



**ANNA UNIVERSITY CHENNAI
CHENNAI - 600 025**

UNIVERSITY DEPARTMENTS

**REGULATIONS 2012
CURRICULA AND SYLLABI FOR
I TO VIII SEMESTERS**

**B. TECH. INDUSTRIAL
BIOTECHNOLOGY (FULL TIME)**

ANNA UNIVERSITY, CHENNAI-600 025**UNIVERSITY DEPARTMENTS****R – 2012****B.TECH. INDUSTRIAL BIOTECHNOLOGY****I – VIII SEMESTERS CURRICULA AND SYLLABI****SEMESTER - I**

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
HS8151	Technical English – I	3	1	0	4
MA8151	Mathematics – I	3	1	0	4
PH8151	Engineering Physics	3	0	0	3
CY8151	Engineering Chemistry	3	0	0	3
GE8151	Computing Techniques	3	0	0	3
GE8152	Engineering Graphics	2	0	3	4
PRACTICAL					
PH8161	Physics Laboratory	0	0	2	1
CY8161	Chemistry Laboratory	0	0	2	1
GE8161	Computer Practices Laboratory	0	0	3	2
GE8162	Engineering Practices Laboratory	0	0	3	2
Total		17	2	13	27

SEMESTER – II

CODE	SUBJECT	L	T	P	C
THEORY					
HS8251	Technical English - II	3	1	0	4
MA8251	Mathematics - II	3	1	0	4
PH8255	Physics of Materials	3	0	0	3
GE8251	Engineering Mechanics	3	1	0	4

IB8201	Applied and Industrial Microbiology	3	0	0	3
IB8202	Biochemistry	3	0	0	3
PRACTICAL					
IB8211	Applied Microbiology Laboratory	0	0	4	2
IB8212	Biochemistry Laboratory	0	0	4	2
TOTAL		18	3	8	25

SEMESTER – III

CODE	SUBJECT	L	T	P	C
THEORY					
MA8301	Mathematics for Biotechnologists	3	1	0	4
IB8301	Applied Thermodynamics for Biotechnologists	3	0	0	3
IB8302	Basic Industrial Biotechnology	3	0	0	3
IB8303	Bioorganic Chemistry	3	0	0	3
IB8304	Cell Biology and Cellular Biochemistry	3	1	0	4
IB8305	Stoichiometry and Fluid Mechanics	3	0	0	3
PRACTICAL					
IB8311	Bioorganic Chemistry Laboratory	0	0	4	2
IB8312	Cell Biology Laboratory	0	0	4	2
TOTAL		18	2	8	24

SEMESTER – IV

CODE	SUBJECT	L	T	P	C
THEORY					
MA8356	Probability and Statistics	3	1	0	4
GE8351	Environmental Science and Engineering	3	0	0	3
IB8401	Bioprocess Principles	3	0	0	3
IB8402	Enzyme Technology and Biotransformations	3	0	0	3
IB8403	Heat Transfer Operations	4	0	0	4
IB8451	Analytical Methods and Instrumentation	3	0	0	3

PRACTICAL					
IB8411	Instrumental Method of Analysis Lab	0	0	4	2
IB8461	Chemical Engineering Lab	0	0	4	2
TOTAL		19	1	8	24

SEMESTER – V

CODE	SUBJECT	L	T	P	C
THEORY					
IB8501	Bioprocess Engineering	3	0	0	3
IB8502	Mass Transfer Operations	3	0	0	3
IB8503	Molecular Biology	3	0	0	3
IB8551	Protein Structure Function and Proteomics	3	1	0	4
	Elective I	3	0	0	3
	Elective II	3	0	0	3
PRACTICAL					
IB8511	Bioprocess Laboratory I	0	0	4	2
IB8512	Molecular Biology Laboratory	0	0	4	2
TOTAL		18	1	8	23

SEMESTER – VI

CODE	SUBJECT	L	T	P	C
THEORY					
MG8654	Total Quality Management	3	0	0	3
IB8601	Chemical Reaction Engineering	3	0	0	3
IB8602	Genetic Engineering and Genomics	4	0	0	4
IB8651	Creativity Innovation and New Product Development	3	0	0	3
	Elective III	3	0	0	3
	Elective IV	3	0	0	3

PRACTICAL					
HS8561	Employability Skills	0	0	2	1
IB8611	Bioprocess Laboratory II	0	0	4	2
IB8612	Genetic Engineering Laboratory	0	0	4	2
	TOTAL	19	0	14	24

***Common to IBT, Food and Pharmaceutical Branch**

SEMESTER – VII

CODE	SUBJECT	L	T	P	C
THEORY					
IB8751	Bioinformatics and Computational Biology	3	0	0	3
IB8752	Downstream Processing	3	0	0	3
IB8753	Immunology	3	0	0	3
IB8754	Metabolic Engineering	3	0	0	3
	Elective V	3	0	0	3
	Elective VI	3	0	0	3
PRACTICAL					
IB8711	Downstream Processing Laboratory	0	0	4	2
IB8712	Immunology Laboratory	0	0	4	2
	TOTAL	18	0	8	22

SEMESTER – VIII

CODE	SUBJECT	L	T	P	C
IB8811	Project Work	0	0	18	9
	TOTAL	0	0	18	9

LIST OF ELECTIVES FOR INDUSTRIAL BIOTECHNOLOGY

CODE	SUBJECT	L	T	P	C
IB8001	Advanced Biochemistry	3	0	0	3
IB8002	Animal Biotechnology	3	0	0	3
IB8003	Bio-industrial Entrepreneurship	3	0	0	3
IB8004	Biopharmaceutical Technology	3	0	0	3
IB8005	Biophysics	3	0	0	3
IB8006	Cancer Biology	3	0	0	3
IB8007	Hazard Assessment and Mitigation in Bioprocess Industries	3	0	0	3
IB8008	Introduction to Symbolic Mathematics	2	0	2	3
IB8009	IPR and Ethical Issues in Biotechnology	3	0	0	3
IB8010	Molecular Modeling	3	0	0	3
IB8011	Molecular Pathogenesis of Infectious Diseases	3	0	0	3
IB8012	Neurobiology and Cognitive Sciences	3	0	0	3
IB8013	Plant Biotechnology	3	0	0	3
IB8014	Principles of Food Processing	3	0	0	3
IB8015	Process Equipments and Plant design	3	0	0	3
IB8016	Systems Biology	3	0	0	3
IB8017	Tissue Engineering	3	0	0	3
IB8071	Bioconjugate Technology and Applications	3	0	0	3
IB8072	Biological Spectroscopy	3	0	0	3
GE8071	Fundamentals of Nano Science	3	0	0	3
CH8651	Process Instrumentation Dynamics and Control	3	0	0	3
CH8751	Transport Phenomena	3	1	0	4

TOTAL NO.OF CREDITS : 178

OBJECTIVES:

- To enable all students of engineering and technology develop their basic communication skills in English.
- To give special emphasis to the development of speaking skills amongst the students of engineering and technology.
- To ensure that students use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading for pleasure.

UNIT I**9 + 3**

Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); Speaking - Speaking about one's place, important festivals etc. – Introducing oneself, one's family / friend; Reading - Skimming a reading passage – Scanning for specific information - Note-making; Writing - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one's leisure time activities, hometown, etc.); Grammar - Prepositions - Reference words - Wh-questions - Tenses (Simple); Vocabulary - Word formation - Word expansion (root words / etymology); E-materials - Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

UNIT II**9 + 3**

Listening - Listening and responding to video lectures / talks; Speaking - Describing a simple process (filling a form, etc.) - Asking & answering questions - Telephone skills – Telephone etiquette; Reading – Critical reading - Finding key information in a given text - Sifting facts from opinions; Writing - Biographical writing (place, people) - Lab descriptions (general/specific description of laboratory experiments) - Definitions - Recommendations; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association; E-materials - Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations / lectures – Picture-based activities.

UNIT III**9 + 3**

Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading - Reading and interpreting visual material; Writing - Jumbled sentences - Coherence and cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause

& effect / compare & contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

UNIT IV

9 + 3

Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Different forms of interviews - Speaking at different types of interviews; Reading - Making inference from the reading passage - Predicting the content of a reading passage; Writing - Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; Grammar - Adverbs – Tenses – future time reference; Vocabulary - Single word substitutes - Use of abbreviations & acronyms; E-materials - Interactive exercises for Grammar and Vocabulary - Sample interviews - film scenes - dialogue writing.

UNIT V

9 + 3

Listening - Listening to different accents, Listening to Speeches/Presentations, Listening to broadcast & telecast from Radio & TV; Speaking - Giving impromptu talks, Making presentations on given topics; Reading - Email communication - Reading the attachment files having a poem/joke/proverb - Sending their responses through email Writing - Creative writing, Poster making; Grammar - Direct and indirect speech; Vocabulary - Lexical items (fixed / semi fixed expressions); E-materials - Interactive exercises for Grammar & Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents, - Interpreting posters.

TOTAL: 60 PERIODS

TEXT BOOKS

1. Mindscapes: English for Technologists and Engineers, Orient Black Swan, 2012 .
2. S.P. Dhanavel, English and Communication Skills for Students of Science and Engineering, Orient Black Swan, Chennai, 2011.

REFERENCES

1. Pickett, Nell Ann, Ann A.Laster and Katherine E.Staples. Technical English: Writing, Reading and Speaking. New York: Longman, 2001.
2. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
3. Morgan, David and Nicholas Regan. Take-Off: Technical English for Engineering. Reading: Garnet Publishing Limited, 2008.

4. Thorn, Michael and Alan Badrick, An Introduction to Technical English, Harlow: Prentice Hall Europe, 1993.
5. Rizvi, M.Ashraf., Effective Technical Communication. New Delhi: Tata McGraw-Hill Publishing Company, 2007.

EXTENSIVE READERS

1. Murthy, Sudha. Wise & Otherwise. New Delhi: Penguin Books India, 2006.
2. Gates, Bill and Collins Hemingway. Business @ the Speed of Thought: Succeeding in the Digital Economy. New York: Warner Business Books, 2000.

WEBSITE RESOURCES

1. www.uefap.com
2. www.eslcafe.com
3. www.listen-to-english.com
4. www.owl.english.purdue.edu
5. www.chompchomp.com

MA 8151

MATHEMATICS – I

L T P C
3 1 0 4

OBJECTIVES

1. To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
2. To make the student knowledgeable in the area of infinite series and their convergence so that he/ she will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modeling.
3. To familiarize the student with functions of several variables. This is needed in many branches of engineering.
4. To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
5. To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I MATRICES

9+3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton Theorem – Diagonalization of matrices –

Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II INFINITE SERIES

9+3

Sequences – Convergence of series – General properties – Series of positive terms – Tests of convergence (Comparison test, Integral test, Comparison of ratios and D’Alembert’s ratio test) – Alternating series – Series of positive and negative terms – Absolute and conditional convergence – Power Series – Convergence of exponential, logarithmic and Binomial Series.

UNIT III FUNCTIONS OF SEVERAL VARIABLES

9+3

Limits and Continuity – Partial derivatives – Homogeneous functions and Euler’s theorem – Total derivative – Differentiation of implicit functions – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor’s series for functions of two variables – Errors and approximations – Maxima and minima of functions of two variables – Lagrange’s method of undetermined multipliers.

UNIT IV IMPROPER INTEGRALS

9+3

Improper integrals of the first and second kind and their convergence – Evaluation of integrals involving a parameter by Leibnitz rule – Beta and Gamma functions – Properties – Evaluation of integrals using Beta and Gamma functions – Error functions

UNIT V MULTIPLE INTEGRALS

9+3

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of Solids – Change of variables in double and triple integrals – Area of a curved surface.

TOTAL: 60 PERIODS

TEXT BOOKS

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Ramana B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.

REFERENCES

1. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.

2. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7th Edition, 2009.
3. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 5th Reprint, 2009.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH8151

ENGINEERING PHYSICS
(Common to all branches of B.E / B.Tech programmes)

L T P C
3 0 0 3

OBJECTIVE:

To introduce the basic physics concepts relevant to different branches of Engineering and Technology.

UNIT I PROPERTIES OF MATTER

9

Elasticity - Poisson's ratio and relationship between moduli (qualitative) - Stress-strain diagram - factors affecting elasticity - bending of beams - cantilever - bending moment - theory and experiment of Young's modulus determination - Uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum - determination of rigidity modulus- moment of inertia of a body (regular and irregular).

UNIT II ACOUSTICS AND ULTRASONICS

9

Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - rate of growth and decay of sound intensity - derivation of Sabine's formula - absorption coefficient and its determination - factors affecting acoustics of buildings : focussing, interference, echo, Echelon effect, resonance - noise and their remedies. Ultrasonics - production - magnetostriction and piezoelectric methods - detection of ultrasound - acoustic grating - industrial applications - NDT - Ultrasonic method: scan modes and practice.

UNIT III THERMAL PHYSICS

9

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity - conduction in solids - Forbe's and Lees' disc methods - Rectilinear flow of heat through a rod - flow of heat through a compound materials - radial flow of heat through a spherical shell - thermal insulation of buildings – Laws of blackbody radiation: Kirchoffs law, Stephens law, Wiens law,

Raleigh-Jean law and Planks law (derivation). Laws of thermodynamics - Otto and diesel engines and their efficiency - entropy - entropy of Carnot's cycle - reverse Carnot's cycle - refrigerator.

UNIT IV APPLIED OPTICS

9

Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its application - Lasers - Einstein's coefficients - CO₂, Nd:YAG and semiconductor lasers - homo junction and hetro junction - construction and working - applications - Optical fibres - classification (index & mode based) - principle and propagation of light in optical fibres - acceptance angle and numerical aperture - fibre optic communication system - active and passive sensors.

UNIT V SOLID STATE PHYSICS

9

Nature of bonding - growth of single crystals (qualitative) - crystal systems - crystal planes and directions - expressions for interplanar distance - coordination number and packing factor for simple structures: SC, BCC, FCC and HCP - structure and significance of NaCl, ZnS, diamond and graphite - crystal imperfections: point defects, dislocations and stacking faults - unit cell, Bravais space lattices - miller indices.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Gaur R.K., and Gupta, S.L., Engineering Physics, Dhanpat Raj Publications, 2003.
2. Palanisamy, P.K., Engineering Physics, Scitech Publications (P) Ltd, 2006.
3. Arumugam, M., Engineering Physics, Anuradha Publications, 2000.

REFERENCE BOOKS

1. Sankar, B.N., Pillai.S.O., Engineering Physics, New Age International (P) Ltd., 2007.
2. Rajendran.V Engineering Physics, Tata McGraw-Hill, 2009.

CY8151

ENGINEERING CHEMISTRY
(Common to All Branches of Engineering and Technology)

L T P C
3 0 0 3

UNIT I CHEMICAL THERMODYNAMICS

9

Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz

and Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation – variation of chemical potential with temperature and pressure.

UNIT II POLYMER CHEMISTRY

9

Introduction: Classification of polymers – Natural and Synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerisation. Types and mechanism of polymerisation: Addition (Free Radical, cationic, anionic and living); condensation and copolymerisation. Properties of polymers: T_g, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerisation: Bulk, emulsion, solution and suspension.

UNIT III KINETICS AND CATALYSIS

9

Introduction – reaction velocity, factors affecting reaction velocity, rate constant, order of reaction, molecularity, pseudo molecular reactions, zero, first, second and third order reactions, reactions of fractional orders, determination of order of reactions. Catalysis: Auto catalysis - Enzyme Catalysis: Michaelis-Menton equation; factors affecting enzyme catalysis. Heterogeneous Catalysis: Types of adsorption isotherms: Langmuir–Hinselwood and Rideal–Eley Mechanism.

UNIT IV PHOTOCHEMISTRY AND SPECTROSCOPY

9

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Photoprocesses - Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitisation. Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and rotational transitions. Width and intensities of spectral lines. Spectrophotometric estimation of iron. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram) and applications.

UNIT V NANOCHEMISTRY

9

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: Nanocluster, nanorod, nanotube and nanowire. Synthesis: Precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation; Properties and Applications. Risk discussion and Future perspectives.

TOTAL: 45 PERIODS

TEXT BOOKS

1. P. Kannan and A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2009.
2. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India, 2011

REFERENCES

1. P.W. Atkins and de Paula Julio, "Physical Chemistry", Oxford University Press, 8th Ed., (Indian Student Edition) (2009).
2. K. K. Rohatgi-Mukherjee, "Fundamental of Photochemistry" New Age International (P) Ltd., New Delhi, 1986.
3. G.A. Ozin and A.C. Arsenault, "Nanotechnology: A Chemical Approach to Nanomaterials", RSC Publishing, 2005.
4. V.R.Gowariker, N.V.Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International P (Ltd.), Chennai, 2006

GE8151

COMPUTING TECHNIQUES

L T P C
3 0 0 3

UNIT I INTRODUCTION

8

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

UNIT II C PROGRAMMING BASICS

10

Problem formulation – Problem Solving - Introduction to 'C' programming –fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS

9

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String-String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

UNIT IV FUNCTIONS AND POINTERS

9

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

UNIT V STRUCTURES AND UNIONS

9

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Pradip Dey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, First Edition, Oxford University Press, 2009
2. Ashok N. Kamthane, “Computer programming”, Pearson Education, 2007.
3. Yashavant P. Kanetkar. “ Let Us C”, BPB Publications, 2011.

REFERENCES

1. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006
2. Byron S Gottfried, “ Programming with C”, Schaum’s Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, “How to Solve it by Computer”, Pearson Education, Fourth Reprint, 2007

GE8152

ENGINEERING GRAPHICS

L T P C

2 0 3 4

OBJECTIVES

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)

1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREE HAND SKETCHING

5+9

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves, Scales: Construction of Diagonal and Vernier scales.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES

5+9

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS

5 + 9

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES

5+9

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS

6 + 9

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids- Prisms, pyramids and cylinders by visual ray method and vanishing point method.

Introduction to drafting packages and demonstration of their use.

TOTAL: 75 PERIODS

TEXT BOOK

1. N.D.Bhatt and V.M.Panchal, "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010

REFERENCES

1. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
2. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
5. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
6. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

PUBLICATION OF BUREAU OF INDIAN STANDARDS:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

SPECIAL POINTS APPLICABLE TO UNIVERSITY EXAMINATIONS ON ENGINEERING GRAPHICS:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

PH8161**PHYSICS LABORATORY**
(Common to all branches of B.E. / B.Tech. Programmes)**L T P C****0 0 2 1**

- | | | |
|-----|----------------------|---|
| 1. | Torsional pendulum | Determination of rigidity modulus of wire and moment of inertia of disc |
| 2. | Non-uniform bending | Determination of young's modulus |
| 3. | Lee's disc | Determination of thermal conductivity of a bad conductor |
| 4. | Potentiometer | Determination of thermo e.m.f. of thermocouple |
| 5. | Air wedge | Determination of thickness of a thin sheet of paper |
| 6. | i. Optical fibre | Determination of Numerical Aperture and acceptance angle |
| | ii. Compact disc | Determination of width of the groove using laser |
| 7. | Acoustic grating | Determination of velocity of ultrasonic waves in liquids |
| 8. | Post office box | Determination of Band gap of a semiconductor |
| 9. | Spectrometer | Determination of wavelength using grating |
| 10. | Viscosity of liquids | Determination of co-efficient of viscosity of a liquid by Poiseuille's flow |

TOTAL: 30 PERIODS**CY8161****CHEMISTRY LABORATORY**
(Common to all branches of Engineering and Technology)**L T P C****0 0 2 1**

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1,10- phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of poly vinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics – ester hydrolysis.
13. Corrosion experiment – weight loss method.

14. Determination of CMC.
15. Phase change in a solid.

TOTAL: 30 PERIODS

REFERENCES

1. A text of quantitative inorganic analysis, A. L.Vogel, ELBS London, 1995.
2. Experiments in physical chemistry, D.P. Shoemaker and C.W. Gardad, McGraw Hill, London, 2001.
3. American Public Health Association.

GE8161

COMPUTER PRACTICES LABORATORY

L T P C
0 0 3 2

LIST OF EXPERIMENTS

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

TOTAL : 45 PERIODS

GE 8162

ENGINEERING PRACTICES LABORATORY

L T P C
0 0 3 2

OBJECTIVE

To provide exposure to the students with hands-on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP – A (CIVIL & ELECTRICAL)

1. CIVIL ENGINEERING PRACTICE

12

PLUMBING

- Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.
- Laying pipe connection to the suction side of a pump – inlet.
- Laying pipe connection to the delivery side of a pump – out let.
- Practice in mixed pipe connections: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK

- Sawing, planning and making common joints: T-Joint, Mortise and Tennon joint, Dovetail joint.

STUDY

- Study of joints in door panels, wooden furniture
- Study of common industrial trusses using models.

2. ELECTRICAL ENGINEERING PRACTICE

9

- Basic household wiring using switches, fuse, indicator – lamp etc.,
- Preparation of wiring diagrams
- Stair case light wiring
- Tube – light wiring
- Study of iron-box, fan with regulator, emergency lamp

GROUP – B (MECHANICAL AND ELECTRONICS)

15

3. MECHANICAL ENGINEERING PRACTICE

WELDING

- Arc welding of butt joints, lap joints, tee joints
- Gas welding Practice.
- Basic Machining

- Simple turning, drilling and tapping operations.
- Machine assembly Practice.
- Study and assembling the following:
- Centrifugal pump, mixies and air conditioners.
- Demonstration on
 - (a) Smithy operations like the production of hexagonal bolt.
 - (b) Foundry operation like mould preparation for grooved pulley.

4. ELECTRONIC ENGINEERING PRACTICE

9

- Soldering simple electronic circuits and checking continuity.
- Assembling electronic components on a small PCB and testing.
- Study of Telephone, FM radio, low-voltage power supplies.

TOTAL: 45 PERIODS

HS8251

TECHNICAL ENGLISH - II

L T P C

(For all branches of B.E / B.Tech programmes)

3 1 0 4

OBJECTIVES

- To make the students acquire listening and speaking skills meant for both formal and informal contexts
- To help them develop their reading skills by exposing them to different types of reading strategies
- To equip them with writing skills needed for academic as well as workplace situations
- To make them acquire language skills at their own pace by using e-materials and language lab component

UNIT I

9 + 3

Listening - Listening to informal conversations and participating; Speaking - Opening a conversation (greetings, comments on something, weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); Reading - Developing analytical skills, Deductive and inductive reasoning - Extensive reading; Writing - Effective use of SMS for sending short notes and messages - Using 'emoticons' as symbols in email messages; Grammar - Regular & irregular verbs - Active and passive voice; Vocabulary - Homonyms (e.g. 'can') - Homophones (e.g. 'some', 'sum'); E-materials - Interactive exercise on Grammar and vocabulary – blogging; Language Lab - Listening to different types of conversation and answering questions.

UNIT II

9 + 3

Listening - Listening to situation based dialogues; Speaking - Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); Reading - Reading a short story or an article from newspaper, Critical reading, Comprehension skills; Writing - Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his success, thanking one's friend / relatives); Grammar - modal verbs, Purpose expressions; Vocabulary - Phrasal verbs and their meanings, Using phrasal verbs in sentences; E-materials - Interactive exercise on Grammar and vocabulary, Extensive reading activity (reading stories / novels from links), Posting reviews in blogs - Language Lab - Dialogues (Fill up exercises), Recording students' dialogues.

UNIT III

9 + 3

Listening - Listening to the conversation - Understanding the structure of conversations; Speaking - Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret etc.); Reading - Speed reading – reading passages with the time limit - Skimming; Writing - Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading the articles from the journals - Format for the journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; Grammar - Conditional clauses - Cause and effect expressions; Vocabulary - Words used as nouns and verbs without any change in the spelling (e.g. 'rock', 'train', 'ring'); E-materials - Interactive exercise on Grammar & vocabulary - Speed Reading practice exercises; Language Lab - Intonation practice using EFLU materials – Attending a meeting and writing minutes.

UNIT IV

9 + 3

Listening - Listening to a telephone conversation, Viewing a model interview (face-to-face, telephonic and video conferencing) and observing the practices; Speaking - Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping the interview skills; Reading - Reading the job advertisements and the profile of the company concerned – scanning; Writing - Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; Grammar - Numerical expressions - Connectives (discourse markers); Vocabulary - Idioms and their meanings – using idioms in sentences; E-materials - Interactive exercises on Grammar & Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; Language Lab - Telephonic interview – recording the responses - e-résumé writing.

UNIT V

9 + 3

Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener; Speaking - Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/ agreement – assertiveness in expressing opinions – mind mapping technique; Reading - Note making skills – making notes from books, or any form of written materials - Intensive reading Writing - Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); Grammar - Use of clauses; Vocabulary – Collocation; E-materials - Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises - Pictures for discussion; Language Lab - Different models of group discussion

TOTAL: 60 PERIODS

TEXT BOOKS

1. Mindscapes: English for Technologists and Engineers, Orient Black Swan, 2012 .
2. S.P. Dhanavel, English and Communication Skills for Students of Science and Engineering, Orient Black Swan, Chennai, 2011.

REFERENCES

1. Laws, Anne. Presentations. Hyderabad: Orient BlackSwan, 2000.
2. Lewis, Hedwig. Body Language: A Guide for Professionals. New Delhi: Sage Publications, 1998.
3. Naterop, Jean B. and Rod Revell. Telephoning in English. Cambridge: Cambridge University Press, 1987.
4. Rutherford, Andrea J. Basic Communication Skills for Technology. New Delhi: Pearson Education, 2001.
5. Ur, Penny. Teaching Listening Comprehension. Cambridge: Cambridge University Press, 1984.

EXTENSIVE READERS

1. Abdul Kalam, A P J. Ignited Minds: Unleashing the Power within India. New Delhi: Penguin Books India, 2002.
2. Parameswaran, Uma. C.V.Raman: A Biography. New Delhi: Penguin Books India, 2011.

WEB RESOURCES

www.esl-lab.com

www.englishgrammar.org

MA8251 **MATHEMATICS II** **L T P C**
(Common to all branches of B.E. / B.Tech. Programmes in II Semester) **3 1 0 4**

OBJECTIVES:

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To acquaint the student with the concepts of vector calculus needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I DIFFERENTIAL EQUATIONS **9+3**

Method of variation of parameters – Method of undetermined coefficients – Homogenous equation of Euler’s and Legendre’s type – System of simultaneous linear differential equations with constant coefficients.

UNIT II VECTOR CALCULUS **9+3**

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral and volume integral - Green’s, Gauss divergence and Stoke’s theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTION **9+3**

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c$, az , $1/z$, z^2 - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION**9+3**

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT V LAPLACE TRANSFORMS**9+3**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems – Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL : 60 PERIODS**TEXT BOOKS**

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2010.

REFERENCES

1. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2007.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7th Edition, 2009.
4. Peter V.O'Neil, Advanced Engineering Mathematics, Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH8255**PHYSICS OF MATERIALS****L T P C**

**(Common to Chemical, Ceramic, Food, Leather, Industrial
Biotechnology and Pharmaceutical)**

3 0 0 3**UNIT I PREPARATION AND PROCESSING OF MATERIALS****9**

Phases - Phase rule – binary systems – tie line rule – lever rule – phase diagram – invariant reactions – diffusion Fick's law - Nucleation – homogeneous and heterogeneous nucleation – Free energy of formation of a critical nucleus – crystal growth – Czochralski, Bridgman, Solution

methods - Thin films – preparation: PVD method - Sol-gel method – heat treatment and hardening processes.

UNIT II PROPERTIES OF CONDUCTING AND SUPERCONDUCTING MATERIALS 9

Classical free electron theory of metals –Fermi function - Schrödinger wave equation - Time independent and time dependent equations. Physical significance of wave function, particle in a box (in one dimension) – electrons in a metal - Density of energy states – effect of temperature on Fermi energy – carrier concentration in metals - Superconducting Phenomena, Properties of superconductors – Meissner effect and Isotope effect. Type I and Type II superconductors, High Tc superconductors – Magnetic levitation and SQUIDS.

UNIT III ELECTRONIC MATERIALS 9

Elemental and compound semiconductors - Origin of band gap in solids (qualitative) - Concept of effective mass of electron and hole – carrier concentration in an intrinsic semiconductor (derivation) – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – carrier concentration in n-type and p-type semiconductors (derivation) – variation of Fermi level with temperature and impurity concentration – Compound semiconductors – Hall effect – Determination of Hall coefficient – LED and Solar cells.

UNIT IV INSULATING AND MAGNETIC MATERIALS 9

Dielectric, paraelectric and ferroelectric materials - Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of Clausius Mosotti equation – dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, Giant Magneto Resistance materials. Magnetic bubbles.

UNIT V CERAMIC AND NEW MATERIALS 9

Introduction to Ceramics and its applications - Ceramic Fibres - Fibre reinforced Plastics – Fibre reinforced Metal – Metallic glasses – Shape memory alloys – Copper base alloys – Nickel – Titanium alloys – Relaxor- Ferroelectric materials – Electro and magneto rheological fluids - Sensors and Actuators – polymer semiconductos – photoconducting polymers – liquid crystals - Bio-sensors - Scintillation detectors (Position sensitive) –Bio materials – hydroxyapatite – PMMA – Silicone.

TOTAL : 45 PERIODS

REFERENCES

1. Raghavan. V. Materials Science and Engineering, Prentice Hall of India, 2002.

2. Kumar.J, Moorthy Babu. S and Vasudevan. S., Engineering Physics, Vijay Nicole Imprints, 2006
3. Palanisamy.. P.K., Materials Science, Scitech., 2003.
4. Calister, W.D., Materials Science and Engineering an Introduction, John Wiley, 2003.
5. Raghavan, V., Physical Metallurgy, Prentice Hall of India, 2002.

GE8251

ENGINEERING MECHANICS

L T P C

3 1 0 4

OBJECTIVE

To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering

UNIT I BASICS AND STATICS OF PARTICLES

9 + 3

Introduction – Units and Dimensions – Laws of Mechanics – Lami’s theorem, Parallelogram and triangular Law of forces — Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES

9 + 3

Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon’s theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III PROPERTIES OF SURFACES AND SOLIDS

9 + 3

Centroids and centre of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass

moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES

9 + 3

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion -Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS

9 + 3

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL: 60 PERIODS

TEXT BOOKS

1. Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004)
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

REFERENCES

1. Hibbeler, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education (2010).
2. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education (2006)
3. J.L.Meriam and L.G.Kraige, " Engineering Mechanics- Statics - Volume 1, Dynamics-Volume 2,Third Edition, John Wiley & Sons,(1993)
4. Rajasekaran, S and Sankarasubramanian, G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., (2005).

IB8201

APPLIED AND INDUSTRIAL MICROBIOLOGY

L T P C

3 0 0 3

AIM

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

OBJECTIVE

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

UNIT I INTRODUCTION 6

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

UNIT II MICROBES- STRUCTURE AND MULTIPLICATION 12

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

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM 12

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

UNIT IV CONTROL OF MICROORGANISMS 6

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

UNIT V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY 9

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

TOTAL: 45 PERIODS

TEXT BOOKS

1. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 1993.

2. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.
3. Prescott LM, Harley JP, Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 1996.

IB8202

BIOCHEMISTRY

L T P C
3 0 0 3

AIM

To enable students learn the fundamentals of biochemical Processes and biomolecules.

OBJECTIVES

- To ensure students have a strong grounding in structures and reactions of biomolecules.
- To introduce them to metabolic pathway of the major biomolecules and relevance to clinical conductors.
- To correlate biochemical processes with biotechnology applications.

UNIT I INTRODUCTION TO BIOMOLECULES

5

Basic principles of organic chemistry, types of functional groups, biomolecules, chemical nature, water, pH and biological buffers.

UNIT II STRUCTURE AND PROPERTIES OF IMPORTANT BIOMOLECULES

15

Carbohydrates (mono, di, oligo & polysaccharides) Proteoglycans, glycosaminoglycans. mutarotation, glycosidic bond, reactions of monosaccharides, reducing sugars

Lipids: fatty acids, glycerol, saponification, iodination, hydrogenation, phospholipids, glycolipids, sphingolipids, cholesterol, steroids, prostaglandins.

Amino Acids, Peptides, Proteins, measurement, structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins. Determination of primary structure.

Nucleic acids: purines, pyrimidines, nucleosides, nucleotides, RNA, DNA reactions, properties, measurement, nucleoprotein complexes

UNIT III METABOLISM CONCEPTS

5

Functions of Proteins, Enzymes, introduction to biocatalysts, metabolic pathways, primary and secondary metabolites.

UNIT IV INTERMEDIARY METABOLISM AND REGULATION

15

Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt, glyoxalate shunt, fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, interconnection of pathways and metabolic regulation. Case study on overproduction of glutamic acid, threonine, lysine, methionine, isoleucine and ethanol.

UNIT V BIOENERGETICS

5

High energy compounds, electronegative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Nelson, D.L. and M.M. Cox, "Lehninger's Principles of Biochemistry", 4th Edition, W.H. Freeman & Co., 2005.
2. Satyanarayana, U. and U. Chakerapani, "Biochemistry" 3rd Rev. Edition, Books & Allied (P) Ltd., 2006.
3. Rastogi, S.C. "Biochemistry" 2nd Edition, Tata McGraw-Hill, 2003.
4. Conn, E.E., et al., "Outlines of Biochemistry" 5th Edition, John Wiley & Sons, 1987.

REFERENCES

1. Berg, Jeremy M. et al. "Biochemistry", 6th Edition, W.H. Freeman & Co., 2006.
2. Voet, D. and Voet, J.G., "Biochemistry", 3rd Edition, John Wiley & Sons Inc., 2004.
3. Murray, R.K., et al. "Harper's Illustrated Biochemistry", 27th Edition, McGraw-Hill, 2006.

IB8211

APPLIED 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 – Operation and Maintenance 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: 30 PERIODS

EQUIPMENT NEEDED FOR 20 STUDENTS

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

REFERENCE BOOKS

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

IB8212

BIOCHEMISTRY LAB

**L T P C
0 0 4 2**

1. General guidelines for working in biochemistry lab (theory)
2. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.

3. Accuracy, precision, sensitivity and specificity (theory)
4. Preparation of buffer –titration of a weak acid and a weak base.
5. Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.
6. Quantitative method for amino acid estimation using ninhydrin – distinguishing amino from imino acid.
7. Protein estimation by Biuret and Lowry's methods.
8. Protein estimation by Bradford and spectroscopic methods.
9. Extraction of lipids and analysis by TLC.
10. Estimation of nucleic acids by absorbance at 260 nm and hyperchromic effect (demo).
11. Enzymatic assay: phosphatase from potato.
12. Enzymatic assay: estimation of glucose by TGO method after hydrolysis of starch with acid and specificity of the enzymatic method.

TOTAL : 60 PERIODS

EQUIPMENT NEEDED FOR 20 STUDENTS

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

MA8301

MATHEMATICS FOR BIOTECHNOLOGISTS

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.

TEXT BOOKS

1. Grewal, B.S. "Higher Engineering Mathematics", Khanna Publications (2007)

REFERENCES

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

IB8301 APPLIED THERMODYNAMICS FOR BIOTECHNOLOGISTS L T P C
3 0 0 3

UNIT I THERMODYNAMIC LAW AND PROPERTIES OF FLUIDS 9

First Law of thermodynamics, a generalized balance equation and conserved quantities, 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; VLE 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 DESCRIPTION OF MICROBIAL GROWTH AND PRODUCT FORMATION

9

Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance, Calculation of the Operational Stoichiometry of a growth process at Different growth rates, Including Heat using the Herbert –Pirt Relation for Electron Donor, thermodynamics and stoichiometry of Product Formation

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.
3. Christiana D. Smolke, " The Metabolic Pathway Engineering Handbook Fundamentals", CRC Press Taylor & Francis Group, 2010.

REFERENCE

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

IB8302

BASIC INDUSTRIAL BIOTECHNOLOGY

**L T P C
3 0 0 3**

UNIT I INTRODUCTION TO INDUSTRIAL BIOPROCESS

10

Fermentation- Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology- A brief survey of organisms, processes, products.

Basic concepts of Upstream and Downstream processing in Bioprocess, Process flow sheeting – block diagrams, pictorial representation.

UNIT II PRODUCTION OF PRIMARY METABOLITES

8

Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids and alcohols.

UNIT III PRODUCTION OF SECONDARY METABOLITES

8

Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids.

UNIT IV PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS

11

Production of Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers Biodiesel. Cheese, Beer, SCP & Mushroom culture, Bioremediation.

UNIT V PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS

8

Production of recombinant proteins having therapeutic and diagnostic applications, vaccines. Bioprocess strategies in Plant Cell 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. et al., "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.
5. Stanbury, P.F., A. Whitaker and S.J. Hall "Principles of Fermentation Technology", 2nd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.
6. C.F.A Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999.
7. K.G.Ramawat & Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand publications.

UNIT I BONDING AND STEREOCHEMISTRY 9

Atoms Electrons and orbitals - Covalent Bonds - Octet rule - Polar covalent Bonds - Electronegativity- formal charge - Resonance Acids and Bases - Arrhenius and Bronsted Lowry Theories - Acid Base equilibria - sp^3 hybridization - Conformations analysis ethane, butane and cyclohexane - Cis- trans isomerism. Stereochem activity around the tetrahedral carbon – optical activity - Conformation of the peptide bond.

UNIT II MECHANISMS OF SUBSTITUTION AND ADDITION REACTIONS 9

SN_1 and SN_2 reactions on tetrahedral carbon- nucleophiles- mechanism steric effects – nucleophilic addition on Acetals and ketals -Aldehyde and ketone groups – reactions of carbonyl group with amines- acid catalyzed ester hydrolysis – Saponification of an ester- hydrolysis of amides. Ester enolates - claisen .condensation – Michael condensation.

UNIT III KINETICS AND MECHANISM 9

Kinetic method – Rate law and mechanism – Transition states- Intermediates – Trapping of intermediates – Microscopic reversibility – Kinetic and thermodynamic reversibility – Isotopes for detecting intermediates. Primary and secondary isotopes – the Arrhenius equation Eyring equation - ΔG , ΔS , ΔH , Thermodynamics of coupled reactions.

UNIT IV CATALYSIS 9

Reactivity – Coenzymes – Proton transfer – metal ions – Intra molecular reactions – Covalent catalysis – Catalysis by organized aggregates and phases. Inclusion complexation

UNIT V BIOORGANIC REACTIONS 9

Timing of Bond formation and fission – Acyl group transfer – C-C bond formation and fission – Catalysis of proton transfer reactions – Transfer of hydride ion – Alkyl group. Transfer – Terpene biosynthesis – Murrfield state peptide synthesis – Sanger method for peptide and DNA sequencing

Fat soluble vitamins, pro vitamins, vitamins A, D, E and K- structure, physiological significance and deficiency symptoms. Water soluble vitamins and co-enzymes. Structure, functions, recommended dietary intake and deficiency symptoms of Thiamine, Riboflavin, Niacin, Folate, Vitamin B12 and biotin. Co-enzymes role in metabolic pathways: NAD, FAD, TPP, PLP and carboxy biotin.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Lodish, Harvey et al., "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 et al., "Molecular Biology of the Cell", 4th Edition, Garland Science (Taylors Francis), 2002.
4. Sadava, D.E. "Cell Biology : Organelle Structure and Functon", Panima Publishing, 2004.
5. Rastogi, S.C. "Cell Biology" 2nd Edition, New Age International, 2002.

REFERENCES

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

IB8305**STOICHIOMETRY AND FLUID MECHANICS****L T P C****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	INTRODUCTION	8
Units, conversion factors –gas laws- humidity and other physical properties		
UNIT II	CONCEPTS IN MATERIAL BALANCES	10
Application problems in unit operations - Material balance in reactions –Application in bioprocesses		
UNIT III	CONCEPTS IN ENERGY BALANCES	9
Sensible, Latent heats- Thermo chemical calculations-use of steam tables-examples of simultaneous material and energy balance- Application of energy balance in Bioprocesses		
UNIT IV	FLUID PROPERTIES	9
Newtonian and Non Newtonian Fluids, Fluid statics, Fluid Flow in pipelines and other flow channels- pressure drop calculations. Flow measurements.		
UNIT V	AGITATION, FLOW THROUGH PACKINGS, FLUIDIZATION, FLUID TRANSPORT	9
Flow in packed columns, fluidization –valves,pumps gas moving devices, gases – equipments. Agitation – power requirement		

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bhatt, B.I. and S.M. Vora “Stoichiometry (SI Units)”, 3rd Edition, Tata McGraw-Hill, 1996.
2. Geankoplis, C.J. “Transport Processes and Separation process Principles”, 4th Edition, PHI, 2006.

REFERENCES

1. McCabe, W.L., J.C. Smith and P.Harriot “Unit Operations of Chemical Engineering”, 6th Edition, Mc Graw Hill, 2001.
2. Himmelblau, D.M. “Basic principles and calculations in Chemical Engineering”, 6thEdition, PHI, 2006.
3. Foust, A.S. etal., “ Principles of Unit Operations”, 2nd Edition, John Wiley & Sons, 1999.

- Narayanan, K.V. and Lakshmi Kutty "Stoichiometry and Process Calculations", PHI, 2006.
- Coulson, J.M. and etal. "Coulson & Richardson's Chemical Engineering", 6th Edition, Vol. I & II, Butterworth – Heinman (an imprint of Elsevier), 2004.
- Perrys Chemical Engineers Hand Book.

IB8311

BIOORGANIC CHEMISTRY LABORATORY

**L T P C
0 0 4 2**

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

TOTAL : 60 PERIODS

EQUIPMENT NEEDED FOR 20 STUDENTS

Colorimeter 2

Glassware, Chemicals, Media as required

REFERENCES

- Organic Chemistry, Francis A.Carey, VII Edition, Tata MCGraw Hill, Fourth reprint 2009.
- Organic and Bio-organic Mechanisms, M.I. Page and Andrew Williams. Pearson, First Impression, 2010.

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.

EQUIPMENT NEEDED FOR 20 STUDENTS

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

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

TOTAL : 60 PERIODS

TEXT BOOKS

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

REFERENCES

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

GE8351

ENVIRONMENTAL SCIENCE AND ENGINEERING

L T P C

3 0 0 3

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

14

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

conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

Field study of common plants, insects, birds

Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION

8

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

Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES

10

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

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

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT

7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act

– Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT

6

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

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2006).

REFERENCE BOOKS

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

IB8401

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. Shuler, Michael L. and Fikret Kargi, “ Bioprocess Engineering “, Prentice Hall, 1992.
2. Doran, Pauline “of Bioprocess Engineering Principles “. Elsevier, 1995

REFERENCES

1. Lydersen, Bjorn K. “Bioprocess Engineering Systems, Equipment and Facilities” John Wiley, 1994.

- Bailey, James E. and David F. Ollis, “ Biochemical Engineering Fundamentals”, 2nd Edition. McGraw Hill , 1986.
- Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.
- Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.

**IB8402 ENZYME TECHNOLOGY AND BIOTRANSFORMATIONS 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 9

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

UNIT III ENZYME IMMOBILIZATION AND BIOSENSORS 9

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages, design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.

UNIT IV PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES 9

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

UNIT V BIOTRANSFORMATION APPLICATIONS OF ENZYMES**9**

Hydrolytic- Ester bond, Amide, Epoxides, Nitriles, Reduction reactions –aldehydes, Ketones, C=C, Oxidation reactions – Alkanes, Aromatic, Baeyer-Villiger, Enzymes in organic synthesis – esters, amide, peptide , Modified and Artificial Enzymes , Catalytic antibodies

TOTAL: 45 PERIODS**REFERENCES**

1. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.
2. James M. Lee, Biochemical Engineering, PHI, USA.
3. James. E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
4. Wiseman, Enzyme Biotechnology, Ellis Horwood Pub.

TEXT BOOKS

1. Trevor Palmer , Enzymes II ed Horwood Publishing Ltd
2. Faber K , Biotransformations in Organic Chemistry, IV edition , Springer

IB8403**HEAT TRANSFER OPERATIONS****L T P C
4 0 0 4****UNIT I MIXING AND AGITATION****12**

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

UNIT II CONDUCTION HEAT TRANSFER**12**

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

UNIT III CONVECTION HEAT TRANSFER**12**

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

UNIT IV RADIATION HEAT TRANSFER**12**

The problem of radiative exchange-Kirchoff's law, radiant heat exchange between two finite black holes-heat transfer among gray bodies

UNIT V HEAT TRANSFER EQUIPMENTS**12**

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

TOTAL: 60 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.

IB8451 ANALYTICAL METHODS AND INSTRUMENTATION**L T P C
3 0 0 3****UNIT I INTRODUCTION TO SPECTROMETRY****9**

Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform optical Measurements.

UNIT II MOLECULAR SPECTROSCOPY**9**

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence – Instrumentation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT III MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY

9

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMR-spectrometers – applications of ^1H and ^{13}C NMR- Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values – instrumentation.

UNIT IV SEPARATION METHODS

9

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography - Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography- principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY

9

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry – Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probe microscopes – AFM and STM.

TOTAL: 45 PERIODS

TEXT BOOK

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch “Instrumental Methods of Analysis”.. Cengage Learning , 2007.
2. Willard, Hobart, etal., “Instrumental Methods of Analysis”. 7th Edition, CBS, 1986.
3. Braun, Robert D. “ Introduction to Instrumental Analysis”. Pharma Book Syndicate, 1987.
4. Ewing,G.W. “Instrumental Methods of Chemical Analysis”, 5th Edition, McGraw-Hill, 1985

REFERENCE

1. Sharma, B.K. “Instrumental Methods of Chemical Analysis : Analytical Chemistry” Goel Publishing House, 1972.
2. Haven, Mary C., etal., “Laboratory Instrumentation “. 4th Edition, John Wiley, 1995.

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 $\text{Fe} (1,10 \text{ phenanthroline})_3$ 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

REFERENCES

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.

EQUIPMENT NEEDED FOR 20 STUDENTS

Colorimeter 2
Glassware, Chemicals, Media as required

1. Flow measurement a) Orifice 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. Characteristics of centrifuge pump
6. Flate and frame filter press
7. Filtration 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

EQUIPMENT NEEDED FOR 20 STUDENTS

Colorimeter	2
Filter leaf	1
Orifice meter	1
Venturimeter	1
Rotameter	1
Glassware, Chemicals, Media	as required

TOTAL : 60 PERIODS

IB8501

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 cerevisiae*, Animal cell cultivation, plant cell cultivation, Insect cell cultivation. High cell density cultivation, process strategies, reactor considerations in the above system

TOTAL: 45 PERIODS

REFERENCES

1. Anton Moser, “Bioprocess Technology, Kinetics and Reactors”, , Springer Verlag.
2. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
3. James M. Lee, Biochemical Engineering, PHI, USA.
4. Atkinson, Handbook of Bioreactors,Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Decker Inc.
5. Shuler and Kargi, “ Bioprocess Engineering “, Prentice Hall, 1992.
6. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications.
7. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.

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.

UNIT I CHEMISTRY OF NUCLEIC ACIDS**10**

Introduction to nucleic acids: Nucleic acids as genetic material, Structure and physicochemical properties of elements in DNA and RNA, Biological significance of differences in DNA and RNA. Primary structure of DNA: Chemical and structural qualities of 3',5'-Phosphodiester bond. Secondary Structure of DNA: Watson & Crick model, Chargaff's rule, X-ray diffraction analysis of DNA, Forces stabilizes DNA structure, Conformational variants of double helical DNA, Hogsteen base pairing, Triple helix, Quadruple helix, Reversible denaturation and hyperchromic effect. Tertiary structure of DNA: DNA supercoiling.

UNIT II DNA REPLICATION & REPAIR**10**

Overview of Central dogma. Organization of prokaryotic and eukaryotic chromosomes. DNA replication: Meselson & Stahl experiment, bi-directional DNA replication, Okazaki fragments, Proteomics of DNA replication, Fidelity of DNA replication, Inhibitors of DNA replication, Overview of differences in prokaryotic and eukaryotic DNA replication, Telomere replication in eukaryotes. D-loop and rolling circle mode of replication. Mutagens, DNA mutations and their mechanism, various types of repair mechanisms.

UNIT III TRANSCRIPTION**8**

Structure and function of mRNA, rRNA and tRNA. Characteristics of promoter and enhancer sequences. RNA synthesis: Initiation, elongation and termination of RNA synthesis, Proteins of RNA synthesis, Fidelity of RNA synthesis, Inhibitors of transcription, Differences in prokaryotic and eukaryotic transcription. Basic concepts in RNA world: Ribozymes, RNA processing: 5'-Capping, Splicing-Alternative splicing, Poly 'A' tail addition and base modification.

UNIT IV TRANSLATION**10**

Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Wobble hypothesis and its importance, Prokaryotic and eukaryotic ribosomes. Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis. Post-translational modifications and its importance.

UNIT V REGULATION OF GENE EXPRESSION

7

Organization of genes in prokaryotic and eukaryotic chromosomes, Hierarchical levels of gene regulation, Prokaryotic gene regulation –*lac* and *trp* operon, Regulation of gene expression with reference to λ phage life cycle.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Friefelder, David. “Molecular Biology.” Narosa Publications, 1999
2. Weaver, Robert F. “Molecular Biology” 2nd Edition, Tata McGraw-Hill, 2003.
3. Karp, Gerald “Cell and Molecular Biology : Concepts and Experiments” 4th Edition, John Wiley, 2005.
4. Friefelder, David and George M. Malacinski “Essentials of Molecular Biology” 2nd Edition, Panima Publishing, 1993.

REFERENCES

1. Tropp, Burton E. “Molecular Biology : Genes to Proteins”. 3rd Edition. Jones and Bartlett, 2008.
2. Glick , B.R. and J.J. Pasternak. “Molecular Biotechnology : Principles and Applications of Recombinant DNA” 4th Edition. ASM, 2010.

IB8551 PROTEIN STRUCTURE FUNCTION AND PROTEOMICS

L T P C
3 1 0 4

UNIT I BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS

10

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. 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).

UNIT II PROTEIN ARCHITECTURE

10

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: Alpha-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.

UNIT III TERTIARY STRUCTURE

5

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures. Quaternary structure: Modular nature, formation of complexes. Computer exercise on the above aspects

UNIT IV STRUCTURE-FUNCTION RELATIONSHIP

10

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eukaryotic 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

Computer exercise on the above aspects

UNIT V PROTEOMICS

10

Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein-protein interactions and methods to study it: protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays.

Computer exercise on the above aspects

**TOTAL : 60
PERIODS**

TEXT BOOKS

1. Branden C. and Tooze J., "Introduction to Protein Structured" 2nd Edition, Garland Publishing, 1999.
2. Creighton T.E. "Proteins" 2nd Edition. W.H. Freeman, 1993.
3. Pennington, S.R and M.J. Dunn, "Proteomics : Protein Sequence to Function". Viva Books, 2002
4. Liebler, "Introduction to Proteomics" Humana Press, 2002.

REFERENCES

1. Voet D. and Voet G., "Biochemistry". 3rd Edition. John Wiley and Sons, 2008.
2. Haggerty, Lauren M. "Protein Structure : Protein Science and Engineering". Nova Science Publications, 2011.
3. Williamson, Mike " How Proteins Work". Garland Science, 2012.

IB8511

BIOPROCESS LABORATORY – I

L T P C
0 0 4 2

1. Enzyme kinetics – Determination of Michaelis Menten parameters
2. Enzyme activity – Effect of Temperature and Deactivation Kinetics
3. Enzyme activity – Effect of pH
4. Enzyme inhibition kinetics
5. Enzyme immobilization – Gel entrapment/ Cross linking
6. Enzymatic conversion in Packed bed Column/Fluidized bed Column
7. Growth of Bacteria – Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
8. Growth of Algae – Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
9. Medium optimization – Plackett Burman Design
10. Medium optimization – Response Surface Methodology

TOTAL : 60 PERIODS

EQUIPMENT NEEDED FOR 20 STUDENTS

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

REFERENCES

1. Bailey and Ollis, " Biochemical Engineering Fundamentals", McGraw Hill (2nd Ed.), 1986.
2. Shuler and Kargi, " Bioprocess Engineering ", Prentice Hall, 1992.
3. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications.
4. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.

IB8512

MOLECULAR BIOLOGY LABORATORY

**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
7. Blue and white selection for recombinants
8. Plating of λ phage
9. Lamda phage lysis of liquid cultures

TOTAL: 60 PERIODS

EQUIPMENT NEEDED FOR 20 STUDENTS

Electrophoresis Kit	1
PCR	1
Incubators	2
Light Microscopes	4
Incubator Shaker	1
Spectrophotometer	2
Laminar Flow Chamber	2
Glassware, Chemicals, Media	as required

REFERENCE

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

AIM

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

OBJECTIVES

- To understand 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 product and service quality - Basic concepts of TQM – TQM Framework - Contributions of Quality Gurus – Barriers to TQM – Cost of Quality.

UNIT II TQM PRINCIPLES**9**

Quality statements - Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Continuous process improvement – PDCA 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 – Performance measures - BPR.

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 –Quality Council

– Leadership, Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward.

TOTAL : 45 PERIODS

TEXT BOOK

1. Dale H. Besterfield, et al., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint, 2006.

REFERENCE BOOKS

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, Third 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.

IB8601

CHEMICAL REACTION ENGINEERING

**L T P C
3 0 0 3**

UNIT I SCOPE OF CHEMICAL KINETICS & CHEMICAL REACTION ENGINEERING 8

Broad outline of chemical reactors; rate equations; concentration and temperature dependence; development of rate equations for different homogeneous reactions. Industrial scale reactors.

UNIT II IDEAL REACTORS 10

Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor systems; multiple reactions.

UNIT III IDEAL FLOW AND NON IDEAL FLOW 10

RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.

UNIT IV GAS-SOLID, GAS-LIQUID REACTIONS**9**

Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

UNIT V FIXED BED AND FLUID BED REACTORS**8**

G/L reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.

TOTAL : 45 PERIODS**TEXT BOOKS**

1. Levenspiel O. Chemical Reaction Engineering. 3rd Edition. John Wiley.1999.
2. Fogler H.S. Elements Of Chemical Reaction Engineering. Prentice Hall India.2002

REFERENCES

1. Missen R.W., Mims C.A., Saville B.A. Introduction To Chemical Reaction Engineering And Kinetics. John Wiley.1999

IB8602**GENETIC ENGINEERING AND GENOMICS****L T P C
4 0 0 4****UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY****12**

Manipulation of DNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction of recombinant DNA in to host cells and selection methods.

UNIT II DNA LIBRARIES**12**

Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Chromosomal walking, Screening of DNA libraries using nucleic acid probes and antisera.

UNIT III SEQUENCING AND AMPLIFICATION OF DNA**12**

Maxam Gilbert's and Sanger's methods of DNA sequencing. Inverse PCR, Nested PCR, AFLP-PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, inverse

PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

UNIT IV

12

Organization and structure of genomes, Genome sequencing methods, Conventional and shotgun genome sequencing methods, Next generation sequencing technologies , Ordering the genome sequence, Genetic maps and Physical maps, STS content based mapping, Restriction Enzyme Finger Printing, Hybridization mapping, Radiation Hybrid Maps, Optical mapping. ORF finding and functional annotation.

UNIT V

12

Current status of genome sequencing projects, Introduction to Functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Subtractive hybridization, DIGE, TOGA, Yeast Two hybrid System, Comparative Genomics, Proteogenomics, Web resources for Genomics, Applications of genome analysis and genomics.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Old RW, Primrose SB, “Principles Of Gene Manipulation, An Introduction To Genetic Engineering “, Blackwell Science Publications, 1993.
2. Principles of Genome Analysis and Genomics by S.B.Primrose and R.M.Twyman, Third Edition (Blackwell Publishing)

REFERENCES

1. Ansubel FM, Brent R, Kingston RE, Moore DD, “Current Protocols In Molecular Biology “Greene Publishing Associates, NY, 1988.
2. Berger SI, Kimmer AR, “Methods In Enzymology”, Vol 152, Academic Press, 1987.
3. Genomes 3 by T.A.Brown, Third Edition (Garland Science Publishing)

IB8651

**CREATIVITY, INNOVATION AND NEW PRODUCT
DEVELOPMENT**

**L T P C
3 0 0 3**

AIM

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

OBJECTIVES

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

UNIT I INTRODUCTION 9

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

UNIT II PROJECT SELECTION AND EVALUATION 9

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

UNIT III NEW PRODUCT DEVELOPMENT 9

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

UNIT IV NEW PRODUCT PLANNING 9

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

UNIT V MODEL PREPARATION & EVALUATION 9

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

TOTAL : 45 PERIODS

TEXT BOOKS

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

REFERENCES

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

(Common to all branches of Fifth or Sixth Semester B.E / B.Tech programmes)

OBJECTIVES

- To enhance the employability skills of students with a special focus on Presentation skills, Group discussion skills and Interview skills
- To help them improve their soft skills, including report writing, necessary for the workplace situations
 1. Making presentations – introducing oneself – introducing a topic – answering questions – individual presentation practice
 2. Creating effective PPTs – presenting the visuals effectively
 3. Using body language with awareness – gestures, facial expressions, etc.
 4. Preparing job applications - writing covering letter and résumé
 5. Applying for jobs online - email etiquette
 6. Participating in group discussions – understanding group dynamics - brainstorming the topic
 7. Training in soft skills - persuasive skills – sociability skills - questioning and clarifying skills – mock GD
 8. Writing reports – collecting, analyzing and interpreting data – drafting the report
 9. Attending job interviews – answering questions confidently
 10. Interview etiquette – dress code – body language – mock interview

TOTAL : 30 PERIODS

REQUIREMENTS FOR A CLASS OF 30 STUDENTS

1. A PC or a lap top with one or two speakers
2. A Collar mike and a speaker
3. An LCD projector and a screen
4. CD's and DVD's on relevant topics
5. Individual chairs for conducting group discussions

REFERENCE BOOKS

1. Dhanavel, S.P. 2010. English and Soft Skills. Hyderabad: Orient BlackSwan Ltd.
2. Corneilssen, Joep. How to Prepare for Group Discussion and Interview. New Delhi: Tata-McGraw-Hill, 2009.

3. D'Abreo, Desmond A. Group Discussion and Team Building. Mumbai: Better Yourself Books, 2004.
4. Ramesh, Gopalswamy, and Mahadevan Ramesh. The ACE of Soft Skills. New Delhi: Pearson, 2010.
5. Gulati, Sarvesh. Corporate Soft Skills. New Delhi: Rupa and Co. 2006.
6. Van Emden, Joan, and Lucinda Becker. Presentation Skills for Students. New York: Palgrave Macmillan, 2004.

EXTENSIVE READERS

1. Covey, Stephen R. The 7 Habits of Highly Effective People. New York: Free Press, 1989.
2. Bagchi, Subroto. The Professional. New Delhi: Penguin Books India, 2009.

WEB RESOURCES

1. www.humanresources.about.com
2. www.careerride.com

IB8611

BIOPROCESS LABORATORY II

L T P C
0 0 4 2

1. Batch Sterilization kinetics
2. Batch cultivation with exhaust gas analysis.
3. Estimation of $K_L a$ – Dynamic Gassing-out method,
4. Estimation of $K_L a$ – Sulphite Oxidation Method
5. Estimation of $K_L a$ – Power Correlation Method
6. Fed batch cultivation and Total cell retention cultivation
7. Algal cultivation-Photobioreactor
8. Residence time distribution
9. Estimation of Overall Heat Transfer Coefficient
10. Estimation of Mixing Time in reactor

TOTAL : 60 PERIODS

EQUIPMENT NEEDED FOR 20 STUDENTS

Electrophoresis Kit	1
Reactors	6

Incubators	2
Light Microscopes	1
Incubator Shaker	1
Spectrophotometer	2
Laminar Flow Chamber	1
Glassware, Chemicals, Media	as required

REFERENCES

1. Anton Moser, "Bioprocess Technology, Kinetics and Reactors", , Springer Verlag.
2. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
3. James M. Lee, Biochemical Engineering, PHI, USA.
4. Atkinson, Handbook of Bioreactors,Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Decker Inc.

IB8612

GENETIC ENGINEERING LABORATORY

**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

EQUIPMENT NEEDED FOR 20 STUDENTS

Electrophoresis Kit	1
PCR	1
Incubators	2

Light Microscopes	4
Incubator Shaker	1
Spectrophotometer	2
Laminar Flow Chamber	2
Glassware, Chemicals, Media	as required

REFERENCES

1. Old RW, Primrose SB, "Principles Of Gene Manipulation, An Introduction To Genetic Engineering ", Blackwell Science Publications, 1993.
2. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols In Molecular Biology ", Greene Publishing Associates, NY, 1988.
3. Berger SI, Kimmer AR, "Methods In Enzymology", Vol 152, Academic Press, 1987

IB8751

BIOINFORMATICS AND COMPUTATIONAL BIOLOGY

L T P C

3 0 0 3

UNIT I

9

Introduction to Operating systems, Linux commands, File transfer protocols ftp and telnet, Introduction to Bioinformatics and Computational Biology, Biological sequences, Biological databases, Genome specific databases, Data file formats, Data life cycle, Database management system models, Basics of Structured Query Language (SQL).

UNIT II

9

Sequence Analysis, Pairwise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment. Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms.

UNIT III

8

Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological

traits, Bootstrapping. Protein Secondary structure and tertiary structure prediction methods, Homology modeling, *abinitio* approaches, Threading, Critical Assessment of Structure Prediction, Structural genomics.

UNIT IV

11

Machine learning techniques: Artificial Neural Networks in protein secondary structure prediction, Hidden Markov Models for gene finding, Decision trees, Support Vector Machines. Introduction to Systems Biology and Synthetic Biology, Microarray analysis, DNA computing, Bioinformatics approaches for drug discovery, Applications of informatics techniques in genomics and proteomics: Assembling the genome, STS content mapping for clone contigs, Functional annotation, Peptide mass fingerprinting.

UNIT V

8

Basics of PERL programming for Bioinformatics: Datatypes: scalars and collections, operators, Program control flow constructs, Library Functions: String specific functions, User defined functions, File handling.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Introduction to Bioinformatics by Arthur K. Lesk , Oxford University Press.
2. Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press.
3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by R.Durbin, S.Eddy, A.Krogh, G.Mitchison.
4. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press.
5. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O'Reilley Media

REFERENCE BOOKS

1. Bioinformatics The Machine Learning Approach by Pierre Baldi and Soren Brunak, MIT Press

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

TEXTBOOKS

1. Belter, P.A. E.L. Cussler And Wei-Houhu – “Bioseparations – Downstream Processing For Biotechnology, Wiley Interscience Pun. (1988).
2. Sivasankar, B. “Bioseparations : Principles and Techniques”. PHI, 2005.

REFERENCE

1. R.O. Jenkins, (Ed.) – Product Recovery In Bioprocess Technology – Biotechnology By Open Learning Series, Butterworth-Heinemann (1992).
2. J.C. Janson And L. Ryden, (Ed.) – Protein Purification – Principles, High Resolution Methods And Applications, VCH Pub. 1989.
3. R.K. Scopes – Protein Purification – Principles And Practice, Narosa Pub. (1994).

UNIT I INTRODUCTION 6

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

UNIT II CELLULAR RESPONSES 12

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

UNIT III INFECTION AND IMMUNITY 16

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

UNIT IV TRANSPLANTATION AND TUMOR IMMUNOLOGY 8

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

UNIT V AUTOIMMUNITY 3

Autoimmunity, Autoimmune disorders and diagnosis.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. Roitt I, Male, Brostoff. Immunology, Mosby Publ., 2002.
2. Kuby J, Immunology, WH Freeman & Co., 2000.
3. Ashim K. Chakravathy, Immunology, TataMcGraw-Hill, 1998.

REFERENCES:

1. Coico, Richard "Immunology : A Short Course" 5th Edition. John Wiley, 2003.
2. Khan, Fahim Halim "Elements of Immunology" Pearson Education, 2009.

UNIT I SUCCESSFUL EXAMPLES OF METABOLIC ENGINEERING 9

Product over production examples: amino acids, polyhydroxyalkanoic acids, By-product minimization of acetate in recombinant *E. coli*, Extension of substrate utilization range for organisms such as *S. cerevisiae* and *Z. mobilis* for ethanol production, Improvement of cellular properties, Altering transport of nutrients including carbon and nitrogen and xenobiotic degradation.

UNIT II METABOLIC FLUX ANALYSIS 9

Comprehensive models of cellular reactions; stoichiometry of cellular reactions, reaction rates, dynamic mass balances, metabolic flux analysis. MFA of exactly determined systems, over determined systems.

UNIT III CONSTRAINT BASED GENOMIC SCALE METABOLIC MODEL 9

Underdetermined systems- linear programming, sensitivity analysis, Development of Genomic scale metabolic model, Flux balance analysis, Regulatory on-off Minimization and Minimization of metabolic adjustments and Opt knock tool development, Elementary mode analysis, Extreme pathways.

UNIT IV METABOLIC FLUX ANALYSIS BY ISOTOPIC LABELLING 9

Methods for the experimental determination of metabolic fluxes by isotope labeling metabolic fluxes using various separation-analytical techniques. Validation of flux estimates by ¹³C labeling studies in mammalian cell culture.

UNIT V METABOLIC CONTROL ANALYSIS AND NETWORK ANALYSIS 9

Fundamental 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. Control of flux distribution at a single branch point, grouping of reactions, optimization of flux amplification.

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. S. Cortassa, M.A.Aon, A.A. Iglesias and D. Llyod, " An Introduction to Metabolic and Cellular Engineering", World Scientific Publishing Co. Pte. Ltd, 2002.
4. Christiana D. Smolke, " The Metabolic Pathway Engineering Handbook Fundamentals", CRC Press Taylor & Francis Group, 2010.
5. Boris N. Kholodenko and Hans V. Westerhoff "Metabolic Engineering in the Post Genomic Era", Horizon Bioscience, 2004.

IB8711

DOWNSTREAM PROCESSING LABORATORY

**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 – dynamill – 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
9. Product polishing – spray drying, freeze drying

TOTAL : 60 PERIODS

LIST OF EQUIPMENTS FOR 30 STUDENTS

- | | |
|---------------------------------|---|
| 1. Centrifuge | 1 |
| 2. Cross flow filtration set up | 2 |
| 3. FPLC | 1 |
| 4. Sonicator | 1 |
| 5. French press | 1 |

REFERENCES

1. P.A. Belter, E.L. Cussler And Wei-Houhu – Bioseparations – Downstream Processing For Biotechnology, Wiley Interscience Pun. (1988).
2. R.O. Jenkins, (Ed.) – Product Recovery In Bioprocess Technology – Biotechnology By Open Learning Series, Butterworth-Heinemann (1992).
3. J.C. Janson And L. Ryden, (Ed.) – Protein Purification – Principles, High Resolution Methods And Applications, VCH Pub. 1989.

IB8712

IMMUNOLOGY LABORATORY

**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 rosetting using sheep RBC.

TOTAL : 60 PERIODS

LIST OF EQUIPMENTS FOR 30 STUDENTS

Elisa reader	1
Microscopes	8
Microwave oven	1
Hot plate	4
Vortex mixer	4
Table top refrigerated Centrifuge	1
Fluorescent microscope	1

REFERENCES

1. Roitt I, Male, Brostoff. Immunology, Mosby Publ., 2002.
2. Kuby J, Immunology, WH Freeman & Co., 2000.
3. Ashim K. Chakravathy, Immunology, TataMcGraw-Hill, 1998.

UNIT I METABOLISM OF AMINO ACIDS 10

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 12

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. Triacylglycerol and phospholipid biosynthesis and degradation; Cholesterol biosynthesis and regulation and targets and action of cholesterol lowering drugs.

UNIT IV VITAMINS AND COENZYMES 9

Fat Soluble Vitamins, provitamins (A, D, E and K). Structure, physiological significance and deficiency symptoms. Water soluble vitamins, structure, coenzyme role and deficiency symptoms. Thiamine, riboflavin, pyridoxine, niacin, folic acid, biotin and Vitamin B12. Recommended dietary intake. Coenzymes: Their role in metabolic pathways. NAD, FAD, TPP, PLP, carboxy biotin

UNIT V HORMONES 9

Introduction. Effects of Hormones. Chemical classification of hormones. Peptide hormone- vasopressin, protein hormone- insulin. Lipid and phospholipid derived hormones- prostaglandin and phospholipids. Steroid hormones- testosterone, estrogen, cortisol. Monoamines: thyroxine, adrenaline. Mechanism of action of the different classes of hormones.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Nelson, D.L et al., "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" 3rd Edition, John Wiley & Sons Inc., 2008.
4. Murray, R.K., et al., "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.

IB8002

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. Agrobios India Limited, 2002
2. Ramadass P, Meera Rani S. Text Book Of Animal Biotechnology. Akshara Printers, 1997.

REFERENCE

1. Masters J.R.W. Animal Cell Culture: Practical Approach. Oxford University Press.2000

IB8003

BIO- INDUSTRIAL ENTREPRENEURSHIP

L T P C

3 0 0 3

UNIT I

9

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

UNIT II

9

- Develop a Business Plan

UNIT III

9

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

UNIT IV	9
<ul style="list-style-type: none"> • Finance, Protect and Insure Your Business • Record Keeping and Accounting • Financial Management 	

UNIT V	9
<ul style="list-style-type: none"> • Meet Your Legal, Ethical, Social Obligations • Growth in Today's Marketplace 	

TOTAL : 45 PERIODS

TEXT BOOK

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

IB8004	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**TEXTBOOK**

1. Finkel, Richard, et al., "Lippincott's Illustrated Reviews Pharmacology" 4th Edition. Wolters Kluwer / Lippincott Williams & Wilkins, 2009.

REFERENCES

1. Gareth Thomas. Medicinal Chemistry. An introduction. John Wiley. 2000.
2. Katzung B.G. Basic and Clinical Pharmacology, Prentice Hall of Intl. 1995.

IB8005**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 – hydrophathy 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

TEXTBOOKS

1. Biophysics ; R. Glaser, Springer Verlag , 2000.
2. Biophysics: Molecules In Motion ; R. Duane. Academic Press , 1999

REFERENCE

1. Cantor, Charles R. and Paul R. Schimmel “Biophysical Chemistry” . 1-3 Vols. W.H.Freeman & Co.,1980.

IB8006

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

TEXTBOOKS

1. Weinberg, R.A. "The Biology of Cancer" Garland Science, 2007
2. McDonald, F etal., " Molecular Biology of Cancer" 2nd Edition. Taylor & Francis, 2004.

REFERENCES

1. King, Roger J.B. "Cancer Biology" Addison Wesley Longman, 1996.
2. Ruddon, Raymond W. " Cancer Biology" 3rd Edition . Oxford University Press, 1995.

IB8007

HAZARD ASSESSMENT AND MITIGATION IN BIOPROCESS INDUSTRIES

L T P C
3 0 0 3

AIM

- To introduce awareness on the importance of plant safety and risk analysis

OBJECTIVES

- Students learn about implementation of safety procedures, risk analysis and assessment, hazard identification

UNIT I

9

Need for safety in industries; Safety Programmes – components and realization; Potential hazards – extreme operating conditions, toxic chemicals; safe handling

UNIT II

9

Implementation of safety procedures – periodic inspection and replacement; Accidents – identification and prevention; promotion of industrial safety

UNIT III

9

Overall risk analysis--emergency planning-on site & off site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment - rapid

and comprehensive risk analysis; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball.

UNIT IV

9

Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough-Mexico-Madras-VizagBopal analysis.

UNIT V

9

Hazop-guide words, parameters, derivation-causes-consequences-recommendation-coarse Hazop study-case studies-pumping system-reactor-mass transfer system.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Fawatt, H.H. and Wood, W.S., "Safety and Accident Prevention in Chemical Operation", Wiley Interscience, 1965.
2. Marcel, V.C., Major Chemical Hazard- Ellis Harwood Ltd., Chi Chester, UK, 1987.
3. Skeleton, B., Process Safety Analysis : An introduction, Institution of chemical Engineers, U.K., 1997.
4. Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis, Dyadem Press, 2004.

REFERENCES

1. Handley, W., "Industrial Safety Hand Book ", 2nd Edn., McGraw-Hill Book Company, 1969.
2. Heinrich, H.W. Dan Peterson, P.E. and Rood, N., "Industrial Accident Prevention", McGraw-Hill Book Co., 1980.
3. Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prantice Hall, NJ, 1990.
4. Taylor, J.R., Risk analysis for process plant, pipelines and transport, Chapman and Hall, London, 1994

UNIT I INTRODUCTION TO MATLAB 9

Introduction - Operations with variables – Arrays - Multidimensional Arrays - Element by Element operations - Polynomial operations using arrays - Cell Arrays - Structure arrays - Writing script files - Logical variables and operators- Flow control- Loop operators- Writing functions- Input/output arguments- Function visibility, path.- Simple graphics- 2D plots- Figures and subplots

UNIT II DATA AND DATA FLOW IN MATLAB 9

Data types- Matrix, string -cell and structure- Creating, accessing elements and manipulating of data of different types - File Input-Output- Matlab files- Text files- Binary files - Mixed text-binary files- Communication with external devices- Serial port- Parallel port- Sound card- Video input

UNIT III FUNCTIONS & FILES 9

Elementary Mathematical Functions - User Defined Functions - Advanced Function Programming - Working with Data Files, Introduction to Numerical Methods -Linear algebra- numerical integration and differentiation- solving systems of ODE's and interpolation of data.

UNIT IV PROGRAMMING TECHNIQUES & DATA VISUALIZATION AND STATISTICS 9

Program Design and Development - Relational Operators and Logical Variables Logical Operators and Functions - Conditional Statements -Loops - Basic statistical tools in Matlab, XY-plotting functions - Subplots and Overlay plots - Special Plot types - Interactive plotting - Designing GUI interfaces using Matlab's GUIDE interface.

UNIT V FUNDAMENTALS OF VIRTUAL INSTRUMENTATION & DATA ACQUISITION 9

Concept of virtual instrumentation (VI)– LabVIEW software- basics- Creating, Editing and debugging a VI in LabVIEW- Creating a sub VI- Loops and charts- data acquisition with LabVIEW- plug-in DAQ boards- Organization of the DAQ VI System- Performing analog input and analog output- Scanning multiple analog channels- Driving the digital I/Os- Buffered data acquisition

TOTAL : 45 PERIODS

TEXT BOOKS

1. Essential Matlab for Engineers and Scientists (Fourth Edition). Copyright © 2010 Elsevier Ltd. Author(s): Brian H. Hahn and Daniel T. Valentine ISBN: 978-0-12-374883-6
2. Rahman, and Herbert Pichlik,, 'LabVIEW – Applications and Solutions', National Instruments Release, ISBN 01309642392. National Instruments LabVIEW Manual

ONLINE MATLAB TUTORIALS AND REFERENCES:

1. Tutorials offered by The Mathworks .The creators of Matlab.
2. Introductory Matlab material from Indiana University
3. A practical introduction to Matlab from Michigan Tec
4. Links to Matlab tutorials, references, books, packages, etc. -- from the Math Department at UIC

MATLAB GUIDES PROVIDED WITH THE MATLAB INSTALLATION

1. Getting Started with Matlab
2. Using Matlab
3. Using Graphs in Matlab
4. Using GUIs in Matlab

For links to these documents visit Dr. Randy Jost's web page (USU ECE Department). For other links related to Matlab,

IB8009

IPR AND ETHICAL ISSUES IN BIOTECHNOLOGY

**L T P C
3 0 0 3**

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 and Bhopal Case Studies.

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)

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 – Uncertainty 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 – molecule specifications running Gaussian – examples.

TOTAL : 45 PERIODS

TEXTBOOKS

1. Leach, Andrew R. “ Molecular Modelling : Principles and Applications” 2nd Edition, Pearson, 2010.
2. Cohen, N.C. “ Guide Book on Molecular Modeling in Drug Design” Academic Press/ Elsevier, 1996.

REFERENCES

1. Statistical Mechanics ; D. McQuarrie, Narosa, 1999.
2. Quantum Mechanics; D. McQuarrie, Narosa, 1999.
3. GROMOS Handbook.

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, Enteropathogenic *E.coli* (EPEC), type III secretion, cytoskeletal changes, intimate attachment; Enterohaemorrhagic *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. Iglewski B.H and Clark V.L “ Molecular basis of Bacterial Pathogenesis “, Academic Press, 1990.
2. Peter Williams, Julian Ketley & George Salmond, “Methods in Microbiology : Bacterial Pathogenesis, Vol. 27”, Academic Press, 1998.
3. Recent reviews in Infect. Immun., Mol. Microbiol., Biochem. J., EMBO etc
4. Nester, Anderson, Roberts, Pearsall, Nester, “Microbiology: A Human Perspective”, Mc Graw Hill, 3rd Edition, 2001.
5. Eduardo A. Groisman, Principles of Bacterial Pathogenesis, Academic Press, 2001.

IB8012**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.

**IB8013 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. Gamburg OL, Philips GC, Plant Tissue & Organ Culture fundamental Methods, Narosa Publications. 1995.
2. Singh BD. Text Book of Biotechnology, Kalyani Publishers. 1998

REFERENCES

1. Heldt HW. Plant Biochemistry & Molecular Biology, Oxford University Press. 1997.
2. Ignacimuthu .S, Applied Plant Biotechnology , Tata McGraw Hill. 1996.

IB8014

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

REFERENCES

1. T.P. Coultate – Food – The Chemistry Of Its Components, 2nd Edn. Royal Society, London, 1992.
2. B. Sivasanker – Food Processing And Preservation, Prentice-Hall Of India Pvt. Ltd. New Delhi 2002.
3. W.C. Frazier And D.C. Westhoff – Food Microbiology, 4th Ed., Mcgraw-Hill Book Co., New York 1988.
4. J.M. Jay – Modern Food Microbiology, Cbs Pub. New Delhi, 1987.

IB8015

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

**IB8016 SYSTEMS BIOLOGY L T P C
3 0 0 3**

UNIT I 9

Introduction to Systems Biology, Systems level understanding of biological systems. Basic concepts in Systems modeling : Model Scope, Model Statements, System state, Variables, parameters and constants, Model behavior, classification and steady state. Merits of computational modeling.

UNIT II 9

Kinetic modeling of biochemical reactions, describing dynamics with ODEs, rate equations, deriving a rate equation, incorporating regulation of enzyme activity by effectors, E-cell platform and erythrocyte modeling.

UNIT III 9

Introduction to Flux balance analysis, Construction of stoichiometric matrices, Constraint based models. Network basics, examples of mathematical reconstruction of transcriptional networks and signal transduction networks.

UNIT IV

9

Network motifs, Feed forward loop network motif. Gene circuits, robustness of models, Chemotaxis model, Integration of data from multiple sources: Building genome scale models.

UNIT V

9

Tools and databases for modeling: Pathway databases KEGG, EMP, Metacyc, Enzyme kinetics database BRENDA, Gene expression databases, Biomodels database, Basics of Systems Biology Markup Language (SBML), SBML editors.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Systems Biology a Textbook by Edda Klipp, Wolfram Liebermeister, Christoph Wierling Wiley-BlackWell Publications (2009 Edition).
2. An introduction to Systems Biology: Design Principles of Biological Circuits by Uri Alon (Chapman and Hall / CRC 2007 Edition)
3. Systems Biology in practice : concepts, implementation and application by Edda Klipp, Ralf Herwig, Axel Kowald, Christoph Wierling, Hans Lehrach. (Wiley – VCH 2005)

REFERENCE BOOKS

1. Foundations of Systems Biology Edited by Hiroaki Kitano (MIT Press)
2. Systems Biology: Definitions and perspectives by Lilia Albergina (Springer Publications 2008)

IB8074

TISSUE ENGINEERING

**L T P C
3 0 0 3**

UNIT I INTRODUCTION

9

Introduction to tissue engineering: Basic definition; current scope of development; use in therapeutics, cells as therapeutic agents, cell numbers and growth rates, measurement of cell characteristics morphology, number viability, motility and functions. Measurement of tissue characteristics, appearance, cellular component, ECM component, mechanical measurements and physical properties.

UNIT II TISSUE ARCHITECTURE

9

Tissue types and Tissue components, Tissue repair, Engineering wound healing and sequence of events. Basic wound healing Applications of growth factors: VEGF/angiogenesis, Basic properties, Cell-Matrix & Cell-Cell Interactions, telomeres and Self-renewal, Control of cell migration in tissue engineering.

UNIT III BIOMATERIALS

9

Biomaterials: Properties of biomaterials, Surface, bulk, mechanical and biological properties. Scaffolds & tissue engineering, Types of biomaterials, biological and synthetic materials, Biopolymers, Applications of biomaterials, Modifications of Biomaterials, Role of Nanotechnology.

UNIT IV BASIC BIOLOGY OF STEM CELLS

9

Stem Cells : Introduction, hematopoietic differentiation pathway Potency and plasticity of stem cells, sources, embryonic stem cells, hematopoietic and mesenchymal stem cells, Stem Cell markers, FACS analysis, Differentiation, Stem cell systems- Liver, neuronal stem cells, Types & sources of stem cell with characteristics: embryonic, adult, haematopoietic, fetal, cord blood, placenta, bone marrow, primordial germ cells, cancer stem cells induced pluripotent stem cells.

UNIT V CLINICAL APPLICATIONS

9

Stem cell therapy, Molecular therapy, In vitro organogenesis, Neurodegenerative diseases, spinal cord injury, heart disease, diabetes, burns and skin ulcers, muscular dystrophy, orthopedic applications, Stem cells and Gene therapy Physiological models, tissue engineered therapies, product characterization, components, safety, efficacy. Preservation –freezing and drying. Patent protection and regulation of tissue-engineered products, ethical issues.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bernhard O. Palsson, Sangeeta N. Bhatia, "Tissue Engineering" Pearson Publishers 2009.
2. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. .Fundamentals of Tissue Engineering and Regenerative Medicine. 2009.

REFERENCE BOOKS

1. Bernard N. Kennedy (editor). New York : Nova Science Publishers, c2008. Stem cell transplantation, tissue engineering, and cancer applications

UNIT V BIOCONJUGATE APPLICATIONS**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**REFERENCES**

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

IB8072**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 – determination of macromolecular structure by NMR – magnetic resonance imaging.

UNIT III MASS SPECTROMETRY**10**

Ion sources sample introduction – mass analyzers and ion detectors – biomolecule mass spectrometry – 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 reflection – unit cell – phase problem – anomalous diffraction – determination 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

REFERENCES

1. Campbell I.D and Dwek R.A., " Biological Spectroscopy ", Benjami Cummins and Company, 1986.
2. Atkins P.W., " Physical Chemistry ", Oxford IV Edition, 1990.

GE8071

FUNDAMENTALS OF NANO SCIENCE

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

REFERENCES

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

CH8651 PROCESS INSTRUMENTATION DYNAMICS AND CONTROL L T P C
3 0 0 3

AIM

To familiarize the students with concepts of process dynamics and control leading to control system design.

OBJECTIVE

To introduce dynamic response of open and closed loop systems, control loop components and stability of control systems along with instrumentation.

UNIT I INSTRUMENTATION 6

Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

UNIT II OPEN LOOP SYSTEMS 11

Laplace transformation, application to solve ODEs. 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; transportation lag.

UNIT III CLOSED LOOP SYSTEMS**10**

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

UNIT IV FREQUENCY RESPONSE**9**

Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controller settings

UNIT V ADVANCED CONTROL SYSTEMS**9**

Introduction to advanced control systems, cascade control, feed forward control, Smith predictor controller, control of distillation towers and heat exchangers, introduction to computer control of chemical processes

TOTAL : 45 PERIODS**TEXT BOOKS**

1. Stephanopoulos, G., "Chemical Process Control", Prentice Hall of India, 2003.
2. Coughnowr, D., " Process Systems Analysis and Control ", 2nd Edn., McGraw Hill, New York, 1991.

REFERENCES

1. Marlin, T. E., " Process Control ", 2nd Edn, McGraw Hill, New York, 2000.
2. Smith, C. A. and Corripio, A. B., "Principles and Practice of Automatic Process Control", 2nd Edn., John Wiley, New York, 1997.

CH8751**TRANSPORT PHENOMENA****L T P C****3 0 0 3****AIM**

To give an overview of mass, momentum and energy transport, present the fundamental equations and illustrate how to use them to solve problems.

OBJECTIVES

To describe mass, momentum and energy transport at molecular, microscopic and macroscopic level, to determine velocity, temperature and concentration profiles

UNIT I MOMENTUM TRANSPORT 7

Viscosity, temperature effect on viscosity of gases and liquids, Newton's law, mechanism of momentum transport, shell balance method, pressure and velocity distributions in falling film, circular tube, annulus, slit.

UNIT II EQUATIONS OF CHANGE AND TURBULENT FLOW 8

Equation of continuity, motion, mechanical energy, use of equations of change to solve flow problems, dimensional analysis of equations of change, comparison of laminar and turbulent flows, time-smoothed equation of change, empirical expressions.

UNIT III ENERGY TRANSPORT 10

Thermal conductivity, temperature and pressure effect on thermal conductivity of gases and liquids, Fourier's law, mechanism of energy transport, shell energy balance, temperature distribution in solids and laminar flow, with electrical, nuclear, viscous, chemical heat source, heat conduction through composite walls, cylinders, spheres, fins, slits.

UNIT IV EQUATIONS OF CHANGE FOR NONISOTHERMAL SYSTEM AND TEMPERATURE DISTRIBUTION IN TURBULENT FLOWS 10

Energy equations, special forms, use of equations of change, dimensional analysis of equations of change, time-smoothed equations of change, empirical expressions, temperature distribution for turbulent flow in tubes, jets.

UNIT V MASS TRANSPORT, EQUATIONS OF CHANGE FOR MULTICOMPONENT SYSTEMS AND CONCENTRATION DISTRIBUTION IN TURBULENT FLOWS 10

Diffusivity, temperature and pressure effect, Fick's law, mechanism of mass transport, theory of diffusion in gases and liquids, shell mass balances, concentration distribution in solids and in laminar flow : stagnant gas film, heterogeneous and homogeneous chemical reaction systems, falling film, porous catalyst. The equation of continuity, summary of equations of change and fluxes, use of equations of change, dimensional analysis, time smoothed equations of change, empirical expressions for turbulent mass flux.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bird, R. B., Stewart, W. E. and Lighfoot, E. W., "Transport Phenomena", 2nd Edn., John Wiley, 2002
2. Brodkey, R. S., and Hershey, H. C., "Transport Phenomena", McGraw-Hill, 1988.

REFERENCES

1. Welty, J. R., Wilson, R. W., and Wicks, C. W., "Fundamentals of Momentum Heat and Mass Transfer ", 3rd Edn. John Wiley, New York, 1984.
2. Slattery, J. S., "Advanced Transport Phenomena", Cambridge University Press, London, 1992.