UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY : : CHENNAI 600 025

R – 2008

B.TECH. FOOD TECHNOLOGY

III - VIII SEMESTERS CURRICULUM AND SYLLABI

SEMESTER III

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
MA 9211	Mathematics III	3	1	0	4
IB 9201	Principles of chemical Engineering	3	0	0	3
IB 9203	Bioorganic Chemistry	3	0	0	3
IB 9204	Cell Biology	3	0	0	3
IB 9205	Microbiology	3	0	0	3
CY 9261	Physical Chemistry	3	0	0	3
FT 9201	Food Chemistry	3	0	0	3
PRACTICALS					
IB 9208	Microbiology Lab	0	0	4	2
PH 9207	Physical & Organic Chemistry Lab	0	0	4	2
	TOTAL	**21**	**1**	**8**	**26**

SEMESTER IV

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
MA 9261	Probability And Statistics	3	1	0	4
IB 9213	Instrumental Methods of Analysis	3	0	0	3
CH 9034	Fundamentals of Heat and Mass Transfer	3	0	0	3
FT 9251	Food Microbiology	3	0	0	3
CH 9023	Biochemical Engineering	3	0	0	3
GE 9261	Environmental Science and Engineering	3	0	0	3
IB 9254	Genetics	3	0	0	3
PRACTICALS					
CY 9214	Instrumental Methods of Analysis lab	0	0	4	2
IB 9256	Chemical Engineering Lab	0	0	4	2
	TOTAL	**21**	**1**	**8**	**26**

SEMESTER V

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
IB 9305	Molecular Biology	3	0	0	3
FT 9301	Biochemical Engineering – II	3	0	0	3
FT 9302	Food Analysis	3	0	0	3
FT 9303	Food Additives	3	0	0	3
GE 9023	Fundamental of Nano science	3	0	0	3
	Electives I	3	0	0	3
PRACTICALS					
IB 9307	Molecular Biology Lab	0	0	4	2
FT 9304	Food Analysis Lab	0	0	4	2
FT 9305	Food Production Analysis Lab	0	0	4	2
FT 9306	Technical Seminar	0	0	2	1
	TOTAL	**18**	**0**	**14**	**25**

SEMESTER VI

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
IB 9351	Chemical Reaction Engineering	3	0	0	3
IB 9353	Genetic Engineering	3	0	0	3
FT 9351	Separation Process	3	0	0	3
FT 9352	Food Processing and Preservation	3	0	0	3
GE 9022	Total Quality Management	3	0	0	3
	Electives II	3	0	0	3
PRACTICALS					
GE 9371	Communication Skills and soft skills Lab	0	0	2	1
FT 9402	Bio Process Lab	0	0	6	3
IB 9355	Genetic Engineering Lab	0	0	4	2
	TOTAL	**18**	**0**	**12**	**24**

SEMESTER VII

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
IB 9403	Immunology	3	0	0	3
FT 9401	Food Safety, Quality and Regulatory Issues	3	0	0	3
FT 9403	Food Process Engineering I	3	0	0	3
FT 9404	Food Process Engineering II	3	0	0	3
FT 9407	Cereal Pulse and Oil seed Technology	3	0	0	3
GE 9021	Professional Ethics in Engineering	3	0	0	3
	Elective III	3	0	0	3
PRACTICALS					
FT 9405	Skills for Food Product Design & Development	0	0	4	2
FT 9406	Food Microbiology, Processing & Preservation Lab	0	0	6	3
	TOTAL	**21**	**0**	**10**	**26**

SEMESTER VIII

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
FT 9451	Project Work	0	0	12	6
	TOTAL	**0**	**0**	**12**	**6**

Total Credits : 186

LIST OF ELECTIVES FOR B.TECH. FOOD TECHNOLOGY PROGRAMME

ELECTIVE I

CODE NO	COURSE TITLE	L	T	P	C
FT 9022	Refrigeration and Cold Chain	3	0	0	3
FT 9023	Biology and Chemistry of Food Flavours	3	0	0	3
FT 9024	Biologically Active Phytochemicals in Food	3	0	0	3
FT 9025	Human Nutrition	3	0	0	3

ELECTIVE II

CODE NO	COURSE TITLE	L	T	P	C
IB 9309	Process Economics and Industrial Management	3	0	0	3
MA 9262	Numerical Methods	3	1	0	4
FT 9026	Technical Writing & Communication	3	0	0	3
IB 9024	Metabolic Engineering	3	0	0	3
FT 9027	Dairy Product Processing	3	0	0	3

ELECTIVE III

CODE NO	COURSE TITLE	L	T	P	C
IB 9402	Protein Engineering	3	0	0	3
FT 9028	Entrepreneurship	3	0	0	3
FT 9029	Operation Research	3	0	0	3
IB 9401	Down Stream Processing	3	0	0	3
FT 9030	Genetically Modified Foods	3	0	0	3
GE 9071	Creativity, Innovation & New Product Development	3	0	0	3

MA9211 **MATHEMATICS III** **L T P C**

(Common to all branches of B.E / B.Tech programmes) **3 1 0 4**

AIM

To facilitate the understanding of the principles and to cultivate the art of formulating physical problems in the language of mathematics.

OBJECTIVES

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic
- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes
- To develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems

UNIT I FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT II FOURIER TRANSFORM 9+3

Fourier integral theorem – Fourier transform pair-Sine and Cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Singular solutions – Lagrange's Linear equation – Integral surface passing through a given curve – Solution of linear equations of higher order with constant coefficients.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Method of separation of Variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS 9+3

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and Final value theorems – Formation of difference equation – Solution of difference equation using Z-transform.

L: 45, T: 15, TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal, B.S. "Higher Engineering Mathematics". 40th Edition. Khanna Publications, 2007.

REFERENCES

1. Glyn, James, "Advanced Modern Engineering Mathematics". Pearson Education,2007.
2. Ramana, B.V. "Higher Engineering Mathematics" Tata McGraw Hill 2007.
3. Bali, N.P. and Manish Goyal, "A Text Book of Engineering" 7th Edition. Lakshmi Publications, 2007.

IB9201 PRINCIPLES OF CHEMICAL ENGINEERING L T P C
(Common for IBT, Food and Pharmaceutical Technology) **3 0 0 3**

AIM

To understand the principles of Process calculations.
To understand principles of fluid mechanics and its application.

OBJECTIVES

- To perform calculations pertaining to processes and operations.
- To apply fluid mechanics principles to applied problems.

UNIT I BASIC PRINCIPLES OF STOICHIOMETRY 8

Importance of material balance and energy balance in a process Industry-Dimensions, Units, conversion factors and their use –Data sources, Humidity and applications.

UNIT II MATERIAL BALANCES 10

Material balance calculations for non reactive operations, once through operations, recycle operations, bypass operations. Material balance calculations for reactive processes, recycle, bypass processes – Application problems in unit operations and processes.

UNIT III ENERGY BALANCES 8

Calculation of enthalpy changes, heat capacity, Latent heats, Data sources, Thermo chemical calculations. Heat of solution, Simultaneous material and energy balances.

UNIT IV FLUID MECHANICS 9

Fluid – properties – compressible, incompressible fluids, Newtonian and Non Newtonian Fluids, Fluid statics for compressible & incompressible fluids-Static pressure-application to pressure measurement, gravity settling, Fluid Flow phenomena – through pipes and other devices – pressure drop calculations. Pressure measuring devices.

UNIT V AGITATION FLOW THROUGH PACKINGS, FLUIDZATION, FLUID TRANSPORT 9

Agitation – power requirement, Flow in packed columns, flow in fluidization columns, settling phenomena, Flow measurement, pumping of liquids and gases – equipments.

TOTAL: 45 PERIODS

TEXT BOOKS

1. McCabe, W.L., J.C. Smith and P.Harriot “Unit Operations of Chemical Engineering”, 6th Edition, Mc Graw Hill, 2001.
2. Bhatt, B.I. and S.M. Vora “Stoichiometry (SI Units)”, 3rd Edition, Tata McGraw- Hill, 1996.

REFERENCES

1. Himmelblau, D.M. “Basic Principles and Calculations in Chemical Engineering”, 6thEdition, PHI, 2006.
2. Geankoplis, C.J. “Transport Processes and Separation Process Principles”, 4th Edition, PHI, 2006.
3. Foust, A.S. etal., “ Principles of Unit Operations”, 2nd Edition, John Wiley & Sons, 1999.
4. Narayanan, K.V. and Lakshmi Kutty “Stoichiometry and Process Calculations”, PHI, 2006.
5. Coulson, J.M. and etal. “Coulson & Richardson’s Chemical Engineering”, 6th Edition, Vol. I & II, Butterworth – Heinman / Elsevier, 2004.

IB9203 BIO-ORGANIC CHEMISTRY L T P C
(Common for IBT, Food and Pharmaceutical Technology) **3 0 0 3**

UNIT I INTRODUCTION TO CHEMISTRY 13
Chirality, Enantiomers, Diastereomers, Enantiotopic Faces, Absolute configuration RS normetclature, Bijvotes method of determining absolute configuration. Con-formers : Ethane, butane, cyclohexane – Reactivity due to change in conformers Reactions : SN1, SN2, E1, E2, Addition of electrophile on a double bond, Hy-dride transfer mechanisms Cannizaro's reaction. Reactivity : Kinetics of Reactions, First order and kinetics of enzyme Determination of $\Delta G^{\ddagger}$, $\Delta H^{\ddagger}$, $\Delta S^{\ddagger}$. Thermodynamics: Boltzmans equation, Gibbs – Helmoltz equation. Acid – Base catalysis – Structure of water.

UNIT II INTRODUCTION TO ORGANIC SYNTHESIS 10
Useful Organic Transformations Reterosynthetic Analysis.
Case Studies : Synthesis of Cholesterol, Synthesis of Chlorophyll.

UNIT III ENZYMES 5
MM kinetics – other mechanisms for enzyme action – Methods for following enzyme reactions – Analysis of Enzymatic reactions.

UNIT IV MECHANISMS 13
Case Studies : Lipase, Carboxypeptidases, Monooxygenases – Esterases Case Study: Engineering an Enzyme – Subtilisn.Case Study: Allostery ATpase Mechanisms of enzymes in a Pathway : Case Study : Serratia marcasens & Prodigiosin.Domain Movements in Enzymes MD simulations Case Study : Lipase.

UNIT V BIOLOGICAL SUPERMOLECULES 4
Supramolecular Systems – Ion Channels – photosynthesis – artificial enzymes – catalytical antibodies – ribozymes..

TOTAL: 45 PERIODS

TEXT BOOKS

1. Page, M.I., and A. Williams, "Organic and Bioorganic Mechanisms," Pearson India Edition, 1997
2. Ariya, K. and T. Kumtake, " Supramolecular Chemistry : Fundamentals and Applications ", Springer India Edition, 2006.
3. Morrison, R.T. and T.N. Boyd "Organic Chemistry", 6th Edition, Prentice Hall of India, 2003.
4. Palmer, Trevor "Enzymes: Biochemistry, Biotechnology, Clinical Chemistry", Affiliated East-West Press Pvt. Ltd., 2004.

REFERENCE

1. Fersht, Alan "Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding", W.H. Freeman, 1998.

IB9204 CELL BIOLOGY L T P C
3 0 0 3

AIM
To introduce students to the principles of cell biology to emphasize the role of organelles and their functions; signal transduction and crosstalk between the cells – towards biotechnological applications.

OBJECTIVE
- To provide to the students the fundamentals of cell biology and ability to solve problems in cell biology.
- To help students understand the pathway mechanisms.

UNIT I CELL STRUCTURE AND FUNCTION OF THE ORGANELLES 9

Eukaryotic, Prokaryotic cells, Subcellular Organelles and Functions Principles of membrane organization membrane proteins, cytoskeletal proteins eg. RBC cytoskeletal contractile proteins Actin, myosin, Actin Polymerization Act- myosin complex, mechanism of myosin-ATpase activity, contraction; microtubules, microfilaments activity in Organelle movement.

UNIT II CELL DIVISION AND CONNECTION 9

Cell cycle – Mitosis, Meiosis, Molecules controlling cell cycle, Extra cellular matrix, role of matrix in cell enthore : Gap junctions, Tight junctions, Desmosomes, Hemidesmosomes.

UNIT III TRANSPORT ACROSS CELL MEMBRANE 9

Passive and Active Transport, Permeases, Ion channels, ATP pumps. Na^{+} / K^{+} / Ca^{+2T} pumps uniport, symport antiporter system. Ligand gated / voltage gated channels, Agonists and Antagonists.

UNIT IV SIGNAL TRANSDUCTION 9

Receptors – extracellular signaling, Cell surface / cytosolic receptors and examples, Different classes of receptors antocrine / paracrine / endocrine models, Secondary messengers molecules.

UNIT V SIGNAL AMPLIFICATION AND CROSSTALK 9

Signal amplification and crosstalk caspases and cell death, Role of Ras and Raf in oncogenesis, introduction to gene therapy.

TOTAL: 45 PERIODS

REFERENCES

1. Lodish, Harvey etal., " Molecular Cell Biology," 6th Edition. W.H.Freeman, 2008.
2. Alberts, Bruce, "Molecular Biology of Cell", 5th Edition, Garland Science, 2008.
3. Cooper,G.M. "The Cell: A Molecular Approach, 4th Edition, ASM Press, 2007.
4. Alberts, Bruce etal., "Essentail Cell Biology", 2nd Edition, Garland Science, 2004

IB9205 MICROBIOLOGY L T P C

3 0 0 3

AIM

To introduce students to the principles of Microbiology to emphasize structure and biochemical aspects of various microbes.

OBJECTIVE

- To provide to the students the fundamentals of Microbiology and solve the problems in microbial infection and their control.

UNIT I INTRODUCTION 6

Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

UNIT II MICROBES- STRUCTURE AND MULTIPLICATION 12

Structural organization and multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages.

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM 12

Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methods to quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

UNIT IV CONTROL OF MICROORGANISMS 6

Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms.

UNIT V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY 9

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vitamin B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control; biosensors

TOTAL: 45 PERIODS

TEXT BOOKS

1. Pelczar M.J., E.C.S. Chan and N.R. Krieg. "Microbiology". 5th Edition, Tata McGraw Hill,1993
2. Prescott, L.M., J.P. Harley, and D.A. Klein. " Microbiology," 7th Edition, Mc Graw-Hill, 2008
3. Casida, L.E. "Industrial Microbiology". New Age International, 1968.
4. Reed, Gerald "Prescott & Dunn's Industrial Microbiology" 4th Edition, CBS, 1987.

REFERENCES

1. Schlegel, Hans G. " General Microbiology", Cambridge University Press, 1993.
2. Stanier, Roger Y etal., "General Microbiology" 5th Edition, Macmillan, 1986.
3. Talaro, Kathleen and Arthur Talaro. "Foundations in Microbiology" 2nd Edition, Wm.C. Brown Publishers, 1996.

CY9261 PHYSICAL CHEMISTRY L T P C
3 0 0 3

AIM

To understand important concepts in physical chemistry.

OBJECTIVE

- To understand the different states of matter, theoretical principles governing the solid, liquid , mesomorphic and solid states and to know methods for experimental determination of characteristic properties of the states.
- To understand the principles of thermodynamics in deciding the spontaneity of reactions and energy changes involved in physical and chemical processes.
- To understand the principles of photochemistry and catalysis.

UNIT I PROPERTIES OF MATTER. GASEOUS AND LIQUID STATES 12

Gaseous state Ideal gas – Gas laws –kinetic theory – Marwell's distribution of molecular velocities – collision frequency -mean free path – real gas- van der Waal's equation of state – critical constants – law of corresponding states – liquefaction of gases (CO_2, NH_3, air, O_2 and N_2) Joule – Thomson effect - inversion temperature. Liquid state Equilibrium vapour pressure – surface tension - viscosity-dipole moment – refractive index - optical rotation - methods of determination - relationship to molecular structure

UNIT II PROPERTIES OF MATTER MESOMORPHIC AND SOLID STATES 9

Mesomorphic state or liquid crystals Themotropic and lyotropic mesomorphism - classification of thermotropic liquid crystals – smectic- nematic – cholesteric - disc shaped - polymer -- molecular arrangements in liquid crystals. Solid state crystal structure - laws of crystallography -7 crystal systems-14 Bravais lattices - X-rays and crystal structure - Bragg's equation - types of crystals – molecular – covalent –ionic – metallic – lattice energy - Born-Lande's equation - experimental determination using Born-Haber cycle - packing in metallic crystals - lattice-defects.

UNIT III THERMODYNAMICS I LAW AND THERMOCHEMISTRY 8

System – surroundings – properties – macroscopic –intensive – extensive processes – isothermal – adiabatic – reversible – irreversible - thermodynamic equilibrium - Zeroth law of thermodynamics – building thermometer - celsius scale - perfect gas/ absolute temperature scale. Internal energy - work done – isothermal , reversible and irreversible expansions – compressions - enthalpy - heat capacity at constant volume

C_v – at constant pressure C_p - relationship between C_p and C_v - work done In adiabatic, reversible and irreversible expansions - compressions. thermochemistry - enthalpy changes – physical and chemical processes - Kirchoffs' equation - Hess' law of constant heat summation - enthalpy of combustion - Bomb calorimeter - bond energies – applications

UNIT IV THERMODYNAMICS II AND III LAW 8

Spontaneous process- cyclic process – Carnot cycle - efficiency of a heat engine – entropy – concept - physical significance-changes accompanying processes – Free energy – Helmholtz – Gibbs - criteria for reversible and irreversible processes – Gibbs-Hermholtz equation-free energy and physical equilibria-Clapeyron and Clausius equation - free energy and chemical equilibria - vant Hoff reaction isotherm - standard free energy changes - Third law - Nernst heat theorem - determination of entropy from thermal measurements - residual entropy

UNIT V PHOTOCHEMISTRY AND CATALYSIS 8

Absorption of light - consequences – laws of photochemistry -quantum yield - photochemical processes – primary – secondary - kinetics of photochemical reactions - hydrogen and chlorine -hydrogen and bromine – photosensitization – quenching - lasers. Catalysis – catalyst – promoter – inhibitor - poisoning of catalyst -homogeneous catalysis - acid-base - metal salts - heterogeneous-adsorption – physisorption – chemisorption - surface area - industrially important processes – oxidation – cracking - reforming

TOTAL: 45 PERIODS

TEXT BOOKS

1. Puri, B.R., L.R.Sharma and M.S.Pathania "Principles of Physical Chemistry:".41st Edition. Vishal Publishing, 2006.
2. Atkins, Peter "Physical Chemistry" 9th Edition, Oxford University Press, 2009

REFERENCES

1. Bhal, B.S.,G.D. Tuli and Arun Bhal "Essentials of Physical Chemistry". S.Chand & Co., 2010
2. Glasstone, Samuel "Thermodynamics for Chemists". Narahari Press, 2008

FT9201 FOOD CHEMISTRY L T P C
3 0 0 3

AIM

The course aims to develop the knowledge of students in the basic area of Food Chemistry. This is necessary for effective understanding of food processing and technology subjects. This course will enable students to appreciate the similarities and complexities of the chemical components in foods.

OBJECTIVES

On completion of the course the students are expected to

- Be able to understand and identify the various food groups; the nutrient components (macro and micro), proximate composition.
- Be able to understand and identify the non-nutritive components in food, naturally present.
- Understand and use effectively, food composition tables and databases.
- Grasp the functional role of food components and their interaction in food products in terms of colour, flavour, texture and nutrient composition

UNIT I CARBOHYDRATES 9

Simple Sugars: mono and disaccharides, Hygroscopcity & solubility, optical rotation, mutarotation; sensory properties-sweetness index, caramelization, Maillard reaction; Glucose syrup, high fructose corn syrup, Dextrose Equivalent, Degree of polmerisation; Sugar alcohols; Oligosaccharides: structure, nomenclature, occurrence, uses in foods. Polysaccharides: Starch- amylose and amylopectin- properties, thickening & gelatinization, modified starches, resistant starch, Dextrins and dextrans, Starch hydrolsates – Malto dextrins and dextrins; Pectins, gums & seaweeds- gel formation & viscosity. Fiber- Cellulose & hemicellulose; Food sources, functional role and uses in foods.

UNIT II PROTEINS 9

Review of protein structure & conformation; Properties & reactions of proteins in food systems: Dissociation, optical activity, solubility, hydration, swelling, foam formation & stabilization, gel formation, emulsifying effect, thickening & binding, amino acids in Maillard reaction, denaturation; Food enzymes ; Texturized proteins; Food sources, functional role and uses in foods.

UNIT III LIPIDS 9

Review of structure, composition & nomenclature of fats. Non-glyceride components in fats & oils; Properties of fats & oils: crystal formation, polymorphism, melting points, plasticity, isomerisation, unsaturation; Modification of fats: hydrogenation- cis and trans isomers, interesterification, acetylation, winterization; Hydrolytic rancidity & oxidative rancidity; radiolysis Shortening power of fats, tenderization, emulsification, frying- smoke point, auto oxidation, polymerization; Fat replacements; Food sources, functional role and uses in foods

UNIT IV WATER

A. WATER **2**

Chemistry, physical properties, free bound & entrapped water, water activity. Drinking water, mineral water, water hardness, water quality for food processing

B. MINERALS & VITAMINS **1**

Mineral & vitamin content of foods- Food and Pharmaceutical grades; stability & degradation in foods.

C. COLOUR, FLAVOUR & AROMA COMPONENTS **6**

Naturally occurring colours, acids, other flavour & aroma components present in herbs, spices, coffee, tea, cocoa, fruits, vegetables & fermented products; Synthetic Colours and Natuarally similar /artificial flavours, Threshold values, off flavours & food taints.

D. OTHER COMPONENTS **4**

Naturally occurring toxic substances, protease inhibitors, bioactive components: phytates, polyphenols, saponins, phytoestrogens etc.

UNIT V FOOD GROUPS & COMPOSITION 5

Food groups, proximate composition, food composition tables- uses, food composition data bases.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Chopra, H.K. and P.S. Panesar. " Food Chemistry". Narosa, 2010.
2. Meyer, Lillian Hoagland. " Food Chemistry". CBS Publishers, 1987.
3. Deman, John M. "Principles of Food Chemistry". 3rd Edition. Springer, 1999.
4. Vaclavik, V. A. and Christian E. W. "Essentials of Food Science". 2nd Edition, Kluwer-Academic, Springer, 2003.

REFERENCES

1. Gopalan C., B.V. Rama Sastri, and S.C. Balasubramanian S. C. "Nutritive Value of Indian Foods". NIN, ICMR, 2004.
2. Damodaran, S., K.L. Parkin and O.R. Fennema. "Fennema's Food Chemistry". 4th Edition, CRC Press, 2008
3. Belitz,H.-D, Grosch W and Schieberle P. "Food Chemistry", 3rd Rev. Edition, Springer-Verlag, 2004.
4. Walstra, P. " Physical Chemistry of Foods". Marcel Dekker Inc. 2003.
5. Owusu-Apenten, Richard. "Introduction to Food Chemistry". CRC Press, 2005.

IB9208 **MICROBIOLOGY LAB** **L T P C**

(Common for IBT, Food and Pharmaceutical Technology) **0 0 4 2**

EXPERIMENTS

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques;
2. Culture Media-Types and Use; Preparation of Nutrient broth and agar
3. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs
4. Microscopy – Working and care of Microscope
5. Microscopic Methods in the Study of Microorganisms; Staining Techniques- Simple, Differential- Gram's Staining
6. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC
7. Effect of Disinfectants- Phenol Coefficient
8. Antibiotic Sensitivity Assay
9. Growth Curve in Bacteria and Yeast
10. Effect of pH, Temperature, UV radiation on Growth Bacteria

TOTAL: 60 PERIODS

Equipment Needed for 20 Students

Autocalve	1
Hot Air Oven	1
Incubators	2
Light Microscopes	4
Incubator Shaker	1
Colorimeter	2
Lamina Flow Chamber	2
Glassware, Chemicals, Media	as required

TEXT BOOKS

1. Cappuccino, J.G. and N. Sherman "Microbiology : A Laboratory Manual", 4th Edition, Addison-Wesley, 1999.
2. Collee, J.G. etal., "Mackie & McCartney Practical Medical Microbiology" 4th Edition,Churchill Livingstone, 1996.

PH9207 **PHYSICAL & ORGANIC CHEMISTRY LAB** **L T P C**

0 0 4 2

1 Determination of Heat of ionisation / Neutralisation of acids.
2 Determination of rate constants and activation energy of simple first and second order reactions.
3 General acid catalysed reactions – Catalytic coefficients and Dissociation Constants.
4 Determination of molecular weight of substances.
5 Experiments based on the principles of Electrochemistry. Applications of Thermodynamic principles and Surface Chemistry.
6 Systematic qualitative analysis of organic compounds by solubility , elemental analysis, group detection, physical constant and derivatization
7 Estimation of selected organic compounds such as aniline / phenol, formaldehyde/acetone, glucose, glycerol.
8 Neutral equivalence of acids and bases and estimations of the following functions groups-amide, ester, acid, amino nitro.
9 Separation and purification of binary mixtures of the type: water soluble water insoluble – water insoluble, liquid-solid and liquid-liquid.
10 Preparation of simple organic compounds involving importance unit operations.

TOTAL: 60 PERIODS

REFERENCES

1. Shoemaker, D.P., C.W. Garland and J.W. Nibler "Experiments in Physical Chemistry", 5th Edition, McGraw-Hill, 1989.
2. Furniss, B.S. etal., "Vogel's Textbook of Practical Organic Chemistry", 5th Edition, [EIBS] Addison Wesley Longman Ltd., 1989.
3. Leonard, J., B. Lygo and G. Procter "Advanced Practical Organic Chemistry", 2nd Edition, Stanley Thomes Pvt. Ltd., 1998.

MA9261 PROBABILITY AND STATISTICS L T P C
3 1 0 4

AIM

This course aims at providing the required skill to apply the statistical tools in engineering problems.

OBJECTIVES

- The students will have a fundamental knowledge of the concepts of probability.
- Have knowledge of standard distributions which can describe real life phenomenon.
- Have the notion of sampling distributions and statistical techniques used in management problems.

UNIT I RANDOM VARIABLES 9 + 3

Discrete and Continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions - Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 9 + 3

Joint distributions – Marginal and Conditional distributions – Covariance – correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS 9 + 3

Sampling distributions - Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – χ^2-test for goodness of fit – Independence of attributes – Non-parametric tests: Test for Randomness and Rank-sum test (Wilcoxon test).

UNIT IV DESIGN OF EXPERIMENTS 9 + 3

Completely randomized design – Randomized block design – Latin square design - 2^2 - factorial design.

UNIT V STATISTICAL QUALITY CONTROL 9 + 3

Control charts for measurements (=and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

L: 45, T: 15, TOTAL : 60 PERIODS

TEXT BOOKS

1. Milton, J. S. and Arnold, J.C., "Introduction to Probability and Statistics", Tata 4th Edition, McGraw Hill, 2007.
2. Johnson, R.A. and Gupta, C.B., "Miller and Freund's Probability and Statistics for Engineers", 7th Edition, Pearson Education, Asia, 2007.

REFERENCES

1. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", 7th Edition Thomson Brooks/Cole, 2008.
2. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K., "Probability and Statistics for Engineers and Scientists", 8th Edition. Pearson Education, Asia, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists," 3rd Edition, Elsevier, 2004.
4. Spiegel, M.R., Schiller, J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw- Hill, 2004.

IB9213 INSTRUMENTAL METHODS OF ANALYSIS L T P C
3 0 0 3

AIM To introduce students to the principles and methods of biological instruments.

OBJECTIVE

- To provide to the students the fundamentals of instrument knowledge and their applications in biology.

UNIT I OPTICAL SPECTROSCOPY 10

Design of Experiments – Error Analysis – S/N ratio – Limit of Detection – UV –VIS Spectroscopy, Applications, Instruments – single beam, double beam and Photo-diode array – applications – IR & Raman – Uses – Design – FT-IR, Raman.

UNIT II CHROMATOGRAPHY 10

Distribution coefficients – solid-liquid, liquid-liquid and gas chromatography – theory of chromatography-normal phase & reverse phase chromatography – gel permeation – ion exchange & affinity chromatography – HPLC- Instrumentation & case studies.

UNIT III STRUCTURAL ELUCIDATION 10

Nuclear Magnetic Resonance – Introduction-spin states – 1H, 13C NMR – Instrumentation-use in structural elucidation. Electron Paramagnetic Resonance-concept & instrumentation – use in metal containing proteins & membrane studies. X-Ray : X-ray spectroscopy –Auger – EELS Instrumentation & applications in Biology- X-ray diffraction- Instrumentation –small molecule & macromalecular crystallography.

UNIT IV MASS SPECTROMETRY 10

Introduction – Instrumentation – CI, EI-Methods of Ionization- Methods for separation of Ions – Method for Detection. MALDI - TOF, ESI and FT-MS.

UNIT V ELECTROCHEMICAL MEASUREMENTS 10

Different types of electrochemical apparatus – Measuring Electrode potentials- Red-Ox proteins – Porous Silicon.

TOTAL : 45 PERIODS

TEXTBOOKS

1. Skoog, D.A., f.J. Holler and S.R. Crouch “Principles of Instrumental f Analysis”.6th Edition, Thomson/Brooks/Cole, 2002.
2. Willard, H.H. etal., “Instrumental Methods of Analysis”.7th Edition. CBS Publishers, 1986.
3. Braun, Robert D. “Introduction to Instrumental Analysis” Pharma Book Syndicate, 1987.
4. Ewing, G.W. “Instrumental Methods of Chemical Analysis” 5th Edition, Tata McGraw-Hill, 1985

CH 9034 FUNDAMENTALS OF HEAT AND MASS TRANSFER L T P C
(Common for Food and Pharmaceutical Technology) **3 0 0 3**

AIM

To understand the principles and applications of heat and mass transfer operations.

OBJECTIVES

- To understand and apply the principles in heat transfer phenomena
- To understand and apply the principles in mass transfer phenomena
- To design heat and mass transfer equipments.

UNIT I HEAT TRANSFER 11

Phenomena of heat transfer by conduction-concept of heat conduction resistances – application of heat conduction in series – heat transfer coefficient –heat convection phenomena- application for different situations –combined conduction and convection-overall heat transfer coefficient –application to design of heat exchangers- Principles of radiation heat transfer – Laws in radiation- View factor concepts – application.

UNIT II DIFFUSION & MASS TRANSFER COEFFICIENTS 8

Diffusion in Mass Transfer –gas, liq, solid diffusion and mass transfer-Diffusion in biological solutions-measurement of diffusion Coefficients – concept of mass transfer Coefficients-application for different situations.

UNIT III ABSORPTION 9

Interphase mass transfer and overall mass transfer Coefficients – Absorption equipments-Hydraulics of Packed Absorbers-Process Design of Packed Absorbers-Concept of height of transfer units and number of transfer units in design.

UNIT IV DISTILLATION 9

Vapour Liquid equilibrium and distillation-simple Distillation, Steam distillation, Flash distillation-Staged distillation Column-Design by Mc Cabe-Thiele method-Enthalpy-Concentration diagrams and use in Distillation Column design.

UNIT V LIQUID EXTRACTION & LEACHING 8

Principles of liq-extraction-Equilibrium –staged extraction calculation – continuous extraction equipments. Principles of Leaching –equilibrium-staged leaching – Leaching equipments. Principles of adsorption -Design of packed adsorber.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Treybal, R.E. “Mass-Transfer Operations” 3rd Edition, McGraw-Hill, 1981.
2. Dutta, Binay, K. “Principles of Mass Transfer and Separation Process”, PHI, 2007.
3. Nag, P.M. “Heat and Mass Transfer”, 2nd Edition, Tata McGraw-Hill, 2007.
4. Geankoplis, C.J. “Transport Processes and Separation Process Principles (Includes unit Operations) 4th Edition, PHI, 2003.

REFERENCES

1. Coulson, J.M. and etal. “Coulson & Richardson’s Chemical Engineering”, 6th Edition, Vol. I & II, Butterworth – Heinman (an imprint of Elsevier), 2004
2. McCabe, W.L., J.C. Smith and P.Harriot “Unit Operations of Chemical Engineering”, 6th Edition, Mc Graw Hill, 2003.

FT9251 FOOD MICROBIOLOGY L T P C
3 0 0 3

AIM

The course aims to develop the knowledge of students in the basic area of Food Microbiology. This is necessary for effective understanding of food processing and technology subjects as well as food safety. This course will enable students to appreciate the role of microbes in food spoilage, preservation of foods and food borne infections.

OBJECTIVES

On completion of the course the students are expected to

- Be able to understand and identify the various microbes associated with foods and food groups.
- Be able to understand and identify the role of these microbes in food spoilage, food preservation.
- Understand the role of pathogens in food borne infections.
- Understand the methods used to detect pathogens in foods.

UNIT I ROLE OF MICROBES IN SPOILAGE OF FOODS 9

Factors affecting spoilage of foods, Microbial flora associated with various food groups their spoilage potential. Microbiological spoilage problems associated with typical food products.

UNIT II CONTROL OF MICROBES IN FOODS 9

Use of antimicrobial chemicals- organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, Benzoates, Sorbates / Propionates naturally occurring antimicrobials; Physical methods- Low and high temperatures, drying, radiation and high pressure; Tolerance of microbes to chemical and physical methods in various foods.

UNIT III MICROBES IN FOOD FERMENTATIONS 9

Microbes of importance in food fermentations, – Homo & hetero-fermentative bacteria, yeasts & fungi; Biochemistry of fermentations – pathways involved, Lactic acid bacteria fermentation and starter cultures, Alcoholic fermentations -Yeast fermentations - characteristics and strain selection, Fungal fermentations. Microbes associated with typical food fermentations- yoghurt, cheese, fermented milks, breads, idli, soy products, fermented vegetables and meats.

UNIT IV MICROBIAL AGENTS OF FOOD BORNE ILLNESS 9

Food borne infections and food poisoning, Microbial toxins, Gram Negative and Gram positive food borne pathogens; Toxigenic algae and fungi; Food borne viruses; helminths, nematodes and protozoa.

UNIT V MICROBIAL EXAMINATION OF FOODS 9

Detection & Enumeration of microbes in foods; Indicator organisms and microbiological criteria; Rapid and automated microbial methods - development and impact on the detection of food borne pathogens; Applications of immunological, techniques to food industry; Detection methods for E. coli, Staphylococci, Yersinia, Campylobacter, B. cereus, Cl. Botulimum & Salmonella, Listeria monocytogenes Norwalk virus, Rotavirus, Hepatitis A virus from food samples.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Frazier, William C. “Food Microbiology” 4th Edition. Tata McGraw-Hill, 1988.
2. Banwart, G.J. “Basic Food Microbiology” 2nd Edition. CBS Publishers, 1998.
3. Vijaya Ramesh. “ Food Microbiology”. MJP Publishers, Chennai, 2007.
4. Jay, J.M. “Modern Food Microbiology”. 4th Edition. CBS Publishers, 2003.
5. Adams, M.R. and M.O. Moss.” Food Microbiology”. New Age International, 2002
6. Khetarpaul, Neelam. “Food Microbiology” Daya Publishing House, 2006.

REFERENCES

1. Montville, Thomas J. and Karl R. Matthews “ Food Microbiology : An Introduction”. ASM Press, 2005.
2. Ray, Bibek and Arun Bhunia. “Fundamental Food Microbiology” 4th Edition, CRC Press, 2008
3. Pawsey, R. K. “Case Studies in Food Microbiology for Food Safety and Quality”. The Royal Society of Chemistry, 2001.
4. Forsythe, S.J. “The Microbiology of Safe Food”. Blackwell Science, 2000.
5. Doyle, Michael P. “Food Microbiology : Fundamentals and Frontiers”. 2nd Edition, ASM Press, 2001.
6. Parry, Thelma J. and R.K. Pawsey. “Principles of Microbiology : For Students of Food Technology”. 2nd Edition, Hutchinson Education, 1984.

CH9023 **BIOCHEMICAL ENGINEERING** **L T P C**
(Common for Food and Pharmaceutical Technology) **3 0 0 3**

UNIT I INTRODUCTION TO ENZYMES 9

Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis – collision theory, transition state theory; role of entropy in catalysis.

UNIT II KINETICS OF ENZYME ACTION 9

Kinetics of single substrate reactions; estimation of Michelis – Menten parameters, multisubstrate reactions- mechanisms and kinetics; turnover number; types of inhibition & models –substrate, product. Allosteric regulation of enzymes, Monod changeux wyman model, ph and temperature effect on enzymes & deactivation kinetics.

UNIT III ENZYME IMMOBILIZATION 6

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages.

UNIT IV OVERVIEW OF FERMENTATION PROCESSES 9

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT V RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS 12

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods

TOTAL: 45 PERIODS

TEXT BOOKS

1. Bailey, J.E. and Ollis, D.F. “Biochemical Engineering Fundamentals”, 2nd Edition, McGraw-Hill, 1986.
2. Blanch, H.W. and D.S. Clark “Biochemical Engineering”, Marcal Dekker, Inc., 1997.
3. Lee, James M. “Biochemical Engineering”, Prentice – Hall, 1992.

REFERENCES

1. Palmer, Trevor “Enzymes : Biochemistry, Biotechnology, Clinical Chemistry”, Affiliated East-West Press Pvt. Ltd., 2004.
2. Stanbury, P.F., A. Whitaker and S.J. Hall “Principles of Fermentation Technology”, 2nd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.
3. Wiseman, Alan “Handbook of Enzyme Biotechnology”, 3rd Edition, Ellis Harwood Publications, 1999.
4. Hartmeier, Winfried “Immobilized Biocatalysts : An Introduction”, Springer –Verlag, 1986.

GE 9261 ENVIRONMENT SCIENCE AND ENGINEERING L T P C
(Common to all branches) 3 0 0 3

AIM

The aim of this course is to create awareness in every engineering graduate about the importance of environment, the effect of technology on the environment and ecological balance and make them sensitive to the environment problems in every professional endeavour that they participates.

OBJECTIVE

- At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity. The role of government and non-government organization in environment managements.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Masters, G.M. "Introduction to Environmental Engineering and Science", 2nd Edition, Pearson Education, 1998.
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, 2006.

REFERENCES

1. Trivedi, R.K. "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
3. Senger, Dharmendra S. "Environmental Law", Prentice Hall of India, 2007.
4. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.

IB9254 GENETICS L T P C
3 0 0 3

AIM

To introduce students to the principles of classical genetics and to emphasize the role of genetics in modern biology.

OBJECTIVE

- To provide to the students the fundamentals of classical genetics and ability to solve problems in genetics.
- To help students understand sex determination mechanisms.
- To enable students appreciate genetic recombination and mapping techniques.

UNIT I CLASSICAL GENETICS 9

Mendelian genetics, symbols and terminology, monohybrid crosses, ratios, dominance , recessiveness, backcross, testcross, codominance, incomplete dominance, lethals Princilples of segregation, Punett square, dihybrid cross, ratios, trihybrids,, geneic interation, epistasis, forked line method for genetic problems.Pedigrees,probability and statistics for geneticists.

UNIT II SEX DETERMINATION, SEX LINKAGE AND PEDIGREE ANALYSIS 9

Sex determination , patterns, sex chromosomes, dosage compensation, Lyon's hypothesis, dosage compensation in Drosophila, sex determination in humans, SRy, XX-XY mechanism, Y chromosome and sex determination in mammals. Balance concept of sex determination in Drosophila. Identification of sex chromosomes.

Sex Linkage- human sex-linked disorders hemophilia, Fragile X, Lesh-Nyhan and Hunter syndrome.Pedigree analysis, penetrance, expressivity, dominant , recessive and sex-linked inheritance. Sex limited, sex influenced traits, mosaics and gynandromorphs.

UNIT III STUCTURE OF CHROMOSOMES AND VARIATION IN CHROMOSOME STRUCTURE AND NUMBER 9

Organization of prokaryotic and eukaryotic chromosomes. Proof that DNA is genetic material. Cytogenenetic variation, human karyotypes, polytene chromosomes, polyploidy, sterile polyploids, polyteny.Aneuploidy- monosomy, trisomy in humans, deletions and duplications in chromosome number. Rearrangements of chromosome structure, inversion, translocation, compound chromosomes, phenotypic effects of chromosome rearrangements.

UNIT IV LINKAGE, CROSSING OVER AND CHROMOSOME MAPPING IN EUKARYOTES 9

Linkage, Crossing over, recombination, exception to Mendelian principles, frequency of recombination, evidence of crossing over, chiasmata, chromosome mapping with two- point and three-point testcrosses. Recombination mapping and map distance, linkage analysis in humans , detection of linked loci by pedigree analysis and somatic cell genetics. Human gene map.

UNIT V GENETICS OF BACTERIA AND VIRUSES 9

Structure and life cycle of bacterial viruses, mapping the bacteriophage genome, deletion mapping. Genetic exchange in Bacteria.Transformation, process and mapping, Conjugation, $F^+X\ F^-$ mapping, HFR, sexduction, conjugation and gene mapping, mapping closely linked genes, origin of plasmids. Transduction – Generalized, Specialized and gene mapping in bacteria significance of sexuality in bacteria.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gardner, E.J., M.J. Simmons and D.P. Snustad "Principles of Genetics".8th Edition. John Wiley & Sons,1991.
2. Sinnott, E.W., L.C. Dunn. "Principles of Genetics". 5th Edition, Tata McGraw-Hill, 1973.
3. Tamarin, R.H. "Principles of Genetics" 7th Edition, Tata McGraw-Hill, 2002.
4. Sambamurthy, A.V.S.S. "Genetics". 2nd Edition, Narosa, 2005.

REFERENCES

1. Klug, William S. and M.R. Cummings. "Essentials of Genetics". 5th Edition, Pearson Education, 2005.
2. Russell, Peter J. "I Genetics : A Molecular Approach". 2nd Edition, Pearson Education, 2006.
3. Brooker, R.J. "Genetics : Analysis and Principles". 2nd Edition, McGraw-Hill, 2004.

CY9214 **INSTRUMENTAL METHODS OF ANALYSIS LAB** **L T P C**
(Common for IBT, Food and Pharmaceutical Technology) **0 0 4 2**

1. Precision and validity in an experiment using absorption spectroscopy.
2. Validating Lambert-Beer's law using $KMnO_4$
3. Finding the molar absorbtivity and stoichiometry of the Fe (1,10 phenanthroline)3 using absorption spectrometry.
4. Finding the pKa of 4-nitrophenol using absorption spectroscopy.
5. UV spectra of nucleic acids.
6. Chemical actinometry using potassium ferrioxolate.
7. Estimation of SO_4^{--} by nephelometry.
8. Estimation of Al^{3+} by flourimetry.
9. Limits of detection using aluminium alizarin complex.
10. Chromatography analysis using TLC.
11. Chromatography analysis using column chromatography.

TOTAL : 60 PERIODS

TEXTBOOKS

1. Skoog, D.A. etal. "Principles of Instrumental Analysis", 5th Edition, Thomson / Brooks – Cole,1998.
2. Braun, R.D. "Introduction to Instrumental Analysis", Pharma Book Syndicate, 1987.
3. Willard, H.H. etal. "Instrumental Methods of Analysis", 7th Edition, CBS, 1986.
4. Ewing,G.W. "Instrumental Methods of Chemical Analysis", 5th Edition, McGraw-Hill, 1985.

IB9256 **CHEMICAL ENGINEERING LAB** **L T P C**
(Common for IBT, Food and Pharmaceutical Technology) **0 0 4 2**

1.Flow measurement a) Arifice meter b) Venturimeter, c) Rotameter
2.Pressure drop flow in pipes
3.Pressure drop in flow through packed column
4.Pressure drop in flow through fluidized beds
5.Chacteristics of centrifuge pump
6.Flate and frame filter press
7.Filteration in leaf filter
8.Heat transfer characteristics in heat exchanger
9.Simple and steam distillation
10.HETP in packed distillation
11.Ternary equilibrium in liquid-liquid extraction
12.Adsorption isotherm
13.Drying characteristics in a pan dryer

TOTAL : 60 PERIODS

TEXT BOOKS

1. McCabe, W.L., J.C. Smith and P.Harriot "Unit Operations of Chemical Engineering", 6th Edition, Mc Graw Hill, 2001.
2. Geankoplis, C.J. "Transport Processes and Separation process Principles", 4th Edition, PHI, 2006.

IB 9305 MOLECULAR BIOLOGY L T P C
3 0 0 3

UNIT I CLASSICAL GENETICS 5
Mendelian genetics, linkage, crossing over, classical experiments – Hershey and chase; Avery McLeod & McCarty. Bacterial conjugation, transduction and transformation.

UNIT II STRUCTURE OF NUCLEIC ACIDS AND DNA REPLICATION 15
Conformation of DNA and RNA; replication in prokaryotes, D-loop and rolling circle mode of replication, replication of linear viral DNA. Organisation of eukaryotic chromosome – cot value, replication of telomeres in eukaryotes

UNIT III TRANSCRIPTION 8
In prokaryotes and eukaryotes, features of promoters and enhancers, transcription factors, nuclear RNA splicing, ribozyme.

UNIT IV TRANSLATION 10
Elucidation of genetic code, mechanism, codon usage, suppressor mutation

UNIT V REGULATION OF GENE EXPRESSION 7
Lac and trp operon, □□phage life cycle, mutation and repair of DNA

TOTAL : 45 PERIODS

TEXT BOOKS
1. Friefelder, David, "Molecular Biology", 2nd Edition, Narosa Publishing House,1999.
2. Lewin Benjamin, "Genes IX" Jones and Bartlett, 2008.
3. Weaver, R.F. "Molecular Biology", 3rd Edition, McGraw Hill, 2005.

REFERENCES
1. Waston, J.D. "Molecular Biology of the Gene", 5th Edition, Pearson Education, 2004.
2. Walker, J.M. and R. Rapley "Molecular Biology and Biotechnology" 4th Edition, Panima, 2002.
3. Karp, Gerald. "Cell and Molecular Biology :Concepts and Experiments."2nd Edition, John Wiley & Sons, 1999.

FT 9301 BIOCHEMICAL ENGINEERING II L T P C
3 0 0 3

UNIT I STERILIZATION KINETICS 5
Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment - batch and continuous.

UNIT II METABOLIC STOICHIOMETRY AND ENERGETICS 12
Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

UNIY III KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION - UNSTRUCTURED KINETIC MODELS 8
Modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - leudeking-piret models, substrate and product inhibition on cell growth and product formation.

UNIT IV KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION- STRUCTURED KINETIC MODELS 8

Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model.

UNIT V BIOREACTOR SCALE – UP 12

Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors – Mass transfer Coefficient- methods for the determination of mass transfer coefficients; mass transfer correlations. Power requirements of Bioreactors. Scale-up considerations on heat transfer oxygen transfer, power consumption and impeller tip speed.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Lee, James M. "Biochemical Engineering", PHI,1992.
2. Shuler, M.L. and Kargi, F. "Bioprocess Engineering : Basic Concepts", 2nd Edition, PHI, 2002.
3. Bailey, J.E. and Ollis, D.F. "Biochemical Engineering Fundamentals" 2nd Edition, McGraw – Hill, 1988.
4. Blanch, H.W. and Clark, D.S. "Biochemical Engineering", Marcel Decker Inc., 1997.

REFERENCES

1. Moser, Anton. "Bioprocess Technology : Kinetics and Reactors", Springer – Verlag, 1988.
2. Stanbury, P.F. etal. "Principles of Fermentation Technology", 2nd Edition,Butterworth – Heinemann / Elsevier, 1995.

FT 9302 FOOD ANALYSIS L T P C
3 0 0 3

AIM

To expose the students to the principles, methods and techniques of chemical and instrumental methods of food analysis.

OBJECTIVE

- To understand the principles behind analytical techniques in food analysis.
- To know the methods of selecting appropriate techniques in the analysis of food products.
- Appreciate the role of food analysis in food standards and regulations for the manufacture and the sale of food products and food quality control in food industries.
- To familiarize with the current state of knowledge in food analysis.

PREREQUISITE

Basic knowledge in chemistry, physics and food chemistry.

UNIT I INTRODUCTION 10

Introduction, food regulations and standards; sampling methods, and sample preparation for analysis; statistical evaluation of analytical data. General methods of food analysis- Moisture determination by different methods; ash analysis-different methods; titrable acidity in foods; determination of crude fiber and dietary fibre.

UNIT II LIPIDS, PROTEINS AND CARBOHYDRATE ANALYSIS 10

Analysis of oils and fats for physical and chemical parameters and quality standards, protein analysis by different techniques; analysis of carbohydrates by different techniques.

UNIT III SPECTROSCOPIC TECHNIQUES 10

Basic principles; application of UV-Visible spectrophotometer in the analysis of food additives; tintometer in color intensity determination; application of Atomic Absorption Spectrophotometer in analysis of mineral elements and fluorimeter in vitamin analysis.

UNIT IV CHROMATOGRAPHIC TECHNIQUES 10

Basic principles; application of paper chromatography and TLC in food analysis; detection of adulterants in foods; HPLC and GC in food analysis; FAME analysis in oils and fats.

UNIT V ELECTROPHORESIS, REFRACTOMETRY AND POLARIMETRY 5

Basic principles; application of the technique; Brixs value of fruit juices; total soluble solids in fruit products; Refractive indices of oils and fats; specific rotations of sugars.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Pomeranz, Yeshajahu. "Food Analysis : Theory and Practice". 3rd Edition. Aspen Publishers / Springer, 2000.
2. Kirk, R.S. and R. Sawyer "Pearson's Composition and Analysis of Food". 9th Edition. Longman,
3. Nielsen, S. Suzanne. "Food Analysis". 3rd Edition. Springer, 2003.

REFERENCES

1. Otles, Semih. "Methods of Analysis of Food Components and Additives". CRC Press, 2005.
2. Nollet, Leo M.L. "Hand Book of Food Analysis" 2nd Rev. Edition. Vol. I, II & III, Marcel & Dekker, 2004.
3. Nollet, Leo M.L. " Food Analysis by HPLC". 2nd Rev. Edition, Marcel & Dekker, 2000
4. Otles, Semih. "Handbook of Food Analysis Instruments". CRC Press, 2009.

FT 9303 FOOD ADDITIVES L T P C
3 0 0 3

AIM

To expose the students to the use of different chemical additives in foods during food processing and preservation.

OBJECTIVES

- To understand the principles of chemical preservation of foods.
- To understand the role of different food additives in the processing of different foods and their specific functions in improving the shelf life, quality, texture and other physical and sensory characteristics of foods.
- To know the regulations and the monitoring agencies involved in controlling the safer use of additives in foods

UNIT I FOOD ADDITIVES 9

Definition; their function in food processing and preservation. Preservatives – definition; natural preservatives; chemical preservatives; acidulants and low pH – organic acids and esters; sulphur dioxide and its salts; nitrites; antibiotics; surface preservation. Permitted preservatives in foods – Antioxidants; natural and chemical antioxidants; mechanism of antioxidant function; primary and secondary antioxidants; sequestrants; selection and application of antioxidants in foods; evaluation of antioxidant effectiveness – permitted antioxidants in foods.

UNIT II FOOD COLORS 9

Natural and synthetic colors; fake colors; inorganic pigments; application of colors in food industry; restriction on the use of colors in foods. Flavoring agents – concept of flavors in foods; natural flavors; nature identical flavors; artificial flavoring substances; restrictions on the use of flavoring agents in foods.

UNIT III EMULSIFIERS AND STABILIZERS 9

Definition; properties; HLB value; function of emulsifiers and stabilizers in foods; permitted emulsifiers and stabilizers used in foods; polyols – physical and chemical properties of polyols, application in food industry, permitted polyols in foods.

UNIT IV SWEETENERS 9

Natural and chemical sweeteners; nutritive and non-nutritive sweeteners; chemical structure & sweetness; saccharine, acesulfame K, aspartame, sucrolose; restriction on the use of sweeteners in foods; Food acids – their function and application in foods; permitted food acids; nutritive additives; enrichment of foods.

UNIT V FOOD SAFETY 9

Food – Safety in the use of food additives in foods; regulations and monitoring agencies; toxicological evaluation of additives; interaction of additives with food ingredients.

TOTAL: 45 PERIODS

TEXT BOOK

1. Mahindru, S.N. "Food Additives: Characteristics, Detection and Estimation". Tata McGraw-Hill, 2000.

REFERENCES

1. Brennen, Alfred Larry. "Food Additives". 2nd Edition, CRC Press,
2. Clydesdale, Fergus M. "Food Additives- Toxicology Regulation and Properties". CRC Press,
3. Emerton, Victoria, "Food Colours". Blackwell Publishing, 2008.
4. Wilson, Rachel. "Sweeteners" Blackwell Publising, 2007.
5. Hutchings, John B. "Food Color and Appearance". Aspen Publication,1999.

GE9023 FUNDAMENTALS OF NANOSCIENCE L T P C
3 0 0 3

AIM

To make the students understand the importance , relevance and potentialities of this emerging field of study.

OBJECTIVES

- Study the basic nano technology and nano science.
- Understand interdisciplinary nature of this field.
- Understand the importance role of physics, chemistry, biology.
- Recognize that the rules of nano science are fundamentally different than those we experience.
- Study the basic fabrication strategies of nano science.

UNIT I INTRODUCTION 10

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II PREPARATION METHODS 10

Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 5

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

UNIT IV PREPARATION ENVIRONMENTS 10

Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

UNIT V CHARECTERISATION TECHNIQUES 10

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

TOTAL : 45 PERIODS

TEXT BOOKS

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale charecterisation of surfaces & Interfaces", 2nd Edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES

1. G Timp (Editor), "Nanotechnology", AIP press/Springer, 1999
2. Akhlesh Lakhtakia (Editor), "The Hand Book of Nano Technology,Nanometer Structure", Theory, Modeling and Simulations", Prentice-Hall of India (P) Ltd, New Delhi, 2007.

IB 9307 MOLECULAR BIOLOGY LAB L T P C
0 0 4 2

1. Isolation of bacterial DNA
2. Isolation of plant cell and animal cell genomic DNA
3. Agarose gel electrophoresis
4. Restriction enzyme digestion
5. Competent cells preparation
6. Transformation and screening for recombinants
7. Agarose gel electrophoresis
8. Restriction enzyme digestion
9. Competent cells preparation
10. Blue and white selection for recombinants
11. Plating of □□□phage
12. phage lysis of liquid cultures

TOTAL: 60 PERIODS

REFERENCE

1. Ausubel, F.M. "Short Protocols in Molecular Biology", 4th Edition, John Wiley, 1999.

FT 9304 **FOOD ANALYSIS LAB** **L T P C**
0 0 4 2

Analysis of foods and food products for chemical components, compliance to standards; detection of adulterants in foods.

Examination of typical food products including

a) Tea, coffee and cocoa,
b) Milk and milk products,
c) Edible oils and fats
d) Cereal and cereal products
e) Non alcoholic beverages and drinks
f) Spices and condiments
g) Bakery, confectionery products,
h) Sugars and sweetening agents.

TOTAL: 60 PERIODS

LAB EXPERIMENTS

1. Determination of moisture in spices powder by distillation method.
2. pH, conductivity, TDS and hardness of water
3. Determination of Peroxide Value in edible oils.
4. Isolation and identification of synthetic food colors in sweets, confectionery, beverages.
5. Determination of total fat in liquid milk.
6. Determination of protein content in ice cream
7. Determination of total sugars in soft drinks.
8. Determination of Gluten in refined wheat flour (maida).
9. Determination of added common salt in table butter.
10. Detection of vanaspathi in ghee.
11. Detection of argemone oil in edible oil.
12. Detection of oil soluble color in spices powder.
13. Microscopic examination of wheat starch, rice starch and chicory in coffee.

FT 9305 **FOOD PRODUCTION ANALYSIS LAB** **L T P C**
0 0 4 2

Analysis of food products for food additives, contaminants, nutrients and compliance to standards.

LAB EXPERIMENTS

1. Studying the expansion characteristics of snack foods on frying.
2. Rancidity test for fried foods to assess primary and secondary oxidative products.
3. Determination of Vitamin C in fruit juices.
4. Estimation of synthetic Food color in sweets, confectioneries and beverages.
5. Determination of Iron content in foods.
6. Determination of Iodine content in iodized salt.
7. Detection of Annatto color in table butter.
8. Determination of Lead in spices powder.
9. Detection of added MSG in foods.
10. Detection of sulphur-di-oxide in foods.
11. Detection of anti oxidant in foods.
12. Detection of certain emulsifiers and stabilizers in foods.

TOTAL: 60 PERIODS

IB 9351 CHEMICAL REACTION ENGINEERING L T P C
3 0 0 3

AIM

To understand kinetics of reaction and rate equations
To understand design principles of reactors.

OBJECTIVES

- To estimate kinetic parameter
- To apply design equations.

UNIT I KINETICS OF HOMOGENEOUS REACTIONS 10

Principles of Homogeneous reactions – and rate equations-estimation of rate constants using constant volume and constant pressure Batch reactor-data for typical reactions – Arrherius equation-Non elementary reaction kinetics-Multiple reactions-yield Concepts.

UNIT II IDEAL REACTORS 8

Performance equations for single batch reactor, ideal CSTR, ideal PFR-Application to design.

UNIT III MULTIPLE REACTORS & NON ISOTHERMAL REACTORS 8

Multiple reactor systems – selection of suitable reactor systems for multiple reactions-recycle reactor-Principles in non isothermal reaction and reactors.

UNIT IV NON IDEAL FLOW & REACTORS 10

Non Ideal reactors- Non Ideal Flow-Tracer experiments and application-TIS model, Axial Dispersion model-for tubular reactors. Exchange volume and By Pass and dead volume models for CSTRS.

UNIT V MULTIPHASE REACTIONS & REACTORS 9

Gas-Liquid Reactions-kinetics-G-L reactor design Principles-Principle of Catalysis-types of Catalytic reactors-Concept of effectiveness factor in Catalytic reactions-G-L-S-reactors – slurry reactor.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Levenspiel, Octave “Chemical Reaction Engineering”, 3rd Edition, John – Wiley & Sons, 1999.
2. Fogler, H.S. “Elements of Chemical Reaction Engineering”, 2nd Edition, Prentice Hall, 1999.
3. Richardson, J.E. and D.G. Peacock “Coulson & Richardson’s Chemical Engineering”, Vol.3 (Chemical & Biochemical Reactors & Process control) 3rd Edition, Butterworth – Heinemann / Elsevier, 2006.

REFERENCES

1. Missen, R.W. etal., “Chemical Reaction Engineering and Kinetics”, John – Wiley, 1999.
2. Davis, Mark E and Robert J. Davis “Fundamentals of Chemical Reaction Engineering” McGraw – Hill, 2005.
3. Harriot, Peter “Chemical Reactor Design” Marcel Dekker, 2003.
4. Sila, Harry “Chemical Process Engineering : Design and Economics” Marcel Dekker, 2003.
5. Nauman, E. Bruce “Chemical Reactor Design, Optimization, and Scaleup”, McGraw – Hill, 2002.

IB 9353 **GENETIC ENGINEERING** **L T P C**
3 0 0 3

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY 4
Role of genes within cells, genetic elements that control gene expression, restriction and modifying enzymes, safety guidelines of recombinant DNA research.

UNIT II CREATION OF RECOMBINANT MOLECULES 10
Restriction mapping, design of linkers and adaptors. Characteristics of plasmid and phage vectors, prokaryotic and eukaryotic expression vectors. Insect, Yeast and Mammalian vectors.

UNIT III CONSTRUCTION OF LIBRARIES 15
Construction of cDNA and genomic libraries. Screening of libraries with DNA probes and with antisera.

UNIT IV POLYMERASE CHAIN REACTION 10
Inverse PCR, Nested PCR, Taqman assay, Molecular beacons, RACE PCR, RAPD, site directed mutagenesis, methods of nucleic acid sequencing- Sangers method, (Kunkel's Method).

UNIT V APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY 6
Cloning in plants, Ti plasmid, and transgenic and knockout animals.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Primrose, S.Twyman, R. "Principles of Gene Manipulation and Genomics" 7th Edition, Blackwell Publishing, 2006.
2. Brown, T.A. "Gene Cloning & DNA Analysis : An Introduction", 5th Edition, Blackwell Publishing, 2006.
3. Watson, James., Molecular Biology of the Gene" 5ht Edition, Pearson Education,2004.
4. Glick, B.R. and J.J. Pasternak "Molecular Biotechnology : Principles and Applications of Recombinant DNA", 3rd Edition, ASM, 2003.

REFERENCES

1. Winnacker, Ernst – L. "From Genes to Clones : Introduction to Gene Technology", Panima, 2003.
2. Karp, Gerald. "Cell and Molecular Biology : Concepts and Experiments", 4th Edition, John – Wiley & Sons, 2005.
3. Mc Pherson, M.J. and S.G. Moller "PCR" Bios Scientific Publication, 2000.
4. Hughes, S. and Moody, "PCR" Scion Publishing Ltd., 2007.

FT 9351 **SEPARATIONS PROCESS** **L T P C**
3 0 0 3

AIM
To understand the principles involved in separation methods.

OBJECTIVES
- To understand Principles of separation methods used in the process industry.
- To appreciate different equipments developed for separation.

UNIT I SIZE REDUCTION 9
Characterisation of solid particles – Mixing of solids – equipments – storage of solids – size reduction of solids – Crushing, grinding Cutting-Power requirements-equipments-size enlargement.

UNIT II FLUID – SOLID SEPARATION 9

Separation of solids & suspension from gas medium-screening- settling- Principles and equipments-classification-clarification.

UNIT III FILTRATION 9

Filtration – Principles –Equipments-Centrifugal filtration-Principles- equipments – Centrifugal separation of immiscible liquids.

UNIT IV MEMBRANE SEPARATION 9

Cross flow filtration- Membranes –Ultrafiltration-Microfiltration-Concentration Polarisation - operation and equipments.

UNIT V DRYING & CRYSTALLISATION 9

Principles of Drying – Drying equipments Principles of Crystallisation- crystallization equipments.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Geankoplis, C.J. "Transport Processes and Separation Process Principles", 4th Edition, Prentice Hall, 2003.
2. McCabe W.L., Smith J.C. "Unit Operations in Chemical Engineering", 7th Edition, McGraw – Hill Int., 2001,

REFERENCE

1. Richardson, J.E. etal., "Coulson & Richardson's Chemical Engineering" Vol.2 (Praticle Technology & Separation Processes") 5th Edition, Butterworth – Heinemann / Elsevier, 2003.

FT 9352 FOOD PROCESSING AND PRESERVATON L T P C
3 0 0 3

AIM

To expose the students to the principles and different methods of food processing and preservation.

OBJECTIVES

- To understand the principles of food processing and preservation.
- To understand the role of different methods the processing of different foods and their impact on the shelf life, quality, and other physical and sensory characteristics of foods.
- To familiarize with the recent methods of minimal processing of foods
- To understand the materials and types of packaging for foods

UNIT I PRINCIPLES OF MASS AND ENERGY BALANCE 9

Transport phenomena with respect to foods; Factors affecting heat and mass transfer; Study of heat transfer and its application in the design of thermal processes and freezing. Thermal processing; calculation of process time temperature-schedules.

UNIT II CANNING OF FOOD PRODUCTS 9

Newer methods of thermal processing; batch and continuous; application of infra-red microwaves; ohmic heating; control of water activity; preservation by concentration and dehydration; osmotic methods.

UNIT III DRYING PROCESS FOR TYPICAL FOODS 9

Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychrometric chart, freezing and cold storage. freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages.

UNIT IV NON-THERMAL METHODS 9

Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology,

UNIT V FOOD PACKAGING 9

Basic packaging materials, types of packaging, packaging design, packaging for different types of foods, retort pouch packing, costs of packaging and recycling of materials.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Sivasankar, B. "Food Processing and Preservation". Prentice Hall of India, 2002.
2. Desrosier, N.W. and Desrosier, J.N. "The Technology of Food Preservation", 4th Edition, CBS, 1987.
3. Khetarpaul, Neelam. "Food Processing and Preservation." Daya Publications, 2005
4. Singh, M.K. "Food Preservation" Discovery Publishing, 2007.
5. Fellows, P.J. "Food Processing Technology : Principles and Practice". 2nd Edition, CRC / Wood Head Publishing, 2000.
6. Gopala Rao, Chandra. "Essentials of Food Process Engineering". B.S. Publications, 2006.

REFERENCES

1. Rahman, M. Shafiur. "Handbook of Food Preservation". Marcel & Dekker, 2006.
2. Zeuthen, Peter and Bogh-Sarensen, Leif. "Food Preservation Techniques". CRC / Wood Head Publishing, 2003.
3. Ranganna, S. "Handbook of Canning and Aseptic Packaging". Tata McGraw-Hill, 2000.

GE9022 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

AIM

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

OBJECTIVES

- To under the various principles, practices of TQM to achieve quality
- To learn the various statistical approaches for quality control.
- To understand the TQM tools for continuous process improvement.
- To learn the importance of ISO and Quality systems.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT II TQM PRINCIPLES 9

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

TOTAL: 45 PERIODS

TEXT BOOK

1. Dale H.Besterfiled, et at., "Total Quality Management", Pearson Education Asia,Third Edition, Indian Reprint (2006).

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.
3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,2006.
4. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

GE 9371 COMMUNICATION SKILLS AND SOFT SKILLS LAB L T P C
0 0 2 1

AIM

To enhance the overall capability of students and to equip them with the necessary Communication Skills and Soft Skills that would help them excel in their profession.

OBJECTIVES

- To equip students of engineering and technology with effective speaking and listening skills in English.
- To help them develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment exercises.

1. PC based session

A. Career Lab (15 periods) Viewing and discussing audio-visual materials

1. **Resume / Report Preparation / Letter Writing:** (3)
   Letter writing – Job application with Resume - Project report - Email etiquette.

2. **Presentation skills:** (3)
   Elements of effective presentation – Structure of presentation - Presentation tools – Body language.

3. **Soft Skills:** (3)
   Time management – Stress management – Assertiveness – Negotiation strategies, Psychometrics - Analytical and logical reasoning.

4. **Group Discussion:** (3)
   Group discussion as part of selection process, Structure of group discussion – Strategies in group discussion – Mock group discussions.

5. **Interview Skills:** (3)
   Kinds of interviews – Interview techniques – Corporate culture – Mock interviews.

TOTAL : 45 PERIODS

II. Class Room Session

1. **Resume / Report Preparation / Letter writing**: Students prepare their own resume and report. (9)
2. **Presentation Skills:** Students make presentations on given topics. (12)
3. **Group Discussion**: Students participate in group discussions. (12)
4. **Interview Skills**: Students participate in Mock Interviews (12)

Note: Classroom sessions are practice sessions.

REFERENCES

1. Prakash, P. "Verbal and Non-Verbal Reasoning". 2nd Edition. Macmillan India Ltd., 2004.
2. Seely, John. "The Oxford Guide to Writing and Speaking". Oxford University Press, 2004.
3. Anderson, Paul V. "Technical Communication". 6th Edition Thomson Wadsworth,2007.
4. Thorpe, Showick. "Objective English". 2nd Edition, Pearson Education, 2007.
5. Evans, David." Decision Maker". Cambridge University Press, 1997.

Lab Requirement:

1. Teacher console and systems for students.
2. English Language Lab Software
3. Tape recorders

FT 9402 **BIO PROCESS LAB** **L T P C**
0 0 6 3

AIM

To enable the students to understand the concepts and operation of equipment in handling of enzymes and cultivation of microbes in industrial scale .

OBJECTIVE

- To sterilize the bioreactor
- To operate the bioreactor
- To design experiments to evaluate the performance of the bioreactor
- To develop enzyme immobilized processes.

1. Growth of bacteria – estimation of biomass, calculation of specific growth rate, yield coefficient
2. Medium optimization – Plackett Burman design, response surface methodology
3. Enzyme kinetics – Michelis Menton parameter, effect of temperature and pH
4. Enzyme immobilization – gel entrapment,cross linking
5. Preparation of bioreactor, utilities for bioreactor operation
6. Thermal death kinetics
7. Batch sterilization design
8. Batch cultivation, estimation of kla – dynamic gassing method, exhaust gas analysis – carbon balancing, gas balancing
9. Fed batch cultivation, exhaust gas analysis – carbon balancing, gas balancing
10. Estimation of kla – sulphite oxidation method
11. Estimation of overall heat transfer coefficient

TOTAL : 90 PERIODS

REFERENCES

1. Bailey, J.E. and Ollis, D.F. "Biochemical Engineering Fundamentals" 2nd Edition, McGraw – Hill, 1988.
2. Lee, James M. "Biochemical Engineering", PHI, U.S.A.
3. Stanbury, P.F. etal. "Principles of Fermentation Technology", 2nd Edition, Butterworth – Heinemann / Elsevier, 1995.
4. El-Mansi, E.M.T. etal., "Fermentation Microbiology and Biotechnology", 2nd Edition, CRC / Taylor & Francis, 2007.
5. Peppler, H.J. and D. Perlman " Microbial Technology" (vol. I Microbial Processes and Vol. I Fermentation Technology)" 2nd Edition, Academic Press / Elsevier, 2004.

IB 9355 GENETIC ENGINEERING LAB L T P C
0 0 4 2

1. Preparation of plasmid DNA
2. Elution of DNA from agarose gels
3. Ligation of DNA into expression vectors
4. Transformation
5. Optimisation of inducer concentration for recombinant protein expression
6. Optimisation of time of inducer for recombinant protein expression
7. SDS-PAGE
8. Western blotting
9. Hybridisation with anti-sera
10. PCR.

TOTAL : 60 PERIODS

REFERENCE

1. Sambrook, Joseph and David W. Russell "The Condensed Protocols : From Molecular Cloning ; A Laboratory Manual" Cold Spring Harbor Laboratory Press, 2006.

IB 9403 IMMUNOLOGY L T P C
3 0 0 3

UNIT I INTRODUCTION 6

Cells of immune system; innate and acquired immunity; primary and secondary lymphoid organs; antigens: chemical and molecular nature; haptens; adjuvants; types of immune responses; theory of clonal selection.

UNIT II CELLULAR RESPONSES 12

Development, maturation, activation and differentiation of T-cells and B-cells; TCR; antibodies: structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions; monoclonal antibodies: principles and applications; antigen presenting cells; major histocompatibility complex; antigen processing and presentation; regulation of T-cell and B-cell responses.

UNIT III INFECTION AND IMMUNITY 16

Injury and inflammation; immune responses to infections: immunity to viruses, bacteria, fungi and parasites; cytokines; complement; immunosuppression, tolerance; allergy and hypersensitivity; AIDS and Immunodeficiencies; resistance and immunisation; Vaccines.

UNIT IV TRANSPLANTATION AND TUMOR IMMUNOLOGY 8

Transplantation: genetics of transplantation; laws of transplantation;; tumor immunology.

UNIT V AUTOIMMUNITY 3

Autoimmunity, Autoimmune disorders and diagnosis.

TOTAL : 45 PERIODS

TEXTBOOKS

1. Male, David etal., "Immunology", 7th Edition, Mosby Publication, 2007.
2. Kindt, T.J. etal., "Immunology", 6th Edition, W.H. Freeman, 2007.
3. Janeway, C.A. etal., "Immunology : The Immuno Systems in Health and Diseases", 6th Edition, Garland Science, 2005.

REFERENCES

1. Coico, R. etal., "Immunology : A Short Course", 5th Edition, Wiley – Liss, 2003.
2. Parham, Peter "The Immune System", 2nd Edition, Garland Science, 2005.
3. Abbas, A.K. etal., "The Cellular and Molecular Immunology", 6th Edition, Sanders / Elsevier, 2007.
4. Weir, D.M. and Stewart, John "Immunology", 8th Edition, Churchill Pvt. Ltd., 2000.
5. Lydyard, P.M. "Instant Notes in Immunology", Viva Books Pvt. Ltd., 2000.

FT 9401 FOOD SAFETY, QUALITY AND REGULATORY ISSUES L T P C
3 0 0 3

AIM

To sensitize students about food safety and risks.

OBJECTIVES

- To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
- To help become skilled in systems for food safety surveillance
- To be aware of the regulatory and statutory bodies in India and the world
- To ensure processed food meets global standards

UNIT I INTRODUCTION 15

Definition of food safety and concept of safe food; characterization of food hazards- physical, chemical and biological; adulteration, filth, plastics, pesticides, heavy metals; Changes due to food processing, trans fatty acids, pyrolytic and thermal decomposition products, urethane, mycotoxins, scrombotoxin, migration, cross - contamination, nitrates and related products, sulfites, phenolic antioxidants, non-nutritive sweeteners, colour additives, fat substitutes, chemical preservatives, veterinary drugs and antibiotics.

UNIT II MICROBIAL HAZARDS AND NATURAL SOURCE HAZARDS 8

Allergens, goitrogens, lathyrogens, alkaloids, lectins, aflatoxins. Implementation of FSIS program for pathogen reduction; prevention of food-borne illness, dose-response, model risk assessment, management and communication; exposure assessment, monitoring; Structured model for microbial risk reduction, microbial biofilms, prevention of microbial hazards; Sanitation, antimicrobial plastics, intelligent packaging, headspace gas modification.

UNIT III MONITORING AND REGULATION 10

HACCP, GMP; Surveillance networks, Consumer and food service operator education, function and roles of USFDA, USDA and EPA; Food Safety and Standards Act India 2006; Prevention of Food Adulteration Act, India, 1954; Responsibilities of the Food service operator, consumer protection, food audit.

UNIT IV SPECIAL FOODS SAFETY, HEALTH CLAIMS AND LABELING 5

Infant foods, formula foods, PKU, regulatory, industrial and international implications; fortified foods, sports nutrition, nutraceuticals, medical foods; Health claims; Labeling

UNIT V WORLD-WIDE FOOD SAFETY ISSUES 7

GM Foods, safety and labeling; International Food Standards ISO 9000 and related standards; Impact of food safety on global trade; Food safety in retail food businesses; international food service operators, institutional food service operators; application of the principals of modern hygiene .

TOTAL : 45 PERIODS

TEXT BOOKS

1. Entis, Phyllis. "Food Safety : Old Habits, New Perspectives." ASM Press, 2007.
2. Hester, R.E. and R.M. Harrison. "Food Safety and Food Quality". Royal Society of Chemistry, 2001.
3. Mortimore, Sara and Carol Wallace. "HACCP" (Food Industry Briefing Series), Blackwell Science Publication, 2001.
4. Paster, Tara. "The HACCP : Food Safety Training Manual." John Wiley & Sons, 2007.
5. Schmidt, Ronald H. and Gary E. Rodrick. "Food Safety Handbook". John Wiley & Sons, 2003.
6. Mehta, Rajesh and J. George. " Food Safety Regulations Concerns and Trade: The Developing Country Perspective". Macmillan, 2005.

REFERENCES

1. Fortin, N.D. "Food Regulation : Law, Science, Policy and Practice". Wiley, 2009.
2. Lightbourne, Muriel. " Food Security, Biological diversity and Intellectual Property Rights". Ashgate, 2009.

FT 9403 FOOD PROCESS ENGINEERING I L T P C
3 0 0 3

AIM

The course aims to develop the knowledge of students in the area of vegetable and fruit processing and technology. This course will enable students to appreciate the application of scientific principles in the processing of these materials.

OBJECTIVES

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for vegetables and fruits and the various products derived from these materials.
- Understand the application of scientific principles in the processing technologies specific to the materials.
- Grasp the changes in the composition of foods with respect to the type of processing technology used.

UNIT I BASIC AGRICULTURAL ASPECTS OF VEGETABLES AND FRUITS 8

Ability to identify all commercially important fruits and vegetables with their names in important Indian languages, important regions, season, basic aspects of cultivation, harvest (Good Agricultural practices) permitted pesticides and stages of application, yield

UNIT II FRESH FRUITS AND VEGETABLES 8

Climatic and non climatic fruits, ripening process, phytonutrients in fruits and vegetables; Handling, transportation , controlled atmosphere ripening process, grading, cleaning, pretreatments, modified atmosphere packaging, chilling.

UNIT III FREEZING & DEHYDRATION OF FRUITS AND VEGETABLES 12

General pre processing, different freezing methods and equipments, problems associated with specific fruits and vegetables; Dehydration – General pre processing, different methods of drying including sun, tray, spray drying and low temperature, osmotic dehydration and other modern methods; Indian Food Regulation and Quality assurance.

UNIT IV CANNING, PUREES AND JUICES 12

Canning- General pre processing, specific or salient points in fruits and vegetables like – Blanching, exhausting, processing conditions; Indian Food Regulation and Quality assurance Fruit Juice / pulp/ Nectar/Drinks, concentrates – General and specific processing, different packing including aseptic. Indian Food Regulation and Quality assurance Vegetable Purees/pastes - General and specific processing, different packing including aseptic. Indian Food Regulation and Quality assurance

UNIT V FRUIT AND VEGETABLE PRODUCTS 5

Ready to eat vegetable products, Jams/Marmalades, Squashes/cordials, Ketchup/sauces, Chutneys, Fruit Bar, Soup powders, Candied Fruits, Natural colors, Fruit and Vegetable Fibres- General and specific processing, different packing including aseptic. Indian Food Regulation and Quality assurance

TOTAL : 45 PERIODS

TEXT BOOKS

1. Singh, R. Paul and D.R. Heldman. "Introduction to Food Engineering". 4th Edition, Academic Press/ Elsevier, 2009.
2. Gopala Rao, Chandra. "Essentials of Food Process Engineering". B.S. Publications, 2006.
3. Toledo, Romeo T. "Fundamentals of Food Process Engineering". 3rd Edition. Springer, 2007.
4. Smith, P.G. " Introduction to Food Process Engineering". Springer, 2004.
5. Berk, Zeki. "Food Process Engineering and Technology". Academic Press / Elsevier, 2009.

FT 9404 FOOD PROCESS ENGINEERING II L T P C
3 0 03

AIM

The course aims to develop the knowledge of students in the area of animal product processing and technology. This course will enable students to appreciate the application of scientific principles in the processing of these materials.

OBJECTIVES

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for meat and such foods and the various products derived from these materials.
- Understand the application of scientific principles in the processing technologies specific to the materials.
- Grasp the changes in the composition of foods with respect to the type of processing technology used.

UNIT I FISH & FISH PROCESSING 8

Marine and fresh water fish, shell fish- composition and nutrition commercially important fish and shell fish, names in important Indian languages, important regions, season; spoilage factors, ship board operations, storage and transport.

Processing and Preservation-chilling, freezing, canning, smoking, curing, salting and drying, fish meal and fish oils; safety issues, Indian regulation and quality assurance.

UNIT II MEAT & MEAT PROCESSING 10

Common and commercially important meats; pre and post slaughter handling, meat inspection and grading; animal welfare and safety in slaughter plant.

Structure and composition of meat, carcass chilling, ageing; storage of fresh meat- Modified atmosphere packaging, packaging of retail cuts; Processing and preservation- artificial tenderizing, chilling, freezing, curing, smoking, sausage manufacture, ready-to-eat meats and meat products; Kosher and Halal certification, safety issues, regulation and quality assurance.

UNIT III POULTRY & EGGS 9

Types of poultry, production, classification & designation, grading.

Processing plant operations- slaughter, bleeding, scalding, defeathering, eviscerating, chilling, packaging; composition and nutrition, poultry meat products; safety issues, regulation and quality assurance.

Eggs- structure, composition, quality factors, storage, pasteurization, freezing and drying, egg substitutes; regulation and Quality assurance.

UNIT IV MILK AND MILK PRODUCTS 9

Processing of Milk – Pasteurisation, homogenisation, sterilization, HTST and UHT processes; Processing and preservation of milk products- cream, sour cream, butter, ghee, skimmed milk concentrate and skimmed milk powder, whey concentrate and whey powder, yoghurt, cheese and other products; Traditional Indian products- curd, lassi, buttermilk, khoa, kulfi, shrikhand, icecream ; packaging of dairy products- sachets, aseptic packs; chilled and frozen storage; Food Regulation and Quality assurance.

UNIT V EXTRUDED FOOD PRODUCTS 9

Principle, types and design of extruders, factors affecting extrusion performance, types of extruded foods- pasta , meat substitutes, textured plant and milk proteins, specialty foods ; uses and advantages of extrusion technology; packaging of extruded products; regulation and quality assurance.

TOTAL : 45 PERIODS

TEXTS BOOKS

1. Berk, Zeki. “Food Process Engineering and Technology”. Academic Press / Elsevier, 2009.
2. Toldra, Fidel. “Meat Biotechnology”. Springer, 2008.
3. Jongen, Wim. “Fruit and Vegetable Processing : Improving Quality”. CRC / Woodhead Publishing, 2002.
4. Arthey, David and P.R. Ashurst. “Fruit Processing : Nutrition, Products and Quality Management”. 2nd Edition, 2001.
5. Reddy, Y.S. “Extraction Techniques for Food Processing”. Gene-Tech Books, 2006.
6. Chintamani, Raghuraj. “Fruit & Vegetable Biotechnology” Dominant Publishers, 2008.

REFERENCES

1. Saravacos, G.D. and Z.B. Maroulis. “Food Process Engineering Operations”. CRC Press, 2010.
2. Lbarz, Albert and G.V. Barbosa-Canovas. “Introduction to Food Process Engineering”. CRC Press, 2010.

FT 9407 CEREAL, PULSE & OIL SEED TECHNOLOGY L T P C
3 0 0 3

AIM

The course aims to develop the knowledge of students in the area of Cereal, pulse and oil seed processing and technology. This is necessary for effective understanding specific aspects of food processing related to these foods. This course will enable students to appreciate the application of scientific principles in the processing of these materials.

OBJECTIVES

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for cereals, pulses and oil seeds and the various products derived from these materials.
- Understand the application of scientific principles in the processing technologies specific to the materials.
- Grasp the changes in the composition of foods with respect to the type of processing technology used.

UNIT I CEREALS 15

Cereal Grains- Basic agricultural aspects, structure and composition; Storage, Insect control; Processing: Wheat- milling, (Atta and maida), quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products – Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Rice- Milling, Parboiling, Quick cooking rice, Traditional Indian Products- Puffed Rice, flaked rice, Idli/Dosa/vada mixes and other savouries; Corn- Wet and dry milling, Corn Products – Corn flakes, Corn starch, canned corn products, puffed product; Oats- Milling, Oat Products – Steel cut, rolled oats, quick cooking; Traditional and Fermented cereal products

UNIT II OTHER CEREALS AND MILLETS 6

Sorghum, Pearl Millet, Finger millet, Foxtail millet, Kodo Millet - Basic agricultural aspects, structure and composition; storage, insect control; processing - pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.

UNIT III SUGARS 6

Honey- Composition and Quality aspects; Sugars- Manufacture of table sugar, High Fructose corn syrup and Glucose syrup; Jaggery – sources, manufacture, uses in traditional food products; stages of sugar saccharine products

UNIT IV PULSES AND LEGUMES 12

Basic agricultural aspects, structure, composition, storage, insect control, processing- Milling/splitting, dhal milling, products – puffed, flakes, flour, legume-based traditional products, flour based Indian sweets and savouries, soya milk, soy protein Isolate, soya paneer

UNIT V OIL SEEDS AND NUTS 6

Basic agricultural aspects structure, composition, Storage, Insect control; processing: traditional and modern methods of oil extraction, refining, bleaching, deodorizing, hydrogenation; oil blends; applications of different oils and fats in food processing & products.

TOTAL : 45 PERIODS

TEXTS BOOKS

1. Matz, Samuel A. “The Chemistry and Technology of Cereals as Food and Feed”. 2nd Edition, CBS, 1996.
2. Morris, Peter C. and J.H. Bryce. “ Cereal Biotechnology”. CRC/Wood head Publishing, 2004.

REFERENCES
1. Delcour, Jan A. and R. Carl Hoseney. " Principles of Cereal Science and Technology". 3rd Edition. American Association of Cereal Chemists, 2010.
2. Hosney, R.C. "Principles of Cereal Science and Technology"2nd Edition, American Association of Cereal Chemists, 1994.
3. Karl Kulp. "handbook of Cereal Science and Technology". 2nd Rev. Edition. CRC Press, 2000.
4. Kole, Chittaranjan. Genome Mapping and Molecular Breeding in Plants". Springer, 2006

GE9021 PROFESSIONAL ETHICS IN ENGINEERING L T P C
3 0 0 3

AIM
To sensitize the engineering students on blending both technical and ethical responsibilities.

OBJECTIVES
- Identify the core values that shape the ethical behavior of an engineer.
- Utilize opportunities to explore one's own values in ethical issues.
- Become aware of ethical concerns and conflicts.
- Enhance familiarity with codes of conduct.
- Increase the ability to recognize and resolve ethical dilemmas.

UNIT I ENGINEERING ETHICS 9
Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9
Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY 9
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal

UNIT IV RESPONSIBILITIES AND RIGHTS 9
Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination

UNIT V GLOBAL ISSUES 9
Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

TOTAL: 45 PERIODS

TEXT BOOKS
1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2005).
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thompson Learning, (2000).

REFERENCES

1. Charles D Fleddermann, “Engineering Ethics”, Prentice Hall, New Mexico, (1999).
2. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, (2003)
3. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, (2001)
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, “Business Ethics – An Indian Perspective”, Biztantra, New Delhi, (2004)
5. David Ermann and Michele S Shauf, “Computers, Ethics and Society”, Oxford University Press, (2003)

FT 9405 SKILLS FOR FOOD PRODUCT DESIGN AND DEVELOPMENT L T P C
0 0 4 2

OVERVIEW (THEORY) 5

Organization and assignment of team, Definition of roles; Product Concepts; factors to consider; concept methodology; consumer testing; Product attributes; Concept testing approaches; Development of product specifications: Prototype development; role of ingredients and processing in defining attributes; scale up; Process flow sheet development; factors to consider in process development; process optimization; Factors to consider beyond formulation and processing - shelf life requirements; product performance testing; market positioning, Packaging and labeling, costing; Marketing: developing test market strategies

3. GROUP PROJECTS TO DEVELOP FOOD PRODUCTS AT LABORATORY SCALE (PRACTICAL) 40

Project Identification: Products/Processes Review, Project Feasibility, Design and Product Specification

Project Planning: Identifying Objectives, Identifying Tools/Methods, Use of Information/Communication Technology

Project Execution: Product Trials and Standardization, Product Quality Profiling – Sensory, Microbial, Nutrient, Shelf Life, Costing, Packaging and Labeling, Product Scale up feasibility

Project Presentation: Documentation and Report, Viva Voce

TOTAL : 45 PERIODS

TEXTBOOKS

1. Brody, Aaron L. and John B. Lord. “ Developing New Food Products for a Changing Marketplace”. 2nd Edition, CRC Press, 2008.
2. Side, Catherine. “Food Product Development : Based on Experience”. IOWA State Press, 2002.
3. MacFie, Hal. “Consumer-Led Food Product Development”. CRC Press, 2007.

REFERENCES

1. Fuller, G. W. “New Food Product Development from Concept to Marketplace”. CRC Press, 1994.
2. Lyon, D. H. “Guidelines for Sensory Analysis in Food Product Development and Quality Control”. Chapman and Hall, 1992.
3. Robinson, J., H. Roberts, E. Barnard, and T. Shepard. “Design and Make It Food Technology”. Nelson Thomes, 2001.
4. Gould, W. A.” Research and Development Guidelines for the Food Industry”. Woodhead, 1991.

FT 9406 FOOD MICROBIOLOGY, PROCESSING & PRESERVATION LAB L T P C
0 0 6 3

1. Water
   - Microbiological quality of water (MPN)
   - Water activity in foods
2. Milk and Dairy products
   - Microbiological quality of milk
   - Enumeration of Lactic acid bacteria from fermented foods
   - Preparation of Yoghurt & Quality Parameters
3. Vegetables & Fruits
   - Yeast & Mould count from fruits
   - Preparation of fruit syrups, squashes, sauces – Refractive index, viscosity
   - Drying of vegetables & fruits- drying rates
   - Freezing of vegetables- freezing rates
4. Cereal & Pulse Products
   - Gelatinization of starch
   - Viscosity of starch pastes and sauces
   - Sugar syrups, caramelization
5. Edible oils
   - Refractive index
   - Expansion Characteristics of snack foods
   - Shelf life of fried snacks,
6. Spices, Salt & Sugar
   - Enumeration of spores from pepper
   - Inhibitory effect of spices on microbial load in fish
   - Salt & sugar tolerance of microbes
7. Flesh foods
   - Enumeration & Isolation of *E. coli* from processed meat/chicken
   - Thermal destruction of microbes : TDT & TDP
8. Processed & Packaged foods
   - Enumeration & Isolation of *Staphylococci* from ready to eat street foods
   - Effect of packaging on shelf life
9. Hygiene & Sanitation
   - Effect of cleaning and disinfection on microbial load
10. Sensory Evaluation & Market testing of foods

TOTAL : 90 PERIODS

REFERENCES

1. Bell, Chris “Food Microbiology and Laboratory Practice”, Blackwell, 2005.
2. McLandsborough, Lynne “Food Microbiology Laboratory”, CRC, 2005.

FT9451 PROJECT WORK L T P C
0 0 12 6

AIM

The project work aims to train the students on systematic analysis of a problem and to enable them to bring out a solution it.

OBJECTIVE

The objective of the project is to make use of the knowledge gained by the student at various stages of the degree course.

Each student is required to submit a report on the project assigned to him/her by the department. The report should be based on the literature collected from the many sources and the actual analysis done by the student on the given project.

FT 9022 REFRIGERATION AND COLD CHAIN L T P C
3 0 0 3

UNIT I MEANING AND IMPORTANCE OF COLD CHAIN, CHART 9

What is cold chain? Need for the chain for chilled / frozen food item, various links of the chain; importance of shelf- life; just – in-time delivereies; Temperature limits;-in various countries- Europe, US, Australia etc; Chilling and freezing;- Chilling injury, cook-chilling systems; cold –shortening; PPP and TTT concepts; Temperature monitoring; -Critical temperatures; Temperature –time indicators(TTI); Time –temperature –correlation-the kinetic approach, effective temperature; Transportation regulations; Role of packaging in cold chain – MAS, MAP, CAS, CAP etc; Thaw indicators.

UNIT II MICRO ORGANISMS AND THE COLD CHAIN 9

Micro organisms and their growth phases; response of micro organisms; Inactivation mechanism during Chilling and freezing; Rapid freezing and slow thawing;Categories (groups) of Organisms in respect of their ability to survivor under Cold / Chilling environment; Cold show proteins and cold shock response. Thawing techniques, microbial quality of thawed foods.

UNIT III PRINCIPLES AND METHODS OF REFRIGERATION 9

Concepts of systems and surrounding; meaning of refrigeration; Types of refrigeration; vapour compression-the refrigerating cycle, capacity, COPetc; Power consumption , efficiency factors; Refrigeration cycle as a series of thermodynamics processes refrigeration cycle; COP, capacity – in vapour absorption refrigeration; comparative study between the above types of refrigeration; Types of regrigeratants –their advantages / disadvantages; Refrigeration load demands and their calculation; closed cycle air refrigeration (CCAR); Cryogenic refrigeration; Freezing time – their prediction models, etc. Types freezer; - Blast freezer, Cryogenic tunnel freezer, spiral freezer, fluidized – bed freezer, Tumbling & rotary tunnel freezer, etc; Choosing the right freezer.

UNIT IV SHELF – LIFE OF FOOD PRODUCTS 9

Defining overall Shelf-life, remaining shelf life in the context of Chilled & Frozen foods; - Deterioration modes of food items; Models of quality deteriroration- Kinetic model; shelf-life model; Q10/q10 model; TTT model for the remaining shelf – life; General procedure for shelf –life testing – the 11 steps procedure.

Storage of frozen foods; - Basic design requirements of storage to uphold the shelf –life – size , insulation, entry –exit position, palletization, proper aisk-space for air-circulation, automatic door –closing, proper lighting, temperature monitoring and recording facility; stacking systems, emergency exits, material handling devices like fork-lifts, pallet trucks, etc floor heaters, vapour barriers, etc.

UNIT V HAZARD ANALYSIS CRITICAL CONTROL POINTS (HACCP) 9

Definition; Purpose; origins of HACCP; Developing the HACCP plan; Preliminary steps- the five –step process-HACCP team assembly, Defining the product and its usage; Constructing the flow diagrams; On-Site confirmation of flow diagram, etc. The 7-point HACCP system: - conducting a hazard analysis; Identifying CCPs; Establishing limits for each CCp; Estabilishing monitoring procedure for critical limits; Corrective actions to be eatablished; Procedures-setting for verification; Establish documentation and record maintaining.

Top-Management Commitment & involvement; Tranining of personnel; Implementation and integrating HACCP system with ISO, TQM, etc.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Anand, M.L. " Refrigeration & Air-Conditioning".Asian Books Pvt., Ltd., 2002.
2. Sun, Da-Wen. " Advances in Food Refrigeration". Leatherhead Publishing, 2001.
3. Kennedy, Christopher J. "Managing Frozen Foods". CRC / Woodhead Publishing, 2000.
2.James, S.J. and C. James. " Meat Refrigeration". CRC / Woodhead Publishing, 2002.
5. Stringer, Mike and C. Dennis. "Chilled Foods : A Comprehensive Guide". 2nd Edition, CRC / Woodhead Publishing, 2002.

REFERENCES

1. Evans, Judith. "Frozen Food Science and Technology". Wiley-Blackwell , 2008.
2. Hui, Y.H. etal., " Handbook of Frozen Foods". Marcel Dekker, 2004.

FT 9023 BIOLOGY AND CHEMISTRY OF FOOD FLAVOURS L T P C
3 0 0 3

UNIT I INTRODUCTION 9
Problems in flavour research – classification of food flavours; chemical compounds responsible for flavour.

UNIT II FLAVOUR COMPOUNDS 9
Chemical compound classes and their flavour responses; flavour development during biogenesis, flavour development during food processing; use of biotechnology to develop flavours.

UNIT III THE CHEMICAL SENSES 9
Anatomy of the chemical senses; neural development of the chemical senses; receptor mechanisms, neural coding; the control of eating.

UNIT IV FLAVOUR ANALYSIS 9
Subjective versus Objective methods of analysis; psychophysics and sensory evaluation; Instrumental analysis; sample handling and artifacts; data handling

UNIT V TEACHING FLAVOUR CONCEPTS 9
Problem based learning; tongue and nose; Onion-Beverage-Maillard reaction-Thio-stench

TOTAL : 45 PERIODS

TEXT BOOKS

1. Fisher, Carolyn and Thomas R. Scott. “Food Flavours : Biology and Chemistry”. The Royal Society of Chemistry, 1997.
2. Heath, H.B. and G. Reineccius. “ Flavor Chemistry and Technology”. CBS Publishers, 1996.
3. Reineccius, Gary. “Flavor Chemistry and Technology”. 2nd Edition, Taylor & Francis, 2006.
4. Shahidi, Fereidoon and Chi-Tang Ho. “Flavor Chemistry of Ethnic Foods”. Kluwer Academic / Plenum, 1999.
5. Ashurst, Philip R. “Food Flavorings”. 3rd Edition, Aspen Publications, 1999.

REFERENCES

1. Hofmann, Thomas. “Challenges in Taste Chemistry and Biology”. American Chemical Society Publications, 2004.
2. Charalambous, G. “Food Flavors: Generation, Analysis and Process Influence”. Elsevier, 1995.

FT 9024 BIOLOGICALLY ACTIVE PHYTOCHEMICALS IN FOOD L T P C
3 0 0 3

UNIT I BIOSYNTHESIS AND SIGNIFICANCE 9
Phytochemicals in food, the plants as chemical factories, synthesis of isotopically labeled phytoestrogens

UNIT II ANALYSIS OF PHYTOCHEMICALS 9
Qualitative and quantitative methods: phytoestrogens in plants; isoflavones; falavnols, polyphenols, tannins, saponins, lignans Multiresidue method for penicillins and cephalosporins in Bovine muscle.

UNIT III ASSESSMENT OF ANTIOXIDANT ACTIVITY 9
In vitro and In vivo methods for the assessment of antioxidant activity, Comparison of different In Vitro methods to evaluate the antioxidant , Prediction of the antioxidant activity of natural phenolics from electrotopological state indices

UNIT IV CARATENOIDS 9

Factors affecting bioavailability , chemical and histochemical characterasition of cell wall polysaccharides in almond seed in relation to lipid bioavailability.

UNIT V OPTIMISING PHYTOCHEMICAL 9

Optimising phytochemical release by process technology, Variation of Antioxidant Activity during technological treatments , new food grade peptidases from plant sources .

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gilbert, John and H. Z. Senyuva "Bioactive Compounds in Food". Blackwell Publishing, 2008.
2. Meskin, Mark S., W.R. Bidlack and R.K. Randolph. "Phytochemicals : Nutrient-Gene Interactions". CRC / Taylor & Francis, 2006.

REFERENCES

1. Premier, Robert. "Phytochemicals in Food". Blackwell, 2010.
2. Johnson, Ian and Gary Williams. "Phytochemical Functional Foods". CRC Press,2003.

FT 9025 HUMAN NUTRITION L T P C
3 0 0 3

AIM

The course aims to develop the knowledge of students in the basic area of Human Nutrition. This is necessary for effective understanding of food processing and technology subjects. This course will enable students to appreciate the relationship between food and the nutrients as well as function and contribution of nutrients to health of individuals.

OBJECTIVES

On completion of the course the students are expected to

- Be able to understand the physiological and metabolic functions of nutrients.
- Be able to understand methods of nutritional assessment, RDA and Dietary Recommendations & Guidelines..
- Understand and use effectively, diet planning principles, exchange lists, food labels and nutrition facts for balanced nutrition and healthy diets.

UNIT I

An Overview of Nutrition 9

Six classes of nutrients, calculating energy values from food, using the RDA, nutritional assessment of individuals and populations, dietary recommendations; research methods in nutrition; Planning a Healthy Diet: Diet planning principles, dietary guidelines; diet planning guides such as food groups, exchange lists, personal diet analysis; food labels: serving sizes, nutrition facts, daily values, descriptive terms, health claims.

Digestion, Absorption and Transport**:** Anatomy and physiology of the digestive tract, mechanical and chemical digestion, absorption of nutrients.

UNIT II

Carbohydrates: Sugars, Starch and Fiber 9

Digestion and absorption of carbohydrates, lactose intolerance; Glycemic and Non-glycemic carbohydrtaes, blood glucose regulation, recommendations of sugar intake for health, health effects of fiber and starch intake, artificial sweeteners; Nutrition and Diabetes: Complications of diabetes mellitus, importance of blood sugar regulation, dietary recommendations for NIDDM and IDDM

UNIT III

Lipids and Proteins **9**

Lipid digestion, absorption and transport;

Functions of the triglycerides; essential fatty acids- n-3 and n-6 fatty acids; trans fatty acids, Medium Chain Triglycerides, phospholipids and sterols; Health effects and recommended intakes of lipids.

Digestion and absorption of proteins; Functions of the proteins; amino acids; Protein quality, methods of assessing protein quality; Recommended intakes of proteins; protein and amino acid supplements; Protein Energy Malnutrition, Marsamus and Kwashiorkor; Chronic Energy Deficiency- short term and long term effects.

UNIT IV

Metabolism, Energy Balance and Body Composition **9**

Review of catabolic and anabolic pathways of glucose, fats and amino acids; Energy Balance and Body Composition: Energy balance; body weight and body composition; health implications; obesity, BMR and BMI calculations; Weight Control: Fat cell development; hunger, satiety and satiation; dangers of weight loss; how to identify unsafe weight loss schemes; treatment of obesity; attitudes and behaviors toward weight control.

UNIT V

Vitamins and Minerals **9**

Water Soluble Vitamins: B vitamins examined individually (Thiamine, Riboflavin, Niacin, Pyridoxine, Biotin, folate and B12, choline, pantothenic acid, carnitine) and in concert; B vitamin deficiencies, toxicities, and food sources; vitamin C roles and recommended intake, deficiency, toxicity and food sources

Fat Soluble Vitamins: A, D, E, and K: Function, recommended intakes, toxicities, food sources of vitamin A, D, E, and K; vitamin E as antioxidant; beta carotene and vitamin A

Water and the Major Minerals: Water balance and recommended intakes; fluid/electrolyte balance, acid-base balance; function, recommended intakes, and regulation of sodium, potassium, and calcium.

Trace Minerals: Food sources, function, recommended intakes, toxicities, deficiencies and transport of iron and zinc; importance of selenium, copper, fluoride, and chromium.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gibney, Michael J. etal., “Introduction to Human Nutrition”. Blackwell, 2002.
2. Gibney, Michael J. etal., “Public Health Nutrition”. Blackwell, 2004.
3. Sanders, Tom and Peter Emery “ Molecular Basis of Human Nutrition”. Taylor & Francis, 2003.
4. Gibney, Michael J. etal., “Clinical Nutrition”. Blackwell, 2005.

REFERENCES

1. Spark, Arlene. “Nutrition in Public Health : Principles, Policies, and Practice”. CRC Press, 2007.
2. Mann, Jim and Stewart Truswell “Essentials of Human Nutrition”. 3rd Edition. Oxford University Press, 2007.
3. Gropper, Sareen S. “Advanced Nutrition and Human Metabolism”. 5th Edition, Smith Wadsworth Publishing, 2008.

IB 9309 PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT L T P C
3 0 0 3

AIM

To introduce process economics and industrial management principles to chemical engineers.

OBJECTIVES

- The objective of this course is to teach principles of cost estimation, feasibility analysis, management, organization and quality control that will enable the students to perform as efficient managers.

UNIT I PRINCIPLES OF PRODUCTION MANAGEMENT AND ORGANISATION 15

Planning, organization, staffing, coordination, directing, controlling, communicating, organization as a process and a structure; types of organizationsMethod study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning; routing; scheduling; dispatching; costs and costs control, inventory and inventory control.

UNIT II ENGINEERING ECONOMICS FOR PROCESS ENGINEERS - INTEREST, INVESTMENT COSTS AND COST ESTIMATION 10

Time Value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital, invested capital and profitability.

UNIT III PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT 8

Estimation of project profitability, sensitivity analysis; investment alternatives; replac ement policy; forecasting sales; inflation and its impact.

UNIT IV ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE 4

Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth.

UNIT V ECONOMIC BALANCE AND QUALITY AND QUALITY CONTROL 8

Essentials of economic balance – Economic balance approach, economic balance for insulation, evaporation, heat transfer.

Elements of quality control, role of control charts in production and quality control.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Peters, M. S. and Timmerhaus, C. D., " Plant Design and Economics for Chemical Engineers ", 5th Edn., McGraw Hill, 2002.
2. Holand, F.A., Watson, F.A. and Wilkinson, J.K., " Introduction to process Economics ", 2nd Edn., John Wiley, 1983.
3. Narang, G.B.S. and Kumar, V., " Production and Costing ", Khanna Publishers, New Delhi, 1988.

REFERENCES

1. Allen, L.A., " Management and Organization", McGraw Hill.
2. Perry, R. H. and Green, D., " Chemical Engineer's Handbook ", 7th Edn., McGraw Hill.

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MA 9262 NUMERICAL METHODS L T P C
3 1 0 4

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 10 +3

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton-Raphson method- Solution of linear system of equations - Gauss Elimination method – Pivoting - Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method and by Jacobi's method.

UNIT II INTERPOLATION AND APPROXIMATION 8 + 3

Interpolation with unequal intervals - Lagrange interpolation – Newton's divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTATION AND INTEGRATION 9 + 3

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules – Romberg's method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATION 9 + 3

Single step-methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations - Multi-step methods - Milne's and Adams-Bashforth predictor-corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIALEQUATIONS 9 + 3

Finite difference methods for solving two-point linear boundary value problems. Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank Nicholson) methods - One dimensional wave equation by explicit method.

L : 45 , T : 15 , TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal, B.S. and Grewal,J.S., " Numerical Methods in Engineering and Science",40th Edition, Khanna Publishers, 2007.
2. Sankara Rao, K. "Numerical Methods for Scientists and Engineers', 3rd Edition Prentice Hall of India, 2007.

REFERENCES

1. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 5th Edition, Tata McGraw-Hill, 2007.
2. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, 2006.
3. Brian Bradie, "Friendly Introduction to Numerical analysis", Pearson Education Asia, 2007.

FT 9026 TECHNICAL WRITING AND COMMUNICATION L T P C
3 0 0 3

UNIT I RESEARCH & WRITING 9
The project/term paper, selecting a topic, using a library, compiling a working bibilography, taking notes, plagiarism, outlining, writing drafts, guides to writing.

UNIT II MECHANICS OF WRITING 9
Spelling, punctuation, numbers, titles and quotations.

UNIT III FORMAT OF A TERM/PROJECT REPORT 9
Typing, paper, margins, spacing, heading and title of paper, page numbers, tables and illustrations, corrections and insertions, binding.

UNIT IV PREPARATION OF CITATIONS 9
General guidelines, placement, arrangement, citing books, citing articles in periodicals, documenting sources, what is a document, parenthetical documentation, information required in parenthetical documentation, readability, sample references.

UNIT V ABBREVIATIONS AND REFERENCES 9
Introduction, time, common scholarly abbreviations and references words, publishers names, symbols and abbreviations used in proof-reading and correction, literary and scientific indexing.

L : 45 , T : 15 , TOTAL : 60 PERIODS

TEXT BOOK
1. Gibaldi W.S. "Achtert Handbook for Writers of Research Papers ", Wiley Eastern, 1987.

REFERENCE
1. "Chicago Manual of Style 14th Edition", Chicaco, University of Chicaco Press, 1996.

IB 9024 METABOLIC ENGINEERING L T P C
3 0 0 3

UNIT I INTRODUCTION TO EXAMPLES OF PATHWAY MANIPULATION - QUALITATIVE TREATMENT 9
Enhancement of Product Yield and Productivity,Extension of substrate Range, Extension of Product spectrum and Novel products, Improvement of Cellular properties, Xenobiotic degradation.

UNIT II MATERIAL BALANCES AND DATA CONSISTENCY 9
Comprehensive models of cellular reactions; stoichiometry of cellular reactions, reaction rates, dynamic mass balances, yield coefficients and linear rate equations, analysis of over determined systems- identification of gross measurement errors. Introduction to MATLAB®

UNIT III METABOLIC FLUX ANALYSIS 9
Theory, overdetermined systems, underdetermined systems- linear programming, sensitivity analysis, methods for the experimental determination of metabolic fluxes by isotope labeling, applications of metabolic flux analysis.

UNIT IV METABOLIC CONTROL ANALYSIS 9
Fundamentals of Metabolic Control Analysis, control coefficients and the summation theorems, Determination of flux control coefficients, MCA of linear pathways, branched pathways, theory of large deviations

UNIT V ANALYSIS OF METABOLIC NETWORKS 9

Control of flux distribution at a single branch point, Grouping of reactions, case studies, extension of control analysis to intermetabolite, optimization of flux amplifications, consistency tests and experimental validation.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Stephanopoulos, G.N. "Metabolic Engineering : Principles and Methodologies". Academic Press / Elsevier, 1998.
2. Lee, S.Y. and Papoutsakis, E.T. "Metabolic Engineering". Marcel Dekker, 1998.
3. Nielsen, J. and Villadsen, J. "Bioreaction Engineering Principles". Springer, 2007.

REFERENCES

1. Voit, E.O. "Computational Analysis of Biochemical Systems : A Practical Guide for Biochemists and Molecular Biologists". Cambridge University Press, 2000.
2. Scheper, T. "Metabolic Engineering" Vol 73 (Advances in Biochemical Engineering Biotechnology) Springer, 2001.
3. Rhodes, P.M. and P.F. Stanbury "Applied Microbial Physiology: Practical Approach". IRL Press, 1997.
4. Caldwell, D.R. "Microbial Physiology & Metabolism". Wm. C. Brown, 1995.
5. Rehm, H.J. and G. Reed, "Biotechnology : Products of Primary Metabolism Vol.6 and Biotechnology : Products of Secondary Metabolism Vol.7, VCH / Wiley, 1997.

FT 9027 DAIRY PRODUCT PROCESSING L T P C
3 0 0 3

AIM

The course aims to develop the knowledge of students in the area of dairy product processing and technology. This course will enable students to appreciate the application of scientific principles in the processing of these materials.

OBJECTIVES

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for milk and the various products derived from milk.
- Understand the application of scientific principles in the processing technologies specific to the materials.
- Grasp the changes in the composition of foods with respect to the type of processing technology used.

UNIT I PROCESSING OF MILK 9

Technology of milk and dairy products; Pasteurisation sterilization, HTST and UHT processes.

UNIT II MILK PRODUCTS 9

Manufacture of condensed milk, milk powder, cheese, ice-cream, butter, ghee, malted products, evaporated and dried products.

UNIT III MILK SUBSTITUTES 9

Substitutes for milk and milk products. Casein , lactose and other by-products.

UNIT IV TECHNOLOGY OF BABY FOODS 9

Weaning foods, therapeutic foods. Fortification and enrichment. Traditional dairy products. Milk confections.

UNIT V QUALITY PARAMETERS 9

Judging and grading of milk; National and international standards of milk and milk products, in plant sanitation and hygiene.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Eckles, C.H., W.B. Combs, and H. Macy " Milk and Milk Products". 4th Edition, Tata McGraw-Hill, 1973.
2. Andrews, A.T. and J. Varley "Biochemistry of Milk Products". Woodhead Publication, 2004.
3. Kapoor, Ajay. "Diary Science and Technology" Vishvabharti Publications, 2005.
4. Anantakrishnan, C.P., A.O. Khan, and P.N. Padmanabhan "Milk Products Preparation and Quality Control". Shri Lakshmi Publications, 1993.
5. Kapoor, Ajay "Milk and its Products". Vishvabharti Publications, 2005.
6. Atherton, Henry V. and J.A. Newlander "Chemistry & Testing of Diary Products". 4th Edition, CBS Publishers, 1987.
7. Welch, R.A.S. etal., "Milk Composition Production and Biotechnology". CAB International, 1997.
8. Spreer, Edgar "Milk and Diary Product Technology". Marcel Dekker, 2005.
9. Walstra, P. etal., "Diary Technology : Principles of Milk Properties and Processes". Marcel Dekker, 1999.

REFERENCES

1. Lampert, Lincoln M. "Modern Dairy Products: Composition, Food Value, Processing, Chemistry, Bacteriology, Testing, Imitation Dairy Products". Chemical Publishing Company, 1998.
2. Selia, Jane dos Reis Coimbra and Jose A. Teixeir "Engineering Aspects of Milk and Dairy Products". Jane Selia dos Reis Coimbra & Jose A. Teixeir, CRC Press, 2009.

IB 9402 PROTEIN ENGINEERING L T P C
3 0 0 3

UNIT I BONDS AND ENERGIES IN PROTEIN MAKEUP 5

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure.

UNIT II AMINO ACIDS AND THEIR CHARACTERISTICS 5

Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), , Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups) and peptide synthesis.

UNIT III PROTEIN ARCHITECTURE 12

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass-spec. High-throughput protein sequencing setup Secondary structure: Alpha, beta and loop structures and methods to determine

Super-secondary structure: Apha-turn-alpha, beta-turn-beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures, Quaternary structure: Modular nature, formation of complexes.

UNIT IV STRUCTURE-FUNCTION RELATIONSHIP 15

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eucaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers, Membrane proteins: General characteristics, Trans-membrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center, Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes: Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase, substrate-assisted catalysis other commercial applications.

UNIT V PROTEIN ENGINEERING 8

Advantages and purpose, overview of methods, underlying principles with specific examples: thermal stability T4-lysozyme, recombinant insulin to reduce aggregation and inactivation, *de novo* protein design.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Voet, D. and Voet, G., "Biochemistry". 3rd Edition, John Wiley and Sons, 2001.
2. Branden C. and Tooze J., "Introduction to Protein Structure", 2nd Edition, Garland Publishing, 1999.
3. Creighton, T.E. "Proteins : Structure and Molecular Properties", 2nd Edition, W.H. Freeman, 1993.

REFERENCES

1. Whitford, David "Proteins : Structure and Function". John Wiley & Sons, 2005.
2. Holland, I Barry & etal., "ABC Proteins : From Bacteria to Man". Academic Press Elsevier, 2003.
3. Alberghina, L. "Protein Engineering in Industrial Biotechnology". Harwood Academic Publications, 2000.
4. Moody P.C.E. and Wilkinson A.J. "Protein Engineering". IRL Press, Oxford, 1990.
5. Rees, A.R., Sternberg, M.J.E. and Wetzel, R. "Protein Engineering : A Practical Approach". IRL Press, 1992.

FT 9028 ENTREPRENEURSHIP L T P C
3 0 0 3

UNIT I

Should You Become an Entrepreneur? **9**
What Skills Do Entrepreneurs Need?
Identify and Meet a Market Need
Entrepreneurs in a Market Economy
Select a Type of Ownership

UNIT II **9**

Develop a Business Plan

UNIT III **9**

Choose Your Location and Set Up for Business
Market Your Business
Hire and Manage a Staff

UNIT IV **9**

Finance, Protect and Insure Your Business
Record Keeping and Accounting
Financial Management

UNIT V **9**

Meet Your Legal, Ethical, Social Obligations
Growth in Today's Marketplace

TOTAL : 45 PERIODS

TEXT BOOK

1. Entrepreneurship Ideas in Action—South-Western, 2000.

FT 9029 **OPERATION RESEARCH** **L T P C**
3 0 0 3

UNIT I **9**
Concept and Scope of Operation Research (OR) – Development of OR - Phases of OR – Models in OR. Linear Programming: Methods of solution – Graphical and SIMPLEX methods of solution – VARIATIONS – Duality in LP – Revised SIMPLEX method – Application for business and Industrial Problems.

UNIT II **9**
Integer programming: Formulation – Graphical Representation – Gomory's Cutting Plane Method. Transportation and Assignment Problems: Initial solution – Methods of improving the initial solution – travelling salesman Problem. Dynamic Programming – Principle of Optimality

UNIT III **9**
Sequencing and Scheduling Problems: Job sequencing – Jobs through Two Machines, Two Jobs through Machines and n Jobs through Machines. PERT and CFM techniques – Critical Path – Normal and crash time. Resource allocation – Resource Leveling and Smoothing

UNIT IV **9**
Inventory Problems: Deterministic model –Costs – Decision Variables – Economic order Quantity – Instantaneous and Non – Instantaneous receipt of goods with and without Shortage – Quantity Discount – Probabilistic inventory Model – Inventory systems– Safety Stock – Reorder Level (ROL) Reorder Point (ROP) determination.

UNIT V **9**
Maintenance and Replacement Problems: Models for routine maintenance and preventive maintenance decisions – Replacement models that deteriorate with time and those that fail completely. (srp/rm/vec)

TOTAL : 45 PERIODS

TEXT BOOKS
1. Sharma, S.D. "Operation Research" Kedarnath Ramnath & Co.
2. Gillet, Billy E. "Introduction to Operation Research", TMH Publishing Co.,
3. Gupta, P.K. and Manomohan "Operation Research and Quantitative Analysis", S.Chand & Co.,

REFERENCE
1. Hambleis, S. and Stevens "Operation Research" McGraw – Hill, Taha, H.A. "Operation Research", Macmillian.

IB 9401 **DOWNSTREAM PROCESSING** **L T P C**
3 0 0 3

UNIT I DOWNSTREAM PROCESSING **10**
Introduction to downstream processing principles characteristics of biomolecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilisation of bioproducts.

UNIT II PHYSICAL METHODS OF SEPERATION **6**
Unit operations for solid-liquid separation - filtration and centrifugation.

UNIT III ISOLATION OF PRODUCTS **12**
Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT IV PRODUCT PURIFICATION 12

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bioaffinity and pseudo affinity chromatographic techniques.

UNIT V FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS 5

Crystallization, drying and lyophilization in final product formulation.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Belter, P.A., Clussler, E.L. “Bioseparation – Downstream Processing & Biotechnology”. John – Wiley Interscience, 1998.
2. Asenjo, Juan A. “Separation Processes in Biotechnology”. Taylor & Francis / CRC, 1990.
3. Scopes, R.K. “Protein Purification : Principles and Practice”. Narosa Publication, 1994.

REFERENCES

1. Ghosh, Raja “Principles of Bioseparations Engineering”. World Scientific, 2006.
2. “Product Recovery in Bioprocess Technology”. (BIOTOL – Biotechnology by Open Learning Series). Butterworth – Heinmann / Elsevier, 2004.

FT 9030 GENETICALLY MODIFIED FOODS L T P C
3 0 0 3

UNIT I GENETIC ENGINEERING AND FOODS I 9

Genetically engineered proteins, Bovine Somatotropin in Milk ;Genetically engineered bacteria, Chymosin Lite beer; Tryptophan ,Transgenic plants , Calgene Flavr SavrTM tomato; Methionine-enriched oil ,

UNIT II GENETIC ENGINEERING AND FOODS II 9

Frost-resistance Drought and Salinity resistance , Herbicide Resistance , Monsanto Round-UpTM Ready ,Ciba Geigy BastaTM resistant crops Insect Resistance :*Bacillus thuringiensis* toxin ,Ciba Geigy, B.t. maize ,Monsanto Golden Harvest Seeds ,Fungal Resistance Bintje potatoes ,Virus Resistance

UNIT III PLANT PHARMACEUTICALS 9

Beta -carotene in rice ,transgenic "heart-healthy" canola oil; Edible vaccines ,Hepatitis B vaccine in maize ,Cholera vaccine in potatoes

UNIT IV TRANSGENIC ANIMALS 9

Growth hormone gene in pigs, *alpha*-lactalbumin and lactoferrin in milk ,Transgenic Fish ,Atlantic salmon

UNIT V ANIMAL CLONING 9

Biotechnology ; Benefits, Risks and Public Perceptions; The Environment, The Third World ,The Western World, Europe's Mistrust

TOTAL : 45 PERIODS

TEXT BOOKS

1. Ahmed, Farid E. “Testing of Genetically Modified Organisms in Foods”. Haworth Press, 2004.
2. Rees, Andy “Genetically Modified Food : A Short Guide for the Confused”. Pluto Press, 2006.
3. Halford, Nigel G. “Genetically Modified Crops”. Imperial College Press, 2003.

GE9071 CREATIVITY, INNOVATION AND NEW PRODUCT DEVELOPMENT **L T P C 3 0 0 3**

AIM

To study the various issues related to Creativity, Innovation and New Product Development.

OBJECTIVES

- To impart the knowledge of various aspects of Creativity, Innovation and New Product Development

UNIT I INTRODUCTION **9**

The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brain storming - different techniques

UNIT II PROJECT SELECTION AND EVALUATION **9**

Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques)

UNIT III NEW PRODUCT DEVELOPMENT **9**

Research and new product development - Patents - Patent search - Patent laws - International code for patents - Intellectual property rights (IPR).

UNIT IV NEW PRODUCT PLANNING **9**

Design of proto type - testing - quality standards - marketing research - introducing new products

UNIT V MODEL PREPARATION & EVALUATION **9**

Creative design - Model Preparation - Testing - Cost evaluation - Patent application

TOTAL: 45 PERIODS

TEXT BOOKS

1. Twiss, Brian. “Managing Technological Innovation”, Pitman Publishing Ltd., 1992.
2. Watton, Harry B. “New Product Planning”, Prentice Hall Inc., 1992.

REFERENCES

1. Nystrom, Harry “Creativity and Innovation”, John Wiley & Sons, 1979.
2. Khandwalla, N. – “Fourth Eye (Excellence through Creativity) - Wheeler Publishing”, 1992.
3. I.P.R. Bulletins, TIFAC, New Delhi, 1997.