESTER VII

S.No	Course Code	Subject	PERIODS			Evaluation Scheme				Subject Total	Credit
			L	T	P	SESSIONAL EXAM					
						CT	TA	Total	ESE		
THEORY SUBJECTS											
1	EOE071- EOE 074	Open elective -I @	3	1	0	30	20	50	100	150	4
2	EFT 701	Cereals, Pulses & Oilseed Products	3	1	0	30	20	50	100	150	4
3	EFT 702	Food Quality & Food Laws	3	1	0	30	20	50	100	150	4
4	ECH 702	Plant Design & Economics	3	1	0	30	20	50	100	150	4
5	EFT 703	Technology of Animal Foods	3	1	0	30	20	50	100	150	4
6	EHU 111	*Human Values & Professional Ethics	2	2	0	15	10	25	50	75	
PRACTICAL /DESIGN/DRAWING											
8	EFT 751	Food Quality Evaluation Lab	0	0	3	10	10	20	30	50	1
9	EFT 752	Food Preservation & Processing Lab- II	0	0	3	10	10	20	30	50	1
10	EFT 753	Project (Dissertation)	0	0	3	-	50	50	-	50	2
11	EFT 754	Industrial Training Viva Voce**	0	0	2	-	50	50	-	50	1
12	GP 701	General Proficiency						50		50	1
		TOTAL	15	5	11					1000	26

Note-**Practical Training (4-6weeks) done after 6th Semesters would be evaluated in 7th semester through Report and viva voce etc.

@Open Elective- I

1. EOE 071- Entrepreneurship Development
 4. EOE 074-Introduction to Biotechnology

2. EOE 072-Quality Management

3. EOE 073- Operations Research

U.P. TECHNICAL UNIVERSITY, LUCKNOW
Study & Evaluation scheme
[Effective from the session 2011-12]
B.Tech (Chemical Technology) [FOOD TECHNOLOGY]

YEAR 4TH , SEMESTER VIII

S.No	Course Code	Subject	PERIODS			Evaluation Scheme				Subject Total	Credit
						SESSIONAL EXAM					
			L	T	P	CT	TA	Total	ESE		
THEORY SUBJECTS											
1	EOE 081- EOE 084	Open elective -II @	3	1	0	30	20	50	100	150	4
2	EFT 011- EFT 013	Departmental Elective -I	3	1	0	30	20	50	100	150	4
3	EFT 021- EFT 023	Departmental Elective -II	3	1	0	30	20	50	100	150	4
4	EFT 801	Traditional & Fermented Foods	3	1	0	30	20	50	100	150	4
5	EHU 111	*Human Values & Professional Ethics	2	0	0	15	10	25	50	75	
PRACTICAL /DESIGN/DRAWING											
6	EFT 851	Project	0	0	12	-	100	100	250	350	8
7	GP 801	General Proficiency						50		50	1
		TOTAL								1000	25

@Open Elective – II

EOE 081: Non Conventional energy Resources
EOE 082: Non linear Dynamic Systems
EOE 083: Product Development
EOE 084 Automation and Robotics

Departmental elective- I

EFT 011: Specialty Foods
EFT 012 :Food Processing Waste Management
EFT 013: Rheological & Sensory Assessment

Departmental Elective- II

EFT 021: Food Products & Process Development
EFT 022 :Food Packaging
EFT 023:Engineered, Texturised & Fabricated Foods

Unit I**Organic Chemistry [8].**

Organic reactions of Industrial Significance.

(i) Alcohols, phenols & ethers : Reactions of alcohols with alkaline earth metals , Iodoform reaction, Oxidation, conversion of alcohols into Mesylates & Tosylates ; Crown ethers & epoxides ; Reimer-Tiemann reaction , Kolbes-Schmidt reaction mechanisms

(ii) Aldehydes & Ketones : Oxidation & reduction , Perkin reaction , Claisen-Schmidt reaction,

Benzoin condensation, Knoevenagel reaction, Reformatsky reaction, Wittig reaction.

(iii) Carboxylic acids and their derivatives : Hell-Volhard-Zelinsky reaction , Hoffmann bromide reaction, Curtius and Lossen Reaction

(iv) Nitrocompounds: Reduction of nitrobenzene under different conditions

(v) Amines : Reactions with nitrous acids , Diazotization and reactions of arenediazonium salts

Unit II [8]

(i) Concept of aromaticity in benzoid and non-benzoid compounds, aromatic and non-aromatic compounds

(ii) Organometallic compounds : Applications of Grignard Reagent and Lithium aluminum hydride

(iii) Stereochemistry : Conformational analysis : various terms , conformational analysis of cyclohexane and 1,2 -disubstituted cyclohexane . Stereoisomerism of cyclic compounds (cyclohexane), chiral drugs (ibuprofen), the relative and absolute configuration , stereoselective and stereospecific reactions .

Unit III [8]**Surface Chemistry**

(i) Catalysis : Acid base catalyzed reaction, enzyme catalyzed reaction and heterogeneous catalyzed reaction

(ii) Surface tension determination and Applications

(iii) Adsorption Isotherms- Freundlich and Langmuir

(iv) Colloids: General methods of preparation and properties, hydrophilic and hydrophobic sols,

Electrical Properties of colloids

(v) Colligative Properties: Lowering of Vapor Pressure, Elevation in boiling point, lowering in melting point, Osmotic Pressure and their relation with molecular weight

Unit IV: [8]**Analytical Chemistry**

Instrumental methods of chemical analysis: A brief introduction and applications of Conductometry , Potentiometer, GLC, HPLC , mass spectroscopy and atomic absorption Spectroscopy.

Unit V: [8]

Natural Organic Molecules

Biomolecules: Definition, types of biomolecules-nucleosides & nucleotides (DNA and RNA), saccharides (glucose, fructose, maltose and cellulose), lignin, lipids and amino acids (protein structure of apoenzymes, isoenzymes and vitamins) and their industrial applications.

Text Books

1. Finar, I.L. "*Organic Chemistry : Vol. I & II*".
2. Morrison & Boyd "*Organic Chemistry*".
3. March, J. "*Organic Chemistry*".
4. Soloman, T. "*Organic Chemistry*".
- 5- Glasstone, S. "*Physical Chemistry*"
- 6- Atkin, P. W. "*Physical Chemistry*"
- 7- Banwell, C. N. "*Fundamentals of Molecular Spectroscopy*"
- 8- Willard Merit & Dean "*Instrumental Methods of Chemical Analysis*"
- 9- Skoog & West "*Instrumental Methods of Chemical Analysis*"

EAS 301 MATHEMATICS III

L: T: P

3 :1: 0

Unit – I : Function of Complex variable Analytic function, C-R equations, Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic function, Taylor's and Laurent's series, singularities, Residue theorem, Evaluation of real integrals of the type $\int_a^b f(x) dx$ and $\int_C f(z) dz$ 10

Unit – II : Statistical Techniques - I Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves etc., Correlation, Linear, non –linear and multiple regression analysis, Probability theory. 08

Unit – III : Statistical Techniques - II Binomial, Poisson and Normal distributions, Sampling theory (small and large), Tests of significations: Chi-square test, t-test, Analysis of variance (one way) , Application to engineering, medicine, agriculture etc. Time series and forecasting (moving and semi-averages), Statistical quality control methods, Control charts, , R, p, np, and c charts. 08

Unit – IV : Numerical Techniques – I Zeroes of transcendental and polynomial equation using Bisection method, Regula-falsi method and Newton-Raphson method, Rate of convergence of above methods. Interpolation: Finite differences, difference tables, Newton's forward and backward interpolation , Lagrange's and Newton's divided difference formula for unequal intervals. 08

Unit – V : Numerical Techniques –II Solution of system of linear equations, Gauss-Seidal method, Crout method. Numerical differentiation, Numerical integration , Trapezoidal , Simpson’s one third and three-eight rules, Solution of ordinary differential (first order, second order and simultaneous) equations by Euler’s, Picard’s and forth-order Runge- Kutta mehthods. 08

Test Books :-

1. Peter V. O’Neil, Advance Engineering Mathematics Thomson (Cengage) Learning, 2007.
2. Jain, Iyenger & Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, New Delhi , 2003.
3. J.N. Kapur, Mathematical Statistics, S. Chand & company Ltd.,2000

Reference Books :-

1. R.K. Jain & S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publication House, 2002.
2. Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudralaya, 1996.
3. E. Kreysig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2005.
5. Devi Prasad, An introduction to Numerical Analysis, Narosa Publication house, New Delhi 2006.

EFT-301 COMPOSITION, QUALITY AND SAFETY OF FOODS

L : T: P
3 1 0

Unit-I L (1 – 9) T (1 – 3)

Composition: Chemical constituents of foods: Desirable and Potentially undesirable food constituents and their importance. Recommended Dietary Allowances (RDA). Composition of foods – General and specific for different foods of plant and animal origin.

Unit-II L (10 – 18) T (4 – 6)

Carbohydrates: Classes, Nomenclature and structure. Dietary utilization and disturbances
Lipids: Definition, Classification and structure: Fatty acids composition of natural lipids of plants and animal origin, Essential fatty acids. Role and use of natural lipids and tailor made fats in foods.

Unit-III L (19 – 27) T (7 – 9)

Protein: Physico-chemical properties of amino acids, peptides and proteins, structure - function relationship of proteins, Essential Amino acids.
Nutritional attributes of food and their implications.

Unit- IV L (28 – 36) T (10 – 12)

Quality: Basic concepts. Nutritional and sensory attributes and their assessments, causes of undesirable changes leading to quality deterioration in foods and their implications. Determination of probable cause(s) of observed quality change in foods.

Unit-V L (37 – 45) T (13 – 15)

Safety: Operational sense of food safety, Potential Food derived health hazard- Microbial contamination, Nutritional Imbalance. Pesticide residues, Environmental Contamination. Naturally occurring compounds and permitted food additives. Testing food for its safety.

Book References:

C. Gopalan : Nutritive value of Indian Foods

L.H. Mayer : Food Chemistry

Kramner & Twigg : Quality control for Food Industry

H.D. Graham : Safety of Foods

ECH 301: PROCESS CALCUALTIONS

L:T:P

3 :1:0

Unit I

Units their dimensions and conversions, Mass and volume relations, Stoichiometric and composition relations, Excess reactants, Degree of completion, Conversion, selectivity and yield. Ideal gas law, Dalton's Law, Amagat's Law, and Average molecular weight of gaseous mixtures. Effect of temperature on vapour pressure, Vapour pressure plot (Cox chart), Vapour pressures of miscible and immiscible liquids and solutions, Raoult's Law and Henry's Law. [10]

Unit II

Humidity and saturation

Relative Humidity and percent saturation, Dew point, Dry and Wet bulb temperatures, Use of humidity charts for engineering calculations. [6]

Unit III

Stoichiometry & Material

Balance Material balances for systems with and without chemical reactions, species and elemental balance, Analysis of systems with by-pass, recycle and purge. [8]

Unit IV

Energy Balance

Heat capacity of gases, liquids and solutions, Heat of fusion and vaporisation. Steady state energy balance for systems with and without chemical reactions. Calculations and application of heat of reaction, combustion, formation, neutralisation and solution. Enthalpy-concentration charts. Combustion of solids, liquids and gaseous fuels, Calculation of theoretical and actual flame temperatures. [8]

Unit V

Degrees of freedom in steady state processes, solution of simultaneous material and energy balance

problems using flow sheeting softwares, Unsteady state material and energy balance [8]

Text books

1. **Himmelblau, D.M.** "*Basic Principles and Calculations in Chemical Engineering*", 6th ed. Prentice Hall (1996).

2. **Felder, R.M. & Rousseau, R.W.** "*Elementary Principles of Chemical Processes* ", 3rd edition. John Wiley. (1999).

3. **Bhatt., B.I. and Vora S.M.** "*Stoichiometry*" IInd edition, Tata McGraw Hill (1984)

Reference Books

Hougan D. A., Watson K.M. and Ragatz R. A. "*Chemical Process principles*" Vol. 1 Asia Publishing House (1962)

Luben W.L. and Wenzel, L.A. "*Chemical Process Analysis Mass and Energy Balance*" Prentice Hall (1988)

ECH-307: FLUID FLOW AND SOLID HANDLING

L:T: P

2 :1: 0

Unit-I

Solids and Their Handling Properties of solids ,screening, industrial screening equipment. Determination of particle size, screen analysis, Sizereduction of solids, stages of reduction , operating variables, intermediate and fine size reduction, power requirement and mechanism. Power driven machines: Crushers, grinders, and conveyors. 8

Unit –II

Filtration: Theory, continuous and batch equipments. Flow of solids through fluids, classification and sedimentation. 8

Unit – III

Fluid flow: Properties of fluids. Fluid statics: Euler's equation, Hydrostatic Law and Pressure Measurement. Transport of fluids, energy relationships, pipe fittings, minor losses in pipe flow 8

Unit IV

Flow measurements: Orifice meter. Nozzle and venturimeters, rotameter and pitot tube. 8

Unit V

Pumping and compressing: reciprocating pumps, rotary pumps, centrifugal pumps and blowers. Introduction to fluidization. 8

1. To Determine size distribution of sample cruoled in a dodge crusher

2. To Determine efficiency of crusting of a roll crusher.

3. To determine surface area volume of a sample using screen analysis.

4. To Determine constants of filtration in case of rotary filter.

5. To Determine terminal velocity in case of hinderel setting in sedimentation.

6. To Calibrate orificemeter

7. To Calibrate vanturimeter.

8. To Calibrate rotameter.
9. To Verify Bernoulli equation

ECY 351: APPLIED ENGINEERING CHEMISTRY LAB

L : T: P
0 : 0 : 3

1. Identification of Organic Compounds in the mixture.
2. Estimation of Glucose, phenol, aniline.
3. Applications of TLC in the organic chemistry.
4. Determination of percentage composition of mixture with the help of viscosity measurements.
5. Freundlich adsorption isotherm verification.
6. Distribution of solute between two immiscible solvents (I₂ / water + organic solvent). Distribution law.
7. Conductivity: (i) Conductivity titration strength of strong acid vs. strong base, (ii) Dissociation constant of a weak acid (CH₃COOH).
8. Determination of molecular weight of a non volatile substance by (i) elevation in boiling point (ii) depression in freezing point.
9. Determination of Iron by Spectrophotometric method.
10. Potentiometric titration.

EFT-351 ANALYSIS OF FOOD CONSTITUENTS LAB

L : T: P
0 0 4

1. Sampling requirements, procedures and methods.
2. Determination of moisture content of foods by oven drying and distillation methods.
3. Determination of Total and Acid insoluble ash content in foods.
4. Determination of Crude fat content by solvent extraction methods in foods.
5. Determination of crude Protein by Kjeldhal Lowry methods.
6. Determination of reducing and total sugar content in foods.
7. Determination of crude fibre content in foods.
8. Determination of specific mineral contents in foods such as Calcium, Iron, Phosphorus, Chloride etc.
9. Determination of specific vitamin content of food such as ascorbic acid, carotenes etc.
10. Determination of specific Natural and/ or added Colouring Matters in foods.
11. Determination of specific added food Preservatives in foods.
12. Chromatographic Separation and identification of sugars and amino acids.

References:

1. BIS and AOAC Methods of Food analysis.
2. "Hand Book of analysis and quality control for fruit and Vegetable Products". IInd edition. Tata McGraw-Hill Publishing Company Ltd. New Delhi.

ECH-357 FLUID FLOW SOLID HANDLING LAB

L: T: P
0 : 0 : 3

1. To determine the coefficient of discharge of an orifice (or a mouth piece) of a given shape. Also to determine the coefficient of velocity and the coefficient of contraction of the orifice (or the mouth piece.).
2. To plot the flow net for a given model using the concept of electrical analogy.
3. To calibrate an orifice meter and study the variation of the coefficient of discharge with the Reynolds number.
4. To verify Darcy's law and to find out the coefficient of permeability of the given medium.
5. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
6. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
7. To study the variation of friction factor, 'f' for turbulent flow in smooth and rough commercial pipes.
8. To determine the loss coefficients for the pipe fittings.
9. To study the flow behaviour in a pipe bend and to calibrate the pipe bend for discharge measurement.
10. To study the performance of Jaw Crusher and find out it's crushing efficiency.
11. To study the performance of Crushing Rolls and find out it's crushing efficiency.
12. To study the settling characteristics.(Free & Hindered settling) of a given suspension of particles.
13. To study the filtration characteristics of Rotary Vacuum /Plate and Frame filter.
14. To carry out differential and cumulative screen analysis of given sample of solid particles

EFT 352 Group Discussion & Seminar

0 0 2

ECH 401: CHEMICAL ENGINEERING THERMODYNAMICS 3 1 0

Unit I

Basic Concept

The firstlaw and conservation of energy. Applications to steady , nonsteady flow and other engineering problems. The second law. Applications to engineering problems relating to equilibrium , maximum and minimum work. 8

Unit II

Properties of Pure Substances

Changes in thermodynamic properties and their inter-relationships. The ideal gas. Fugacity and Fugacity

coefficients for real gases. 8

Unit III

Multicomponent System

Partial molal properties. Mathematical models for the chemical potential. Ideal and non-ideal solutions.

Activity and activity coefficients. The Gibbs Duhem equations. Excess properties of mixtures. 8

Unit IV

Phase Equilibria

Criteria for equilibrium between different phases in Multicomponent nonreacting systems.

Applications to

systems of engineering interest, particularly to vapour – liquid equilibria and solubility. 8

Unit V

Chemical Equilibrium

The equilibrium constant and the variation of yield in chemical reactions with pressure, temperature and composition. 8

Text Books

1. Smith, J.M., Van Ness, H.C. & Abbot, M.M. "Intro to Chemical Engineering Thermodynamics", 5th edition. New York: Mc-Graw Hill (1996)"

2. Daubert T.E., "Chemical Engineering Thermodynamics" McGraw Hill (1986).

Reference Books

1. Y.V.C.Rao," Chemical Engineering Thermodynamics" University press (1997).

ECH 402: HEAT TRANSFER OPERATIONS

3 1 0

Unit I

Introduction to heat transfer and general concepts of heat transfer by conduction, convection and radiation.

Conduction: Basic concepts of conduction in solids, liquids and gases, steady state temperature fields and

one dimensional conduction without heat generation, e.g., through plane walls, cylindrical and spherical

surfaces, composite layers, etc. Insulation materials, critical and optimum insulation thickness.

Extended surfaces, fins and their practical applications. Introduction to unsteady state heat transfer. [07]

Unit II

Convection: Fundamentals of convection, Basic concepts and definitions, natural and forced

convection, hydrodynamic and thermal boundary layers, laminar and turbulent heat transfer inside and outside tubes, Dimensional analysis, determination of individual and

overall heat transfer coefficients and their temperature dependence, heat transfer in molten metals. [09]

Unit III

Radiation: Basic laws of heat transfer by radiation, black body and gray body concepts, view factors,

Kirchoff's law, solar radiations, combined heat transfer coefficients by convection and radiation. [04]

Unit IV

Heat Transfer with Phase Change: Condensation of pure and mixed vapors, film wise and drop wise

condensation, loading in condensers and basic calculation on condensers, heat transfer in boiling liquids, boiling heat transfer coefficients.

Evaporation: Elementary principles, types of evaporators. Single and multiple effect evaporators and their

calculation, thermocompression. [10]

Unit V

Heat Transfer Equipment: Classification, principles and design criteria, types of exchangers, viz., double

pipe, shell and tube, plate type, extended surface,

Furnaces and their classification and application. [10]

Books Recommended

Holman, J.P.: "Heat Transfer" 9 th ed. McGraw Hill (1989).

Reference Books

1. **Coulson, J.M. & Richardson, J.F.** "*Chemical Engineering :Vol-1*", 6th ed.

Butterworth-

Heinemann(1999)

2. **McAdams W.H.** "*Heat Transmission*", 3rd ed., McGraw-Hill, (1954)

3. **Kern D.Q.** "*Process Heat Transfer*" McGraw Hill Book (1950)

4. **Badger W.L. & Bancharo J.T.** ,"*Introduction to chemical engineering*" Tata McGraw Hill

EFT-401 : BASIC AND FOOD MICROBIOLOGY

L : T: P

3 : 1 : 0

Unit-I **L (1 – 8) T (1 – 4)**

General characteristics of microorganism: Classification, morphology, physiology, growth, nutrition and reproduction; Pure culture techniques and maintenance of cultures, control of microorganism.

Unit-II **L (9 – 14) T (5 – 7)**

Incidence of microorganism in foods, source of contamination. Principle underlying spoilage and preservation of foods.

Unit-III **L (15 – 24) T (8 –12)**

Contamination, spoilage and preservation of cereal products, sugar products, fruit and vegetable products, meat products, fish and sea foods egg and poultry products milk and milk products and other foods, Microbiological standard of foods.

Unit-IV L (25 – 30) T (13 – 15)

Food poisoning and food borne infections, food plant sanitation, inspection and control, personnel hygiene, HACCP in food industry. Beneficial microorganisms and their utilization in food fermentation.

Book references:

Author Title

M.J.Pelczar Microbiology

James M. Jay Modern Food Microbiology

Adams & M.O..Moss Food Microbiology

W.C.Frazier Food Microbiology

EFT-402 : FOOD ADDITIVES

L : T: P

2 : 1: 0

Unit-I L (1 – 8) T (1 – 4)

Definitions, uses and functions of:Acid, Base, Buffer systems, Salts and chelating/sequestering agents, Masticatory substances. Low calorie and non nutritive sweeteners, Polyols

Unit-II L (9 – 16) T (5 – 8)

Antioxidants, Emulsifying and stabilizing agents, Anti-caking agents, thickeners, Firming agents. Flour bleaching agents and Bread improvers.

Unit-III L (17 – 22) T (9 –12)

Anti microbial agents / Class I and Class II preservatives as per PFA Act.

Unit-IV L (23 – 30) T (13 – 15)

Colorants, Flavoring agents and related substances, Clarifying agents. Gases and Propellants. Tracers and other additives.

Book References:

Author Title

O.R.Fennema Food Chemistry

N.S.Manay Food Acts and Principles

PFA Rules 1955 PFA Act 1954

EFT-451 : BASIC AND FOOD MICROBIOLOGY LAB

L : T: P

0 : 0 : 3

1. Microscope its parts and utility in identification and differentiation of bacteria, yeast and mold.
2. Familiarization with common techniques for handling pure culture serial dilution, Inoculation,

slide preparation incubation, counting etc.

3. Micrometry and determination of size of different microbes.
4. Simple and differential staining of microorganisms and their examination.
5. Direct total, viable, and non-viable count of microorganisms in milk.
6. Preparation and sterilization of media and glass ware for microbial counts.
- 7-8. Determination of Standard Plate Count (SPC) in natural and/or processed foods.
- 9-10. Microbiological examination of some selected natural and processed foods.
- 11-12 Microbiological examination of potable water: Total and coliform count.
13. Enumeration of coliform organism in some selected processed foods.

Book Reference:

Author Title

H. W. Selley Jr. and Paul J. Van. Microbes in action

ECH 452: HEAT TRANSFER OPERATIONS LAB

L:T:P

0:0:3

1. To find the thermal conductivity of metallic rod at different temperature and draw the temperature profile for steady and unsteady state conduction.
2. To find out the thermal conductivity of insulating powder.
3. To find the thermal conductivity of liquid / gases.
4. To find the emissivity of grey plate with respect to black plate
5. To study the critical heat flux behaviour of a liquid
6. To find the heat transfer coefficient for parallel and counter current flow condition for a Double pipe heat exchanger
7. To study the shell & Tube heat exchanger and find the heat duty and Overall heat transfer coefficient for parallel flow condition.
8. To study the shell & Tube heat exchanger and find the heat duty and Overall heat transfer coefficient for counter flow condition.
9. Compare the heat duty for parallel & Counter flow And find the energy saving.
10. To study the Plate heat exchanger and find the Overall heat transfer coefficient
11. To study the performance of heat pipe.
12. To find the heat transfer coefficient for open pan evaporator for steady and unsteady state condition.
13. To study Single/Double/Trippl effect Evaporator and find its Steam economy.

EFT 452 GROUP DISCUSSION & SEMINAR

0 0 2

EHU-501: ENGINEERING & MANAGERIAL ECONOMICS

**L : T: P
3 : 1: 0**

Unit –I

Introduction : Nature and Significance of economics. Meaning of Science, Engineering and Technology and their relationship with economic development. 4

Unit-II

Basic Concept: The concept of demand and supply. Elasticity of Demand and Supply. Indifference curve analysis, Price effect, Income effect and Substitution .

Unit -III

Money and Banking: Functions of Money. Value of Money, Inflation and Measures to control it. Brief idea of functions of banking system , viz.,Commercial and Central Banking.

Unit -IV

Introduction: Definition ,Nature and Significance of Management. Evaluation of Management thought Contribution of Max Weber, Taylor and Fay

Unit – V

Human Behaviour: Factors of Individual Behaviour, Perception, Learning and Personality development, Interpersonal Relationship and Group Behaviour. 10

EAS-501: COMPUTER BASED NUMERICAL METHODS

**L: T: P
3: 1: 0**

Unit 1

Problem solving on computer. Algorithms and flow charts. Introduction to numerical computing, approximations and errors in numerical computations. Truncation and round off errors, propagation of errors. Root finding: bisection method, regula falsi method, iteration method, Newton Raphson method, Secant method, systems of nonlinear equations. 08

Unit 2

Matrix algebra, Solution of simultaneous linear algebraic equations: Gauss elimination, Gauss Jordan method, LU decomposition, Jacobi method, Gauss Seidel method, SOR method, convergence of iterative methods. Tridiagonal systems and Thomas algorithm, Condition of a system and stability issues. 06

Unit 3

Interpolation and Extrapolation: Newton's forward and backward interpolation formula, Lagrange interpolation formula. Divided differences and Newton's general formula. Numerical differentiation, Numerical integration : Trapezoidal and Simpson's rules. Newton-Cotes integration formulas, Romberg integration, Gaussian Quadrature. 10

Unit 4

Numerical solution of O.D.E.: Taylor series method, Euler's method, Runge Kutta methods. Multistep methods: Milne's method, Adams method, accuracy, Convergence criteria, stiffness, systems of equations. 08

Unit 5

Boundary Value problems: Finite difference method, solving eigenvalue problems, polynomial method, power method. Numerical solution of Partial Differential equations. Elliptic, Parabolic and hyperbolic PDEs. 08

Books Recommended

E. Balagurusamy: Numerical Methods, Tata McGraw hill.

Reference Books

1. **Sastry, S. S.** “*Introductory Methods of Numerical Analysis*”, 3 rd ed. Prentice- Hall of India, New Delhi (2002).
2. “*Schaum's Outlines: Numerical Analysis*”, 2 nd ed. Tata Mc Graw Hill Publishing Co. Limited (1968)
3. **Kandasamy, P. Thialagawathy, K. & Gumawathy, K.** “*Numerical Methods*”, S. Chand & Company Ltd., New Delhi (1999).
4. **Balaguruswamy, E.** “*Numerical Methods*. Tata Mc Graw Hill Publishing Company Limited, New Delhi (2001).
5. **V. K. Singh** “*Numerical and Statistical Methods in Computer*” (2005), Paragon International Publishers, New Delhi.
6. **Jain, Iyengar and Jain**, “*Numerical Methods for Scientific and Engineering Computation*” (2003), New Age International, New Delhi.
7. **Grewal B.S.**, “*Numerical Methods in Engineering and Science*”, Khanna Publishers, Delhi.

EME 509 : MACHINE DESIGN

L : T: P
2 : 1: 0

Unit-I

Introduction to the methodology of Engineering design; Design circle for a product/system; Important considerations in design; Formulation of design concepts; Miscellaneous considerations like wear, environmental, human and aesthetic aspects; Ergonomics considerations. 8

Unit-II

Estimation of design load under static and dynamic conditions; Design for safety; Stress concentration and its effect and its prevention; Consideration of creep, fatigue and thermal stresses in design. 8

Unit III

Design of power transmission systems- belt, pulley and shafts; Design of riveted and welded joints; Design of keys, couplings, lever and brackets. 8

Unit-IV

Design of pressure vessels- thick and thin cylinders, pipe and joints; Elementary ideas and importance of computer aided design; Basics of computer graphics - general introduction to AutoCAD.

8

EFT– 501 : FOOD CHEMISTRY

L : T: P
3 : 1: 0

Unit-I L (1 – 9) T (1 – 3)

(a) Water in Foods: Structure. Properties, Interactions, Water activity, and stability.

(b) Carbohydrates: Functions, Reactions and properties of simple and complex carbohydrate, Selection of Natural or Modified carbohydrates for incorporation into processed food.

Unit-II L (10 – 18) T (4 – 6)

Lipids: Consistency of commercial fats Lipolysis, Auto oxidation, Thermal Decomposition and effect of ionizing radiation, Refining of oils, Modification of oils and fats, Role of food lipids in flavor, Nutritional aspects of natural and modified fats.

Unit-III L (19 – 27) T (7 – 9)

Proteins: Nutritive and supplementary value of food protein, Chemical reactions and interactions of amino acids and proteins, De-naturation and its implications, Functional properties of food proteins, Modification of food proteins in processing and storage and its implications.

Unit-IV L (28 – 36) T (10 – 12)

Vitamins, Minerals, Pigments and Flavours: Chemistry and stability of water and fat-soluble vitamins, Chemical properties of minerals and their bioavailability, Enrichment and fortification. Natural pigments in foods and their retention in processed foods. Flavoring constituents in foods, Development of process and reaction flavour volatiles.

Unit-V L (37 – 45) T (13 – 15)

Characteristics of muscle tissues, Milk, Egg and edible plant tissues, Integrated approach to food chemistry.

Book references:

O.R. Fennema Food Chemistry

EFT– 502 : FOOD BIOCHEMISTRY AND BIOTECHNOLOGY

L : T: P
3 : 1: 0

Unit-I L (1 – 9) T (1 – 3)

Nomenclature, Classification and specificity of enzymes and cofactors, Enzyme Kinetics: Factors affecting the rate of enzyme catalyzed reaction, regulation and control of enzyme action.

Unit-II L (19 – 27) T (7 – 9)

Metabolic Pathways: Carbohydrates, proteins and fats; catabolism and anabolism

Unit-III L (10 – 18) T (4 – 6)

Digestion absorption, Assimilation and Transport of nutrients in human beings.

Unit-IV L (28– 36) T (10 – 12)

Post harvest and Postmortem biochemical changes in foods: Changes in composition, color, texture, flavor and its implications on quality of foods.

Unit-V L (37 – 45) T (13 – 15)

Application of enzymes in food processing: Endogenous enzymes and their role in modification of foods, enzyme added to foods during processing sources, conversions and specific applications.

Book References:

- O.R.Fennema Food Chemistry
A.L.Lehninger Principle of biochemistry
Lubert Stryen Biochemistry
N.A.M.Eskin Biochemistry of Foods
S.A.Joshi Nutrition and Dietetics
J.H.Weil General Biochemistry

ECH- 507 : INSTRUMENTATION AND PROCESS CONTROL

**L : T: P
2 : 1: 0**

Unit-I

Elements of measurement , functions and general classifications of measuring instruments. Indicating and recording type of instruments. Elements of measuring instruments,static and dynamic characteristics of measuring instruments. 6

Unit-II

Principle of operation, construction and application of important industrial instruments for the measurement of temperature, flow, liquid level and composition. 10

Unit-III

Dynamic behavior of first order, second order and two or more first order systems in series. 10

Unit-IV

Block and physical diagrams of control system. Open and closed loop control systems. Characteristics of measuring elements, controllers and final control elements. Mode of control actions. (08 lectures)

Books

1. Eckman, D.P., Industrial Instrumentation, Wiley Eastern Ltd., New York 1990.
2. Jain, R.K., Mechanical and Industrial Measurements, Khanna Publishers.
3. Process system Analysis & Control, D.R. Coughanoowr, McGraw Hill Publication
4. Process Control. Peter Harriot, Tata McGraw Hill.
5. Process control, Staphno polies, Prentic Hall India Ltd.

EFT– 551 : FOOD CHEMISTRY LAB**L : T: P****0 0 3**

1. Analysis of water for potable and food purposes
2. Moisture content in foods in relation to their stability
3. Non-enzymatic browning reactions and its determinations
4. Determination of rate/ extent of hydrolysis of sucrose/starch
5. Determination of free fatty acid content in fats and oils
6. Detection and estimation of oxidative rancidity in fats/oils
7. Determination of heat stability of vitamin c
8. Study of some reactions of proteins
9. Study of some processing changes in proteins
10. Study of some functional properties of proteins
11. Detection / Estimation of some additives in foods
12. Detection/Estimation of adulterants in some foods

Book References:

1. The chemical analysis of foods and food products, by Morris B. Jacobs, III Edition, CBS Publishers and distributors New Delhi.
2. ISI hand book of food analysis
3. Hand book of analysis and quality control for fruit and vegetable products, by S. Ranganna, II Ed., Tata McGraw Hill Publishing Co. New Delhi.
4. Official Method of analysis of AOAC

EFT– 552 : FOOD BIOCHEMISTRY AND BIOTECHNOLOGY LAB**L : T: P****0 : 0 : 3**

1. Determination of enzyme activity and specific activity (Enzyme assay)
2. Determination of effect of temperature on enzyme activity
3. Determination of effect of pH on enzyme activity
4. Determination of effect of substrate concentration on enzyme activity and estimation of K_m .
5. Estimation of enzymatic browning in a food
6. Estimation of enhancement in an enzyme activity during ripening of a fruit
7. Estimation of enhancement in an enzyme activity during sprouting of a grain
8. Detection/ estimation of catalase and peroxidase activity in vegetable
- 9-13. Application of enzymes:
Amylase in hydrolysis of starch.
Invertase in hydrolysis of sucrose.
Protease in hydrolysis of protein
Lipase in hydrolysis of fat.
Cellulase and hemicellulase for dehulling of a grain, etc.

Book references:

1. An introduction to practical biochemistry by D.T.Plummer, III Ed. Tata McGraw Hill Publishing Co. New Delhi

2. Principles of Enzymology for Food Science by J.R. Whitaker, Marcel Dekker Inc
3. Methods in Enzymology by S.P. Colwick and N.O. Kaplan, Academic Press

EAS 551 : COMPUTER BASED NUMERICAL TECHNIQUES LAB

L T P
0 0 3

Use of following Techniques in C/C++ Language

1. Solution of single non-linear algebraic equations by Newton Raphson method.
2. Solution of single non-linear equations by Regula-falsi method.
3. Solution of system of linear simultaneous by Gauss Elimination method.
4. Solution of system of linear simultaneous equation by Gauss-Seidel method and successive over relaxation method.
5. Solution of single first order ordinary differential equations by fourth order Runge-Kutta method.
6. Solution of Heat equations (Parabolic equations) by finite difference method.
7. Solution of Laplace equations (elliptic equation) by finite difference method.
8. Solution of wave equations (Hyperbolic equation) by finite difference method.
9. Finding Newton's interpolatory polynomial for n points.
10. Finding Newton's interpolatory polynomial based on finite difference table for n points.
11. Simpson's 3/8-rule.

EHU 601 INDUSTRIAL MANAGEMENT

3 0 0

EFT - 601 : FOOD PRESERVATION & PROCESSING PRINCIPLES

L : T : P
3 : 1 : 0

Unit-I L (1 – 9) T (1 – 3)

Basic considerations: Aims and objectives of preservation & processing of foods, Characteristics of tissues and non-tissues foods, Degree of perishability of unmodified foods, Causes of quality deterioration and spoilage of perishable foods, intermediate moisture foods, wastage of foods.

Unit-II L (10 – 18) T (4 – 6)

Preservation of foods by low temperatures:

(A) Chilling temperatures: Consideration relating to storage of foods at chilling temperatures, Applications and procedures, Controlled and Modified atmosphere storage of foods, Post storage Handling of foods.

(B) Freezing temperatures: Freezing process, Slow and fast freezing of foods and its consequence, other occurrences associated with freezing of foods. Technological aspects of pre freezing, Actual freezing, Frozen storage and thawing of foods.

Unit-III L (19 – 27) T (7 – 9)

Preservation of foods by high temperatures: Basic concepts in thermal destruction of microorganisms D,Z,F values. Heat resistance and thermophilic microorganisms. Cooking, Blanching, Pasteurization and Sterilization of foods. Assessing adequacy of thermal processing of foods, General process of canning of foods, Spoilage in canned foods.

Unit-IV L (28 – 36) T (10 – 12)

Preservation by water removal:

(a) Principles, Technological aspects and application of evaporative concentration process; Freeze concentration and membrane process for food concentrations.

(b) Principles, Technological aspects and application of drying and dehydration of foods, Cabinet, tunnel, belt, bin, drum, spray, vacuum, foam mat, fluidized-bed and freeze drying of foods.

Unit-V L (37 – 45) T (13 – 15)

Principles, Technological aspects and application of sugar and salt, Antimicrobial agents, Biological agents, non ionizing and ionizing radiations in preservation of foods. Hurdle technology.

Book References Author

O.R.Fennema Principles of Food science

V.Kyzlink Principle of Food Preservation

James M.Jay Modern Food Microbiology

EFT – 602 FRUITS, VEGETABLES AND PLANTATION PRODUCTS L : T : P
3 : 1 : 0

Unit-I L (1 – 9) T (1 – 3)

Structural, Compositional and Nutritional aspects of fruits and vegetables. Physiological development: Growth, Maturation, Ripening and Senescence. Post harvest handling including controlled and modified storage. Techniques of processing and preservation of fruits and vegetables by refrigeration and freezing, canning and bottling, drying and dehydration.

Unit-II L (10 – 18) T (4 – 6)

Technology of fruits and vegetable products: Juices and pulps, Concentrates and powders, Squashes and cordials. Beverage: Still and carbonated. Jams, Jellies and Marmalades. Preserves, candies and crystallized fruits. Tomato products: Puree, Paste, Ketchup, Sauce and soup. Chutneys, pickles and other products.

Unit-III L (19 – 25) T (7 – 9)

Spices: Composition, Structure and characteristics. Preservation and processing of major and minor spices of India; whole spice, Spice powder, Paste and extracts, Spice oils and oleoresins. Composition, Structure, characteristics & processing of cashew nut and other dry fruits

Unit-IV L (26 – 36) T (10 – 12)

Composition, Production and processing of Tealeaves: Black tea, Green tea and Oolong tea. Instant tea. Production and processing of coffee cherries by wet and dry methods to obtain coffee beans, grinding, storage and preparation of brew, Soluble /Instant coffee, Use of chicory in coffee, decaffeinated coffee.

Unit-V L (37 – 45) T(13 – 15)

Production, processing and chemical composition of cocoa beans. Cocoa Processes: Cleaning, roasting, alkalization, cracking and fanning, Nib grinding for cocoa liquor, cocoa butter and cocoa powder. Manufacturing process for chocolate: Ingredients, Mixing, Refining, Conching, Tempering, Moulding etc. to obtain chocolate slabs, chocolate bars. Enrobed and other confectionary products.

Book References:

Author Title

G. Lal, G.S. Siddappa and G.L. Tondan Preservation of fruits & vegetables.

& G.L. Tandon B.L. Amla Food Industry.

B. Shrilakshmi Food Science.

Bernard. W. Minifie Chocolate, Cocoa and Confectionary: Science and Technology.

R.H.H. Wills et.al. An introduction to the Post-harvest physiology and handling of fruits and vegetables.

ECH- 607: CHEMICAL REACTION ENGINEERING

L : T: P

2 : 1: 0

Unit-I

Chemical Reactions : Rate of chemical reactions, variable affecting the reaction rate, order of reaction ,reaction rate constant , elementary and non-elementary reaction mechanism. Arrhenius equation, Collision theory and theory of absolute reaction rates, predictability of reaction rate. 8

Unit-II

Kinetics of homogeneous chemical reactions, rate equations for simple and complex reactions, irreversible reaction, parallel reactions,consecutive reactions, auto catalytic reactions and homogeneous catalytic reactions. 8

Unit-III

Interpretation of reactor data in constant volume and variable volume batch reactions, integral and differential method of following kinetic data. Reactor designs for homogeneous, batch, semi-batch, plug flow and continuous stirred tank. Electrochemical reactors 6

Unit-IV

Classification of chemical reactions, Interpretation of reactor data in flow reactions.. Isothermal as well as non-isothermal operation, space velocity and residence time in flow reactors. Size comparison of single reactors like batch, plug flow and CSIR for first and second order single reactions. Multiple reactor systems, Plug flow reactions in series and for parallel equal sized CSTR's in series. 6

Text Books

1.Levenspiel, O.. “Chemical Reaction Engineering”, 3rd ed. New York John Wiley (1998)

2. Fogler, H.S. "Elements of Chemical Reaction Engineering", 4th ed. Prentice Hall (1997).
3. Smith, J. "Chemical Engineering Kinetics ", 3rd edition. McGraw-Hill, . (1990).

ECH 608 INTRODUCTION TO MODELLING & SIMULATION

L T P
2 1 0

Unit I

Introduction to mathematical modelling , Classification of models –Simple vs. dynamic, Transport phenomena based vs. statistical; fundamental laws of modelling, model building, modelling difficulties.

Unit - II

Simple examples of process models i.e. reactors (Plug Flow, CSTR, Batch etc.), mass. Transfer equipments (distillation column, humidifiers, dehumidifiers, absorbers etc.), heat transfer equipments (evaporators, condensers, heat exchangers etc.)

Unit - III

Introduction to flow sheet simulation; Sequential modular approach; Equation oriented approach; Partitioning and tearing; Recycle convergence methods,

Unit - IV

Review of thermodynamic correlations for estimates of physical properties like phase equilibria, bubble and dew points etc.
Software for material and energy balance.

Text Books

1. Luyben W.L., "Process Modelling, Simulation, and Control for Chemical Engineering", Wiley
2. Hussain Asghar, "Chemical Process Simulation", Wiley Eastern Ltd., New Delhi,(1986)

Reference Books

1. M.M. Denn, "Process Modelling", Wiley, New York, (1990)
2. C.D. Holland and A.L. Liapis, " Computer Methods for solving Dynamic Separation Problems", McGraw Hill, (1983)
3. C.D. Holland, "Fundamentals of Modelling Separation Processes ", Prentice Hall, (1975)

ECH- 609 : MASS TRANSFER OPERATIONS

L : T: P
3 : 1: 0

Unit-I

Basic Principles of mass transfer: Molecular diffusion in fluids, mass transfer coefficients, Interphase mass transfer. Vapour pressure, enthalpy, absolute humidity, dew point, etc., Unsaturated vapour gas mixtures. 8

Unit-II

Gas absorption: Countercurrent, co-current, multistage continuous contact operations.

Distillation : Entrainment, pressure drops , flooding , transfer coefficients and relative volatility. McCabe Thiele and Ponchon method for binary component distillation of azeotropes. Flash vaporization and Multicomponent distillation. 8

Unit-III

Diffusion: Molecular and turbulent diffusion , diffusion coefficient. Fick's law of diffusion, measurement and estimation of diffusivity. Diffusion in multicomponent gas mixtures. Diffusion in solids: Molecular, Knudsen and surface diffusion.

Inter phase mass transfer: Mass transfer coefficients, diffusion between phases, equilibrium solubility of gases in liquids. Mass transfer theories. Mass transfer in fluidized beds 10

Unit-IV

Adsorption and Stripping, Equipments, gas-liquid equilibria, Henry's law, selection of solvent, absorption in tray column, graphical and analytical methods. Adsorption in packed columns. HTU, NTU & HETP concepts, design equations for packed column. 7

Unit-V

Drying: Batch and freeze drying, rotary driers. Surface vs diffusion controlled operations. Solid-gas equilibria, definitions of moisture contents, types of batch and continuous dryers, rate of batch drying , time of drying, mechanism of batch drying, continuous drying. 7

Text Books

1. Treybal, R "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, (1980).
2. Sherwood T. K., Pigford R. L. and Ingle P. "Mass Transfer" McGraw Hill (1975).
1. Foust A. S. et.al., "Principles of Unit Operations" John Wiley (1980).
2. Geankoplis, C.J.. "Transport Processes and Unit Operations", 3rd ed. Prentice Hall. (1993)

EFT-651 FOOD PRESERVATION AND PROCESSING LAB -I

**L : T: P
0 : 0 : 6**

1. Extension of shelf life/ preservation of foods by use of low temperature.
2. Processing and preservation of Peas by use of high temperature.
3. Preservation and processing of certain vegetables by drying and dehydration (water removal)
4. Osmotic concentration/dehydration of certain fruits and vegetables using concentrated sugar and salts solutions (reduction in water activity)
5. Preparation of Jam/Jelly and its preservation by sugar.
6. Preparation of tomato puree/ketchup and its preservation by chemical

- preservatives.
7. Preparation of fruit juice/pulp and its preservation by chemical preservatives/ thermal processing.
 8. Preparation of cordials and squash as per FPO specification.
 9. Preparation of pickles/ sauerkraut.
 10. Preparation of sugar boiled candy.

Author Title

G.Lal, G.S.Siddappa & G.L.Tondan Preservation of Fruits and Vegetables

ECH-655 : MASS TRANSFER OPERATIONS LAB

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

1. Separation factors of the experiments with differential distillation.
2. Separation factors of the experiments with flash vaporization.
3. Separation factors of the experiments with vapour liquid equilibrium.
4. Separation factors of the experiments with liquid – liquid extraction.
5. Separation factors of the experiments with solid –liquid extraction.
6. Separation factors of the experiments with ion exchange.
7. Separation factors of the experiments with membrane separation.
8. Studies on Bubble cap/ tray/ fractional column.
9. Studies on Absorption/ Humidification/ Dehumidification columns.
10. Studies on crystallization and adsorption.

EFT-652 SEMINAR

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

The student will be required to prepare and deliver a seminar as well as submit a written report on the topic assigned to him/her

EOE 071- EOE 074 :OPEN ELECTIVE -I

**L : T: P
3 : 1: 0**

EFT - 701 CEREALS, PULSES AND OILSEED PRODUCTS

**L : T: P
3 : 1: 0**

Unit-I L (1 – 9) T (1 – 3)

Composition, Structure and Processing characteristic of Cereal grains, Legumes and oilseeds, Post harvest, Post processing practices for their safe storage. Parboiling and Milling of paddy, Quality characteristics, Curing and aging of rice, Processed rice products.

Unit-II L (10 – 18) T (4 – 6)

Wheat and its quality characteristics for milling into flour and semolina, Flour milling, Turbo grinding and air classification, Flour grades and their suitability for baking

purposes, Assessment of flour quality and characteristics, Milling of Durum wheat, Macaroni products.

Unit-III L (19 –27) T (7 – 9)

Ingredients, Technology and quality parameters for baked products: Bread, Biscuits and cakes; Breakfast cereals.

Unit-IV L (28 – 36) T (10 – 12)

Dry and Wet milling of corn, Starches and its conversion products, Malting of barley, Pearlring of Millets, Milling of legume-pulses by traditional and improved processes.

Unit-V L (37 – 45) T (13 – 15)

Processing of oil seeds for direct use and consumption, Oil and protein products. Processing of extracted oil refining, hydrogenation, interestrification. Processing of deoiled cake into protein concentrates and isolates, Textured protein, Functional protein preparations. Peanut butter, Margarine and Spread.

Book references:

Author Title

C.F.T.R.I. Mysore Manuals on Rice and its Processing

N.N.Potter Food Science

S.A.Matz Cereal Technology

S.A.Matz Bakery Technology

EFT - 702 FOOD QUALITY AND FOOD LAWS

L : T: P

3 : 1: 0

Unit-I L (1 – 9) T (1 – 3)

Ways of describing of Food Quality, Quality control and Quality Assurance functions. Total Quality Control (TQC) and the role of management/ TQM.. Statistical quality control. Quality costs., Analysis and Interpretation of sensory scores. Application of sensory evaluation in Quality Management of foods.

Unit-II L (19 – 27) T (7 – 9)

Instrumental measurements of sensory attribute of foods: Appearance, color, volume, density and specific gravity, Rheological and textural characteristics . Texture profile analysis. Correlation between instrumental and Sensory analysis of food quality attributes.

Unit-III L (28 – 36) T (10 – 12)

Nutritional Quality of foods and its assessments: Food proteins (Digestibility, Biological value, NPU, PER), Modifications of foods constituents due to processing and storage and their nutritional implications.

Unit-IV L (37 – 45) T (13 – 15)

Food standards and Specifications: Compulsory and voluntary trade and Company standards. Consumer, company, In-process and finished product specifications. Relevant Food laws : PFA, FPO, SWMA, MPO, AgMark, and BIS Standards.

Book References:

Author Title

J.M.DeMan Rheology and Texture in Food Quality

Y.Pomeranz Food Analysis : Theory and practice IS: 6273 (Part-1& Part-2)

M.A. Amerine Principles of Sensory Analysis of Food

ECH 702: PLANT DESIGN AND ECONOMICS

L : T: P

3 : 1: 0

Unit I

Process Development

Process selection, study of alternative processes, pilot plant, Scale up methods, Flow sheet preparation, sketching techniques, Equipment numbering, Stream designation, Material and energy balances.

Plant Design

Design basis ,Process selection -Selection of equipment, specification and design of equipment's, material of construction, Plant location, Plant layout and installation, Safety, Start up, Shutdown and Operating guidelines. [8]

Unit II

Cost Engineering

Time value of money and equivalence, Interest, cost comparisons by present worth, Annual equivalent cost and capitalised cost methods, Uniform gradient and series. Depreciation, Taxes and Insurances

Nature of depreciation, Methods of determining depreciation, depreciation rates in current Indian situation, Types of taxes and insurance's, Procedure for cost comparison after taxes. [8]

Unit III

Cost Estimation

Types of cost estimation, capital investment cost, fixed capital cost, working capital cost, start-up costs, process equipment cost estimation, cost index, Equipment costs due to inflation, Battery limit investments, estimation of plant cost, Estimation of total product cost, Manufacturing cost, General expenses.

Profitability

Criteria of profitability, Payout period, Return on investment, Present value, Cash flow analysis, Alternative investment analysis, Sensitive analysis in project profitability. [8]

Unit IV

Economic Optimization and Optimum Design

Nature of optimisation, Uni-variable and multivariable systems, Analytical, graphical and incremental methods of solution, LaGrange multiplier method, Linear programming and dynamic programming establishing optimum conditions, Break even chart for production

schedule, Optimum production rates in plant operation, Optimum conditions in batch, cyclic and semicyclic operation, Sensitivity and response analysis.

[8]

Unit V

Optimisation of Different Process Equipment

Viz., transportation systems, heat exchangers, evaporators, mass transfer equipments and reactors. Determination of height and diameter of different process equipments at conditions of optimum cost .Pinch Technology analysis.

Preparation of techno-economic feasibility report. [8]

Books Recommended

- 1.Peters M., Timmerhaus K. & Ronald W., Plant Design & Economics for Chemical Engineers, McGraw Hill
- 2.James R Couper, Process Engg. Economics (Chemical Industries) CRC Press
3. Aries & Newton, Chemical Engg. Cost Estimation, McGraw Hill

EFT-703 : TECHNOLOGY OF ANIMAL FOODS

L : T: P

3 : 1 : 0

Unit-I

Fluid Milk: Composition of milk and factor affecting it. Physico-chemical characteristics of milk and milk constituents. Production and collection , cooling and transportation of milk. Packaging storage and distribution of pasteurized milk.: Whole, Standardized, Toned, Double toned and skim milk. Test for milk quality and Adulteration. UHT processed milk, flavoured, Sterilized milk. Cleaning and sanitization of dairy equipments.

Unit-II

Definition, Classification, Composition and physico-chemical properties of cream. Production processes and quality control. Butter: Definition, Classification, Composition and methods of manufacture, Packaging and storage. Butter oil/Ghee. Ice cream: Definition, Classification and Composition, Constituents and their role.

Preparation of mixes and freezing of Ice cream, Overrun, Judging, Grading, and defects of Ice cream.

Unit-III

Evaporated and Condensed milk: Method of manufacture, Packaging and storage. Defects, Causes, and prevention. Roller and Spray Drying of milk solids. Instantization. Flow ability, Dustiness, Reconstituability, Dispersability, Wet ability, Sink ability and appearance of milk powders. Manufacture of casein, Whey protein, Lactose from milk or use in formulated foods.

Unit-IV

Ante-mortem examination of meat animals, Scientific slaughtering, Post mortem changes, Tendering and curing of meat, Beef Mutton, Pork Sausages and other meat products. Catch, Handling and transportation of fish. Fish spoilage, Processing, Preservation of fish, Shell fish and other sea foods.

Unit-V

Poultry processing, Canning of poultry products. Physical, Chemical Nutritional and Functional characteristics of Egg. Causes of deterioration of quality of egg, Preservation and Processing of Egg. Manufacturing of egg white, Egg yolk and Whole Egg solids/powder.

Book References:

Author Title

H.V.Athortone Chemistry and testing of dairy products

N.Warner Principles of dairy processing

Sukumar De Outlines of dairy technology

R.A.Lawrie Meat Science.

G.J.Mountney Poultry Products Technology

B.Srilakshmi Food Science

EFT-751: FOOD QUALITY EVALUATION LAB

L : T: P

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1. Sensitivity tests (Threshold/Dilution) to measure individual ability for sensory analysis.
- 2-3. Difference tests to evaluate qualitative and' quantitative differences and/or preference between test products.
- 4-5. Assessment of quality of wheat flour (Water Absorption Power, Gluten Content, Sedimentation Value etc.).
6. Evaluation of quality of Bakery Products: Bread, Biscuits, Cakes etc.
- 7-8. Evaluation of quality of Dairy Products: Over ran and fat content in IceCream, Specific gravity of Milks etc.
- 9-10. Assessment of quality of Fruit & Vegetable Products: Tomato Products, Jam, Jelly, Marmalades, Squashes& Cordials, Canned Products.
- 11-12.Assessment of Quality of Beverages: Tea & Coffee, Carbonated and RTS Beverages.

Book References:

Author Title

BIS Specifications

Morris B. Jacobs The Chemical Analysis of Foods & Food Products

S. Ranganna Hand Book of Analysis and Quality Control for Fruit & Vegetable Products

Official Method of Analysis of AOAC

EFT 752 : FOOD PRESERVATION AND PROCESSING LAB-II

L T P

0 0 3

1. Preparation of Bread/test baking.
2. Pre-treatment and milling of legume-pulses / dehulling of oil seeds.
3. Preparation of certain baked products – Buns, Cakes, Pizza etc.
4. Preparation of Biscuits and Cookies.
5. Extraction of crude oil from oilseeds.
6. Studies on policing of rice.

7. Pearling of millets.
8. Preparation of malt.
9. Preparation of noodles/pasta/vermicelli.
10. Preparation of protein isolates/concentrates

EFT-753: PROJECT

L : T: P
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The student (s) will be required to search literature pertaining to design of an equipment / processing of a food commodity / production of food product, comprehend it and prepare a report for assessment.

EFT-754 : INDUSTRIAL TRAINING

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The student(s) will be required to undertake training in the food industry after III B. Tech.VI semester for a specified period and submit its report after completion for evaluation and oral examination in the VII semester of his studies in Final B.Tech

EOE 081- EOE 084: OPEN ELECTIVE – II

L : T: P
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(DEPARTMENTAL ELECTIVE – I)

EFT-011 : SPECIALITY FOODS

L : T: P
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Unit-I

Infant and baby foods, Adolescent / Teen-age foods, Geriatric foods, Foods for pregnant ladies and nursing mothers. Functional foods and Probiotics.

Unit-II

Foods / Diets in metabolic disorders and disturbances.

Unit-III

Foods and Diets recommended and restricted in Gastrointestinal disorders; Fever and Infection; Liver, gallbladder and pancreatic disturbances.

Unit-IV

Foods and Diets recommended and restricted in blood, circulatory and Cardiac diseases; urinary and Musculoskeletal diseases. Allergies.

Unit-V

Beneficial Effects of Spices, gamma-linolenic acid, Spirulina, antioxidants and other food constituents. New Developments.

Book References:

Author Title

Benzamin T. Burton Human Nutrition

Shubhangini A. Joshi Nutrition and Dietetics
B. Srilakshmi Dietetics
Arnold E. Bender Nutrition and Dietetic foods
AFST(I) & CFTRI Proceedings of IFCON 98
Periodicals by AFST(I), CFTRI Indian Food Industry
P. S. Howe, W.B. Saunders Basic Nutrition in Health & Disease

EFT-012 : FOOD PROCESSING WASTE MANAGEMENT

L : T: P
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Unit-I

Basic considerations: Standards for emission or discharge of environmental pollutants from food processing Industries as per the updated provision of Environment (Protection) Act, 1986. Elements of importance in the efficient management of food processing wastes.

Unit-II

Characterization and utilization of by-products from Cereal Pulses, Oilseeds, Fruits and vegetables, Plantation products, Fermented foods, Milk, Fish, Meat, Egg and poultry processing industries.

Unit-III

Characterization of food Industry effluents, Physical and chemical parameters, Oxygen demands and their interrelationships, Residues (solids), Fats, Oils and grease, Forms of Nitrogen, Sulphur and Phosphorus, Anions and cations, Surfactants, Colour, Odour, Taste, Toxicity. Unit concept of treatment of food industry effluent, Screening, Sedimentation Flootation as pre - and primary reactants.

Unit-IV

Biological oxidations: Objects, Organisms, Reactions, Oxygen requirements, Aeration devices Systems: Lagoons, Activated sludge process, Oxidation ditches, Rotating biological contactors and their Variations and advanced modifications.

Unit-V

Advanced wastewater treatment systems. Physical separations, Micro-strainers, Filters, Ultra filtration and reverse osmosis. Physico-chemical separations: activated carbon adsorption, Ion-exchange electro-dialysis and magnetic separation. Chemical oxidations and treatment Coagulation and flocculation. Disinfection. Handling disposal of sludge.

Book References:

Author Title

J.H. Green Food Processing Waste Management Environment (Protection) Act
AFST(I) & CFTRI Proceedings of the Symposium on By-products From food Industries:
Utilization and Disposal

EFT-013: RHEOLOGICAL AND SENSORY ANALYSIS OF FOODS

L : T: P
3 : 1 : 0

Unit-I

Mechanical properties of foods. Mechanical models to visualise behaviour of foods. Basic and applied rheological considerations and their application to foods.

Unit-II

Food Microstructure and its study by light, Scanning and Transmission Electron microscopy. Implications of micro-structure in determining mechanical and sensory characteristics of foods.

Unit-III

Requirement of test systems for measuring food texture. Types of texture Instrument and their operating mechanisms, Calibration, Performance of test and measurements of test parameters. Interpretation of test results.

Unit-IV

Textural properties of fruits & vegetables; Dough, Pasta and Baked products; dairy products; Meat; Fat and fat products; and their instrumental Measurements.

Unit-V

Rheology of chocolate, Textural characteristics of food emulsions, Functions of emulsifiers in relation to food texture, Sensory measurement of food texture and texture profile.

Book References:

Author Title

J.M. de Man Rheology and Texture in Food quality

(DEPARTMENTAL ELECTIVE –I I)

EFT-021: FOOD PRODUCT AND PROCESS DEVELOPMENT

**L : T: P
3 : 1 : 0**

Unit-I

Innovation and product development concept. Generation of ideas. Desk Research. Screening/ appraisal of initial ideas.

Unit-II

Detailed study of product, process and market, Planning and developmental activities and evaluating them.

Unit-III

Development of prototype product and its testing for acceptance.

Unit-IV

Development of process and planning for production trials. Planning the test market. Actual production trials and test marketing. Evaluation of test results.

Unit-V

Launching of the product. Advertising and marketing plans. Suggestions for improving success.

Book References:

Author Title

Chicago: Arlington Food Product Development

EFT- 022 : FOOD PACKAGING**L : T: P**
3 : 1 : 0**Unit-I**

Basic Concepts: Concept of packaging, Functions of a Food Package, Package development factors and Food package development. Aseptic Packaging. Newer trends.

Unit-II

Cellulosic and Polymeric packaging materials and forms: Food grade polymeric packaging materials, Rigid plastic packages. Films: Oriented, Co-extruded, Laminates and Metallised; Cellophane, Olefins, Polyamides, Polyesters, PVC, PVDC, PVA, Inomers, Copolymers, Polycarbonates, Phenoxy, Acrylic and Polyurethane. Their mechanical sealing and barrier properties.

Unit-III

Glass and Metal containers: Glass: Composition, Properties, Bottle making and Closures for glass containers. Metal: Bulk containers, Tin-plate containers, Tin free steel containers, Aluminium containers, Latest development in metal cans and protective lacquers.

Unit-IV

Food product characteristics and package requirement, Selection of materials, Forms, Machinery and methods for fresh produce (Fruits, Vegetables, Egg, Meat and Fish), Edible oils and Fats, Spice and spice products, Processed products (Fruit & Vegetable, Cereal & Pulse, Dairy, Confectionary & Snacks, Meat & Marine products).

Unit-V

Package printing, Packaging Laws and Regulations, Evaluation of food packaging materials and package performance.

Book References:**Author Title**

M. Mahadeviah and R.V. Gowramma Food Packaging Materials

S. Saclarow and R.C. Griffin Principles of Food Packaging

Trends in Food Science & Technology Proceedings of IFCON-1988

EFT 023 : ENGINEERED, TEXTURISED & FABRICATED FOODS**L T P**
3 1 0**Unit I**

Extruders. Single Screw & Multiple Screw Extruders. Extrusion process. Extrusion cooking. Physical & Chemical Changes during Extrusion Process.

Unit II

Textured vegetable protein products. Puffing Gun ,Puffed Products. Meat Analogues., Imitation Paneer

Unit III

Fabricated RTS Beverages, Bakery Products, Margarine, Peanut Butter, Imitation Milks Designer Lipids etc.

Unit IV

Weaning Foods/ Baby Foods. Therapeutic Foods . Geriatric Foods.

Unit V

Technology and manufacture of Macaroni, Pasta, Noodles, Vermicilli etc.

EFT- 801 :TRADITIONAL AND FERMENTED FOODS

L : T: P

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Unit-I

Indian traditional sweet, savory and snack food products: Sweetmeats, Namkins, Papads Idli and Dosa.

Unit-II

Preparation and Maintenance of Bacterial, Yeast and Mold cultures for food fermentations. Lactic acid bacteria-activities and health-promoting effects. Mushrooms: Cultivation and preservation.

Unit-III

Fermented Dairy Products: Cheeses, Curd and Yoghurt, Butter milk and the fermented milks. Spoilages and defects of fermented dairy products and their control. Fermented meat and fish products.

Unit-IV

Fermentative Production of Beer, Wines, Cider and Vinegar. Fermented Vegetables (Pickles).

Unit-V

Production of Baker's Yeast, Microbial Proteins and fats, Food enzymes, and Food additives. Oriental fermented foods.

Book References:

Author Title

K.H. Steinkrus Handbook of Indigenous Fermented Foods

Sukumar De Outlines of Dairy Technology

Prescott & Dunn Industrial Microbiology

L.E. Casida Industrial Microbiology

W.C. Frazier and D.C. Westhoff Food Microbiology

EFT-851 PROJECT

L : T: P

0: 0:12

The student (s) will be required to prepare a detailed project report on fabrication of an equipment / establishment of a plant for processing of a food commodity for production of food product(s) with complete lay-out and economic analysis for assessment.