# UNIVERSITY DEPARTMENTS

## ANNA UNIVERSITY CHENNAI :: CHENNAI 600 025

## REGULATIONS – 2008

## CURRICULUM FROM III & IV SEMESTERS FOR

# B.TECH. FOOD TECHNOLOGY

### SEMESTER – III

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

### SEMESTER – IV

| CODE NO | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|
| **THEORY** | | | | | |
| MA 9261 | Probability And Statistics | 3 | 1 | 0 | 4 |
| CY 9213 | Instrumental Methods of Analysis | 2 | 1 | 0 | 3 |
| CH 9034 | Fundamentals of Heat and Mass Transfer | 2 | 1 | 0 | 3 |
| FT 9251 | Food Microbiology | 2 | 1 | 0 | 3 |
| CH 9023 | Biochemical Engineering | 3 | 0 | 0 | 3 |
| GE 9021 | 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** | | | | **26** |

### MA9211 MATHEMATICS III

| L | T | P | C |
|---|---|---|---|
| 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

**1. 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.

**2. FOURIER TRANSFORM** **9+3**

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

**3. 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.

**4. 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.

**5. 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**

**TEXT BOOKS**

Grewal, B.S. “Higher Engineering Mathematics”, 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 (2007) Lakshmi Publications (P) Limited, New Delhi.

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

**Aim**

1. To understand the principles of Process calculations.
2. 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.

**1. 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.

**2. 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.

**3. Energy Balances 8**

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

**4. 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.

5. **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 Hrs**

**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 (an imprint of Elsevier), 2004.


**IB9204 CELL BIOLOGY 2 1 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 1: To provide to the students the fundamentals of cell biology and ability to solve problems in cell biology.
Objective 2: To help students understand the pathway mechanisms.

**1. Cell Structure and Function of the Organelles**
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.

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

**3. Transport across cell membrane**
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.

**4. Signal Transduction**

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

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

**REFERENCE:**


1. Darnell J, Lodish H, Baltimore D, Molecular Cell Biology, W.H.Freeman, 2005.
2. Alberts, Bruce, "Molecular Biology of Cell", 4th Edition, Garland Science, 2002.
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 3 0 0 3**

**Aim:** To introduce students to the principles of Microbiology to emphasize structure and biochemical aspects of various microbes.
Objective 1: To provide to the students the fundamentals of Microbiology and solve the problems in microbial infection and their control.

**Unit 1**
**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 2**
**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 3**
**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 4**
**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 5**
**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 hours**

**Text Books**


1. **Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 1993.**
2. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.
3. Prescott LM, Harley JP, Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 1996.


**CY9261 PHYSICAL CHEMISTRY 3 0 0 3**

**AIM** To understand important concepts in physical chemistry.

**Objective** (i) 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.

(ii) To understand the principles of thermodynamics in deciding the spontaneity of reactions and energy changes involved in physical and chemical processes.

(iii) To understand the principles of photochemistry and catalysis.

**UNIT 1 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 2 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 3 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 4 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 5 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

**Text Books**


1. Principles of physical chemistry:
   Puri B.R, Sharma L.R, Pathania, M.S. Vishal Publishing co. -41st Edition, 2006.
2. Physical Chemistry-P.W.Atkins, VI Edition.


**References**


1. Essentials of Physical Chemistry-Bahl B S, Tuli G D, Arun Bahl-S.Chand and Company Ltd.
2. Thermodynamics for chemists, Samuel Glasstone.
3. Physical Chemistry, Samuel Glasstone

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

**1. 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.

**2. Introduction to Organic Synthesis** **10**

Useful Organic Transformations Reterosynthetic Analysis. Case Studies : Synthesis of Cholesterol, Synthesis of Chlorophyll.

**3. Enzymes** **5**

MM kinetics – other mechanisms for enzyme action – Methods for following enzyme reactions – Analysis of Enzymatic reactions.

**4. 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.

**5. Catalysis by antibodies** – RNA catalysis – DNAzymes. **4**

**Text Books:**

1. Dugas, H. Bio-Organic chemistry: A Chemical Approach to Enzymes Action", 3rd Edition, Springer, 2003.
2. Morrison, R.T. and T.N. Boyd "Organic Chemistry", 6th Edition, Prentice Hall of India, 2003.
3. 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.

**FT9201 FOOD CHEMISTRY 2 1 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 1**
**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 2**
**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 3**
**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 4**
**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 5**

**Food groups & Composition** **5**

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

**Total No. of periods** **45**

**TEXT BOOKS**


1. Vaclavik, V. A. and Christian E. W. Essentials of Food Science, 2nd Edition, Kluwer-Academic, Springer, 2003.
2. Belitz,H.-D, Grosch W and Schieberle P. Food Chemistry, 3rd Revised Edition, Springer-Verlag, 2004.


**REFERNCE BOOKS**


1. Gopalan C. Rama Sastri B. V. and Balasubramanian S. C. Nutritive Value of Indian Foods, NIN, ICMR, 2004.
2. Walstra, P Physical Chemistry of Foods, Marcel Dekker Inc. 2003.
3. Food Chemistry – Fenema


**IB9208 MICROBIOLOGY LAB 0 0 4 2**

(**Common for IBT, Food and Pharmaceutical Technology)**

**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

**30 Hrs**

**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 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 30 hrs**

**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.

### 1. 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.

### 2. 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).

### 3. 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 – $\chi^2$-test for goodness of fit – Independence of attributes – Non-parametric tests: Test for Randomness and Rank-sum test (Wilcoxon test).

### 4. Design of Experiments 9 + 3

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

### 5. Statistical Quality Control 9 + 3

Control charts for measurements ($\overline{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

**L: 45, T: 15, Total : 60**

**TEXT BOOKS**


1. Milton, J. S. and Arnold, J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th edition, (2007).

2. Johnson, R.A. and Gupta, C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th edition, (2007).


**REFERENCES**


1. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, 7th edition, (2008).

2. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8th edition, (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 edition, (2004).

## CY9213 INSTRUMENTAL METHODS OF ANALYSIS 2 1 0 3

**Aim:** To introduce students to the principles and methods of biological instruments.

Objective 1: To provide to the students the fundamentals of instrument knowledge and their applications in biology.

**1. 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.

**2. 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.

**3. 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.

**4. Mass Spectrometry:** 10

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

**5. Electrochemical Measurements :** 10

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

**Textbooks :**

1. Instrumental Methods of Analysis , Skoog , BHI Publishers , 2002.
Instrumental Methods of Analysis , Willard and Meritt , PHI publishers, 2000

## CH 9034 FUNDAMENTALS OF HEAT AND MASS TRANSFER 3 0 0 3
## (Common for Food and Pharmaceutical Technology)

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

**Objectives:** 1. To understand and apply the principles in heat transfer phenomena
2. To understand and apply the principles in mass transfer phenomena
3. To design heat and mass transfer equipments.

**UNIT 1: 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 2: 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 3: 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 4: Distillation**

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 5: 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 Hours**

**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 2 1 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 1**

**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 2**

**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 3**

**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 4**

**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 5**

**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 HOURS**

**TEXT BOOKS**

1.Vijaya Ramesh Food Microbiology, MJP Publishers, Chennai, 2007
2.Jay JM Modern Food Microbiology4th Edition CBS Publishers and Distributors, New Delhi, 2003
3.Adams. MR and Moss, MO Food Microbiology, New Age International, New Delhi, 2002

**REFERENCES**

1. Pawsey R K *Case Studies in Food Microbiology for Food Safety and Quality,* The Royal Society of Chemistry, Cambridge 2001.
2. Forsythe SJ *The Microbiology of Safe Food* Blackwell Science, Oxford, 2000.
3. Harrigan W F 1998 Laboratory Methods in Food Microbiology 3rd Edition, Academic Press, London.

## CH9023 BIOCHEMICAL ENGINEERING 3 0 0 3

**(Common for Food and Pharmaceutical Technology)**

### 1. 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.

### 2. 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.

### 3. ENZYME IMMOBILIZATION 6

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

### 4. 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.

### 5.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 HOURS**

**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.


| GE9021 ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to all branches) | L | T | P | C |
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**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 1 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 2 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 3. 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 4. 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 5. 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**

**TEXT BOOKS**

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).

2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2006).

**REFERENCE BOOKS**

1. R.K. Trivedi, '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. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.

4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

**FT9021 GENETICS 2 1 0 3**

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

Objective 1: To provide to the students the fundamentals of classical genetics and ability to solve problems in genetics.
Objective 2: To help students understand sex determination mechanisms.
Objective 3: To enable students appreciate genetic recombination and mapping techniques.

**1. Classical Genetics**

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.

**2. Sex Determination, Sex Linkage and Pedigree Analysis**

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.

**3. Stucture of Chromosomes and variation in chromosome structure and Number.**

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.

**4. Linkage, Crossing Over and Chromosome Mapping in Eukaryotes**

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.

**5. Genetics of Bacteria and Viruses**

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.

**References:**


1. Principles of Genetics by Gardner Simmons and Snustad. (John wiley & Sons)
2. Principles of Genetics by S.Peter Smutted and Michael J. Simmons. John Wiley & Sons.
3. Genetics Analysis and Principles Robert J. Brookker (Addison – wiley)
4. Principles of Genetics by Robert H Tamarin – Tata Mc Graw Hill Company Ltd.,


**CY9214 INSTRUMENTAL METHODS OF ANALYSIS LAB 0 0 4 2**

**(Common for IBT, Food and Pharmaceutical Technology)**

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 : 30 Hrs**

**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”, 6th Edition, CBS, 1986.
4. Ewing,G.W. “Instrumental Methods of Chemical Analysis”, 5th Edition, McGraw-Hill, 1985.

**IB9256 CHEMICAL ENGINEERING LAB 0 0 4 2**

(**Common for IBT, Food and Pharmaceutical Technology)**

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 : 30 Hrs**

**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.