ANNA UNIVERSITY : : CHENNAI 600 025

UNIVERSITY DEPARTMENTS

R – 2008

B.TECH. INDUSTRIAL BIOTECHNOLOGY

III TO VIII SEMESTERS CURRICULA 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 9202	Basic Industrial Biotechnology	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
PRACTICAL					
IB 9206	Bioorganic Laboratory	0	0	4	2
IB 9207	Cell Biology Laboratory	0	0	4	2
IB 9208	Microbiology Laboratory	0	0	4	2
	TOTAL	**18**	**1**	**12**	**25**

SEMESTER IV

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
MA 9261	Probability & Statistics	3	1	0	4
IB 9251	Unit Operations	3	0	0	3
IB 9252	Chemical Thermodynamics & Bio thermodynamics	3	0	0	3
IB 9213	Instrumental Methods of Analysis	3	0	0	3
IB 9254	Genetics	3	0	0	3
GE 9261	Environmental Science and Engineering	3	0	0	3
	Elective I	3	0	0	3
PRACTICAL					
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.	SUBJECT	L	T	P	C
THEORY					
IB9301	Mass Transfer Operations	3	0	0	3
IB9302	Bioprocess Principles	3	0	0	3
IB9303	Enzyme Engineering & Technology	3	0	0	3
IB9304	Biochemistry II	3	0	0	3
IB9305	Molecular Biology*	3	0	0	3
	Elective III: Professional Ethics in Engineering[#]	3	0	0	3
	Elective IV	3	0	0	3
PRACTICAL					
IB9306	Bioprocess Lab I	0	0	6	3
IB9307	Molecular Biology Lab*	0	0	4	2
	TOTAL	**21**	**0**	**10**	**26**

Professional Ethics in Engineering[#] **- Compulsory elective for all**

SEMESTER: VI

CODE NO.	SUBJECT	L	T	P	C
Theory					
IB9351	Chemical Reaction Engineering*	3	0	0	3
IB9352	Bioprocess Engineering	3	0	0	3
IB9353	Genetic Engineering *	3	0	0	3
IB9309	Process Economics and Industrial Management[@]	3	0	0	3
	Elective V	3	0	0	3
	Elective VI	3	0	0	3
Practical					
IB9356	Bioprocess Lab II	0	0	6	3
IB9355	Genetic Engineering Lab*	0	0	4	2
GE9371	Communication Skills and Soft skills Lab[#]	0	0	2	1
	TOTAL	**18**	**0**	**12**	**24**

SEMESTER: VII

CODE NO.	SUBJECT	L	T	P	C
Theory					
IB9401	Downstream processing	3	0	0	3
IB9402	Protein Engineering [@]	3	0	0	3
IB9403	Immunology*	3	0	0	3
IB9404	Bioinformatics[@]	3	0	0	3
	ElectiveVII: [#]	3	0	0	3
	Elective VIII	3	0	0	3
Practical					
IB9405	Analytical Techniques in Biotechnology lab	0	0	4	2
IB9406	Downstream processing Laboratory	0	0	4	2
IB9407	Immunology Laboratory	0	0	4	2
	TOTAL	**18**	**0**	**12**	**24**

SEMESTER: VIII

CODE NO.	SUBJECT	L	T	P	C
IB9451	Project Work	0	0	12	6
	TOTAL	**0**	**0**	**12**	**6**

*** :** Common to IBT, Food and Pharmaceutical Technology
@: Core for IBT but Electives for Food and Pharmaceutical Technology

Total No. of Credits for 8 Semesters – 185

LIST OF ELECTIVES

CODE	SUBJECT	L	T	P	C
IB9021	Plant Biotechnology	3	0	0	3
IB9022	Animal Biotechnology	3	0	0	3
CH9353	Process Instrumentation Dynamics and Control	3	0	0	3
IB9023	Bioconjugate Technology and Applications	3	0	0	3
IB9024	Metabolic Engineering	3	0	0	3
IB9025	Principles of Food Processing	3	0	0	3
IB9026	Biopharmaceutical Technology	3	0	0	3
IB9027	Bioprocess Economics and Plant Design	3	0	0	3
IB9028	Process Equipments and Plant Design	3	0	0	3
IB9029	Cancer Biology	3	0	0	3
IB9030	Biological Spectroscopy	3	0	0	3
IB9031	Genomics and Proteomics	3	0	0	3
IB9032	Molecular Pathogenesis	3	0	0	3
IB9033	Biophysics	3	0	0	3
IB9034	Molecular Modeling	3	0	0	3
IB9035	Neurobiology and Cognitive Sciences	3	0	0	3
GE9021	Professional Ethics in Engineering	3	0	0	3
GE9022	Total Quality Management	3	0	0	3
GE9024	Nanoscience and Technology	3	0	0	3

LANGUAGE ELECTIVES FOR BIOTECHNOLOGY BRANCH

CODE	COURSE TITLE	L	T	P	C
GE 9071	Creativity, Innovation And New Product Development	2	0	2	3
HS	Technical Tamil	3	1	0	4
HS	Technical German-I	3	1	0	4
HS	Technical German – II	3	1	0	4
HS	Technical Japanese – I	3	1	0	4
HS	Technical Japanese – II	3	1	0	4
HS	Technical French – I	3	1	0	4
HS	Technical French– II	3	1	0	4
HS	Technical English – I	3	1	0	4
HS	Technical English – II	3	1	0	4

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

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 BOOK

1. Grewal, B.S. "Higher Engineering Mathematics". 40thEdition. 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 9

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 (an imprint of Elsevier), 2004.

IB9202 BASIC INDUSTRIAL BIOTECHNOLOGY L T P C
3 0 0 3

UNIT I INTRODUCTION TO INDUSTRIAL BIOPROCESS 7

A historical overview of industrial fermentation process – traditional and modern biotechnology. A brief survey of organisms, processes, products relating to modern biotechnology. Process flow sheeting – block diagrams, pictorial representation.

UNIT II PRODUCTION OF PRIMARY METABOLITES 10

A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid etc.,); amino acids (glutamic acid, phenyalanine, aspartic acid etc.,) and alcohols (ethanol, butanol etc.,)

UNIT III PRODUCTION OF SECONDARY METABOLITES 10

Study of production processes for various classes of secondary metabolites: antibiotics: beta-lactams (penicillin, cephalosporin etc.), aminoglycosides (streptomycin etc.,) macrolides (erythromycin), vitamins and steroids.

UNIT IV PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS 8

Production of industrial enzymes such as proteases, amylases, lipases, cellulases etc.,. Production of biopesticides, biofertilisers, biopreservatives (Nisin), cheese, biopolymers (xanthan gum, PHB etc.,), single cell protein.

UNIT V PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS 10

Production of recombinant proteins having therapeutic and diagnostic applications, production of vaccines. Production of monoclonal antibodies. Products of plant and animal cell culture.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Satyanarayana, U. “Biotechnology” Books & Allied (P) Ltd., 2005.
2. Kumar, H.D. “A Textbook on Biotechnology” 2nd Edition. Affiliated East West Press Pvt. Ltd., 1998.
3. Balasubramanian, D. etal., “Concepts in Biotechnology” Universities Press Pvt.Ltd., 2004.
4. Ratledge, Colin and Bjorn Kristiansen “Basic Biotechnology” 2nd Edition Cambridge University Press, 2001.
5. Dubey, R.C. “A Textbook of Biotechnology” S.Chand & Co. Ltd., 2006.

REFERENCES

1. Casida, L.E. “Industrial Microbiology”, New Age International (P) Ltd, 1968.
2. Presscott, S.C. and Cecil G. Dunn, “Industrial Microbiology”, Agrobios (India), 2005.
3. Cruger,Wulf and Anneliese Crueger, “Biotechnology: A Textbook of Industrial Microbiology”, 2nd Edition, Panima Publishing, 2000.
4. Moo-Young, Murrey, “Comprehensive Biotechnology”, 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004.

IB9203 **BIOORGANIC 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

TEXTBOOKS

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**

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

OBJECTIVES

- 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 8

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 10

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

TEXT BOOKS

1. Lodish, Harvey etal., “Molecular Cell Biology”, 5th Edition, W.H.Freeman, 2005.
2. Cooper, G.M. and R.E. Hansman “The Cell : A Molecular Approach”, 4th Edition, ASM Press, 2007.
3. Alberts, Bruce etal., “Molecular Biology of the Cell”, 4th Edition, Garland Science (Taylors Francis), 2002.
4. Sadava, D.E. “Cell Biology : Organelle Structure and Funtion”, Panima Publishing, 2004.
5. Rastogi, S.C. “Cell Biology” 2nd Edition, New Age International, 2002.

REFERENCES

1. Becker, W.M. etal., “The World of the Cell”, 5th Edition, Pearson Education, 2003.
2. Campbell, N.A., J.B. Recee and E.J. Simon “Essential Biology”, 3rd Edition,Pearson International, 2007.
3. Alberts, Bruce etal., “Essential Cell Biology”, 2nd Edition, Garland Press (Taylor & Francis), 2004.

IB9205 **MICROBIOLOGY** **L T P C**

(Common for IBT, Food and Pharmaceutical Technology) **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. “Microbiology”, 5th Edition, Tata McGraw-Hill, 1993.
2. Ananthanarayanan, R. and C.K. Jayaram Paniker, “Textbook of Microbiology”,4th Edition, Orient Longman, 1990.
3. Stanier, R.Y. etal., “General Microbiology”, 5th Edition, Macmillan, 1986.
4. Casida, L.E. “Industrial Microbiology”, New Age International, 1968.
5. Schlegel, H.G. “General Microbiology”, 7th Edition, Cambridge University Press, 1993.

REFERENCES

1. Nester, E.W. etal., “Microbiology : A Human Prespective”, 4th Edition, McGraw- Hill, 2004.
2. Talaro, K.T. and Arthur Talaro “Foundations in Microbiology”, 2nd Edition, Wm.C. Brown Publisher, 1996.
3. Prescott, L.M. “Microbiology”, 6th Edition, McGraw-Hill, 2005.
4. Prescott, S.C. and Cecil G. Dunn “Industrial Microbiology”, Agrobios (India), 2005.

IB9206 **BIOORGANIC LAB** **L T P C**
0 0 4 2

1. Synthesis of aspirin
2. Hydrolysis of sucrose
3. Preparation of pyruvic acid from tartaric acid
4. Preparation of oleic acid from tartaric acid
5. Preparation of alpha d- glucopyranose pentaacetate
6. Preparation of 1,2,5,6 dicyclohexylnoine alpha d glucofuranose
7. Isolation of lycopene from tomato paste
8. Preparation of l-proline
9. Preparation of l-cysteine from hair
10. Preparation of s-ethyl hydroxybutonate from ethyl acetoacetate using yeast
11. Resolution of s-ethyl hydroxybutonate using 3,5 dinitrobenzoate.
12. Preparation of 5,10,15,20-tetrakisphenyl porphyrin.

TOTAL: 60 PERIODS

REFERENCE

1. Fummis B.S., Hannaford A.J., Smith P.W.G., "Text Book Of Practical Organic Chemistry ", Longman Edition, 1995.

IB9207 **CELL BIOLOGY LAB** **L T P C**
(Common to IBT and food only) **0 0 4 2**

1. Introduction to principles of sterile techniques and cell propagation
2. Principles of microscopy, phase contrast and fluorescent microscopy
3. Identification of given plant, animal and bacterial cells and their components by microscopy
4. Gram's Staining
5. Leishman Staining
6. Giemsa Staining
7. Thin Layer Chromatography
8. Separation of Peripheral Blood Mononuclear Cells from blood
9. Osmosis and Tonicity
10. Tryphan Blue Assay
11. Staining for different stages of mitosis in AlliumCepa (Onion)

TOTAL: 60 PERIODS

REFERENCES

1. Rickwood, D. and J.R. Harris "Cell Biology : Essential Techniques", Johnwiley, 1996.
2. Davis, J.M. "Basic Cell Culture : A Practical Approach", IRL, 1994.

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.

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 ($\overline{X}$ 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.

IB9251 UNIT OPERATIONS L T P C

3 0 0 3

UNIT I MIXING AND AGITATION 8

Dimensional analysis; power for agitation; agitation of liquids; gas-liquid systems; gas-solid suspensions; agitator scale up.

UNIT II FILTRATION 8

Constant pressure, constant volume batch filtration; continuous filtration; industrial filters; settling and sedimentation; centrifugation.

UNIT III MECHANISM OF HEAT TRANSFER 10

Steady state conduction; combined resistances; unsteady state conduction; lumped heat capacity; extended surfaces; combined conduction and convection.

UNIT IV CONVECTION HEAT TRANSFER 10

Dimensional analysis; forced and natural convection; convection in flow over surfaces through pipes boiling and condensation.

UNIT V HEAT EXCHANGERS 9

Equipments; overall heat transfer coefficients; design of heat exchangers; NTU concept; evaporators; single and multiple effects; mass and enthalpy balances.

TOTAL: 45 PERIODS

TEXT BOOKS

1. McCabe, W.L., J.C. Smith and P. Harriott "Unit Operations of Chemical Engineering", 6th Edition, McGraw-Hill, 2001.
2. Geankoplis, C.J. "Transport Process and Separation Process Principles", 4th Edition, Prentice Hall of India, 2005.

REFERENCE

1. Incropera F.P. "Fundamentals Of Heat And Mass Transfer", John Wiley,1998.

IB9252 CHEMICAL THERMODYNAMICS AND BIO THERMODYNAMICS L T P C
3 0 0 3

UNIT I THERMODYNAMIC PROPERTIES OF FLUIDS 9

Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications.

UNIT II SOLUTION THERMODYNAMICS 9

Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient; composition models; Gibbs Duhem equation.

UNIT III PHASE EQUILIBRIA 9

Criteria for phase equilibria; v-l-e calculations for binary and multi component systems; liquid-liquid equilibria and solid-solid equilibria.

UNIT IV CHEMICAL REACTION EQUILIBRIA 9

Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.

UNIT V THERMODYNAMIC ANALYSIS OF PROCESSES 9

Concept of lost work; entropy generation; calculation of real irreversible processes; power cycle; liquefaction.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Smith J.M., Van Ness H.C., and Abbot M.M. "Introduction to Chemical Engineering Thermodynamics", 6th Edition. Tata McGraw-Hill, 2003.
2. Narayanan K.V. "A Text Book of Chemical Engineering Thermodynamics", PHI, 2003.

REFERENCE

1. Sandler S.I. "Chemical and Engineering Thermodynamics", John Wiley,1989.

IB9213 INSTRUMENTAL METHODS OF ANALYSIS L T P C
(Common for IBT, Food and Pharmaceutical Technology) **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 8
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 7
Different types of electrochemical apparatus – Measuring Electrode potentials- Red-Ox proteins – Porous Silicon.

TOTAL: 45 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”, 6th Edition, CBS, 1986.
4. Ewing,G.W. “Instrumental Methods of Chemical Analysis”, 5th Edition, McGraw-Hill, 1985.

IB9254 **GENETICS** **L T P C**

(Common to IBT and Food Technology only) **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 5

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 10

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 STRUCTURE OF CHROMOSOMES AND VARIATION IN CHROMOSOME STRUCTURE AND NUMBER 10

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 10

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 10

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. etal., "Principles of Genetics", 8th Edition, John Wiley & Sons, 1991.
2. Tamarin, R.H. "Principles of Genetics", 7th Edition, Tata McGraw-Hill, 2002.
3. Sambamurthy, A.V.S.S. "Genetics", 2nd Edition, Narosa, 2005.

REFERENCES

1. Snustad, D.P. "Principles of Genetics", 2nd Edition, John Wiley & Sons, 2000.
2. Hartl, D.L. "Genetics", 3rd Edition, Jones and Bartlett Pub., 1994.
3. Miglani, G.S. "Advanced Genetics", Narosa, 2002.

GE9261 ENVIRONMENTAL 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 (h) e-waste – 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. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, 2006.

REFERENCES

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., 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

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

TEXT BOOKS

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 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

IB9301 MASS TRANSFER OPERATIONS L T P C

3 0 0 3

UNIT I DIFFUSION AND MASS TRANSFER 9

Molecular diffusion in fluids and solids; Interphase Mass Transfer; Mass Transfer coefficients; Analogies in Transport Phenomenon.

UNIT II GAS LIQUID OPERATIONS 9

Principles of gas absorption; Single and Multi component absorption; Absorption with Chemical Reaction; Design principles of absorbers; Industrial absorbers; HTU, NTU concepts.

UNIT III VAPOUR LIQUID OPERATIONS 9

V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCABE-THIELE & PONCHON-SAVARIT Principles; Industrial distillation equipments, HETP, HTU and NTU concepts.

UNIT IV EXTRACTION OPERATIONS 9

L-L equilibria, Staged and continuous extraction, Solid-liquid equilibria, Leaching Principles.

UNIT V SOLID FLUID OPERATIONS 9

Adsorption equilibria – Batch and fixed bed adsorption; Drying-Mechanism-Drying curves-Time of Drying; Batch and continuous dryers.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Treybal R.E. Mass Transfer Operations.3rd Edition. Mcgraw Hill, 1981.
2. Geankoplis C.J. Transport Processes and Unit Operations. 3rd Edition, Prentice Hall of India, 2002.

REFERENCE

1. Coulson and Richardson's Chemical Engineering. Vol I & II, Asian Books Pvt Ltd, 1998.

IB9302 BIOPROCESS PRINCIPLES L T P C
3 0 0 3

UNIT I OVERVIEW OF FERMENTATION PROCESSES 6

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 II RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS 10

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

UNIT III STERILIZATION KINETICS 6

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 IV 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.

UNIT V KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION 11

Batch cultivation and continuous cultivation. Simple unstructured 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. Biomass estimation – Direct and Indirect 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.
4. Stanbury, P.F., A. Whitaker and S.J. Hall "Principles of Fermentation Technology", 2nd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.
5. Shuler, M.L. and F. Kargi. Bioprocess Engineering : Basic Concepts" 2nd Edition. Pearson, 2002.

IB9303 ENZYME ENGINEERING AND TECHNOLOGY L T P C
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 12

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 8

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

UNIT IV PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES 8

Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays.

UNIT V ENZYME BIOSENSORS 8

Application of enzymes in analysis; design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Palmer, Trevor "Enzymes : Biochemistry, Biotechnology, Clinical Chemistry", Affiliated East-West Press Pvt. Ltd., 2004.
2. Bailey, J.E. and Ollis, D.F. "Biochemical Engineering Fundamentals", 2nd Edition, McGraw-Hill, 1986.
3. Blanch, H.W. and D.S. Clark. "Biochemical Engineering". Marcal & Dekker, Inc., 1997.

REFERENCES

1. Lee, James M. "Biochemical Engineering", Prentice – Hall, 1992.
2. Wiseman, Alan "Handbook of Enzyme Biotechnology", 3rd Edition, Ellis Harwood Publications, 1999.
3. Hartmeier, Winfried "Immobilized Biocatalysts : An Introduction", Springer – Verlag,1986.

IB9304 BIOCHEMISTRY-II L T P C
3 0 0 3

UNIT I METABOLISM OF AMINO ACIDS 10

Nitrogen metabolism and urea cycle. Biosynthesis of Gly, Ser and Cys; Biosynthesis of six essential amino acids (Met, Thr, Lys, Ile, Val, Leu) and regulation of branched chain amino acids (concerted inhibition, allosteric regulation and enzyme multiplicity, sequential feed back) from oxaloacetate and pyruvate; Biosynthesis of aromatic amino acids. Metabolic disorders associated with branched chain and aromatic amino acid degradation. Important molecules derived from amino acids (auxins, DOPA, Serotonin, porphyrins, T3, T4, Adrenaline, Noradrenaline, histamine, GABA, polyamines etc)

UNIT II PROTEIN TRANSPORT AND DEGRADATION 5

Protein targeting, signal sequence, secretion; Folding, Chaperons and targeting of organelle proteins, Protein degradation, receptor-mediated endocytosis, turnover.

UNIT III METABOLISM OF NUCLEIC ACIDS, POLYSACCHARIDES AND LIPIDS 15

Biosynthesis of nucleotides, denovo and salvage pathways for purines and pyrimidines, regulatory mechanisms: Degradation of nucleic acid by exo and endo nucleases. Biosynthesis and degradation of starch and glycogen, Biosynthesis and degradation of Lipids: Fatty acid synthesis and oxidative degradation, Triacylglycerol and phospholipid biosynthesis and degradation; Cholesterol biosynthesis and regulation and targets and action of cholesterol lowering drugs. Vitamins (fat and water-soluble), Co-enzymes, hormones (steroids like corticoids, amino acids derived like adrenaline and noradrenaline and peptides like insulin and growth hormone).

UNIT IV STRUCTURAL PROTEINS AND CYTOSKELETON 5

Contractile proteins, Actin, myosin, actin polymerization, acto-myosin complexes, mechanism of myosin ATPase activity, excitation- contraction coupling and relaxation, microtubules, microfilaments and their role in organelle movements

UNIT V BIOMEMBRANE, TRANSPORT AND ELECTRICAL CONDUCTIVITY 10

Micelles, lipid bilayer structure of membranes, membrane proteins, passive, career-mediated and active transport, ion-selective channels, trans-membrane potential coupled ATP generation, receptors, acetylcholine receptor as a ligand gated ion-channel, Neuronal sodium channel as voltage-gated ion channel, neurotransmitters and their mechanism of action, action potential, depolarization and nerve conduction. Ion-channel agonists and antagonists as drugs. Ion channel defects (Cystic Fibrosis)

TOTAL: 45 PERIODS

TEXT BOOKS

1. Nelson, D.L etal., “Lehninger's Principles of Biochemistry”
2. Stryer, Lubert. “Biochemistry”. 4th Edition, W.H Freeman & Co., 2000.
3. Voet, D.J and J.G. Voet and C.W. Pratt “Principles of Biochemistry” 3rdEdition, John Wiley & Sons Inc., 2008.
4. Murray, R.K., etal., “Harper’s Illustrated Biochemistry”. 27th Edition. McGraw-Hill, 2006.

REFERENCES

1. Creighton. T.E., “Proteins : Structure and Molecular Properties” 2nd Edition, W.H. Freeman and Co.,1993.
2. Salway, J.G., “Metabolism at a Glance”. 2nd Edition, Blackwell Science Ltd., 2000.

IB9305 **MOLECULAR BIOLOGY** **L T P C**
3 0 0 3

UNIT I STRUCTURE OF NUCLEIC ACIDS AND DNA REPLICATION 10

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 II TRANSCRIPTION 8

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

UNIT III TRANSLATION 10

Elucidation of genetic code, mechanism, codon usage, suppressor mutation

UNIT IV REGULATION OF GENE EXPRESSION 9

Operons: prokaryotic gene regulation; Lac and trp operon , Lamda phage life cycle and gene regulation

UNIT V MUTAGENESIS AND REPAIR 8

Mutagens, DNA mutations and their mechanism, various types of repair mechanisms

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.

IB9306 **BIOPROCESS LAB I** **L T P C**
0 0 6 3

1. Growth of bacteria – estimation of biomass, calculation of specific growth rate, yield coefficient
2. Growth of yeast – estimation of biomass, calculation of specific growth rate, yield coefficient
3. Medium optimization – plackett burman design
4. Medium optimization – response surface methodology
5. Enzyme kinetics – Michelis Menton parameters
6. Enzyme activity – effect of temperature and pH
7. Enzyme inhibition kinetics
8. Enzyme immobilization – gel entrapment
9. Enzyme immobilization – cross linking
10. Preparation of bioreactor, utilities for bioreactor operation

TOTAL : 90 PERIODS

REFERENCES

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.
4. Stanbury, P.F., A. Whitaker and S.J. Hall "Principles of Fermentation Technology", 2nd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995

IB9307 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. Lamda phage lysis of liquid cultures

TOTAL: 60 PERIODS

REFERENCES

1. Ausubel, F.M. "Short Protocols in Molecular Biology", 4th Edition, John Wiley, 1999.
2. Stephenson, F.H. "Calculations in Molecular Biology and Biotechnology : A Guide to Mathematics in the Laboratory". Academic Press / Elsevier, 2003.

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.

IB9352 BIOPROCESS ENGINEERING L T P C
3 0 0 3

UNIT I OPERATIONAL MODES OF BIOREACTORS 10

Fed batch cultivation, Cell recycle cultivation, Cell recycle cultivation in waste water treatment, two stage cultivation, Packed bed reactor, airlift reactor, fluidized bed reactor, bubble column reactors

UNIT II BIOREACTOR SCALE – UP 8

Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors - microbial oxygen demands; methods for the determination of mass transfer coefficients; mass transfer correlations. Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed.

UNIT III BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS 8

Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation of dimensionless groups and calculation of effectiveness factors. Design of immobilized enzyme reactors – packed bed, fluidized bed and membrane reactors

UNIT IV MODELLING AND SIMULATION OF BIOPROCESSES 12

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. Dynamic simulation of batch, fed batch, steady and transient culture metabolism.

UNIT V RECOMBINANT CELL CULTIVATION 7

Different host vector system for recombinant cell cultivation strategies and advantages. E.coli, yeast Pichia pastoris/ Saccharomyces cereviseae, Animal cell cultivation, plant cell cultivation, Insect cell cultivation. High cell density cultivation, process strategies, reactor considerations in the above system

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.

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, transgenic and knockout animals.

TOTAL : 45 PERIODS

TEXT BOOK

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.

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.
5. Glick, B.R. and J.J. Pasternak "Molecular Biotechnology : Principles and Applications of Recombinant DNA", 3rd Edition, ASM, 2003.

IB9309 PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT L T P C
3 0 0 3

AIM

To introduce process economics and industrial management principles to biochemical 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 organizations Method of 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; replacement 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 Edition., McGraw Hill, 2002.
2. Holand, F.A., Watson, F.A. and Wilkinson, J.K., " Introduction to process Economics ", 2nd Edition., John Wiley, 1983.
3. Narang, G.B.S. and Kumar, V., " Production and Costing ", Khanna Publishers,1988.

REFERENCES

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

IB9356 BIOPROCESS LAB II L T P C
0 0 6 3

1. Thermal death kinetics
2. Batch sterilization design
3. Batch cultivation, estimation of K_La – dynamic gassing method, exhaust gas analysis – carbon balancing, gas balancing
4. Fed batch cultivation, exhaust gas analysis – carbon balancing, gas balancing
5. Total cell retention cultivation, exhaust gas analysis – carbon balancing, gas balancing
6. Estimation of K_La – sulphite oxidation method
7. Estimation of K_La – power correlation method
8. Residence time distribution
9. Estimation of overall heat transfer coefficient
10. Continuous cultivation – x-d diagram, pulse and shift method, evaluation of kinetic parameters, exhaust gas analysis – carbon balancing, gas balancing.

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,
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.

IB9355 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

REFERENCES

1. Stephenson, F.H. "Calculations in Molecular Biology and Biotechnology : A Guide to Mathematics in the Laboratory". Academic Press / Elsevier, 2003.
2. Sambrook, Joseph and David W. Russell "The Condensed Protocols : From Molecular Cloning ; A Laboratory Manual" Cold Spring Harbor Laboratory Press, 2006.

GE9371 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 15 PERIODS

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.

II. Class Room Session	**45 periods**

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.

TOTAL: 60 PERIODS

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

IB9401 DOWNSTREAM PROCESSING L T P C
3 0 0 3

UNIT I DOWNSTREAM PROCESSING 8

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 7

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.

IB9402 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.

IB9403 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

TEXT BOOKS

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.

IB9404 BIOINFORMATICS L T P C

3 0 0 3

UNIT I INTRODUCTION 9

Basic UNIX commands – telnet – ftp – protocols – hardware – topology -search engines – search algorithms.

UNIT II DATABASES 9

Data management – data life cycle – database technology – interfaces and implementation – biological databases and their uses

UNIT III PATTERN MATCHING & MACHINE LEARNING 9

Pairwise sequence alignment – local vs. global alignment – multiple sequence alignment – dot matrix analysis – substitution matrices – dynamic programming – bayesian methods – tools – BLAST – FASTA- machine learning – neural networks – statistical methods – Hidden Markov models.

UNIT IV PHYLOGENY 9

Introduction; mutations; irrelevant mutations; controls; mutations as a measure of time; distances; reconstruction; distances between species; estimating time intervals from distances.

UNIT V ADVANCED TOPICS IN BIOINFORMATICS 9

Biomolecular and cellular computing – micro array analysis – systems biology.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Bergeron,B. "Bioinformatics Computing". PHI, 2002.
2. Westhead, D.R., Parish, J.H., Twyman, R.M., "Instant Notes In Bioinformatics". BIOS Scientific Publishers, 2000.
3. Gibas, C. and Jambeck,P. "Developing Bioinformatics Skills", O'Reilly, 1999.

REFERENCES

1. Baxevanis, A.D. "Bioinformatics : A Practical Guide to the Analysis of Genes and Proteins", John Wiley, 1998.
2. Gusfield, Dan "Algorithms on Strings, Trees and Sequences : Computer Science and Computational Biology". Cambridge University Press, 1997.
3. Lesk, A.M. "Introduction to Bioinformatics", Oxford University Press, 2003.
4. Attwood, T.K. "Introduction to Bioinformatics" Addison Wesley Longman, 1999.
5. Gautham, N. "Bioinformatics : Databases and Algorithms", Narosa, 2006.

IB9405 ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY LAB L T P C
(Demonstrations & Seminar) **0 0 4 2**

1. Principles of various types of centrifugation
2. Principles of Chromatography: TLC - Paper & Silica, Column – Silica and Alumina, HPLC
3. Principles of Electrophoresis – 2D gel & Isoelectric focusing.
4. Principles of Immunological techniques – ELISA, Cell identification using monoclonal antibodies & PCR FACS.
5. Principles of electroporation RFLP & DNA sequencing.
6. Running of a pilot fermentor.

TOTAL: 60 PERIODS

TEXT BOOKS

1. Schalkhammer, Thomas G.M. "Analytical Biotechnology". (Methods and Tools in Biosciences and Medicine). Birkhauser / Springer, 2002.
2. Asokan, P. "Analytical Biochemistry : Biochemical Techniques". Chinna Publications, 2001.
3. Srivastava, M.L. "Bioanalytical Techniques". Narosa, 2008.
4. Kealey, D. and P.J. Haines "Instant Notes Analytical Chemistry". Viva Books Pvt. Ltd., 2002.
5. Holme, David J. and Hazel Peck "Analytical Biochemistry", 3rd Edition. Addison Wesley Longman Ltd., 1998.
6. Stephenson, F.H. "Calculations in Molecular Biology and Biotechnology : A Guide to Mathematics in the Laboratory". Academic Press / Elsevier, 2003.
7. Segel, Irwin H. "Biochemical Calculations : How to Solve Mathematical Problems in General Biochemistry". 2nd Edition, John Wiley & Sons, 2004.

IB9406 DOWNSTREAM PROCESSING LAB L T P C
0 0 4 2

1.Solid liquid separation – centrifugation, microfiltration
2.Cell disruption techniques – ultrasonication, French pressure cell
3.Cell disruption techniques – dynomill – batch and continuous
4.Precipitation – ammonium sulphite precipitation
5.Ultra filtration separation
6.Aqueous two phase extraction of biologicals
7.High resolution purification – affinity chromatography
8.High resolution purification – ion exchange chromatography
Product polishing – spray drying, freeze drying

TOTAL : 60 PERIODS

REFERENCES

1. Belter, P.A., Clussler, E.L. "Bioseparation – Downstream Processing & Biotechnology". John – Wiley Interscience, 1998.
2. Scopes, R.K. "Protein Purification : Principles and Practice". Narosa Publication, 1994.
3. "Product Recovery in Bioprocess Technology". (BIOTOL – Biotechnology by Open Learning Series). Butterworth – Heinmann / Elsevier, 2004

IB9407 **IMMUNOLOGY LAB** **L T P C**
0 0 4 2

1. Handling of animals, immunization and raising antisera
2. Identification of cells in a blood smear
3. Identification of blood group
4. Immunodiffusion & immunoelectrophoresis
5. Testing for typhoid antigens by Widal test
6. Enzyme Linked ImmunoSorbent Assay (ELISA)
7. Isolation of peripheral blood mononuclear cells
8. Isolation of monocytes from blood
9. Immunofluorescence
10. Identification of t cells by T-cell rossetting using sheep RBC.

TOTAL: 60 PERIODS

REFERENCES

1. Hay, Frank C. and Olwyn M.R.Westwood. "Practical Immunology" 4th Edition, Blackwell Science, 2002.
2. Talwar, G.P. and S.K.Gupta. "A Handbook of Practical and Clinical Immunology". Vol.1 and CBS Publishers, 1992.

IB9021 **PLANT BIOTECHNOLOGY** **L T P C**
3 0 0 3

UNIT I ORGANIZATION OF GENETIC MATERIAL 9

Genetic material of plant cells – nucleosome structure and its biological significance; junk and repeat sequences; outline of transcription and translation.

UNIT II CHLOROPLAST & MITOCHONDRIA 9

Structure, function and genetic material; rubisco synthesis and assembly, coordination, regulation and transport of proteins. Mitochondria: Genome, cytoplasmic male sterility and import of proteins.

UNIT III NITROGEN FIXATION 9

Nitrogenase activity, nod genes, nif genes, bacteroids.

UNIT IV AGROBACTERIUM & VIRAL VECTORS 9

Pathogenesis, crown gall disease, genes involved in the pathogenesis, Ti plasmid – t-DNA, importance in genetic engineering. Viral Vectors: Gemini virus, cauliflower mosaic virus, viral vectors and its benefits.

UNIT V APPLICATION OF PLANT BIOTECHNOLOGY 9

Outline of plant tissue culture, transgenic plants, herbicide and pest resistant plants, molecular pharming , theraputic products.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Slater, Adrian. etal., "Plant Biotechnology : The Genetic Manipulation of Plants". 2nd Edition, Oxford University Press, 2008.
2. Nirmala, C.B., G.Rajalakshmi and Chandra Karthick. " Plant Biotechnology". MJP Publishers, 2009.
3. Schuler, Mary A. and Raymond E. Zielinski " Methods in Plant Molecular Biology". Academic Press / Elsevier, 2005.
4. Heldt, Hans-Walter. "Plant Biochemistry". 3rd Edition, Elsevier, 2005.
5. Dey, P.M. and J.B. Harborne. " Plant Biochemistry". Harcourt Asia Pvt.Ltd., 2000.

REFERENCES

1. Grierson, D. and S.N. Covey "Plant Molecular Biology" 2nd Edition, Blackie,1988.
2. Gilmartin, P.M. and C.Bowler. "Molecular Plant Biology : Practical Approach." Vol.I & II. Oxford University Press, 2005

IB9022 ANIMAL BIOTECHNOLOGY L T P C

3 0 0 3

UNIT I ANIMAL CELL CULTURE 12

Introduction to basic tissue culture techniques; chemically defined and serum free media; animal cell cultures, their maintenance and preservation; various types of cultures- suspension cultures, continuous flow cultures, immobilized cultures; somatic cell fusion; cell cultures as a source of valuable products; organ cultures.

UNIT II ANIMAL DISEASES AND THEIR DIAGNOSIS 10

Bacterial and viral diseases in animals; monoclonal antibodies and their use in diagnosis; molecular diagnostic techniques like PCR, *in-situ* hybridization; northern and southern blotting; RFLP.

UNIT III THERAPY OF ANIMAL DISEASES 12

Recombinant cytokines and their use in the treatment of animal infections; monoclonal antibodies in therapy; vaccines and their applications in animal infections; gene therapy for animal diseases.

UNIT IV MICROMANIPULATION OF EMBRYO'S 6

What is micromanipulation technology; equipments used in micromanipulation; enrichment of x and y bearing sperms from semen samples of animals; artificial insemination and germ cell manipulations; in vitro fertilization and embryo transfer; micromanipulation technology and breeding of farm animals.

UNIT V TRANSGENIC ANIMALS 5

Concepts of transgenic animal technology; strategies for the production of transgenic animals and their importance in biotechnology; stem cell cultures in the production of transgenic animals.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Ranga M.M. "Animal Biotechnology". 2nd Rev. Edition. Agrobios India Limited, 2002.
2. Ramadass P, Meera Rani S. "Text Book of Animal Biotechnology". Akshara Printers, 1997.
3. Ramadass, P. "Animal Biotechnology : Recent Concepts and Developments". MJP Publishers, 2008.
4. Sasidhara, R. "Animal Biotechnology". MJP Publishers, 2006.

REFERENCES

1. Masters J.R.W. “Animal Cell Culture: Practical Approach”. Oxford University Press.2000.
2. Babiuk, Lorne A. and John P. Philips “Animal Biotechnology : Comprehensive Biotechnology” (First Supplement) . Pergamon Press, 1989.

CH9353 PROCESS INSTRUMENTATION DYNAMICS AND CONTROL L T P C
3 0 0 3

UNIT I **9**

Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in Laplace transformation, application.Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics, transfer function for chemical reactors and dynamics.

UNIT II **9**

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulator problems, Transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transportation lag, transient response of closed-loop control systems and their stability.

UNIT III **9**

Introduction to frequency response of closed-loop systems, control system design by frequency, Bode diagram, stability criterion, Nyquist diagram; Tuning of controller settings.

UNIT IV **9**

Controller mechanism,introduction to advanced control systems, cascade control, feed forward control, control of distillation towers and heat exchangers, introduction to microprocessors and computer control of chemical processes.

UNIT V **9**

Principles of measurements and classification of process control instruments, measurements of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity and consistency, pH, concentration, electrical and thermal conductivity, humidity of gases, composition by physical and chemical properties and spectroscopy.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Coughnowr and Koppel, " Process Systems Analysis and Control ", McGraw-Hill,1986.
2. Stephanopolous, George. "Chemical Process Control". Prentice-Hall of India, 1990.

REFERENCES

1. Emenule, S.Savas, " Computer Control of Industrial Processes ", McGraw-Hill, 1965.
2. Eckman, D.P., " Industrial Instrumentation ", Wiley, 1978.

IB9023 BIOCONJUGATE TECHNOLOGY AND APPLICATIONS L T P C
3 0 0 3

UNIT I FUNCTIONAL TARGETS 9

Modification of Amino Acids, Peptides and Proteins – Modification of sugars, polysaccharides and glycoconjugates – modification of nucleic acids and oligonucleotides.

UNIT II CHEMISTRY OF ACIVE GROUPS 9

Amine reactive chemical reactions – Thiol reactive chemical reactions – carboxylate reactive chemical reactions – hydroxyl reactive chemical reactions – aldehyde and ketone reactive chemical reactions – Photoreactive chemical reactions.

UNIT III BIOCONJUGATE REAGENTS 9

Zero length cross linkers – Homobifunctional cross linkers – Heterobifunctional cross linkers – Trifunctional cross linkers – Cleavable reagent systems – tags and probes.

UNIT IV ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUGATION 9

Properties of common enzymes – Activated enzymes for conjugation – biotinylated enzymes – chemical modification of nucleic acids – biotin labeling of DNA- enzyme conjugation to DNA – Fluorescent of DNA.

UNIT V BIOCONJUGATE APLICATIONS 9

Preparation of Hapten-carrier Immunogen conjugates - antibody modification and conjugation – immunotoxin conjugation techniques – liposome conjugated and derivatives- Colloidal – gold-labeled proteins – modification with synthetic polymers.

TOTAL: 45 PERIODS

REFERENCE

1. Hermanson, G.T. “Bioconjugate Techniques”. Academic Press, 1999

IB9024 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.

IB9025 PRINCIPLES OF FOOD PROCESSING L T P C
3 0 0 3

UNIT I FOOD AND ENERGY 9

Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food, contribution to organoleptic and textural characteristics.

UNIT II FOOD ADDITIVES 9

Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants – natural and artificial; food flavours; enzymes as food processing aids.

UNIT III MICROORGANISMS ASSOCIATED WITH FOOD 9

Bacteria, yeasts and molds – sources, types and species of importance in food processing and preservation; fermented foods and food chemicals, single cell protein.

UNIT IV FOOD BORNE DISEASES 9

Classification – food infections – bacterial and other types; food intoxications and poisonings – bacterial and non-bacterial; food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.

UNIT V FOOD PRESERVATION 9

Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning; frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.

TOTAL: 45 PERIODS

TEXTBOOKS

1. Sivasankar, B. "Food Processing and Preservation". Prentice-Hall, 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. Vaclavik, V. A. and Christian E. W. "Essentials of Food Science". 2ndEdition, Kluwer-Academic, Springer, 2003.
7. Norman, Peter. "Food Science". 5th Edition, CBS publications, 1996.

IB9026 BIOPHARMACEUTICAL TECHNOLOGY L T P C
3 0 0 3

UNIT I INTRODUCTION 7

Pharmaceutical industry & development of drugs ; types of therapeutic agents and their uses ; economics and regulatory aspects .

UNIT II DRUG ACTION, METABOLISM AND PHARMACOKINETICS 9

Mechanism of drug action; physico-chemical principles of drug metabolism; radioactivity; pharmacokinetics.

UNIT III MANUFACTURE OF DRUGS, PROCESS AND APPLICATIONS 7

Types of reaction process and special requirements for bulk drug manufacture.

UNIT IV PRINCIPLES OF DRUG MANUFACTURE 15

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oval liquids – vegetable drugs – topical applications; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management; GMP.

UNIT V BIOPHARMACEUTICALS 7

Various categories of therapeutics like vitamins, laxatives, analgesics, contraceptives, antibiotics, hormones and biologicals.

TOTAL: 45 PERIODS

TEXTBOOKS

1. Harvey, Richard A, etal., "Lippincott's Illustrated Reviews : Pharmacology", Wolters Kluwer / Lippincott Williams & Wilkins, 2009.
2. Tripathi, K.D. "Essentials of Medical Pharmacology" 6th Edition, Jaypee Brothers, 2008.
3. Brahmankar, D.M. and Sunil B. Jaiswal. " Biopharmaceutucs and Pharmacokinetics : A Treatise." Vallabh Prakashan, 1995.

REFERENCE

1. Katzung B.G. "Basic and Clinical Pharmacology". 6th Edition, Prentice Hall of Intl. 1995.

IB9027 BIOPROCESS ECONOMICS AND PLANT DESIGN L T P C
3 0 0 3

UNIT I PROCESS ECONOMICS AND BUSINESS ORGANIZATIONS 10

Definition of Bio Process, Bio Process Economics, Importance of various M-inputs-Globalization concept-Competition by Dumping-It's effect on Plant size-Status of India with adjoining ASEAN countries (Singapore, Malaysia,Indonesia etc)-Project profile concept-details; Structure and Types of Organizations; Simple Management Principles.

UNIT II PROJECT DESIGN AND DEVELOPMENT 10

Choosing a Project, Market Survey, Importance of Techno-Economic-Viability Studies, Sourcing of Processes,Process alternatives, Fixing most economic processes, Technology-Scanning, Plant Location Principles, Plant Lay out, Process Flow sheets, Preparation of Budgetory investment and production costs.

UNIT III COST ESTIMATION, PROFITABILITY AND ACCOUNTING 10

Capital investment, Concept of time-Value of money, Source Sink concept of Profitability, Capital Costs, Depreciation, Estimation of Capital costs, Manufacturing Costs, Working Capital; Profitablity Standards, Project profitability evaluation,Alternative investments and Replacements; Annual reports, Balance Sheets, Performance Analysis.

UNIT IV PROCESS OPTIMIZATION TECHNIQUES 6

Optimum design-Design Strategy, Economic-Balance, Different unit-Operations with Single and Multiple Variables.

UNIT V QUALITY AND QUALITY CONTROL 9

Current good manufacturing practices. Concepts of Quality Control in 20th century; Elements of quality control envisaged by ISI since 1947; Emergence of Statistical Process Control (SPC), Simple SPC concept details, Fundamental Concepts of ISO 9000 Quality System and the various requirements for ISO certification.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Peters, M.S., and D. Klaus. " Plant Design and Economics for Chemical Engineers." McGraw-Hill,1992.
2. Senapathy, R. "Textbook of Principles of Management and Industrial Psychology." Lakshmi Publications, 2001.
3. Rudd and Watson "Strategy for Process Engineering ." Wiley, 1987.

IB9028 PROCESS EQUIPMENTS AND PLANT DESIGN L T P C
3 0 0 3

UNIT I HEAT EXCHANGERS, CONDENSERS, EVAPORATORS 12

Single and multi process exchangers, double pipe, U tube heat exchangers, combustion details supporting structure. Single and vertical tube evaporation, Single and multi effect evaporators, forced circulation evaporators.

UNIT II STORAGE VESSEL FOR VOLATILE AND NON VOLATILE FLUIDS, PRESSURE VESSEL STRUCTURE 6

Design of the following equipments as per ASME, ISI codes, drawing according to scale; monoblock and multiplayer vessels, combustion details and supporting structure.

UNIT III EXTRACTOR, DISTILLATION AND ABSORPTION TOWER 10

Construction details and assembly drawing; Plate and Packed Extraction Towers; Plate and Packed absorption Towers; Plate and Packed Distillation Towers.

UNIT IV PUMPS, MECHANICAL SEALS, VALVES AND SWITCHES 8

Various types of pumps, Principle of working, construction, usages, advantages and disadvantages; Various types of seals, effectiveness, usages; Pneumatic Seals; Gate, Globe and Butterfly Valves, their material of construction; Pneumatically Controlled Valves.

UNIT V PIPING, PLANT LAY OUT AND DESIGN 9

Various types of Piping, material of construction, their usage; Pipe lay out; Modern Plant Design and case Studies.

TOTAL: 45 PERIODS

REFERENCES

1. Brownbell I.E., Young E.H.. "Chemical Plant Design" 1985.
2. Kern D.Q. "Heat Transfer". McGraw Hill, 1985.
3. McCabe, W.L., J.C. Smith and P. Harriott "Unit Operations of Chemical Engineering", 6th Edition, McGraw-Hill, 2001.

IB9029 CANCER BIOLOGY L T P C
3 0 0 3

UNIT I FUNDAMENTALS OF CANCER BIOLOGY 9

Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer.

UNIT II PRINCIPLES OF CARCINOGENESIS 12

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis.

UNIT III PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER 9

Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity. Growth factors related to transformation. Telomerases.

UNIT IV PRINCIPLES OF CANCER METASTASIS 9

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion.

UNIT V NEW MOLECULES FOR CANCER THERAPY 6

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy.

TOTAL: 45 PERIODS

TEXTBOOK

1. MacDonald, Fiona., C.H.J. Ford, Christopher, and A.G. Casson "Molecular Biology of Cancer". 2nd Edition, Taylor & Francis, 2004.
2. Franks, L.M. and N.M. Teich. "An Introduciton to the Cellular and Molecular Biology of Cancer ". 2nd Edition, Oxford University Press, 1991.
3. Varmus, Harold and R.A. Weinberg. " Genes and the Biology of the Cancer". Scientific American Library, 1993.

REFERENCES

1. Ruddon, Raymond W. "Cancer Biology". 3rd Edition. Oxford University Press, 1995.
2. King, Roger J.B. "Cancer Biology". Addison Wesley Longman Ltd., 1996.
3. Weinberg, Robert A. "The Biology of Cancer". Garland Science / Taylor & Francis, 2007.

IB9030 BIOLOGICAL SPECTROSCOPY L T P C
3 0 0 3

UNIT I OPTICAL ROTATORY DISPERSION 5

Polarized light – optical rotation – circular dichroism – circular dichroism of nucleic acids and proteins .

UNIT II NUCLEAR MAGNETIC RESONANCE 10

Chemical shifts – spin – spin coupling – relaxation mechanisms – nuclear overhauser effect – multidimensional nmr spectroscopy – detemination of macromolecular structure by nmr – magnetic resonance imaging.

UNIT III MASS SPECTROMETRY 10

Ion sources sample introduction – mass analyzers and ion detectors – biomolecule mass sepctrometry – peptide and protein analysis – carbohydrates and small molecules – specific applications.

UNIT IV X-RAY DIFFRACTION 10

Scattering by x- rays – diffraction by a crystal – measuring diffraction pattern – bragg eflection – unit cell – phase problem – anomalous diffraction – detemination of crystal structure – electron and neutron diffraction.

UNIT V SPECIAL TOPICS AND APPLICATIONS 10

Electron microscopy – transmission and scanning electron microscopy – scanning tunneling and atomic force microscopy – combinatorial chemistry and high throughput screening methods.

TOTAL: 45 PERIODS

TEXTBOOK

1. Banwell, Colin N. and E.M. McCash. "Fundamentals of Molecular Spectroscopy" 4th Edition, Tata McGraw-Hill, 1994.
2. Aruldas, G. "Molecular Structure and Spectroscopy". 2nd Edition, Prentice Hall of India, 2007.
3. Pavia, D.L., G.M. Lampman and G.S. Kriz. " Introduction to Spectroscopy:" 3rd Edition, Thomson, Brooks/ Cole, 2001.
4. Williams, Dudley H. and Ian Fleming. "Spectroscopic Methods in Organic Chemistry". 5th Edition, Tata McGraw-Hill, 1995.

REFERENCES

1. Siuzdak, Gary. "Mass Spectrometry for Biotechnology ". Academic Press / Elsevier, 1996.
2. Hammes, Gordon G. "Spectroscopy for the Biological Sciences". John Wiley, 2005.

IB9031 GENOMICS AND PROTEOMICS L T P C
3 0 0 3

UNIT I INTRODUCTION 9
Overview Of Genomes Of Bacteria, Archae And Eukaryota

UNIT II PHYSICAL MAPPING TECHNIQUES 9
Top down and bottom up approach; linking and jumping of clones; genome sequencing; placing small fragments on map; STS assembly; gap closure; pooling strategies; cytogenetic mapping techniques.

UNIT III FUNCTIONAL GENOMICS 9
Gene finding; annotation; ORF and functional prediction; Substractive DNA library screening; differential display and representational difference analysis; SAGE;TOGA.

UNIT IV PROTEOMICS TECHNIQUES 9
Protein level estimation; Edman protein microsequencing; protein cleavage; 2 D gel electrophoresis; metabolic labeling; detection of proteins on SDS gels; pattern analysis; Mass spectrometry- principles of MALDI-TOF; Tandem MS-MS; Peptide mass fingerprinting.

UNIT V PROTEIN PROFILING 9
Post translational modification; protein-protein interactions; glycoprotein analysis; phosphoprotein analysis.

TOTAL: 45 PERIODS

TEXTBOOKS

1. Suhai, Sandor " Genomics and Proteomics : Functional and Computational Aspects". Springer, 2000
2. Pennington, S.R. and M.J. Dunn "Proteomics : From Protein Sequence to Function". Viva Books Pvt. Ltd., 2002.
3. O'Connor, C.D. and B.D.Hames. " Proteomics". Scion Publishing, 2008.
4. Primrose, S.B. and Twyman. "Principles of Genome Analysis and Genomics". 3rd Edition, Blakwell Publishing, 2007

REFERENCES

1. Cantor, Charles R. and Cassandra L. Smith. "Genomics : The Science and Technology Behind the Human Genome Project". John Wiley & Sons, 1999.
2. Liebler, R.C. "Introduction to Proteomics". Humana Press, 2002.
3. Hunt, Stephen P. and Frederick J. Livesey. "Functional Genomics". Oxford University Press, 2000.
4. Conard, Edward. "Genomics". Apple Academics, 2010.

IB9032 MOLECULAR PATHOGENESIS L T P C
3 0 0 3

UNIT I OVERVIEW 5

Historical perspective - discovery of microscope, Louis Pasteur's contributions, Robert Koch's postulates, early discoveries of microbial toxins, toxic assays, vaccines, antibiotics and birth of molecular genetics and modern molecular pathogenesis studies, Various pathogen types and modes of entry.

UNIT II HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES 8

Attributes & components of microbial pathogenesis, Host defense: skin, mucosa, cilia, secretions, physical movements, limitation of free iron, antimicrobial compounds, mechanism of killing by humoral and cellular defense mechanisms, complements, inflammation process, general disease symptoms, Pathogenic adaptations to overcome the above defenses.

UNIT III MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES) 16

Virulence, virulence factors, virulence-associated factors and virulence lifestyle factors, molecular genetics and gene regulation in virulence of pathogens, Vibrio Cholerae: Cholera toxin, co-regulated pili, filamentous phage, survival *E.coli* pathogens: Enterotoxigenic *E.coli* (ETEC), labile & stable toxins, Entero- pathogenic *E.coli* (EPEC), type III secretion, cytoskeletal changes, intimate attachment; Enterohaemerrohogic *E.coli* (EHEC), mechanism of bloody diarrhoea and Hemolytic Uremic Syndrome, Enteroaggregative *E.coli* (EAEC). Shigella: Entry, macrophage apoptosis, induction of macropinocytosis, uptake by epithelial cells, intracellular spread, inflammatory response, tissue damage Plasmodium: Life cycle, erythrocyte stages, transport mechanism and processes to support the rapidly growing schizont, parasitiparous vacuoles, and knob protein transport, Antimalarials based on transport processes. Influenza virus: Intracellular stages, Neuraminidase & Haemagglutinin in entry, M1 & M2 proteins in assembly and disassembly, action of amantidine.

UNIT IV EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS 8

Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction & host responses

UNIT V MODERN APPROACHES TO CONTROL PATHOGENS 8

Classical approaches based on serotyping. Modern diagnosis based on highly conserved virulence factors, immuno & DNA-based techniques. New therapeutic strategies based on recent findings on molecular pathogenesis of a variety of pathogens, Vaccines - DNA, subunit and cocktail vaccines.

TOTAL : 45 PERIODS

REFERENCES

1. Clark V.L and P.M. Bavoil " Bacterial Pathogenesis ", Academic Press, 1997.
2. Williams, Peter, and etal., "Bacterial Pathogenesis". (Methods in Microbiology Vol. 27), Academic Press, 1998.
3. Groisman, Eduardo A. " Principles of Bacterial Pathogenesis". Academic Press, 2001.
4. Nester, Anderson, Roberts, Pearsall, Nester, "Microbiology: A Human Perspective", 3rd Edition. McGraw-Hill, 2001.
5. Salyers, Abigail A. and Dixie D. Whitt. " Bacterial Pathogenesis : A Molecular Approach". 2nd Edition, ASM, 2002.
6. McClane, Bruce A. and Timothy A. Mietzner "Microbial Pathogenesis : A Principles-Oriented Approach". Fence Creek Publishing, 1999.
7. Subramanian, M.A. " Toxicology : Principles and Methods" . MJP Publishers, 2004.
8. "Bergey's Manual of Systematic Bacteriology" Vol. 1-3. 2nd Edition, Springer, 2005.

IB9033 **BIOPHYSICS** **L T P C**
3 0 0 3

UNIT I MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS 9

Intramolecular bonds – covalent – ionic and hydrogen bonds – biological structures -general features – water structure – hydration – interfacial phenomena and membranes – self assembly and molecular structure of membranes.

UNIT II CONFORMATION OF NUCLEIC ACIDS 9

Primary structure – the bases – sugars and the phosphodiester bonds- double helical structure – the a b and z forms – properties of circular DNA – topology – polymorphism and flexibility of DNA – structure of ribonucleic acids – hydration of nucleic acids.

UNIT III CONFORMATION OF PROTEINS 9

Conformation of the peptide bond – secondary structures – Ramachandran plots – use of potential functions – tertiary structure – folding – hydration of proteins – hydropathy index.

UNIT IV CELLULAR PERMEABILITY AND ION – TRANSPORT 9

Ionic conductivity – transport across ion channels – mechanism - ion pumps- proton transfer – nerve conduction – techniques of studying ion transport and models.

UNIT V ENERGETICS & DYNAMICS OF BIOLOGICAL SYSTEMS 9

Concepts in thermodynamics – force and motion – entropy and stability – analyses of fluxes – diffusion potential – basic properties of fluids and biomaterials – laminar and turbulent flows.

TOTAL: 45 PERIODS

TEXTBOOK

1. Pattabhi, Vasantha and N.Gautham. “Biophysics” Narosa, 2002.
2. Nolting, Bengt “Methods in Modern Biophysics”. Springer, 2004.
3. Narayanan, P. “Essentials of Biophysics”. New Age International, 2000.
4. Glaser, Ronald. “Biophysics”. Springer, 2001.
5. Tuszynski, Jack K. and M. Kurzynski “Introduction to Molecular Biophysics”. CRC Press, 2003.

REFERENCES

1. Cotterill, Rodney. “Biophysics : An Introduction”. John Wiley & Sons, 2002.
2. Cantor C.R. and P.R. Schimmel “Biophysical Chemistry”. Vol.1-3. W.H. Freeman & Co., 1980.
3. Nelson, Philip. “ Biological Physics : Energy, Information, Life.” W.H. Freeman & Co., 2004.

IB9034 MOLECULAR MODELING L T P C
3 0 0 3

UNIT I INTRODUCTION TO CLASSICAL MECHANICS 9
Newtons laws of motion – time intervals- algorithms

UNIT II INTRODUCTION TO STATISTICAL MECHANICS 9
Boltzman's Equation – Ensembles – Distribution law for non interacting molecules – Statistical mechanics of fluids.

UNIT III QUANTUM MECHANICS 9
Photoelectric effect – De Broglies hypothesis – Uncertainity principle – Schrodingers time independent equation – particle in a one -dimensional box.

UNIT IV GROMOS , GROMACS , AMBER & DOCK 9
Various forcefields for proteins and nucleic acids – Molecular mechanics – Molecular dynamics – Molecular dynamics simulations in water and organic solvents.

UNIT V GAUSSIAN 03 9
Preparing input files – job types – model chemistries – basis sets – moleculae specifications running Gaussian – examples.

TOTAL: 45 PERIODS

TEXTBOOKS
1. Leach, Andrew R. "Molecular Modelling : Principles and Applications". 2nd Edition, Pearson, 2010.
2. Cohen, N.Claude "Guidebook on Molecular Modeling in Drug Design". Academic Press / Elsevier, 1996.

REFERENCES
1. Frenkel, Daan and Berend Smit "Understanding Molecular Simulation : From Algorithms to Applications". 2nd Edition, Academic Press, 2002.
2. McQuarrie, D. "Statistical Mechanics ". Narosa, 1999.
3. McQuarrie, D. "Quantum Mechanics". Narosa, 1999.
4. GROMOS Handbook.

IB9035 NEUROBIOLOGY AND COGNITIVE SCIENCES L T P C
3 0 0 3

UNIT I NEUROANATOMY 9
What are central and peripheral nervous systems; Structure and function of neurons; types of neurons; Synapses; Glial cells; myelination; Blood Brain barrier; Neuronal differentiation; Characterization of neuronal cells; Meninges and Cerebrospinal fluid; Spinal Cord.

UNIT II NEUROPHYSIOLOGY 9
Resting and action potentials; Mechanism of action potential conduction; Voltage dependent channels; nodes of Ranvier; Chemical and electrical synaptic transmission; information representation and coding by neurons.

UNIT III NEUROPHARMACOLOGY 9
Synaptic transmission, neurotransmitters and their release; fast and slow neurotransmission; characteristics of neurites; hormones and their effect on neuronal function.

UNIT IV APPLIED NEUROBIOLOGY 9

Basic mechanisms of sensations like touch, pain, smell and taste; neurological mechanisms of vision and audition; skeletal muscle contraction.

UNIT V BEHAVIOUR SCIENCE 9

Basic mechanisms associated with motivation; control of feeding, sleep, hearing and memory; Disorders associated with the nervous system.

TOTAL: 45 PERIODS

REFERENCE

1. Mathews G.G. Neurobiology, 2nd edition, Blackwell Science, UK, 2000.

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)

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 9024 NANOSCIENCE AND TECHNOLOGY L T P C
3 0 0 3

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. Edelstein, A.S. and R.C. Cammearata, "Nanomaterials: Synthesis, Properties and Applications". Institute of Physics Publishing,1996.
2. Dinardo, N John. "Nanoscale Charecterisation of Surfaces and Interfaces". 2nd Edition, Wiley-VCH, 2000.

REFERENCES

1. Timp, G. "Nanotechnology". AIP Press / Springer, 1999.
2. Lakhtakia, Akhlesh. "The Hand Book of Nano Technology : Nanometer Structure, Theory, Modeling and Simulations". Prentice`-Hall of India, 2007.