

2007-2008

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

B.TECH. BIO-TECHNOLOGY

I YEAR COURSE STRUCTURE

CODE	SUBJECT	T	P/D	C
	C Programming and Data Structures	3+1*	-	6
	English	2+1*	-	4
	Basic Electrical and Electronics Engineering	3+1*	-	6
	Fundamentals of Biology	4+1*	-	8
	Mathematics - I	3+1*	-	6
	Process Engineering Principles	3+1*	-	6
	Engineering Drawing	-	3	4
	Engineering Workshop Practice	-	3	4
	Computer Programming Lab	-	3	4
	Applied Electrical and Electronics Engineering Lab	-	3	4
	English Language Communication Skills Lab	-	3	4
	Total	24	15	56

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B.TECH. BIO-TECHNOLOGY

**II YEAR I SEMESTER
COURSE STRUCTURE**

CODE	SUBJECT	T	P	C
	Biochemistry	4+1*	-	4
	Thermodynamics for Biotechnologists	4+1*	-	4
	Cell Biology	4+1*	-	4
	Mathematics -II	4+1*	-	4
	Genetics	4+1*	-	4
	Microbiology	4+1*	-	4
	Biochemistry Lab	-	3	2
	Cell Biology and Microbiology Lab	-	3	2
	TOTAL	30	6	28

**II YEAR II SEMESTER
COURSE STRUCTURE**

CODE	SUBJECT	T	P	C
	Mass Transfer and Separation	4+1*	-	4
	Environmental Studies	4+1*	-	4
	Instrumental Methods of Analysis	4+1*	-	4
	Molecular Biology	4+1*	-	4
	Engineering Physics	4+1*	-	4
	Bioprocess Engineering	4+1*	-	4
	Bioprocess Engineering Lab	-	3	2
	Instrumental Methods of Analysis Lab	-	3	2
	TOTAL	30	6	28

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B.TECH. BIO-TECHNOLOGY

**III YEAR I SEMESTER
COURSE STRUCTURE**

CODE	SUBJECT	T	P	C
	Transport Phenomena in Bio Processes	4+1*	-	4
	Biochemical Reaction Engineering - I	4+1*	-	4
	Basic Industrial and Environmental Biotechnology	4+1*	-	4
	Genetic Engineering	4+1*	-	4
	Plant Biotechnology	4 +1*	-	4
	Managerial Economics and Financial Analysis	4 +1*	-	4
	Molecular Biology and Genetic Engineering Lab	-	3	2
	Advanced English Communication Skills Lab	-	3	2
	TOTAL	30	6	28

**III YEAR II SEMESTER
COURSE STRUCTURE**

CODE	SUBJECT	T	P	C
	Computational Molecular Biology	4+1*	-	4
	Biochemical Reaction Engineering - II	4+1*	-	4
	Heat Transfer in Bioprocesses	4+1*	-	4
	Instrumentation and Bio Process Control	4+1*	-	4
	Immunology	4 +1*	-	4
	Probability and Statistics	4+1*	-	4
	Plant Tissue Culture Lab	-	3	2
	Immunology Lab	-	3	2
	TOTAL	30	6	28

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B.TECH. BIO-TECHNOLOGY

**IV YEAR I SEMESTER
COURSE STRUCTURE**

CODE	SUBJECT	T	P	C
	Bioinformatics	4+1*	-	4
	Bio Ethics, Bio Safety And Intellectual Property Rights	4+1*	-	4
	Downstream Processing	4 +1*	-	4
	Biosensors and Bioelectronics	4+1*	-	4
	ELECTIVE –I	4 +1*	-	4
	Biomaterials Science and Technology			
	Cell Signaling			
	Structural Biology			
	Cancer Biology			
	ELECTIVE –II	4 +1*	-	4
	Creativity Innovation and Product Development			
	Nano Biotechnology			
	Metabolic Engineering			
	Bioinformatics Lab	-	3	2
	Downstream Processing Lab	-	3	2
	TOTAL	30	6	28

**IV YEAR II SEMESTER
COURSE STRUCTURE**

CODE	SUBJECT	T	P	C
	Animal Cell Science and Technology	4+1*	-	4
	ELECTIVE –III	4+1*	-	4
	Food Science and Technology			
	Molecular Modeling and Drug Design			
	Bio Process Economics and Plant Design			
	ELECTIVE –IV	4+1*	-	4
	Biopharmaceutical Technology			
	Phytochemicals and Herbal Medicine			
	Bioprocess Optimization			
	Industry Oriented Mini project	-	-	2
	Seminar	-	-	2
	Project Work	-	-	10
	Comprehensive Viva	-	-	2
	TOTAL	15	-	28

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I Year B . Tech BT

T	P	C
3+1*	0	6

C PROGRAMMING AND DATA STRUCTURES

UNIT - I

Algorithm / pseudo code, flowchart, program development steps, structure of C program, A Simple C program, identifiers, basic data types and sizes, Constants, variables, arithmetic, relational and logical operators, increment and decrement operators, conditional operator, bit-wise operators, assignment operators, expressions, type conversions, conditional expressions, precedence and order of evaluation.

Input-output statements, statements and blocks, if and switch statements, loops- while, do-while and for statements, break, continue, goto and labels, programming examples.

UNIT - II

Designing structured programs, Functions, basics, parameter passing, storage classes- extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, header files, C preprocessor, example c programs.

UNIT - III

Arrays- concepts, declaration, definition, accessing elements, storing elements, arrays and functions, two-dimensional and multi-dimensional arrays, applications of arrays. pointers- concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays, dynamic memory managements functions, command line arguments, c program examples.

UNIT - IV

Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bitfields, C program examples.

UNIT - V

Input and output – concept of a file, text files and binary files, streams, standard I/o, Formatted I/o, file I/o operations, error handling, C program examples.

UNIT - VI

Searching – Linear and binary search methods, sorting – Bubble sort, selection sort, Insertion sort, Quick sort, merge sort.

UNIT – VII

Introduction to data structures, singly linked lists, doubly linked lists, circular list, representing stacks and queues in C using arrays and linked lists, infix to post fix conversion, postfix expression evaluation.

UNIT - VIII

Trees- Binary trees, terminology, representation, traversals, graphs- terminology, representation, graph traversals (dfs & bfs)

TEXT BOOKS :

1. Computer science, A structured programming approach using C, B.A. Forouzan and R.F. Gilberg, Third edition, Thomson.
2. DataStructures Using C – A.S.Tanenbaum, Y. Langsam, and M.J. Augenstein, PHI/Pearson education.

REFERENCES :

1. C& Data structures – P. Padmanabham, B.S. Publications.
2. The C Programming Language, B.W. Kernighan, Dennis M.Ritchie, PHI/Pearson Education
3. C Programming with problem solving, J.A. Jones & K. Harrow, dreamtech Press
4. Programming in C – Stephen G. Kochan, III Edition, Pearson Eductaion.
5. Data Structures and Program Design in C, R.Kruse, C.L. Tondo, BP Leung, Shashi M, Second Edition, Pearson Education.

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T	P	C
2+1*	0	4

ENGLISH

1. INTRODUCTION :

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire communicative competence, the syllabus has been designed to develop linguistic and communicative competence of Engineering students. The prescribed books and the exercises are meant to serve broadly as students' handbooks.

In the English classes, the focus should be on the skills of reading, writing, listening and speaking and for this the teachers should use the text prescribed for detailed study. For example, the students should be encouraged to read the texts/selected paragraphs silently. The teachers can ask comprehension questions to stimulate discussion and based on the discussions students can be made to write short paragraphs/essays etc.

The text for non-detailed study is for extensive reading/reading for pleasure by the students. Hence, it is suggested that they read it on their own with topics selected for discussion in the class. The time should be utilized for working out the exercises given after each section, as also for supplementing the exercises with authentic materials of a similar kind for example, from newspaper articles, advertisements, promotional material etc.. *However, the stress in this syllabus is on skill development and practice of language skills.*

2. OBJECTIVES:

- a. To improve the language proficiency of the students in English with emphasis on LSRW skills.
- b. To equip the students to study academic subjects with greater facility through the theoretical and practical components of the English syllabus.
- c. To develop the study skills and communication skills in formal and informal situations.

3. SYLLABUS :

Listening Skills:

Objectives

1. To enable students to develop their listening skill so that they may appreciate its role in the LSRW skills approach to language and improve their pronunciation
2. To equip students with necessary training in listening so that can comprehend the speech of people of different backgrounds and regions

Students should be given practice in listening to the sounds of the language to be able to recognise them, to distinguish between them to mark stress and recognise and use the right intonation in sentences.

- Listening for general content
- Listening to fill up information
- Intensive listening
- Listening for specific information

Speaking Skills :

Objectives

1. To make students aware of the role of speaking in English and its contribution to their success.
2. To enable students to express themselves fluently and appropriately in social and professional contexts.

- Oral practice
- Describing objects/situations/people
- Role play – Individual/Group activities (Using exercises from all the nine units of the prescribed text:

Learning English : A Communicative Approach.)

- Just A Minute(JAM) Sessions.

Reading Skills:

Objectives

1. To develop an awareness in the students about the significance of silent reading and comprehension.

2. To develop the ability of students to guess the meanings of words from context and grasp the overall message of the text, draw inferences etc.

- Skimming the text
- Understanding the gist of an argument
- Identifying the topic sentence
- Inferring lexical and contextual meaning
- Understanding discourse features
- Recognizing coherence/sequencing of sentences

NOTE : *The students will be trained in reading skills using the prescribed text for detailed study. They will be examined in reading and answering questions using 'unseen' passages which may be taken from the non-detailed text or other authentic texts, such as magazines/newspaper articles.*

Writing Skills :

Objectives

1. To develop an awareness in the students about writing as an exact and formal skill
2. To equip them with the components of different forms of writing, beginning with the lower order ones.

- Writing sentences
- Use of appropriate vocabulary
- Paragraph writing
- Coherence and cohesiveness
- Narration / description
- Note Making
- Formal and informal letter writing
- Editing a passage

4. TEXTBOOKS PRESCRIBED:

In order to improve the proficiency of the student in the acquisition of the four skills mentioned above, the following texts and course content, divided into **Eight Units**, are prescribed:

For Detailed study

- 1. LEARNING ENGLISH: A Communicative Approach**, Hyderabad: Orient Longman, 2006. (Six Selected Lessons)

For Non-detailed study

- 2. WINGS OF FIRE: An Autobiography – APJ Abdul Kalam**, Abridged version with Exercises, Universities Press (India) Pvt. Ltd., 2004.

A. STUDY MATERIAL:

Unit –I

1. Astronomy from **LEARNING ENGLISH: A Communicative Approach**, Orient Longman, 2005.

2. Chapters 1-4 from **Wings of Fire: An Autobiography – APJ Abdul Kalam, an abridged version with Exercises, Universities Press (India) Pvt. Ltd.,2004**

Unit –II

3. Information Technology from **LEARNING ENGLISH: A Communicative Approach, Orient Longman, 2005.**

4. Chapters 5-8 from **Wings of Fire: An Autobiography – APJ Abdul Kalam, an abridged version with Exercises, Universities Press (India) Pvt. Ltd.,2004**

Unit –III

5. Humour from **LEARNING ENGLISH: A Communicative Approach, Orient Longman, 2005.**

6. Chapters 9-12 from **Wings of Fire: An Autobiography – APJ Abdul Kalam, an abridged version with Exercises., Universities Press (India) Pvt. Ltd.,2004**

Unit –IV

7. Environment from **LEARNING ENGLISH: A Communicative Approach, Orient Longman, 2005.**

8. Chapters 13-16 from Wings of Fire: An Autobiography – APJ Abdul Kalam, an abridged version with Exercises, Universities Press (India) Pvt. Ltd., 2004

Unit –V

9. Inspiration from LEARNING ENGLISH: A Communicative Approach, Orient Longman, 2005.
10. Chapters 17-20 from Wings of Fire: An Autobiography – APJ Abdul Kalam, an abridged version with Exercises, Universities Press (India) Pvt. Ltd., 2004.

Unit – VI

11. Human Interest from LEARNING ENGLISH: A Communicative Approach, Orient Longman, 2005.
12. Chapters 21-24 from Wings of Fire: An Autobiography – APJ Abdul Kalam, an abridged version with Exercises, Universities Press (India) Pvt. Ltd., 2004.

* Exercises from the lessons not prescribed shall also be used for classroom tasks.

Unit – VII

Exercises on

Reading and Writing Skills
Reading Comprehension
Situational dialogues
Letter writing
Essay writing

Unit – VIII

Practice Exercises on Remedial Grammar covering

Common errors in English, Subject-Verb agreement, Use of Articles and Prepositions, Tense and aspect

Vocabulary development covering

Synonyms & Antonyms, one-word substitutes, prefixes & suffixes, Idioms & phrases, words often confused.

REFERENCES :

1. **Strengthen Your English**, Bhaskaran & Horsburgh, Oxford University Press
2. **Basic Communication Skills for Technology**, Andrea J Rutherford, Pearson Education Asia.
3. **Murphy's English Grammar with CD**, Murphy, Cambridge University Press
4. **English Skills for Technical Students** by Orient Longman
5. **Everyday Dialogues in English** by Robert J. Dixon, Prentice-Hall of India Ltd., 2006.
6. **English For Technical Communication**, Vol. 1 & 2, by K. R. Lakshmi Narayanan, Sci tech. Publications.
7. **A Hand book of English for Engineers & Technologists** by Dr. P. Eliah, B. S. Publications.
8. **Developing Communication Skills** by Krishna Mohan & Meera Benerji (Macmillan)
9. **Speaking and Writing for Effective Business Communication**, Francis Soundararaj, MacMillan India Ltd., 2007.
10. **The Oxford Guide to Writing and Speaking**, John Seely, Oxford

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T	P	C
3+1*	0	6

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

UNIT I ELECTRICAL CIRCUITS

Ohms Law -Kirchoffs Laws - steady state solution of D C Circuits - Introduction to AC circuits - Waveforms and RMS value - power and power factor, single phase and three phase balanced circuits.

UNIT II ELECTRICAL MACHINES

Principles of operation and characteristics of D C machines, Transformers (single phase and three phase) - Synchronous Machines - three Phase and single phase induction motors - (op. Principles).

UNIT III MEASUREMENTS

Moving coil and moving iron instruments (Ammeter and voltmeter). Dynamometer type watt meters and energy meters (op. Principles).

UNIT IV

SEMICONDUCTOR DEVICES & RECTIFIERS

Classification of solids based on energy band theory - Intrinsic semiconductors - Extrinsic semiconductors - P type and N type - P-N junction - V I characteristic of PN junction diode - Zener diode - Zener diode characteristics - Half wave and full wave rectifiers - Voltage regulation, SCR, Diac, Triac, Characteristics and simple applications.

UNIT V TRANSISTORS

Bipolar junction transistor - CB, CE, CC - Configurations and characteristics – Biasing circuits - Field Effect Transistor - Configurations and characteristics - FET amplifier - UJT - characteristics and simple applications - switching transistors - concept of feed back - negative feed back - application in temperature and motor speed control.

UNIT VI AMPLIFIERS

Elementary treatment of voltage amplifier - Class A, B and C power amplifiers - principles of Tuned amplifiers.

UNIT VII SIGNAL GENERATORS AND LINEAR IC'S

Sinusoidal oscillators - positive feed back - RC phase shift, Hartley, Colpit's, Wien bridge Oscillators - multivibrators - operational amplifier - adder, multiplier, integrator and differentiators -Integrated circuits.

UNIT VIII DIGITAL ELECTRONICS

Binary number system - AND, OR, NOT, NAND, NOR circuits - Boolean algebra - Exclusive OR gate - Half and Full adders - flip flops - registers and counters - A/D, D/A conversion - Digital computer principle.

TEXT BOOKS:

1. Mittle, V.N., Basic Electrical Engineering, TMH Edition, New - Delhi, 1990 2. Del Taro, Electrical Engineering Fundamentals, Prentice Hall of India Pvt. Ltd., New Delhi, Second edition.

REFERENCES

1. Millman & Halkias, Integrated Electronics, McGraw Hill, 1979.

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T	P	C
4+1*	0	8

FUNDAMENTALS OF BIOLOGY

UNIT I: INTRODUCTION TO MICROORGANISMS

Diversity in biological systems, Cell biology and cell structure, Difference between Prokaryotes & Eukaryotes. Kingdom systems. Five-kingdom classification General characters, Brief account on Ecology, Morphology, Nutrition, Locomotion and Reproduction, useful and harmful effects of Bacteria, Viruses, Algae, Fungi and Protozoans.

UNIT II: PLANT BIOLOGY

Classification of Plant Kingdom. Concepts of Growth, Meristems. Development of different plant organs; Plant growth regulators; Economic Importance of Plants, Biology of Pests in relation to Rice, Cotton, Sugarcane and Groundnut.

UNIT III: ANIMAL BIOLOGY

Classification of Animal Kingdom, Functions, morphology, growth and Reproduction, economic importance. Phylogeny of Invertebrate & Vertebrate Phyla, Concepts of Species & Ecosystem. Protozoan Parasites – two important forms in man (*Plasmodium*, *Entamoeba histolytica*), Helminthes (*Fasciolopsis buski*, *Taenia solium*, *Ascaris*, *Wucharia bancrafti*)

UNIT IV: BASIC MOLECULAR BIOLOGY

Genetics: DNA as genetic material, Structure of DNA, DNA replication, Transcription, Translation, Genes to proteins to protein function, Gene expression and regulation, Recombinant DNA technology.

UNIT V: HUMAN BIOLOGY I

Introduction of body as a whole, Cells and Tissue Organization, Electrolytes and Body fluids. Physiology of Blood. Digestive system, Respiratory system and Endocrine system.

UNIT VI: HUMAN BIOLOGY II

Human Physiology: Biological axons and neurons, Neuromuscular and synaptic junctions, Sensory systems - hearing, taste, smell and visual receptors.

UNIT VII: PHOTOSYNTHESIS

Bacterial & Plant photosynthesis; oxygenic and anoxygenic photosynthesis; chlorophyll as trapper of solar energy, photosynthetic reaction centres, Hill reaction, PS I & PS II, Photophosphorylation - cyclic & non-cyclic; Dark reaction & CO₂ fixation.

UNIT VIII : APPLICATIONS OF BIOTECHNOLOGY: BASIC CONCEPTS

Drugs and Chemicals from Plants & Animals, Definition and importance (in general) of Biofuels, ifertilizers, Biopesticides, Bioindicators and Biosensors, Microbial Enzymes, Single Cell Protein (SCP), Monoclonal Antibodies, Introduction to Transgenic Plants & Animals.

TEXT BOOKS:

1. H.G. Rehen and G.Reed, biotechnology Volume I & 2
2. Basic Biotechnology, Second Edition, by Colin Ratledge and Bjorn Kristiansen, Cambridge University Press.
3. Anatomy and Physiology In Health and Disease,K. J.W. Wilison and A. Waugh, Churchill & Livingston.

REFERENCES

- 1) Plant Physiology F.B Salisbury & C.W. Ross 4th edition Thomson Wadsworth
- 2) Dr. C.C. Chatterjee, *Human Physiology (11th Edition) Vol I and II*, Medical Allied Agency, Kolkata, 1987.

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T	P	C
3+1*	0	6

MATHEMATICS – I

UNIT – I

Differential equations of first order and first degree – exact, linear and Bernoulli. Applications to Newton's Law of cooling, Law of natural growth and decay, orthogonal trajectories.

UNIT – II

Non-homogeneous linear differential equations of second and higher order with constant coefficients with RHS term of the type e^{ax} , $\sin ax$, $\cos ax$, polynomials in x , $e^{ax} V(x)$, $xV(x)$, method of variation of parameters.

UNIT – III

Rolle's Theorem – Lagrange's Mean Value Theorem – Cauchy's mean value Theorem – Generalized Mean Value theorem (all theorems without proof) Functions of several variables – Functional dependence- Jacobian- Maxima and Minima of functions of two variables with constraints and without constraints

UNIT – IV

Radius, Centre and Circle of Curvature – Evolutes and Envelopes Curve tracing – Cartesian, polar and Parametric curves.

UNIT – V

Applications of integration to lengths, volumes and surface areas in Cartesian and polar coordinates multiple integrals - double and triple integrals – change of variables – change of order of integration.

UNIT – VI

Sequences – series – Convergences and divergence – Ratio test – Comparison test – Integral test – Cauchy's root test – Raabe's test – Absolute and conditional convergence

UNIT – VII

Vector Calculus: Gradient- Divergence- Curl and their related properties of sums- products- Laplacian and second order operators. Vector Integration - Line integral – work done – Potential function – area- surface and volume integrals Vector integral theorems: Green's theorem-Stoke's and Gauss's Divergence Theorem (With out proof). Verification of Green's - Stoke's and Gauss's Theorems.

UNIT – VIII

Laplace transform of standard functions – Inverse transform – first shifting Theorem, Transforms of derivatives and integrals – Unit step function – second shifting theorem – Dirac's delta function – Convolution theorem – Periodic function - Differentiation and integration of transforms-Application of Laplace transforms to ordinary differential equations Partial fractions-Heaviside's Partial fraction expansion theorem.

Text Books:

1. A text Book of Engineering Mathematics, Vol-1 T. K. V. Iyengar, B. Krishna Gandhi and Others, S. Chand & Company.
2. A text Book of Engineering Mathematics, C. Sankaraiah, V. G. S. Book Links.
3. A text Book of Engineering Mathematics, Shahnaz Bathul, Right Publishers.
4. A text Book of Engineering Mathematics, P. Nageshwara Rao, Y. Narasimhulu & N. Prabhakar Rao, Deepthi Publications.

References:

1. A text Book of Engineering Mathematics, B. V. Raman, Tata Mc Graw Hill.
2. Advanced Engineering Mathematics, Irvin Kreyszig, Wiley India Pvt. Ltd.
3. A text Book of Engineering Mathematics, Thomson Book Collection.

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PROCESS ENGINEERING PRINCIPLES

UNIT-I

Application of Engineering principles in biotech Industries-Introduction to unit operations and unit processes–application of transport phenomenon principles (momentum, mass and heat transfer) in bioprocessing.

UNIT-II

Units and dimensions, basic quantities and derived units. Conversion of units. Concept of mass and force, definition of gc and its utility. Various equations of state including ideal gas law to evaluate P-V.T data, their application in process calculations by solving basics numerical problems.

UNIT-III

Fluid mechanics- Properties of fluids, fluid statics, energy balance in fluid flow through pipes and conduits, Bernoulli's equation and its application, calculation of power required for pumping fluids. Examples from bioprocessing systems .

UNIT-IV

Rheology of fluids - Newton's law of viscosity. Concept of Newtonian and non - Newtonian fluids- Different types of non-Newtonian fluids with examples in bioprocessing. Measurement of viscosity using extrusion rheometer, plate and cone viscometer, coaxial cylinder viscometer.

UNIT-V

Flow through pipes, average velocity, flow regimes, boundary layer concept. Laminar and turbulent flow – characterization by Reynold's number, pressure drop due to skin friction and form friction, friction factor chart, Hagen -Poiseuille equation. Brief introduction to flow of compressible fluids.

UNIT-VI

Flow past immersed bodies: Definition of drag and drag coefficient. Friction in flow through beds of solids, derivation of friction factor equations and pressure drop expressions. Introduction of the concept of packed beds. Motion of particles through fluids, terminal velocity.

UNIT-VII

Flow measuring and monitoring systems- valves, bends, elbows, prevention of leaks, mechanical seals, stuffing box. Flow measuring devices-manometers, orifice meter, venture meter and rotameter.

UNIT-VIII

Fluid transportation machinery: Different types of pumps, positive displacement pumps, reciprocating pumps, diaphragm pumps, peristaltic pumps. Calculation of pump horse power.

TEXT BOOKS:

1. Introduction to Biochemical Engineering, D.G.Rao, Tata Mc Hill (2005)
2. Bio-process Engineering Principles, Pauline M.Doran. Academic press (1995)
3. Unit operations of chemical engineering, Mc Cabe, W.L, Smith J.C., and Harriot P., Mc-Graw Hill, 3rd Ed. (1993).

REFERENCES:

1. "Technical aspects of the rheological properties of microbial cultures", - Charles, M (1978) in Advanmces in Biochemical Engineering, Ghose, T.K., Fiechter, A and Blakebrough, N.(Eds), Spinger-Verlag, Berlin, pp. 1-62
2. Unit operation in Food processing, Earle, R.L. (1996) Pergamon Press, Oxford, PP. 212-282.

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I Year B . Tech BT

T	P	C
0	3	4

ENGINEERING DRAWING

UNIT – I

Introduction to engineering graphics – construction of ellipse, parabola and hyperbola – cylindrical curves.

UNIT – II

Orthographic projections of points, lines and planes – axis inclined to one planes and inclined to both the planes.

UNIT – III

Orthographic projections of solids :

Cylinder, cone, prism, pyramid and sphere positions and axis inclined to both the planes.

UNIT – IV

Isomeric projections of lines, planes and simple solids

UNIT – V

Conversion of orthographic views into isometric views and vice-versa.

TEXT BOOKS :

1. Engineering drawings By N.D.Bhatt
2. Engineering graphics By K.L. Narayana & P.Kannayya

REFERENCES:-

1. Engineering drawing and graphics: Venugopal/ New age
2. Engineering drawing : Johle / TMH

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T	P	C
0	3	4

ENGINEERING WORK SHOP PRACTICE

1. TRADES FOR EXERCISES:

1. Carpentry
2. Fitting
3. Tin-Smithy and Development of jobs carried out and soldering.
4. Black Smithy
5. House-wiring
6. Foundry
7. IT Workshop-I : Computer hard ware , identification of parts , Disassembly, Assembly of computer to working condition, Simple diagnostic exercises.
8. IT workshop-II : Installation of Operating system windows and Linux , simple diagnostic exercises.

II TRADES FOR DEMONSTRATION & EXPOSURE:

1. Plumbing
2. Welding
3. Machine Shop
4. Power tools in construction, Wood working, Electrical Engg & Mechanical Engg
5. Metal Cutting (water plasma)

Text Books: Work shop Manual / P.Kannaiah/ K.L.Narayana/ Scitech publishers

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0	3	4

COMPUTER PROGRAMMING LAB

Objectives:

- To make the student learn a programming language.
- To teach the student to write programs in C solve the problems
- To Introduce the student to simple linear and non linear data structures such as lists, stacks, queues, trees and graphs.

Recommended Systems/Software Requirements:

- Intel based desktop PC
- ANSI C Compiler with Supporting Editors

Week 1.

- a) Write a C program to find the sum of individual digits of a positive integer.
- b) A Fibonacci Sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
- c) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

Week 2.

- a) Write a C program to calculate the following Sum:
Sum= $1-x^2/2! +x^4/4!-x^6/6!+x^8/8!-x^{10}/10!$
- b) Write a C program to find the roots of a quadratic equation.

Week 3

- a) Write C programs that use both recursive and non-recursive functions
 - i) To find the factorial of a given integer.
 - ii) To find the GCD (greatest common divisor) of two given integers.
 - iii) To solve Towers of Hanoi problem.

Week 4

- a) The total distance travelled by vehicle in 't' seconds is given by distance = $ut+1/2at^2$ where 'u' and 'a' are the initial velocity (m/sec.) and acceleration (m/sec²). Write C program to find the distance travelled at regular intervals of time given the values of 'u' and 'a'. The program should provide the flexibility to the user to select his own time intervals and repeat the calculations for different values of 'u' and 'a'.
- b) Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +, -, *, /, % and use Switch Statement)

Week 5

- a) Write a C program to find both the largest and smallest number in a list of integers.
- b) Write a C program that uses functions to perform the following:
 - i) Addition of Two Matrices
 - ii) Multiplication of Two Matrices

Week 6

- a) Write a C program that uses functions to perform the following operations:
 - i) To insert a sub-string in to given main string from a given position.
 - ii) To delete n Characters from a given position in a given string.
- b) Write a C program to determine if the given string is a palindrome or not

Week 7

- a) Write a C program that displays the position or index in the string S where the string T begins, or - 1 if S doesn't contain T.
- b) Write a C program to count the lines, words and characters in a given text.

Week 8

- a) Write a C program to generate Pascal's triangle.
- b) Write a C program to construct a pyramid of numbers.

Week 9

Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression:

$$1+x+x^2+x^3+\dots+x^n$$

For example: if n is 3 and x is 5, then the program computes 1+5+25+125.

Print x, n, the sum

Perform error checking. For example, the formula does not make sense for negative exponents – if n is less than 0. Have your program print an error message if n<0, then go back and read in the next pair of numbers of without computing the sum. Are any values of x also illegal ? If so, test for them too.

Week 10

- a) 2's complement of a number is obtained by scanning it from right to left and complementing all the bits after the first appearance of a 1. Thus 2's complement of 11100 is 00100. Write a C program to find the 2's complement of a binary number.
- b) Write a C program to convert a Roman numeral to its decimal equivalent.

Week 11

Write a C program that uses functions to perform the following operations:

- i) Reading a complex number
- ii) Writing a complex number
- iii) Addition of two complex numbers
- iv) Multiplication of two complex numbers

(Note: represent complex number using a structure.)

Week 12

- a) Write a C program which copies one file to another.
 - b) Write a C program to reverse the first n characters in a file.
- (Note: The file name and n are specified on the command line.)

Week 13

Write a C program that uses functions to perform the following operations on singly linked list.:

- i) Creation ii) Insertion iii) Deletion iv) Traversal

Week 14

Write a C program that uses functions to perform the following operations on doubly linked list.:

- i) Creation ii) Insertion iii) Deletion iv) Traversal in both ways

Week 15

Write C programs that implement stack (its operations) using

- i) Arrays ii) Pointers

Week 16

Write C programs that implement Queue (its operations) using

- i) Arrays ii) Pointers

Week 17

Write a C program that uses Stack operations to perform the following:

- i) Converting infix expression into postfix expression
- ii) Evaluating the postfix expression

Week 18

Write a C program that uses functions to perform the following:

- i) Creating a Binary Tree of integers
- ii) Traversing the above binary tree in preorder, inorder and postorder.

Week 19

Write C programs that use both recursive and non recursive functions to perform the following searching operations for a Key value in a given list of integers :

- i) Linear search
- ii) Binary search

Week 20

Write C programs that implement the following sorting methods to sort a given list of integers in ascending order:

- i) Bubble sort
- ii) Quick sort

Week 21

Write C programs that implement the following sorting methods to sort a given list of integers in ascending order:

- i) Insertion sort
- ii) Merge sort

Week 22

Write C programs to implement the Lagrange interpolation and Newton- Gregory forward interpolation.

Week 23

Write C programs to implement the linear regression and polynomial regression algorithms.

Week 24

Write C programs to implement Trapezoidal and Simpson methods.

Text Books

1. C programming and Data Structures, P. Padmanabham, Third Edition, BS Publications
2. Data Structures: A pseudo code approach with C, second edition R.F. Gilberg and B.A. Forouzan
3. Programming in C, P.Dey & M. Ghosh, Oxford Univ.Press.
4. C and Data Structures, E Balaguruswamy, TMH publications.

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BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB

- 1) Power measurement in 3 phase systems using two-wattmeter method (star connected)
- 2) Verification of kirchoff's laws
- 3) Measurement of choke coil parameters using 3 voltmeter & 3 ammeter method.
- 4) Magnetization characteristics of a dc shunt machine, determination of critical field resistance and critical speed.
- 5) Open circuit and Shortest Circuit on any 1 phase transformer.
- 6) Load test on 1-phase transformer.
- 7) Regulation of 3 phase synchronous generator using OC and SC test.
- 8) Brake test on 3 phase squirrel cage induction motor.
- 9) Calibration and testing of single phase energy meter.
- 10) Calibration of dynamometer type power factor meter.
- 11) Calibration of PMMC ammeter and voltmeter crompton DC potentio meter.
- 12) PN junction diode characteristics
a) forward bias b) reverse bias
- 13) Zener diode characteristics
- 14) Transistor CE characteristics (Input and Output)
- 15) Rectifier without filters (Full wave & Half wave)
- 16) UJT characteristics
- 17) FET characteristics
- 18) Study of CRO
- 19) CE amplifier
- 20) Class A Amplifier
- 21) RC Phase shift Oscillator
- 22) Study of logic gates using ICS.

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ENGLISH LANGUAGE COMMUNICATION SKILLS LAB

The **Language Lab** focuses on the production and practice of sounds of language and familiarises the students with the use of English in everyday situations and contexts.

Objectives:

1. To expose the students to a variety of self-instructional, learner-friendly modes of language learning.
2. To help the students cultivate the habit of reading passages from the computer monitor, thus providing them with the required facility to face computer-based competitive exams such GRE, TOEFL, GMAT etc.
3. To enable them to learn better pronunciation through stress on word accent, intonation, and rhythm.
4. To train them to use language effectively to face interviews, group discussions, public speaking.
5. To initiate them into greater use of the computer in resume preparation, report writing, format-making etc.

SYLLABUS :

The following course content is prescribed for the **English Language Laboratory** sessions:

1. Introduction to the Sounds of English- Vowels, Diphthongs & Consonants.
2. Introduction to Stress and Intonation.
3. Situational Dialogues / Role Play.
4. Oral Presentations- Prepared and Extempore.
5. 'Just A Minute' Sessions (JAM).
6. Describing Objects / Situations / People.
7. Information Transfer
8. Debate
9. Telephoning Skills.
10. Giving Directions.

Minimum Requirement:

The English Language Lab shall have two parts:

- i) **The Computer aided Language Lab** for 60 students with 60 systems, one master console, LAN facility and English language software for self- study by learners.
- ii) **The Communication Skills Lab** with movable chairs and audio-visual aids with a P.A System, a T. V., a digital stereo –audio & video system and camcorder etc.

System Requirement (Hardware component):

Computer network with Lan with minimum 60 multimedia systems with the following specifications:

- i) P – IV Processor
 - a) Speed – 2.8 GHZ
 - b) RAM – 512 MB Minimum
 - c) Hard Disk – 80 GB
- ii) Headphones of High quality

Suggested Software:

- Cambridge Advanced Learners' English Dictionary with CD.
- The Rosetta Stone English Library
- Clarity Pronunciation Power – Part I
- Mastering English in Vocabulary, Grammar, Spellings, Composition
- Dorling Kindersley series of Grammar, Punctuation, Composition etc.
- Language in Use, Foundation Books Pvt Ltd with CD.
- Oxford Advanced Learner's Compass, 7th Edition
- Learning to Speak English - 4 CDs
- Microsoft Encarta with CD
- Murphy's English Grammar, Cambridge with CD
- English in Mind, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge

Books Suggested for English Language Lab Library (to be located within the lab in addition to the CDs of the text book which are loaded on the systems):

1. **Spoken English** (CIEFL) in 3 volumes with 6 cassettes, OUP.

2. **English Pronouncing Dictionary** Daniel Jones Current Edition with CD.
3. **Spoken English-** R. K. Bansal and J. B. Harrison, Orient Longman 2006 Edn.
4. **English Language Communication : A Reader cum Lab Manual** Dr A Ramakrishna Rao, Dr G Natanam & Prof SA Sankaranarayanan, Anuradha Publications, Chennai
5. **Speaking English Effectively** by Krishna Mohan & NP Singh (Macmillan)
6. **A Practical Course in English Pronunciation**, (with two Audio cassettes) by J. Sethi, Kamlesh Sadanand & D.V. Jindal, Prentice-Hall of India Pvt. Ltd., New Delhi.
7. **A text book of English Phonetics for Indian Students** by T.Balasubramanian (Macmillan)
8. **English Skills for Technical Students**, WBSCTE with British Council, OL

DISTRIBUTION AND WEIGHTAGE OF MARKS

English Language Laboratory Practical Paper:

1. The practical examinations for the English Language Laboratory shall be conducted as per the University norms prescribed for the core engineering practical sessions.
2. For the Language lab sessions, there shall be a continuous evaluation during the year for 25 sessional marks and 50 year-end Examination marks. Of the 25 marks, 15 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting Internal Lab Test(s). The year- end Examination shall be conducted by the teacher concerned with the help of another member of the staff of the same department of the same institution.

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BIOCHEMISTRY

UNIT I: CARBOHYDRATE STRUCTURE & FUNCTION

Structure and properties of Mono, Di, Oligo & polysaccharides, complex carbohydrates, Confirmation of pyranose & furanose ring, glycosidic bond, Glycogen, starch & dextran; as mobilizable stores of glucose. cellulose, glycoproteins, glycosaminoglycans & lectins; structure and function.

UNIT II: BASIC CONCEPTS OF ENZYMES

Introduction to Enzymes, Nomenclature, Functions, Mechanism of action and control, Michaelis – Menten Enzymes and Allosteric Enzymes

UNIT III CARBOHYDRATE METABOLISM

Glycolysis, Glucogenesis, Glycogenolysis, Gluconeogenesis, ED Pathway, Pentoses phosphate shunt & TCA cycle

UNIT IV : BIOENERGETICS

Respiratory chain, Aerobic and anaerobic respiration.

UNIT V: PROTEINS & AMINO ACIDS METABOLISM -I

Amino acids - Classifications, Physico – Chemical Properties, Protein structure, folding & function, Nitrogen Cycle, Nitrogen Balance, reductive amination & transamination & Urea cycle.

UNIT VI : PROTEINS & AMINO ACIDS METABOLISM -II

Synthesis of amino acids - Glutamate pathway; Serine pathway; shikimate pathway for the production of aromatic amino acids.

UNIT VII: LIPIDS & THEIR METABOLISM

Classifications, Structures and roles of fatty acids; fatty acid breakdown; fatty acid synthesis; synthesis and metabolism of triglycerols, cholesterol structure and function. Lipoproteins – classification & function.

UNIT VIII: INTERMEDIARY METABOLISM

Interconnection of pathways & metabolic regulation

NUCLEIC ACIDS AND THEIR METABOLISM

Structure and Properties of purines, pyrimidines, Nucleosides and Nucleotides. Biosynthesis and degradation of nucleic acids

TEXT BOOKS:

1. Lehninger A.L, Nelson O.'L, M.M. Cox, Principles of Biochemistry 3rd Edition, 2000 CBS Publications, 1993. ,
2. Fundamentals of Biochemistry J.L. Jain S. Chand Publishers

REFERENCES:

1. Voet D, Voet J. G, Biochemistry, Second Edition, John C Wiley and Sons, 1994.
2. L. Stryer, J.M. Berg, JL Tymoczko Biochemistry 5th edition, WH Freeman & Co 2002.
3. Biochemistry by K. Mathews, K.E. Van Holde, Kevin G Ahern, Pearson education.
4. Protein's Structure and function. David Whitford John Wiley Publications.
5. Biochemistry by Christopher K. Mathews, K.E. Van Holde, Pearson's education.

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THERMODYNAMICS FOR BIOTECHNOLOGISTS

UNIT I: BASIC CONCEPTS IN ENGINEERING THERMODYNAMICS

First and Second law of thermodynamics; Calculation of Work, energy and property changes in reversible processes, Thermodynamics of flow processes; Power cycles and refrigeration cycles, Residual properties

UNIT II: MATERIAL BALANCE

Steady state and equilibrium, types of material balances, stoichiometry of growth and product formation, Electron balance, Theoretical oxygen demand

UNIT III: ENERGY BALANCES

Basic Energy concepts, Intensive and Extensive properties, general energy balance equations, Enthalpy calculations, State properties-reactive and non-reactive systems, Heat of solutions, Heat of combustion, Heat of reaction in non-standard condition; Energy balance equation for cell culture with basic numerical calculations.

Unit IV: UNSTEADY-STATE MATERIAL AND ENERGY BALANCES

Unsteady state material balance and energy balance equations; Solving unsteady equations for biological systems in CSTR, fed-batch and plug flow reactors.

Unit V: THERMODYNAMIC PROPERTIES OF FLUIDS

Estimation of thermodynamic properties using equations of state; Maxwell relationships and their applications; Calculation of flow processes based on actual property changes

UNIT VI: SOLUTION THERMODYNAMICS

Partial molar properties; concepts of chemical potential and fugacity Ideal non ideal solutions; Gibbs Duhem equation; Excess properties of mixtures; Activity Coefficient - corn position models

UNIT VII: PHASE EQUILIBRIA

Criteria for phase equilibrium; Vapour-liquid equilibrium calculations for binary mixtures, liquid -Liquid equilibrium and Solid-liquid equilibrium

UNIT VIII: CHEMICAL REACTION EQUILIBRIA

Equilibrium criteria for homogeneous chemical reactions; Evaluation of equilibrium constant and effect of pressure and temperature on equilibrium constant; Calculation of equilibrium conversions and yields for single and multiple chemical reactions

TEXT BOOKS :

1. J.M. Smith, H.C. Van Ness and M.M. Abbott. Introduction to Chemical Engineering Thermodynamics McGraw Hill
2. P.M. Doaran, Bioprocess Engineering Principles, Academic Press, 1995.

REFERENCES:

M.D. Koretsky, Engineering and Chemical Thermodynamics, John Wiley and sons, 2004

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CELL BIOLOGY

UNIT I: CELL STRUCTURE AND FUNCTION

Discovery of cells; Basic properties of cells; Cell theory; Cell complexity – Cell size & shape; Different classes of cells; Prokaryotic & Eukaryotic cells;

UNIT II: CHEMISTRY OF THE CELL

Importance of carbon and water; Plasma membrane- structure and function; Cytoplasm ; Cytoskeleton - Microtubules, microfilaments & intermediate filaments, cell motility – cilia & flagella

UNIT III: INTRACELLULAR COMPARTMENTS

Structure and functions of Nucleus, Endoplasmic Reticulum, Golgi Complex, Lysosomes, Peroxisomes, Chloroplast & Mitochondria. Protein Glycosylation, intracellular protein traffic & Targeting.

UNIT IV: TRANSPORT ACROSS CELL MEMBRANES

Passive and Active Transport, Uniport, Symport, Antiport, Permeases, P- Type & V - Type Pumps, Na⁺/K⁺ ATPase, Lysosomal & Vacuolar membrane ATP dependent Proton Pumps, Endocytosis and Exocytosis, Transport into Prokaryotic Cells

UNIT V: CELL DIVISION

Overview of the Cell Cycle, Interphase, Mitosis, Cytokinesis & Meiosis. Animal Cell & Yeast Cell Division, Cell Cycle Control & Checkpoints.

UNIT VI: CELL DIFFERENTIATION

General Characteristics of Cell Differentiation, Differentiation in Unicellular & Multicellular Organism, Cytoplasmic determinants, Nucleoplasmic Interactions; Embryonic and adult stem cells and its Biological Importance.

UNIT VII: CELL SIGNALING - BASIC CONCEPTS

Intracellular signaling, types of signal receptors - Cytosolic, Nuclear & Membrane bound receptors, Chemo receptors of Bacteria (Attractants & Repellents), Signal Transduction by hormones - Steroid / Peptide hormones; Concept of Secondary messengers, cAMP, cGMP, Protein Kinases, G Proteins; Receptors & Non - receptors associated tyrosine kinases.

UNIT VIII: CANCER BIOLOGY - BASIC CONCEPTS

Characteristics of Cancer Cells, Types of Tumors, Molecular Basis of Cancer – Proto oncogene, Tumor Suppressor gene, telomerase, apoptosis, angiogenesis and metastasis, chemical carcinogens, cancer therapy.

TEXT BOOKS:

- 1) The Cell by Cooper.
- 2) Cell and Molecular biology – De Robertis and De Robertis (1998) Waverly Pvt. Ltd.

References:

- 1) Cell & Molecular Biology by Gerald Karp (2nd Ed.) Wiley publishers.
- 2) The World of the cell by Becker, Reece, Poenie (3rd edition) Benjamin Publishers.
- 3) Molecular Biology of the cell by Bruce Alberts.
- 4) The biochemistry of Cell Signalling-Ernst J.M.Helmreich. Oxford Press.
- 5) The world of Cell. 5th edition- Becker, Kleinsmith, Harden,-Pearson Publishers.
- 6) Cell & Molecular Biology by Phillip Sheeler and Donald E.Blanchi 3rd edition John Wiley &sons

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MATHEMATICS -II

UNIT – I

Matrices: Elementary row transformations – Rank – Normal form - Echelon form – Consistency – Solution of system of simultaneous linear homogeneous and non-homogeneous equations.

UNIT – II

Eigen values, Eigen vectors – properties – Cayley-Hamilton Theorem - Inverse and powers of a matrix by Cayley-Hamilton theorem – Diagonalization of matrix. Calculation of powers of matrix – Modal and spectral matrices.

UNIT-III

Real matrices – Symmetric, skew - symmetric, orthogonal, Linear Transformation - Orthogonal Transformation. Complex matrices: Hermitian, Skew-Hermitian and Unitary – Eigen values and Eigen vectors of complex matrices and their properties Quadratic forms- Reduction of quadratic form to canonical form – Rank - Positive, negative definite - semi definite - index - signature - Sylvester law.

UNIT –IV

Fourier Series: Determination of Fourier coefficients – Fourier series – even and odd functions – Fourier series in an arbitrary interval – even and odd periodic continuation – Half-range Fourier sine and cosine expansions.

UNIT-V

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – solutions of first order linear (Lagrange) equation and nonlinear (standard type) equations.

UNIT –VI

Method of separation of variables – Classification of second order linear Partial Differential Equations, solutions of one dimensional heat equation, wave equation and two-dimensional Laplace's equation under initial and boundary conditions.

UNIT –VII

Fourier integral theorem – Fourier sine and cosine integrals. Fourier transforms – Fourier sine and cosine transforms – properties – inverse transforms – Finite Fourier transforms.

UNIT-VIII

Z-transform – inverse z-transform - properties – Damping rule – Shifting rule – Initial and final value theorems. Convolution theorem – Solution of difference equation by z-transforms.

TEXT BOOKS:

1. A text Book of Engineering Mathematics, Vol-II T. K. V. Iyengar, B. Krishna Gandhi and Others, S. Chand & Company.
2. A text Book of Engineering Mathematics, C. Sankaraiah, V. G. S. Book Links.
3. A text Book of Engineering Mathematics, Shahnaz Bathul, Right Publishers.
4. A text Book of Engineering Mathematics, P. Nageshwara Rao, Y. Narasimhulu & N. Prabhakar Rao, Deepthi Publications.

REFERENCES:

1. A text Book of Engineering Mathematics, B. V. Raman, Tata Mc Graw Hill.
2. Advanced Engineering Mathematics, Irvin Kreyszig, Wiley India Pvt. Ltd.
3. A text Book of Engineering Mathematics, Thomson Book Collection.

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GENETICS

UNIT I: PHYSICAL BASIS OF HEREDITY

Basic laws of inheritance mono-hybrid, dihybrid and tri-hybrid ratios, Modification of Mendel's ratios due to gene interaction. Multiple factors of inheritance. Genes and environment, identification of the genetic materials - classical experiments. Hershey Chase, Avery McLeod etc,

UNIT II: ORGANIZATION OF GENETIC MATERIAL

Packing of DNA, organization of genetic material in prokaryotes, Eukaryotes. Euchromatin and Heterochromatin organization of Nucleosomes.

UNIT III: LINKAGE & RECOMBINATION

Chromosomal inheritance, the concept of linkage, cytological basis of crossing over. Mechanism of recombination, Transduction phenomena, Methods of transduction, Generalized, Specialized & Abortive transduction, Bacteriophages - lytic & lysogenic life cycle Discovery, Detection, Molecular mechanisms of transformation, transformation methods. Bacterial conjugation.

UNIT IV: MAPPING

Two point and three point testcrosses and gene mapping. Mapping of genes by tetrad analysis by mitotic crossing over.

UNIT V: CHROMOSOME STRUCTURE, ORGANIZATION & ABERRATIONS

Chromosome morphology, classification, karyotyping. Special chromosome, chromosome aberrations, origins, types and cytogenetic effects.

UNIT VI: SEX DETERMINATION IN PROKARYOTES AND EUKARYOTES

Mechanism of sex determination in insect (Fruit fly) and plants (Melandrium), Sex factors in bacteria, F and HFr transfer, mechanism of transfer.

UNIT VII: SEX DETERMINATION IN HUMANS

Sex differentiation and developments in humans, Dosage compensation, Maryleons hypothesis, Sex linked disorders in human beings – Haemophilia, Fragile-x syndrome, Down's syndrome

UNIT VIII: EXTRA CHROMOSOMAL INHERITANCE

Introduction to extra chromosomal inheritance, examples of extra chromosomal inheritance. Petite phenotypes in yeast. Uniparental inheritance in algae.

TEXT BOOKS

1. E.J. Gardner, M.J. Simmons & DP Shustad. Principles of Genetics, 1991.

REFERENCES:

1. Genetics, Goodenough U, Hold International 1985
2. Genetics by Griffith.
3. Principles of Genetics, Gardner EJ, Snustad DP, 2002
2. Genetics by Strickberger
4. Essentials of Genetics (In genomics prospective), Hartwell, 2003
5. Principles of genetics-Robert H. Tamarin, Tata McGraw Hill.
6. Genetics from Genes to Genomes-Leland H. Hartwell, Leroy Hood, Mc Graw Hill.
7. Concepts of Genetics- VII edition-William S. Klug, Michael R. Cummings.

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MICROBIOLOGY

UNIT I: INTRODUCTION TO MICROBIOLOGY

1. Discovery of microorganisms; Theory of spontaneous generation, Germ theory of diseases; Major contribution and events in the field of Microbiology. Scope and relevance of microbiology.
2. Identification of Microorganisms - A general account. Microdiversity

UNIT II: MAJOR GROUPS OF MICROORGANISMS.

1. General characteristics of Bacteria, Archaea and Eubacteria. Diversity classification of Woese et al. Three domains of life. Five - kingdom system of Whittaker.
2. Classification systems - Phylogenetic, Phenetic, Taxonomic ranks, Major characteristics used in Taxonomy - Morphological, Physiological, ecological, Biochemical, Immunological, Genetical and Molecular.

UNIT III: INTRODUCTION TO VIRUSES

Virus properties, Structure of Viruses; Animal Virology; Plant Virology; Viruses of Arthropods, bacteria and other lower organisms; and classification of viruses (Bacterial, plant and animal replication with 1 example each) and Applications of Virology in Biotech Industry,

UNIT IV: REPLICATION OF VIRUSES

Viral Replication, Bacterial, plant and animal replication with 1 example each (in case of animal viruses the teaching should include the examples of DNA and RNA viral replication and also of those that replicate in the cytoplasm and nucleus).

UNIT V: IDENTIFICATION, CULTURING AND ASSAY OF VIRUSES

Identification and in vitro cultivation of viruses. Assay of viruses (Both Bacterial and animal viruses)

UNIT VI: NUTRITION AND CULTIVATION

1. Nutrition of microorganisms; nutritional classes of microbes, Macro and micronutrients, their sources and physiological functions of nutrients. Growth factors and their functions in metabolism. Aerobic and anaerobic metabolism.
2. Cultivation of microorganisms; Culture media, synthetic, complex media, solidifying agents, types of media -selective, differential and enrichment and enriched media, pure culture methods - spread plate, pour plate and streak plate, special techniques for cultivation of anaerobes.

UNIT VII : IDENTIFICATION AND PRESERVATION OF MICROBES

1. Preservation of Microorganisms: working and primary stock cultures – agar slants, agar stabs, spore preparation, use of sterile soil, cryopreservation, lyophilisation, Application and limitations of various methods.
2. Influence of environmental factors on growth – solutes, water activity, pH, temperature, oxygen, osmotic pressure, radiation.
3. Colony characteristics, staining techniques; Fixation, Principle dyes, simple staining, differential staining, spore staining, flagellar staining.
4. Biochemical tests – Sugar fermentations, IMVIC tests, Catalase production etc.

UNIT VIII : MEDICAL BIOTECHNOLOGY

Disease causing microorganisms, Molecular Basis of pathogenesis and identification methods (for at least 6 important bacterial and viral infections)

TEXT BOOKS:

1. Microbiology, Pelczar M.J. Chan ECE and Krieg NR. Tata McGraw Hill.
2. Introduction to Micro Biology a case History approach 3rd edition John. L. Ingraham, Catherine A Ingraham, Thomson Publications.

REFERENCES:

1. Biology of Microorganism. BROCK, Prentice Hall, International Inc.
2. General Microbiology. Hons. G.Schlege. Cambridge university press.
3. General Microbiology. Roger Y stanier, Macmillan.
4. General Microbiology. Prescott and Dunn Mc Graw Hill Publishers.
5. Introduction to microbiology – A case history approach 3rd edition – john L. ingram, Catherine A. Ingram Thomson Publishers.

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BIOCHEMISTRY LAB

1. Units, Volume & Weight measurements. Concentration units, pH Measurement. Preparation of buffers,
2. Qualitative tests for carbohydrates. Estimation of Reducing sugars by the Benedict's method.
3. Qualitative tests for Amino Acids. Quantitative method for Amino Acids, Ninhydrin method
4. Protein estimation by Biuret / Folin's / Bradford method.
5. Extraction of lipids. Saponification of Fats.
6. Estimation of cholesterol.
8. Estimation of Nucleic Acids, Precipitation by sodium sulphate, Test for ribose and deoxyribose sugar.
9. Extraction of Caffeine from tea leaves.
10. Hydrolysis of ester using Papain.

TEXT BOOK:

1. Laboratory Manual in Biochemistry by J. Jayaraman New age International Publications.
2. Principles & Techniques of Practical Biochemistry 5th edition. K. Wilson & J. Walker, Cambridge University Press, 2000.

Equipments;

1. Refrigerator
2. Centrifuge.
3. Boiling water bath.
4. Calorimeter.
5. pH Meter.
6. Weighing Balance.

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CELL BIOLOGY AND MICROBIOLOGY LAB

LABORATORY

2. Identification of Animal, Plant & Bacterial cells.
3. Micrometry.
4. Differential centrifugation and isolation of Chloroplast & Mitochondria.
5. Sterilization techniques (lecture/demonstrations)
6. Preparation of culture media (a) Broth type of media (b) Solid media
7. Culturing of microorganisms: (a) Broth (b) Pure culture techniques: Streak plate, pour plate.
8. Isolation and preservation of bacterial culture.
9. Identification of microorganisms (a) Staining technique (b) Biochemical testing.
10. Antibiotic test - Disc diffusion method, minimum inhibitory concentration.
11. Microbiological examination of water.
12. Biochemical tests
IMVIC test
Catalase test
Coagulase test
Gelatinase test
Oxidase test.
13. Determination of Bacterial growth by turbidometry/ colorimetry.
14. Factors effecting the bacterial growth – effects of temperature of pH.

TEXT BOOKS:

1. Microbiological and applications, Laboratory, Manual in General Microbiology by Benson, Mc Graw Publications. First edition 2007
2. Laboratory manual in microbiology by P. Gunasekharan, Newage international Publishers.

REFERENCES :

J.G. Cappucin and N.Sherman, A Laboratory manual, 4th edition, Addison & weslay, 1999.

EQUIPMENTS:

1. Bright field microscope.
2. Ocular micrometer.
3. Stage micrometer.
4. Hot air oven.
5. Autoclave.
6. Antibiotic disc.
7. Laminar air flow chamber .
8. Bunsen burner.
9. Spectrophotometer.
10. Incubator and shaker.
11. pH Meter.
12. Compound microscope.

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MASS TRANSFER AND SEPARATION

UNIT I: INTRODUCTION TO MASS TRANSFER AND DIFFUSION

Introduction to Mass Transfer Operations; Fick's Law of Diffusion, Gas diffusion and Liquid diffusion (one component transferring to non-transferring component and equimolar counter diffusion.) Diffusivity estimation (Stefan's experiment); permeability, distribution of gas and liquid components through solid, diffusion of biological solutes in liquids, diffusion in biological gels.

UNIT II: MASS TRANSFER CO-EFFICIENT

Definition of k_L , F-type, K-type coefficients, Dimensionless numbers, Sherwood number, Stanton number, Schmidt number; estimation of MTC for the case where mass is diffusing from solid wall to bulk liquid. (Flat plates, cylindrical tubes) and flow past single solids, Application of $k_L a$ in Biological Systems.

UNIT III :

Interface mass transfer, gas phase controlling, and liquid phase controlling operations.

UNIT IV: GAS LIQUID OPERATION - I

Absorption: Definition, Solubilities of gases in liquids, single stage (one component transferring) operation.

UNIT V: GAS LIQUID OPERATION -II

Distillation: VLE, single stage equilibrium distillation, simple distillation and steam distillation operation; continuous distillation (McCabe Thiele method only).

UNIT VI: LIQUID – LIQUID AND SOLID –LIQUID OPERATIONS -I

Liquid-Liquid extraction: LLE, types of equilibrium system, Single stage extraction, Multi stage cross and counter current operations. Solid liquid operation: Leaching, SLE, Single stage leaching.

UNIT VII: LIQUID – LIQUID AND SOLID –LIQUID OPERATIONS -II

Adsorption: Physical adsorption, Chemisorption, Adsorption hysteresis, adsorption isotherm, Single stage operation, Fixed bed adsorption, Case Studies with immobilized cell/enzyme systems

UNIT VIII: MEMBRANE SEPARATION PROCESSES

Dialysis; Hemodialysis; Gas permeation process, introduction to types of flow in gas permeation; hollow – fiber separation assembly, reverse osmosis, application of reverse osmosis, introduction of ultra filtration processes and micro filtration processes.

TEXT BOOKS:

1. Robert E. Treybal, Mass Transfer Operations III Edition, Mc. Graw Hill International. **YEAR**
2. Christi J. Geankoplis, Transport process & Unit operations, III ed., Prentice Hall India Pvt. Ltd.
3. P.M.Doran Bioprocess Engineering Principles, Academic Press 1995

REFERENCES:

1. Judson Kind: Separation Processes, II Edition, Mc Graw Hill Chemical Engineering series.
2. Philip A. Schweitzer, Handbook of separation Techniques for chemical Engineering, III Edition, Mc. Graw Hill.
3. Philip C. Wankat Rate, Controlled separations, Chapman and Hall, 1985.

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ENVIRONMENTAL STUDIES

UNIT - I

Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance – Need for Public Awareness.

UNIT - II

Natural Resources : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest 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.

UNIT - III

Ecosystems : 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 following ecosystem:

- a. Forest ecosystem
- b. Grassland ecosystem
- c. Desert ecosystem
- d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT - IV

Biodiversity and its conservation : Introduction - Definition: genetic, species and ecosystem diversity. - Bio-geographical 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.

UNIT - V

Environmental Pollution : Definition, Cause, 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

Solid waste Management : Causes, effects and control measures of urban and industrial wastes. - Role of an individual in prevention of pollution. - Pollution case studies. - Disaster management: floods, earthquake, cyclone and landslides.

UNIT - VI

Social Issues and the Environment : 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 -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 Protection Act. -Air (Prevention and Control of Pollution) Act. -Water (Prevention and control of Pollution) Act

-Wildlife Protection Act -Forest Conservation Act -Issues involved in enforcement of environmental legislation. -Public awareness.

UNIT - VII

Human Population and the Environment : 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.

UNIT - VIII

Field work : Visit to a local area to document environmental assets River /forest grassland/hill/mountain -Visit to a local polluted site-Urban/Rural/industrial/ Agricultural Study of common plants, insects, birds. -Study of simple ecosystemspond, river, hill slopes, etc.

TEXT BOOK:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE:

- 1 Textbook of Environmental Sciences and Technology by M. Anji Reddy, BS Publication.

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INSTRUMENTAL METHODS OF ANALYSIS

UNIT I: INTRODUCTION

Types of Analytical Methods – Instruments for Analysis – Uncertainties in Instrumental measurements – Sensitivity and detection limit for instruments.

UNIT II: MICROSCOPY

Bright field, Dark field, Fluorescent, Phase contrast, confocal microscopy, SEM & TEM Microscopy, Flow Cytometry.

UNIT III: CENTRIFUGATION

General Principles, Ultra Centrifugation, velocity Sedimentation & measurements, Equilibrium Ultracentrifugation – Density Gradient centrifugation

UNIT IV : SPECTROSCOPY - I

General principles – Radiation, energy and atomic structure- types of spectra and their biochemical usefulness – basic laws of light absorption. Electromagnetic radiation & Spectrum, Beer – Lambert's Law and apparent deviations; UV - VIS Spectrophotometer, Spectrofluorimetry, Atomic absorption & Atomic emission spectroscopy, Circular Dichroism (CD)- principles, instrumentation and applications.

UNIT V: SPECTROSCOPY-II

Infra Red Spectroscopy. Mass spectroscopy-Introduction, analysis, applications in biology ESR principles - instrumentation-applications

UNIT VI: ONLINE MONITORING AND CONTROL DEVICES

pH, temperature, dissolved oxygen, agitation, sensors and their operation.

UNIT VI: X RAY DIFFRACTION AND CRYSTALLOGRAPHY

Principle, Mode of Operation and Applications

UNIT VII: SEPARATION EQUIPMENTS – PRINCIPLES AND OPERATION:

HPLC, Gas chromatography, Ion – exchange Chromatography, Gel – filtration Chromatography, Affinity Chromatography, Membrane separations, Ultrafiltration , Reverse Osmosis

UNIT VIII: NMR

High resolution NMR –Chemical shift-Spin-spin coupling Frequency lock- double resonance-applications of proton NMR-quantitative analysis-qualitative analysis, application of NMR in biology and study of macromolecules

TEXT BOOKS:

1. A Biologist Guide to principles and techniques of practical Biochemistry. By Keith Wilson, Kenneth H. Goulding 3rd ed. ELBS Series.
2. Skoog & West, Fundamentals of Analytical Chemistry, 1982

REFERENCES:

1. Vogel, Text Book of Quantitative Inorganic Analysis, 1990
2. Ewing, Instrumental Methods of Analysis, 1992
3. Hobert H Willard D. L. Merritt & J. R. J. A. Dean, Instrumental Methods of Analysis, CBS Publishers & Distributors, 1992
4. F. Settle. Hand book of Instrumental techniques for Analytical Chemistry, Prentice Hall, 1997.

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MOLECULAR BIOLOGY

UNIT I: STRUCTURE OF DNA

Detailed structure of DNA, variation from Watson & Crick model, Z - DNA, A & B DNA, Denaturation & melting curves.

UNIT-II: DNA REPLICATION - I

Models of DNA replication: semi conservative Mechanism of DNA replication in *E.coli* (bi- directional). Mitochondrial (D-loop), Viral DNA (Rolling circle), Single stranded- DNA phages (M13, Ø174),

UNIT – III : DNA REPLICATION- II

Eukaryotic telomeres and its replication Inhibitors of DNA Replication. Enzymes involved in replication, step by step process.

UNIT IV: RNA STRUCTURE AND BIOSYNTHESIS

m-RNA, r-RNA, t-RNA structures, Transcription apparatus, RNA polymerases and proteins involved in transcription (initiation, elongation and termination steps)

UNIT V : POST TRANSCRIPTIONAL PROCESSING

Post transcriptional processing of RNA 's t-RNA, r-RNA, m- RNA splicing. Inhibitors of transcription.

UNIT VI: PROTEIN BIOSYNTHESIS

The genetic code and Wobble Hypothesis, Codon usage, Protein synthesis In Prokaryotes.

UNIT VII : PROTEIN SYNTHESIS IN EUKARYOTES

Eukaryotic Protein synthesis, differences between prokaryotic and eukaryotic protein synthesis, Post translational modifications. Inhibitors of protein synthesis .

UNIT VIII : MUTAGENESIS

Mutations, spontaneous, induced, lethal, mutagens their types and actions, classification of mutations and their applications. Site - directed mutagenesis and reverse genetics. DNA damage and repair mechanisms. Mutagenicity testing using microbial systems, Ames TEST.

TEXT BOOKS

1. Molecular Biology, David Friefelder, Jones and Bartlett Publishing Home, 1987.
2. Short Protocols in Molecular Biology, 2nd edition T. M. Ausubel, Brent, R. E. Kingston, D. D. Moore, J. G. Seidman, J. A. Smith, K. Struhl Green Publication Associates and John Wiley and sons 1991

REFERENCES:

1. Lodish, H., Berk A., Zipursky, S.L. Matsudaria, P. Baltimore, D. and Darnell, J. 2003. Molecular Cell Biology, Media connected, W.H. Freeman and Company.
2. Bio Chemistry and Molecular biology by William H. Elioff. Oxford Publications
3. Cell and Molecular biology by Philip Sheeler Donald E. Bianchi Wiley Publishers.
4. Cell and Molecular Biology 1996. De Robertis E.D. Pi and De Robertis E.M.F. B I Waverly Pvt. Ltd., New Delhi.

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ENGINEERING PHYSICS

UNIT I

OPTICS : Interference - Superposition of waves - Young's double slit experiment – Coherence - Interference in thin films by reflection - Newton's rings - Diffraction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction at a Single slit – Double slit - Diffraction grating - Grating spectrum - Resolving power of a grating - Rayleigh's criterion for resolving power – Polarization - Types of Polarization – Double refraction – Nicol prism.

UNIT II

ULTRASONICS : Introduction - Production of ultrasonic waves - Magnetostriction method – Piezo electric method - Detection of ultrasonic waves - Properties of ultrasonic waves - Use of ultrasonics for nondestructive testing - Applications of ultrasonics.

ACOUSTICS OF BUILDINGS: Basic requirement of acoustically good hall - Reverberation and time of reverberation – Sabine's formula for reverberation time - Measurement of absorption coefficient of a material - Factors affecting the architectural acoustics and their remedy.

UNIT III

MAGNETIC PROPERTIES: Permeability - Magnetization - Origin of magnetic moment – Classification of magnetic materials - Dia, para and ferro magnetism - Hysteresis curve - Soft and hard magnetic materials.

SUPERCONDUCTIVITY: General properties - Meissner effect - Penetration depth - Type I and Type II superconductors - Flux quantization – DC and AC Josephson effect –BCS Theory - Applications of superconductors.

UNIT IV

CRYSTAL STRUCTURES AND X-RAY DIFFRACTION: Introduction -Space lattice - Basis - Unit cell - Lattice parameter - Bravais lattices – Crystal systems - Structure and packing fractions of Simple cubic - Body centered cubic – Face centered cubic crystals - Directions and planes in crystals – Miller indices - Separation between successive [h k l] planes - Diffraction of X-rays by crystal planes - Bragg's law - Laue method - Powder method.

UNIT V

LASERS : Introduction - Characteristics of lasers - Spontaneous and stimulated emission of radiation - Einstein's coefficients - Population inversion - Ruby laser - Helium-Neon laser – CO₂ laser - Semiconductor laser - Applications of lasers in industry, scientific and medical fields.

UNIT VI

FIBER OPTICS AND HOLOGRAPHY: Introduction - Principle of optical fiber - Acceptance angle and acceptance cone - Numerical aperture – Types of optical fibers and refractive index profiles – Attenuation in optical fibers - Application of optical fibers – Basic principles of holography – Construction and reconstruction of image on hologram – Applications of holography.

UNIT VII

DIELECTRIC PROPERTIES: Introduction - Dielectric constant - Electronic, ionic and orientational polarizations - Internal fields in solids – Clausius - Mossotti equation – Dielectrics in alternating fields – Frequency dependence of the polarizability - Ferro and Piezo electricity.

THERMAL PROPERTIES : Introduction - Specific Heat of Solids – Einstein Model – Debye Model – Lattice Vibrations – Phonons – Thermal Conductivity.

UNIT VIII

SCIENCE & TECHNOLOGY OF NANOMATERIALS: Introduction to Nano materials - Basic principles of Nanoscience & Technology – Fabrication of nano materials – Physical & chemical properties of nanomaterials – Carbon nanotubes – Applications of nanotechnology.

TEXT BOOKS :

1. **Physics Volume 2** by Halliday, Resnick and Krane; John Wiley & Son.
2. **Applied Physics 2nd Edition** by Dr. P. Appala Naidu & Dr. M. Chandra Shekar V.G.S. Book links.
3. **Engineering Physics** by R.K.Gaur & S.L. Gupta; Dhanpat Rai and Sons.

REFERENCES:

1. **Nanotechnology** by Mark Ratner and Daniel Ratner, Pearson Education.
2. **Introduction to solid state physics** by C. Kittel; Wiley Eastern Ltd.
3. **Materials Science and Engineering** by V. Raghavan; Prentice-Hall India.
4. **Engineering Physics** by Dr. M. Arumugam; Anuradha Agencies.
5. **Nanomaterials** by A.K. Bandyopadhyay; New Age International Publishers.
6. **Engineering Physics** by M.N. Avadhanulu & P.G. Kshirasagar; S. Chand & Company Ltd.

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BIOPROCESS ENGINEERING

UNIT I: INTRODUCTION TO BIOPROCESSES

An overview of traditional and modern applications of biotechnology industry, outline of an integrated bioprocess and the various (upstream and down stream) unit operations involved in bioprocesses, generalized process flow sheets.

UNIT II: FERMENTATION PROCESSES-I

General requirements of fermentation processes, Basic design and construction of fermentor and ancillaries, Main parameters to be monitored and controlled in fermentation processes;

UNIT III: FERMENTATION PROCESSES-II

An overview of aerobic and anaerobic fermentation processes and their application in the biotechnology industry, solid-substrate, slurry fermentation and its applications, whole cell immobilization, behaviour of microbes in different reactors (air lift, fluidized, batch, continuous fed batch condition).

UNIT IV: MEDIA DESIGN

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

UNIT V : METABOLIC STOICHIOMETRY

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.

UNIT VI: ENERGETICS

Energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

UNIT VII: KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION

Phases of cell growth in batch cultures, Simple unstructured kinetic models for microbial growth, Monod model, Growth of filamentous organisms. Growth associated (primary) and non - growth associated (secondary) product formation Kinetics. Leudeking-Piret models, substrate and product inhibition on cell growth and product formation. Introduction to Structured Models for growth and product formation.

UNIT VIII: ENZYME PROCESSES

Production of enzymes in submerged and solid-state processes, extraction and purification of enzymes, methods of characterization, specific activity and activity definitions.

All relevant units will have basic numerical problems.

TEXT BOOKS

1. M.L.Shuler and F. kargi Bioprocess engineering, Prentice Hall of India 1992.
2. P.M. Doran, Biochemical process principles, Academic Press, 1995.
3. Harvey W. Blanch, Douglas S. Clark Biochemical Engineering, Marcecel, Dekker, 2007.
4. Bailey Ollis, Biochemical Engineering fundamentals, 2nd edition, McGraw-Hill, 1986.
5. D.G.Rao, Introduction to Biochemical Engineering, McGraw-Hill,2005

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BIOPROCESS ENGINEERING LAB

1. ENZYME ISOLATION AND ASSAY OF ENZYMATIC ACTIVITY

Extraction of commercially important enzymes from natural source Development of enzyme assays; quantification of enzyme activity and specific activity.

2. ENZYME KINETICS

Estimation of Michaelis-Menten parameters, Effect of pH and temperature on enzyme activity, kinetics of inhibition.

3. IMMOBILIZED ENZYME REACTIONS

Techniques of enzyme immobilization - matrix entrapment, ionic and cross linking; column packing; analysis of mass transfer effects on kinetics of immobilized enzyme reactions; bioconversion studies with immobilized - enzyme packed – bed reactors.

4. MICROBIAL CULTURE STUDIES:

Growth of microorganisms, estimation of monod's parameters.

5. SCREENING OF PROCESS VARIABLES

Plackett-Burman design practice

6. DEMONSTRATION OF REACTOR STUDIES

Batch, fed-batch, and continuous flow reactor analysis and residence time distribution.

EQUIPMENTS

1. Autoclave.
2. pH Meter.
3. Laminar air flow chamber.
4. Centrifuge.
5. Compound microscope.
6. Water bath.
7. Packed-bed reactor.
8. Shaker-incubator.
9. Lyophilizer.
10. Spectrofluorimeter.
11. U.V. Visible spectrophotometer.
12. Hot air oven.
13. Incubator.
14. Petri plates.
15. Micropipettes.
16. Bioreactor

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INSTRUMENTAL METHODS OF ANALYSIS LAB

1. Demonstration of viable cells using phase contrast microscopy.
2. Verification of Lambert – Beers Law by UV – VIS spectrophotometer, scanning.
3. Estimation of different macromolecules by visible spectrophotometer.
4. Estimation of turbidity using UV-VIS spectrophotometer.
5. Emission spectra of Anthracene using Spectrofluorimeter.
6. Estimation of proteins & nucleic acids by U.V. method.
7. Separation of different macromolecules by Paper, Thin layer & HPLC chromatography.
8. Membrane separation-dialysis and ultrafiltration.

REFERENCES

1. I.D.Campbell and R.T.Dwek, Biological Spectroscopy, Benjameer Cunmeib & Co., 1986.
2. F. Settle. Handbook of Instrumental Techniques for Analytical Chemistry, Prence Hall, 1997.
3. W.Botton, Instrumentation and Process Measurements, University Press, 1993.

Equipments

1. U.V .Visible spectrophotometer
2. Spectroflourimeter.
3. HPLC
4. Chromatographic chamber.
5. Microscope
6. Dialysis bags.
7. Magnetic stirrer with magnetic beads

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TRANSPORT PHENOMENA IN BIOPROCESSES

Unit I: Momentum Transport-I

Mechanism of Momentum Transport: Newton's Law of Viscosity, Non-Newtonian fluids, theory of viscosity of liquids, time dependant viscosity, viscosity measurement (cone-and-plate viscometer, coaxial cylinder rotary viscometer, impeller viscometer), use of viscometers with biological reaction fluids, rheological properties of fermentation broth, factors affecting broth viscosity (cell concentration, cell morphology, osmotic pressure, product and substrate concentration), Velocity distribution in laminar flow and turbulent flow

Unit II: Momentum Transport-II

Equation of change for isothermal system (equation of continuity, equation of motion, equation of mechanical energy), interphase transport in isothermal systems (friction factors for flow in tubes and in packed columns) mixing, mixing mechanism, power requirements in ungasged Newtonian and Non Newtonian fluids, gassed fluids, interaction between cell and turbulent Eddies, operating conditions for turbulent shear damage. Macroscopic Balances- mass, momentum and mechanical energy balances.

Unit III: Energy Transport-I

Thermal conductivity and the mechanisms of energy transport- measurement of thermal conductivity, Fourier's law, steady state conduction, analogy between heat and momentum transfer

Unit IV: Energy Transport-II

Temperature distribution with more than one independent variables- heating in a semi infinite and finite slab, temperature distribution in turbulent flow- reference to stirred tank reactor, relationship between heat transfer, cell concentrations and stirring conditions

Unit V: Mass Transport I

Diffusivity, theory of diffusion, analogy between mass heat and momentum transfer, role of diffusion in bioprocessing, film theory, concentration distribution with more than one independent variable- unsteady diffusion, boundary layer theory, concentration distribution in turbulent flow- Corrsin equation

Unit VI: Mass Transport II

Definition of binary mass transfer coefficients, transfer coefficients at high mass transfer rates- boundary layer theory, penetration theory

Unit VII: Mass Transport III

Convective mass transfer, Liquid -solid mass transfer, liquid-liquid mass transfer, gas-liquid mass transfer

Unit VIII: Oxygen Transport

Oxygen uptake in cell cultures, Factors affecting cellular oxygen demand, oxygen transfer from gas bubbles to aerobic culture, oxygen transfer in fermentors- bubbles, factors affecting oxygen transport- sparging, stirring, medium properties, antifoam agents, temperature, mass transfer correlations, measurements of $k_L a$ - oxygen balance method, dynamic method.

Note: In all units relevant basic numerical problems should be practiced

TEXT BOOKS

- 1 R.B.Bird, W.E.Stewart, E.N.Lightfoot, Transport Phenomena, John wiley and sons, Singapore , 1994
- 2 P.M.Doran, Bioprocess Principles, Academic Press, 1995
- 3 Harvey W. Blanch, Douglas S. Clark Biochemical Engineering, Marcecel, Dekker, 2007.

REFERENCE BOOK

- 1 M.L.Shuler and F. Kargi, Bioprocess Engineering: Basic concepts, 2nd edition, Prentice Hall of India, 2003

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BIOCHEMICAL REACTION ENGINEERING -I

UNIT I: Fundamentals of reaction engineering

Concept of order, molecularity of a reaction, searching a mechanism for a reaction, evaluation of rate constants, factors affecting reaction rates- pH, temperature using Arrhenius equation.

Unit II: Reactions involving cells-I

Growth Kinetics- batch, fed-batch and continuous mode of operation in reaction system, evaluation of kinetic parameters Monod's equation- parameters, death rate of cell-batch and continuous sterilization.

UNIT III: Reactions involving cells-II

Influence of cell age distribution on growth kinetics, effect of inhibitors, substrate inhibition, Models for inhibition kinetics, Evaluation of parameters in Han-Levenspiel model.

Unit IV: Reactions involving cells-III

Stoichiometry of cell growth and product formation- elemental and available electron balances, degrees of reduction, maintenance coefficient, online data analysis for measurement of biochemical parameters, state and parameter estimation technique.

UNIT V: Multiple Reactions

Parallel series, series – parallel reactions, calculation of yield and selectivity, role of thermodynamic parameters, metabolic flux analysis, basic concepts of structured model and introduction to cybernetic models, Design principles- non isothermal reactions and pressure effects, concepts of residence time distribution, micromixing and macromixing

Unit VI: Mechanisms and Kinetics of Enzyme Action

Mechanisms of Enzyme Action; Concept of active site and energetics of enzyme Kinetics, substrate complex formation; Specificity of enzyme action; Kinetics of single substrate reactions; turnover number; estimation of Michaelis-Menten parameters. Importance of K_M , Multi-substrate reaction mechanisms and kinetics. Types of Inhibition- kinetic models; Substrate and Product Inhibition; Allosteric regulation of enzymes; Deactivation kinetics.

Unit VII: Enzyme Immobilization

Physical and Chemical techniques for enzyme Immobilization - adsorption. matrix entrapment, encapsulation. cross-linking. covalent binding - examples; Advantages and disadvantages of different Immobilization techniques. overview of applications of immobilized enzyme systems, effect of pH, temperature on immobilized reaction kinetics.

Unit VIII: Mass Transfer Effects In Immobilized Enzyme Systems and Design of Enzyme Reactors

Analysis of Film and Pore Diffusion Effects on kinetics of Immobilized Enzyme Reactions; Formulation of dimensionless groups and calculation of Effectiveness Factors, Thiele modulus

Note: In all units relevant basic numerical problems should be practiced.

TEXT BOOKS:

- Harvey W. Blanch, Douglas S. Clark Biochemical Engineering, Marcel Dekker, 2007.
O.Levenspiel. Chemical Reaction Engineering 3ed edition, Wiley, New York, 1999.
P.M.Doran Bioprocess Engineering principles, Academic Press, London, 1995.
D.G.Rao, Introduction to Biochemical Engineering, McGraw-Hill, 2005
K.A. Gavhane, Chemical Reaction Engineering –I, Nirali Prakashan, 2006
J. Nielsen, J. Villadsen and G. Liden, Bioreaction Engineering Principles, Springer International, 2nd edition, 2003.
7. G.Hammes, Thermodynamics and kinetics for the biological sciences, Wiley – VCH, 2000

REFERENCES:

1. H. Scott Fogler, Elements of Chemical Reaction Engineering, II Edition, Prentice Hall of India Pvt. Ltd.
2. J.M. Smith, Chemical Engineering Kinetics, McGraw Hill, 1981.
3. M.L. Shuler and F. Kargi Bioprocess Engineering: basic concepts.
 4. H.J. Fromm Initial rate Enzyme kinetics, Springer-verlog. Berlin 1975.

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BASIC INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY

Unit I : Production of Primary Metabolites

A brief outline of processes for the production of some commercially important Organic acids (e.g. citric acid, lactic acid, acetic acid, gluconic acid.); Amino acids (Glutamic acid, lysine, aspartic acid&Phenylalanine); and Alcohols (ethanol, 2,3- butanediol)

UNIT II: Secondary Metabolites :

Study of production processes for various classes of low molecular weight secondary metabolites: Antibiotics-beta-lactams (Penicillins), semi synthetic Pencillins and Cephalosporins amino-glycosides (streptomycin), macrolids (erythromycin), quinines, and aromatics. Vitamin (B12) and Steroids, dual or multiple fermentation.

Unit III: Production of Commercially Important Enzymes

Proteases, Amylases Lipases, Cellulases, Pectinases, Isomerases and other commercially important. Enzymes for the food pharmaceutical industries;

UNIT IV : Recombinant Proteins

Production of recombinant proteins (Insulin, Interleukin & Interferon's) having therapeutic and diagnostic applications; production of vaccines.

Unit V : Bio products and other Processes

Natural Biopreservatives (Nisin), and Biopolymers (Xanthan Gum and PHB); Single Cell Protein, Racemically-pure Drug Intermediates, Steroid Bioconversions; High -Fructose Corn syrup; Bioconversion of Vegetable Oils, Bioleaching.

Unit VI : Biological treatment of waste Water – Aerobic and Anaerobic Systems

Biological processes for domestic and industrial waste water treatments; Aerobic systems - activated sludge process, trickling filters, biological filters, rotating biological contractors (RBC), Fluidized bed reactor (FBR), expanded bed reactor, Inverse fluidized bed biofilm reactor (IFBBR) packed bed reactors air- sparged reactors ; Anaerobic Systems - contact digesters, packed column reactors, UASB.

Unit VII: Bioremediation

Introduction, constraints and priorities of Bioremediation, Biostimulation of Naturally occurring microbial activities, Bioaugmentation, in situ, ex situ, intrinsic & engineered bioremediation, Solid phase bioremediation - land farming, prepared beds, soil piles, Phytoremediation. Composting, Bioventing & Biosparging; Liquid phase bioremediation - suspended bioreactors, fixed biofilm reactors.

Unit VIII: Hazardous Waste Management

Introduction - Xenobiotic compounds, recalcitrance. hazardous wastes - biodegradation of Xenobiotics . Biological detoxification - hazardous waste management with at least 3 – 4 Examples.

TEXT BOOKS:

- Biotechnology, 3rd edition by John E. Smith. Cambridge low price editions.
- Industrial Microbiology: - J. E. Casida;
- 3 Environmental Biotechnology by S. K. Agarwal
- 4 Biodegradation & Bioremediation (1999), Martin Alexander, Academic press.

REFERENCES:

1. Microbiology: - Prescott and Dunn.
2. Microbial biotechnology: Glazer, A.N. and Nikaido, H. 1995 W.H. Freeman & Company, New York.
3. Industrial Microbiology:- A. H. Patel., Stanier R. Y., Ingram J.L., Wheelis M.L., Painter R.R., General Microbiology McMillan Publications, 1989.
4. Foster C.F., John Ware D.A., Environmental Biotechnology, Ellis Horwood Ltd., 1987.
5. Karrelly D., Chakrabarty K., Omen G.S., Biotechnology and Biodegradation,
6. Advances in Applied Biotechnology Series, Vol.4, Gulf Publications Co. London, 1989.
7. Bioremediation engineering; design and application 1995 John. T. cookson, Jr. Mc Graw Hill, Inc.
8. Environmental Biotechnology by A.K. Chatterjee
9. Environmental Biotechnology by S.N. Jogdand Himalaya Publishing

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GENETIC ENGINEERING

Unit I: Gene Regulation and Expression in Prokaryotes

Lactose, Arabinose and Tryptophan operons, Repressors and activator, Sigma switch in *Bacillus subtilis*.

Unit II: Gene Regulation in Eukaryotic system

Gene regulation in Eukaryotic system, Repetitive DNA, Gene rearrangement, Promoters, enhancer elements, gene amplification.

Unit III: Plasmids, Transposons / Vectors for Gene Transfers

Plasmids: Definition, types, Identification, classification and purifications and transfer of Plasmids. Host restriction in transfer. Transposable elements: Definition, detection of transposition in bacteria, types of bacterial transposons, mechanisms of transposition and excision, applications of transposons. Retrotransposons.

UNIT IV: DNA Technology

Purification of genomic DNA from living cells, Manipulation of purified DNA; construction of prototype vector (pBR 322), different types of cloning vectors (plasmid – pUC 19, ? phage, cosmid, M13). Enzymes involved in genetic engineering; cloning strategies, Introduction of DNA into living cells. Methods of Gene transfer, Restriction mapping.

UNIT – V Expression and Detection of clones

Detection of clones and its expression: Expression of cloned genes in yeast & *E. coli*. Blot analysis - Southern, Northern & Western blot; dot and slot blot. Immunological techniques. DNA methylation, DNA hybridization. Genomic and cDNA library construction and application. DNA sequencing.

Unit VI: PCR and its application

Principles, designing of primers, PCR methodology, RT - PCR, multiplex PCR, identification of PCR product, application of PCR technology.

Unit VII: Molecular markers

Molecular markers: RFLP, RAPD, AFLP, 16s r-RNA typing, gene chip and micro array; applications in disease profile

Unit VIII: Applications of r-DNA Technology

Gene cloning in medicine (Insulin, Blood clotting factor VIII) High level expression of proteins in different host systems (*E. coli*, yeast, Insect, mammalian cells) Limitation and advantages and novel technologies- for generation of transgenic animals. Introduction to Gene therapy (Ex vivo & In vivo), case study of ADA as an example. Advantages and limitations of Gene therapy.

TEXT BOOKS:

1. Old RW, Primrose SB, principles of Gene manipulation, An introduction to Genetic engineering, Blackwell Scientific Publications, 1993
2. T.A. Brown, Gene Cloning.

REFERENCES:

1. Ansubel FM., Brent A, Kingston AE, Moore DO, Current protocols in Molecular Biology, Greene Publishing Associates, NY, 1988.
2. Berger SL, Kimmer AR, Methods in Enzymology, Vol 152, Academic Press, 1987.
3. Molecular Cell Biology – Gerald Carp.

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PLANT BIOTECHNOLOGY

UNIT I TISSUE CULTURE

Introduction to cell and tissue culture; Tissue culture media (composition, preparation); Initiation and maintenance of callus and cell suspension culture, Somatic embryogenesis, organogenesis; Protoplast isolation culture and fusion;

UNIT II TISSUE CULTURE APPLICATIONS I

Production of haploids, Somaclonal variations, Germplasm conservation (Cryopreservation);

UNIT III TISSUE CULTURE APPLICATIONS II

Production of secondary metabolites from plant cell cultures; Processes for enhancing the production of secondary metabolites. Technology of plant cell culture for production of chemicals; Bioreactors systems and models for mass cultivation of plant cells;

UNIT IV PLANT TRANSFORMATION TECHNOLOGY

Agrobacterium mediated gene transfer; Agrobacterium based vectors, viral vectors and their application. Direct gene transfer methods; chemical methods, electroporation, microinjection, particle bombardment.

UNIT V PLANT GENETIC ENGINEERING FOR PRODUCTIVITY AND PERFORMANCE I (BIOTIC STRESS)

Herbicide resistance, Insect resistance, Disease resistance, virus resistance,.

UNIT VI PLANT GENETIC ENGINEERING FOR PRODUCTIVITY AND PERFORMANCE II (ABIOTIC STRESS)

Abiotic stress tolerance ;Drought, temperature, salt .

UNIT VII MOLECULAR FARMING & INDUSTRIAL PRODUCTS

Application of Plant biotechnology for the production of quality oil, Industrial enzymes, Therapeutic Proteins , Antigens (edible vaccine) and plantibodies.

UNIT VIII METABOLIC ENGINEERING

Metabolic engineering for plant primary metabolites and secondary metabolites.

TEXT BOOKS:

1. Roberta Smith, Plant Tissue Culture: Techniques and Experiments. 2nd ed., Academic Press, 2000.
2. Bhojwani, S.S. and Rajdan, Plant Tissue Culture: Theory and Practice. 2004

REFERENCES:

1. Crispeels, M.J. and Sadava, D.E., Plants, Genes and Crop Biotechnology, Jones and Bartlett Publishers (2nd Edition), 2003.
2. Bhowjwani, S.S., Plant Tissue Culture: Application and Limitations. Amsterdam, Elsevier, 1990.
3. Charles Cunningham and Andrew J.R. Porter, Recombinant Proteins from Plants: Production and Isolation of Clinically Useful Compounds (Methods in Biotechnology), Humana Press, 1997.
4. Bernard R. Glick and John E. Thompson, Methods in Plant Molecular Biology and Biotechnology, CRC Press, 1993.
5. I. Potrykus and G. Spangenberg, , Gene Transfer to Plants (Springer Lab Manual), Springer Verlag, 1997.
6. Peter M. Gresshoff, Plant Genome Analysis: Current Topics in Plant Molecular Biology. CRC Press, 1994.
7. John Hammond, Peter McGarvey, Vidadi Yusibov, Plant Biotechnology: New Products and Applications, Springer Verlag, 1999.

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MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Unit I Introduction to Managerial Economics:

Definition, Nature and Scope of Managerial Economics–Demand Analysis: Demand Determinants, Law of Demand and its exceptions.

Unit II Elasticity of Demand: Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting (survey methods, statistical methods, expert opinion method, test marketing, controlled experiments, judgmental approach to demand forecasting)

Unit III Theory of Production and Cost Analysis: Production Function – Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs, Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale.

Cost Analysis: Cost concepts, Opportunity cost, Fixed vs. Variable costs, Explicit costs Vs. Implicit costs, Out of pocket costs vs. Imputed costs. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems)- Managerial Significance and limitations of BEA.

Unit IV Introduction to Markets & Pricing Policies:

Market structures: Types of competition, Features of Perfect competition, Monopoly and Monopolistic Competition. Price-Output Determination in case of Perfect Competition and Monopoly.

Objectives and Policies of Pricing- Methods of Pricing: Cost Plus Pricing, Marginal Cost Pricing, Sealed Bid Pricing, Going Rate Pricing, Limit Pricing, Market Skimming Pricing, Penetration Pricing, Two-Part Pricing, Block Pricing, Bundling Pricing, Peak Load Pricing, Cross Subsidization.

Unit V Business & New Economic Environment: Characteristic features of Business, Features and evaluation of Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises and their types, Changing Business Environment in Post-liberalization scenario.

Unit VI Capital and Capital Budgeting: Capital and its significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising finance.

Nature and scope of capital budgeting, features of capital budgeting proposals, Methods of Capital Budgeting: Payback Method, Accounting Rate of Return (ARR) and Net Present Value Method (simple problems)

Unit VII Introduction to Financial Accounting: Double-Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments).

Unit VIII Financial Analysis through ratios: Computation, Analysis and Interpretation of Liquidity Ratios (Current Ratio and quick ratio), Activity Ratios (Inventory turnover ratio and Debtor Turnover ratio), Capital structure Ratios (Debt- Equity ratio, Interest Coverage ratio), and Profitability ratios (Gross Profit Ratio, Net Profit ratio, Operating Ratio, P/E Ratio and EPS).

TEXT BOOKS:

1. Aryasri: Managerial Economics and Financial Analysis, 2/e, TMH, 2005.
2. Varshney & Maheswari: Managerial Economics, Sultan Chand, 2003.

REFERENCES:

1. Ambrish Gupta, Financial Accounting for Management, Pearson Education, New Delhi.
2. H. Craig Peterson & W. Cris Lewis, Managerial Economics, PHI, 4th Ed.
3. Suma Damodaran, Managerial Economics, Oxford University Press.
4. Lipsey & Chrystel, Economics, Oxford University Press.
5. S. A. Siddiqui & A. S. Siddiqui, Managerial Economics & Financial Analysis, New age International Space Publications.
6. Domnick Salvatore: Managerial Economics In a Global Economy, 4th Edition, Thomson.
7. Narayanaswamy: Financial Accounting—A Managerial Perspective, PHI.
8. Raghunatha Reddy & Narasimhachary: Managerial Economics & Financial Analysis, Scitech.
9. S.N.Maheswari & S.K. Maheswari, Financial Accounting, Vikas.
10. Truet and Truet: Managerial Economics: Analysis, Problems and Cases, Wiley.
11. Dwivedi: Managerial Economics, 6th Ed., Vikas.

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MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB

1. Isolation of Plant and Bacterial Genomic DNA and Plasmid DNA.
2. Agarose Gel Electrophoresis.
3. Restriction Enzyme digestion.
4. Demonstration Chemical mutagenesis.
5. Isolation and visualization of plasmid on Agarose gel.
6. Restriction mapping and ligation.
7. Transformation, screening for recombinants.
8. Characterization of secondary metabolites by Polyacrylamide gel Electrophoresis. Silver staining of protein gels.
9. Blotting Techniques.
10. Expression of Beta – galactosidase and assay.
11. Cloning of DNA into plasmid vector.

REFERENCES:

Current protocols in Molecular Biology by Maniatis.

EQUIPMENTS:

Autoclave.
Laminar air flow chamber.
Water bath
Balance.
Microfuge.
Micropipettes
Submarine gel electrophoresis unit with power pack.
U.V. Transilluminator.
Vertical slab gel electrophoresis equipment.

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ADVANCED ENGLISH COMMUNICATION SKILLS LAB

1. Introduction

The introduction of the English Language Lab is considered essential at 3rd year level. At this stage the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.

The proposed course should be an integrated theory and lab course to enable students to use 'good' English and perform the following:

- Gather ideas and information, to organise ideas relevantly and coherently.
- Engage in debates.
- Participate in group discussions.
- Face interviews.
- Write project/research reports/technical reports.
- Make oral presentations.
- Write formal letters.
- Transfer information from non-verbal to verbal texts and vice versa.
- To take part in social and professional communication.

2. Objectives:

This Lab focuses on using computer-aided multimedia instruction for language development to meet the following targets:

- To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.

3. Syllabus:

The following course content is prescribed for the Advanced Communication Skills Lab:

- Functional English - starting a conversation – responding appropriately and relevantly – using the right body language – role play in different situations.
- Vocabulary building – synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, analogy, idioms and phrases.
- Group Discussion – dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and coherence.
- Interview Skills – concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele and video-conferencing.
- Resume' writing – structure and presentation, planning, defining the career objective, projecting ones strengths and skill-sets, summary, formats and styles, letter-writing.
- Reading comprehension – reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading.
- Technical Report writing – Types of formats and styles, subject matter – organization, clarity, coherence and style, planning, data-collection, tools, analysis.

4. Minimum Requirement:

The English Language Lab shall have two parts:

- i) **The Computer aided Language Lab** for 60 students with 60 systems, one master console, LAN facility and English language software for self- study by learners.
- ii) **The Communication Skills Lab** with movable chairs and audio-visual aids with a P.A System, a T. V., a digital stereo –audio & video system and camcorder etc.

System Requirement (Hardware component):

Computer network with Lan with minimum 60 multimedia systems with the following specifications:

- iii) P – IV Processor
 - a) Speed – 2.8 GHZ
 - b) RAM – 512 MB Minimum
 - c) Hard Disk – 80 GB
- iv) Headphones of High quality

5. Suggested Software:

The software consisting of the prescribed topics elaborated above should be procured and used.

Suggested Software:

- **Clarity Pronunciation Power** – part II
- **Oxford Advanced Learner's Compass**, 7th Edition
- **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**
- **Lingua TOEFL CBT Insider**, by Dreamtech
- **TOEFL & GRE**(KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- **The following software from 'train2success.com'**
 - **Preparing for being Interviewed,**
 - **Positive Thinking,**
 - **Interviewing Skills,**
 - **Telephone Skills,**
 - **Time Management**
 - **Team Building,**
 - **Decision making**
- **English in Mind**, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge

6. Books Recommended:

1. **Effective Technical Communication**, M. Ashraf Rizvi, Tata Mc. Graw-Hill Publishing Company Ltd.
2. **A Course in English communication** by Madhavi Apte, Prentice-Hall of India, 2007.
3. **Communication Skills** by Leena Sen, Prentice-Hall of India, 2005.
4. **Academic Writing- A Practical guide for students** by Stephen Bailey, Rontledge Falmer, London & New York, 2004.
5. **English Language Communication : A Reader cum Lab Manual** Dr A Ramakrishna Rao, Dr G Natanam & Prof SA Sankaranarayanan, Anuradha Publications, Chennai
6. **Body Language- Your Success Mantra** by Dr. Shalini Verma, S. Chand, 2006.
7. **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice**, New Age International (P) Ltd., Publishers, New Delhi.
8. Books on **TOEFL/GRE/GMAT/CAT** by Barron's/cup
9. **IELTS series with CDs** by Cambridge University Press.
10. **Technical Report Writing Today** by Daniel G. Riordan & Steven E. Pauley, Biztantra Publishers, 2005.
11. **Basic Communication Skills for Technology** by Andra J. Rutherford, 2nd Edition, Pearson Education, 2007.
12. **Communication Skills for Engineers** by Sunita Mishra & C. Muralikrishna, Pearson Education, 2007.
13. **Objective English** by Edgar Thorpe & Showick Thorpe, 2nd edition, Pearson Education, 2007.
14. **Cambridge Preparation for the TOEFL Test** by Jolene Gear & Robert Gear, 4th Edition.
15. **Technical Communication** by Meenakshi Raman & Sangeeta Sharma, Oxford University Press.

DISTRIBUTION AND WEIGHTAGE OF MARKS:**Advanced Communication Skills Lab Practicals:**

1. The practical examinations for the English Language Laboratory practice shall be conducted as per the University norms prescribed for the core engineering practical sessions.
2. For the English Language lab sessions, there shall be a continuous evaluation during the year for 25 sessional marks and 50 End Examination marks. Of the 25 marks, 15 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting Internal Lab Test(s). The End Examination shall be conducted by the teacher concerned with the help of another member of the staff of the same department of the same institution.

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COMPUTATIONAL MOLECULAR BIOLOGY

UNIT I: INTRODUCTION TO COMPUTATIONAL MOLECULAR BIOLOGY

Introduction to active areas of research in Computational Molecular Biology, Functional Genomics, Comparative Genomics, Dynamic Programming, Graphical representation of biochemical systems, S-systems equations, steady state analysis, Model refinements

UNIT II : GENOMICS

DNA Sequence assembly and gene identification. Homology based gene prediction. SNPs and applications. Methods of studying gene expression, EST approach,

UNIT-III MICRO ARRAYS

Basics of Micro array

UNIT IV: PROTEOMICS I

Introduction to proteins. Protein identification, structure and function determination. Structure comparison methods. Prediction of secondary structure from sequence.

UNIT V: PROTEOMICS II

Protein homology modeling, Protein threading. Protein ab initio structure prediction. Protein design emphasis on structural Bioinformatics.

UNIT VI: TAXONOMY AND PHYLOGENY

Basic concepts in systematics, Molecular evolution, Definition and description of Phylogenetic trees and types of trees

UNIT-VII: DENDROGRAMS

Dendograms and its interpretation

UNIT-VIII: DRUG DESIGN

Drug discovery cycle, Role of Bioinformatics in Drug discovery

TEXT BOOKS:

1. David W Mount. Bioinformatics- Sequence and genome analysis. CSHL Press.
2. Jonathan Pevsner . Bioinformatics and Functional Genomics. A Jhon Wiely & Sons, Inc., Publication
3. E.O.Voit Computational Analysis of Biochemical systems, Cambridge University Press 2000.

REFERENCES:

1. Moody P C E and A J Wilkinson. Protein Engineering. IRL Press.
2. Creighton T E, Proteins. Freeman W H. Second edition 1993.
3. Journal BIOINFORMATICS (Oxford University).
4. BRANDOND TOOZE – Proteomics

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BIOCHEMICAL REACTION ENGINEERING -II

UNIT I: BASIC CONCEPT

Definition of bioreactor, fundamental principles, Concept in energy and mass balances and in biological reaction modeling.

UNIT II:

Classification of reactors and their configurations, Application in submerged fermentation and solid state fermentation, classification based schuegerl, kafarov components of bioreactors and operation of bioreactors.

UNIT III: ANALYSIS OF IDEAL REACTORS

Concepts of reactors based on flow characteristics, design of ideal reactors using material and energy balance. Batch bioreactor design.

UNIT IV: CHEMOSTAT ANALYSIS

Definition of chemostat, turbidostat, single flow single stage chemostat, single flow multistage chemostat, recycle flow in chemostat, concepts of dilution rate productivity analysis.

UNIT V : PLUG FLOW REACTION SYSTEM

Plug flow behavior, design of plug flow reactor, comparison of productivity in plug flow and single stage single flow chemostat.

UNIT VI: NON-IDEAL BEHAVIOUR IN REACTION SYSTEMS

Reasons for non-ideality, concept of macro using –RTD analysis (E-C-F functions), diagnosing the ills of non-ideal bioreactors.

UNIT VII : DESIGN AND ANALYSIS OF ENZYME REACTORS

Application tubular reactor concept in immobilized packed bed reactors, fluidized bed reactors.

UNIT VIII: SPECIFIC BIOREACTORS ANALYSIS AND SCALE-UP

Design and analysis of fed-batch and air-lift bioreactors. Application in animal cell culture. Basic concept of scale-up, non-dimensional analysis.

Text Books:

1. O.Levenspiel, Chemical Reaction Engineering. 3rd edition, Wiley Newyork,1992.
2. D.G.Rao, Introduction to Biochemical Engineering, McGraw-Hill,2005
3. H.Scott Fogler Elements of chemical reaction Engineering 3rd edition ,Prentice-Hall of India pvt ltd, 2004

References:

1. P.M.Doran Bioprocess Engineering Principles, Academic Press, 1995.
2. Jens Nielsen ,Johan villadsen,Gunnar liden, Bioreaction Engineering principles 2nd edition springer 2007

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HEAT TRANSFER IN BIOPROCESSES

UNIT-I: BASICS OF HEAT TRANSFER

Various modes of heat transfers, conduction, convection, and radiation. Mechanism of heat transfer by conduction, conductive heat transfer through a series of resistances.

UNIT-II: CONDUCTIVE HEAT TRANSFER:

Steady state and unsteady state heat transfer by conduction. Heat transfer through slab and cylinder. Concept of log mean radius for transfer through pipes. Extended surface heat transfer through fins etc.

UNIT-III

Convection–Dimensional analysis, Forced convection in pipe and other geometries

UNIT-IV

Natural convection - various correlation for evaluating heat transfer coefficients.

UNIT-V

Boiling and condensations. Mechanism of boiling: Film and nucleate boiling.

UNIT-VI: HEAT TRANSFER EQUIPMENTS

Double pipe heat exchangers, Shell and tube heat exchangers, pinfin heat exchangers–Overall transfer coefficient. Overview of various types of heat exchangers and concept of LMTD.

UNIT- VII

Single and Multiple effect evaporators and problems on evaporators. Steam economy, Steam capacity, evaporators performance with various feedings viz, forward, backward and parallel.

UNIT-VIII

Analogy between heat, mass and momentum transfer. Applications of heat transfer in bioprocessing–batch sterilization and design of continuous sterilizer.

* Relevant basic numerical problems should be dealt in the units.

TEXT BOOKS:

1. W.L. McCabe and J.C. Smith, Unit Operations of Chemical Engineering, Mc Graw Hill, 5th edition, 1993.
2. P.M. Doran, Bioprocess Engineering Principles, Academic Press, 1995.

REFERENCE BOOKS:

- BIOTOL Series: Transport phenomena in bioprocesses, Verlag
 D.G.Rao, Introduction to Biochemical Engineering, Tata Mc Graw Hill, 2005.
 H.W. Blanch and D.S. Clark, Biochemical Engineering, Marcel Dekker Inc. New York, 1996.

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INSTRUMENTATION AND BIOPROCESS CONTROL

UNIT I: PROCESS DYNAMICS

Process variables-Load variables-Dynamics of simple processes. Flow, level, temperature and pressure

UNIT II:

Interacting and non-interacting system, continuous and batch process-self - regulation-Servo and regulator operation problems.

UNIT III: CONTROL ACTIONS AND CONTROLLERS

Basic control actions-characteristics of two position, three position, proportional, single speed floating. Integral and derivative control modes- P+I. P+D and P+I+D control modes.Problems on pneumatic, hydraulic and electronic controllers to realize various control actions.

UNIT IV: OPTIMUM CONTROLLER SETTINGS

Evaluation criteria, 1/4th decay ratio, IAE. ISE, ITAE- determination of optimum settings for mathematically described process using time response and frequency response.

UNIT V:

Tuning process reaction curve method-continuous, oscillation method-damped oscillation method-problems.

UNIT VI: FINAL CONTROL ELEMENT

I/P Converter-pneumatic, electric and hydraulic actuators- valve positioner- control valves-characteristics of control valves-valve body-Globe, butterfly, diaphragm; Ball valves- Control valve sizing-Cavitation, flashing problem.

UNIT VII: MULTI LOOP CONTROL SYSTEM

Feed forward control-Ratio control-Cascade control-Split range-Multivariable control and examples from distillation column & Boiler system.

UNIT VIII:BIOSENSORS

Types, Transducers in biosensors- calorimetric, optical, potentiometric / amperometric, conductometric/resistometric, piezoelectric, semi conductor, mechanical and molecular electronics based, molecular wires and switches, development of molecular arrays as memory stores, design for a biomolecular photonic computers- information processing.

TEXT BOOKS:

1. Process control, Pollard A. Heinemann, Educational Books. London, 1971.
2. Process control, Harriott P., Tata McGraw- publishing Co. New Delhi. Reprint 1991.
3. J.R. Leigh: Modeling and control in bioprocesses
4. JE Pearson, A Gill and P. Vadgama, Analytical aspects of biosensors, Annual Clinical Biochemistry 37, 119-145.
4. Patranabis, Process Control year?
5. KR Rogers, M. Mascion, Biosensors for analytical monitoring EP & biosensors year
6. Donald R. Coughanowr, Process Systems Analysis and Control, McGraw-Hill,1991

REFERENCES:

1. Automatic process control, Eckman D.P., Wiley Eastern Ltd. New Delhi. 1993.
2. Chemical Process Control Stephanoupolis, G., Prentice Hall, New Delhi. 1990.

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IMMUNOLOGY

UNIT I: THE IMMUNE SYSTEM

Introduction, Phylogeny of the Immune system, Innate and acquired immunity. **Immunochemistry:** Immunogens, antigens, their chemical nature, Properties influencing immunogenicity, Haptens, adjuvants.

UNIT II: BIOLOGY OF THE IMMUNE SYSTEM

Cells of the IS: Haematopoiesis, lymphocyte trafficking, T, B, Macrophages, Dendritic cells, Natural killer cells, Eosinophils, Neutrophils, Mast cells and Phagocytosis.

UNIT III: ORGANS OF THE I.S. :

Primary and Secondary organs of I.S. (Thymus, Spleen, Lymphnode, lymphoid follicles, MALT, CALT, SALT)

UNIT IV: HUMORAL IMMUNITY-I

B-lymphocytes, their lineage, Immunoglobulins, their structure function, classes, sub classes, genetic control of antibody production. (Maturation of B cell) Isotype, allotypes, Idiotypes. Antigen-Antibody interactions, hypersensitivity.

UNIT V: HUMORAL IMMUNITY -II

Activation of B cells, their differentiation and effector functions. Hybridoma Technology Monoclonal antibodies their application. Immunotoxins chimeric antibodies and antibodies.

UNIT VI: CELL MEDIATED IMMUNITY

T-cells subclasses their lineage, maturation TCR diversity, MHC, Ag processing and presentation, T-cell activation, effector functions.

UNIT VII: Hypersensitivity

Hypersensitivity: Types of hypersensitivity, Principle, mechanisms their relevance & significance. Role of immune system in transplantation, autoimmunity, tumors.

UNIT VIII: Role of immune system in transplantation, autoimmunity, tumors

Transplantation- Graft rejection evidence and mechanisms of graft rejection, prevention of graft rejection, immunosuppressive drugs, Autoimmunity – experimental models of autoimmune disease treatment of autoimmune disorders and Tumor immunology.

TEXT BOOKS:

1. E. Roitt Essential Immunology, Vaccines conventional, subunit and recombinant, antidiotypic vaccine, Blackwell Scientific publications, Oxford, 1991.
2. Kuby Immunology, 5th Edition . Richard A Goldsby, Thomas J Kindt Barbara A Osborne . W H Freeman and Company.

REFERENCES:

1. Benjamin E and Leskowitz S, immunology A short Course. Wiley LISS NY, 1991. ELISA Immunological Techniques. DNA vaccines Immunotechnology
2. Cellular Molecular Immunology. Abul Abbas and Litchman. 2003.

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PROBABILITY AND STATISTICS

UNIT-I

Probability: Sample space and events – Probability – The axioms of probability – Some Elementary theorems - Conditional probability – Baye's theorem.

UNIT-II

Random variables – Discrete and continuous – Distribution – Distribution function. Distribution

UNIT-III

Binomial and poison distributions Normal distribution – related properties.

UNIT-IV

Sampling distribution: Populations and samples - Sampling distributions of mean (known and unknown) proportions, sums and differences.

UNIT-V

Estimation: Point estimation – interval estimation - Bayesian estimation.

UNIT-VI

Test of Hypothesis – Means– Hypothesis concerning one and two means– Type I and Type II errors. One tail, two-tail tests.

UNIT-VII

Tests of significance – Student's t-test, F-test, χ^2 test. Estimation of proportions.

UNIT-VIII

Queuing Theory: Pure Birth and Death Process M/M/1 Model and Simple Problems.

Text Books:

1. Probability & Statistics, T. K. V. Iyengar, B. Krishna Gandhi and Others, S. Chand & Company.
2. A text book of Probability & Statistics, Shahnaz Bathul, V. G. S. Book Links.

References:

1. Probability & Statistics, Arnold O. Allen, Academic Press.
2. Probability & Statistics for Engineers, Miller and John E. Freund, Prentice Hall of India.
3. Probability & Statistics, Mendan Hall, Beaver Thomson Publishers.
4. Probability & Statistics, D. K. Murugeson & P. Guru Swamy, Anuradha Publishers.

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PLANT TISSUE CULTURE LAB

1. Preparation of Media
2. Surface sterilization
3. Callus induction
4. Organ culture
5. Protoplast isolation, culture and Cytological examination
6. *Agrobacterium* mediated gene transfer, selection of transformants, reporter gene (GUS) assays.

REFERENCE:

Plant Biotechnology: Practical Manual, C.C.Giri & Archana Giri, IK International, 2007.

EQUIPMENTS:

1. Autoclave.
2. pH Meter.
3. Laminar air flow chamber.
4. B.O.D. Incubator.

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IMMUNOLOGY LAB

1. Immunoprecipitation
 - a) Ouchterlony's immuno diffusion technique.
 - b) Counter current immuno electrophoresis.
2. Agglutination: Haemagglutination & Blood typing / grouping.
3. Enzyme linked immunosorbant assay(ELISA)
4. Immunoglobulins purification.
5. Differential (Identification of cell types) & Total leukocyte counts of blood
6. Isolation & Viability determination of Lymphocytes from peripheral blood.
7. Lymphocyte proliferation with mitogen and migration with capillary tubes.
8. Identification of cell types by receptors – Immunofluorescence.
9. Raising of antibodies in animals – Polyclonal antibodies.

Equipments:

1. Haemocytometer
2. ELISA reader
3. Centrifuge
4. Electrophoresis unit
5. Microscope

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BIOINFORMATICS

UNIT I: INTRODUCTION TO BIOINFORMATICS

Scope of Bioinformatics, Elementary commands and protocols, ftp, telnet, http. Primer on information theory.

UNIT-II: INTRODUCTION TO HOMOLOGY

Introduction to Homology (with special mention to Charles Darwin, Sir Richard Owen, Willie Henning, Alfred Russel Wallace).

UNIT III: SPECIAL TOPICS IN BIOINFORMATICS

DNA mapping and sequencing, Map alignment, Large scale sequencing methods Shotgun and Sanger method.

UNIT IV : SEQUENCING ALIGNMENT AND DYNAMIC PROGRAMMING

Heuristic Alignment algorithms. Global sequence alignments-Neddleman-Wunsch Algorithm Smith-Waterman Algorithm-Local sequence alignments (Amino acid substitution Matrices (PAM, BLOSUM).

UNIT V: PRIMARY DATABASE AND THEIR USE

Introduction to Biological databases, Organization and management of databases. Searching and retrieval of information from the World Wide Web. Structure databases - PDB (Protein Data Bank), Molecular Modeling Databases (MMDB). Primary Databases NCBL,EMBL, DDBJ.

UNIT-VI: SECONDARY DATABASES

Introduction to Secondary Databases Organization and management of databases Swissprot, PIR,KEGG

UNIT-VII: BIOCHEMICAL DATA BASES

Introduction to BioChemical databases-organization and Management of databases. KEGG, EXGESCY, BRENDA, WIT.

UNIT VIII: EVOLUTIONARY TREES AND PHYLOGENY

Multiple sequence alignment and phylogenetic analysis.

TEXT BOOKS:

1. Bioinformatics Basics. Applications in Biological Science and Medicine by Hooman H. Rashidi and Lukas K.Buehler CAC Press 2000.
2. Algorithms on Strings Trees and Sequences Dan Gusfiled. Cambridge University Press 1997.

REFERENCES:

1. Bioinformatics: A Machine Learning Approach P. Baldi. S. Brunak, MIT Press 1988.
2. Bioinformatics. David Mount, 2000. CSH Publications
3. Developing Bioinformatics Skills. Cynthia Gibbas & Per Jamberk
4. Genomics and Proteomics-Functional and Computational aspects. Springer Publications. Editor-Sandor Suhai.
5. Bioinformatics- Methods and Protocols-Human Press. Stephen Misener, Stephen A. Krawetz.
6. Computational Biochemistry – C.Stan ,TSAI WILEY Publications.
7. Bioinformatics – A Practical guide to the Analysis of Genes and Proteins – ANDREAS D.BAXEVANIS, B.F. FRANCIS OUELLETTE.
8. Bioinformatics – Principles and Applications – Harshawardhan P.Bal TATA MEGRAW HILL.
9. BLAST : An Essential guide Ian Korf, O'Reilly publishers.
10. Bioinformatics Computer skills Cynthia Gibas O'Reille publishers.

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BIOETHICS, BIO SAFETY AND INTELLECTUAL PROPERTY RIGHTS

UNIT I: BIOETHICS

Introduction to Bioethics. Social and ethical issues in Biotechnology

UNIT II: BIOSAFETY I

Definition of Biosafety. Biosafety for human health and environment. Social and ethical issues.

UNIT III: BIOSAFETY II

Use of genetically modified organisms and their release in to the environment. Special procedures for r-DNA based products

UNIT IV: REGULATORY AFFAIRS

Regulatory requirements for drugs and Biologics. GLP. GMP

UNIT V: INTELLECTUAL PROPERTY RIGHTS I

Intellectual property rights, and Intellectual Property protection, patents and methods of application of patents,

UNIT VI: INTELLECTUAL PROPERTY RIGHTS II

Trade Secrets copyrights, Trade Marks, legal implications, farmers rights, plant breeder's rights.

UNIT VII: INTELLECTUAL PROPERTY RIGHTS III

International and National conventions on biotechnology and related areas.

UNIT VIII

WTO guidelines

TEXT BOOKS:

1. Sasson A, Biotechnologies and Development, UNESCO Publications, 1988.
2. Sasson A. Biotechnologies in developing countries present and future, UNESCO publishers, 1993.

REFERENCE:

1. Singh K. Intellectual Property Rights on Biotechnology, BCII, New Delhi.

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DOWNSTREAM PROCESSING

UNIT I: ROLE OF DOWNSTREAM PROCESSING IN BIOTECHNOLOGY

Role and importance of downstream processing in biotechnological processes. Problems and requirements of bioproduct purification. Economics of downstream processing in Biotechnology, cost-cutting strategies, characteristics of biological mixtures, process design criteria for various classes of bioproducts (high volume, low value products and low volume, high Value products)

UNIT-II:

Physico-chemical basis of bio-separation processes. Recent development in product Isolation (for ex. one step purification, reverse Micro cellular extraction on line membrane separation).

UNITIII: PRIMARY SEPARATION AND RECOVER PROCESS

Cell disruption methods for intracellular products, removal of insoluble, biomass (and particulate debris) separation techniques, flocculation and sedimentation, centrifugation and filtration methods.

UNIT IV: MEMBRANE SEPARATIONS

Membrane-based separations (micro and ultrafiltration), theory, design and configuration of membrane separation equipment applications,

UNIT V: ENRICHMENT OPERATIONS

Precipitation methods (with salts, organic solvents, and polymers, extractive separations, aqueous two-phase extraction, supercritical extraction), in situ product removal, integrated bioprocessing.

UNIT VI: ELECTROPHORESIS

Electrophoresis of proteins and nucleic acids, 1D-2D Gels, Types of Electrophoretic techniques (Capillary and Pulse field).

UNIT VII: PRODUCT RESOLUTION / FRACTIONATION

Chromatographic techniques- Paper, TLC, Adsorption, Ion exchange, Gel filtration, affinity chromatographic separation processes, GC, HPLC, FPLC, Chromatofocusing electrophoretic separations.

UNIT VIII: NEW AND EMERGING TECHNOLOGIES

Dialysis, Crystallization Pervaporation, super liquid extraction foam based separation case study with examples for processing of Two Industrial Products (Citric acid / Penicillin and Low volume high value product like recombinant proteins).

TEXT BOOKS:

1. Wankat PC. Rate controlled separations, Elsevier, 1990.
2. Belter PA and Cussler E. Bioseparations, Wiley 1985.

REFERENCES:

1. Product Recovery in Bioprocess Technology, BIOTOL.' Series, VCH, 1990.
2. Asenjo J.M. Separation processes in Biotechnology, 1993, Marcel Dekkera Inc
3. M.R.Ladisch, Bioseparation engineering: Principles, Practice and Economics, Wiley Interscience 2001

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BIOSENSORS AND BIOELECTRONICS

UNIT I: INTRODUCTION

What are Biosensors? Advantages and limitations, various components of biosensors

UNIT II TYPES OF BIOSENSORS

Biocatalysis based biosensors, bioaffinity based biosensors & microorganisms based biosensors, biologically active material and analyte. Types of membranes used in biosensor constructions.

UNIT III: TRANSDUCERS IN BIOSENSORS I

Various types of transducers; principles and applications - Calorimetric, optical, potentiometric / amperometric conductometric/resistometric,

UNIT IV: TRANSDUCERS IN BIOSENSORS II

Piezoelectric, semiconductor, impedimetric, mechanical and molecular electronics based transducers. Chemiluminiscene - based biosensors.

UNIT V: APPLICATION AND USES OF BIOSENSORS I

Biosensors in clinical chemistry, medicine and health care, biosensors for veterinary, agriculture and food

UNIT VI: APPLICATION AND USES OF BIOSENSORS II

Low cost- biosensor for industrial processes for online monitoring; biosensors for environmental monitoring.

UNIT VII: MOLECULAR ELECTRONICS I

Potential advantages & Developments towards a biomolecular computer, development of molecular arrays as memory stores; molecular wires and switches; mechanisms of unit assembly;

UNIT VIII: DESIGN FOR A BIOMOLECULAR PHOTONIC COMPUTER

Assembly of photonic biomolecular memory store; Information processing; commercial prospects for biomolecular computing systems.

TEXT BOOKS:

1. Aboul - Enein, H. V., Stefan, R. and Van Staden, (1999) Chemiluminiscence - based biosensors - An overview crit Rev. Anal. Chem. 29, 323-331.
2. Pearson, J.E. Gill, A., and Vadgama, P. (2000) Analytical aspects of biosensors Ann Clin Biochem 37, 119-145.

REFERENCES:

1. Roger, K.R. and Gerlach, C.L. 1~99. Update on environmental for biosensors. Env. Sci. Techno! 33 500A - 506A.
2. Bilitewski, U. Turner, A.P.F. 2000 Biosensors for environmental monitoring Harwood, Amsterdam.
3. Moses, V and Cape, R.E. 1991, Biotechnology the science and business, Harwood, Academic Publisher London
4. Rogers, K.R. and Mascini, M. 2001. Biosensors for analytical monitoring EPA biosensors group.

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**BIOMATERIAL SCIENCE AND TECHNOLOGY
(Elective I)**

UNIT I: INTRODUCTION

Definition of polymers and biomaterials, functionality, polymer isomerism

UNIT II: SELECTION OF BIOMATERIALS

Selection criteria, fiber folding, membrane lamination, in situ polymerization

UNIT III: BIOLOGICALLY DERIVED BIOMATERIALS

Polyhydroxialkanoates, polylactides- characterization, synthesis in organism and extraction

UNIT IV: MATERIALS FOR TISSUE ENGINEERING

Case studies with regenerated polymers

UNIT V: TRENDS IN BIOCOMPOSITE

Biodiode , polymer coated blood, polymer precursor synthesis and characterization

UNIT VI: IMPROVED FUNCTIONS OF BIOPOLYMERS

Genetic and molecular Biology aspects of synthesis

UNIT VII: FERMENTATIVE PRODUCTION

Biopolyester, microbial polysaccharides, microbial cellulose, bioadhesive, polyglutamic acid

UNIT VIII: OPTIMIZATION OF PRODUCTION KINETICS, SEPARATION

Statistical optimization of probable variables for production of biomaterials, use of reactors, kinetic analysis for production, separation of Biomaterials by cell digestion and extraction

BOOKS:

1. D. Byrom, Biomaterials –novel materials from biological sources, Stockton press, New York, 1991.
2. J.B.Park, Biomaterials science and engineering, Plenum Pulo, 1984.

REFERENCE BOOK:

1. A. Steinbuechel – Biopolymers.

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**CELL SIGNALING
(Elective 1)**

UNIT I: INTRACELLULAR SIGNALING.

Introduction, Receptor-Ligand interactions.

UNIT II: ROLE OF RECEPTORS –I

Extra Cellular Receptors, Coupling to different signal transducing systems.

UNIT III : ROLE OF RECEPTORS –II

Type of intracellular receptors, steroid receptors, structure and function.

UNIT IV:SPECIFIC MOLECULES

Role and functions of G-proteins, CREB proteins, Calcium channels, second messengers-inositol, diacyl glycerol

UNIT V: MECHANISM

Signal transduction, mechanism and involvement of molecules.

UNIT VI: RECEPTORS

Regulations of receptor function,modification and adaptation of cells.

UNIT VII :PATHWAYS

Signal transduction pathways, applications in development and diseases.

UNIT VIII :ROLE OF DEFECTIVE SIGNALING

Development of abnormalities, signal transducing machinery as targets for potential drugs.

Textbooks

1. G.Posil and S.T. Croke, Mechanism of receptor regulations, Plenum Press,1985.
2. R.H Getzenberg and E.E. Bittar, Cell structure and signaling, Elsevier Science, 1997.

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STRUCTURAL BIOLOGY

(Elective - I)

UNIT I: INTRODUCTION

Levels of structures in Biological macromolecules, the chirality of biomolecules, proteins, nucleic acids, carbohydrates and lipids, cofactors, vitamins and hormones.

UNIT II: CONFORMATIONAL ANALYSIS

Forces that determine Protein and Nucleic acid structure, basic problems. Polypeptide chains; geometric, potential energy calculations, observed values for rotation angles, hydrogen bonding, hydrophobic interactions and water structures; ionic interactions, disulphide bonds.

UNIT III: PROTEIN FOLDING

Types of proteins and interactions that govern protein folding, protein structure, The protein globule and hydrophobic interactions organized folds, folding mechanisms, membrane proteins, helix-coil transitions,

UNIT IV: BIOMOLECULAR INTERACTIONS

Molecular recognition, supramolecular interactions, Functional importance of Protein-protein and protein-nucleic acid interactions. Specific and non-specific DNA-protein complexes.

UNIT V: STRUCTURAL ANALYSIS OF MACROMOLECULES

Prediction of protein structure; Sequence-structure relationships, Nucleic acids; general characteristics of nucleic acid structure, geometric, glycosidic bond rotational isomers backbone rotational isomers and ribose puckering forces stabilizing ordered forms, base pairing, base stacking; tertiary structure of nucleic acids.

UNIT VI: KINETICS OF LIGAND INTERACTIONS:

Biochemical Kinetics studies, uni-molecular reactions, simple bimolecular multiple intermediates, steady state kinetics, catalytic efficiency relaxation spectrometry, ribonuclease as an example.

UNIT VII: TECHNIQUES FOR THE STUDY OF BIOLOGICAL STRUCTURE & FUNCTION I

Size and shape of micro molecules: photons, chromophores, transition dipole moments, absorbance, and concentration. circular dichroism: molecular chirality and structural transitions of macromolecules, methods of direct visualization macromolecules as hydrodynamic particles - macromolecular diffusion ultra centrifugation viscometry.

UNIT VIII: TECHNIQUES FOR THE STUDY OF BIOLOGICAL STRUCTURE & FUNCTION II

X- ray crystallography; determination of molecular structures, X- ray fiber diffraction electron microscopy; neutron scattering - light scattering, NMR spectroscopy.

Text Book:

1. Tinoco, I., Jr., Sauer, K., Wang, J. C., & Puglisi, J. D. (2001) Physical Chemistry: Principles and Applications in Biological Sciences, 4th ed. Prentice Hall.

References :

1. Introduction to Protein Architecture, by A.M. Lesk
2. Introduction to Protein Structure, by Branden and Tooze

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CANCER BIOLOGY

(Elective-I)

UNIT I: FUNDAMENTALS OF CANCER BIOLOGY

Regulation of Cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches,

UNIT II: TUMOR SUPPRESSION

tumour suppressor genes, modulation of cell cycle in cancer. Different forms of cancers, Diet and cancer.

UNIT III: PRINCIPLES OF CARCINOGENESIS I

Chemical Carcinogenesis, Metabolism of Carcinogenesis, Natural History of Carcinogenesis, Targets of Chemical Carcinogenesis

UNIT IV: PRINCIPLES OF CARCINOGENESIS II

Principles of Physical Carcinogenesis, X - Ray radiation - mechanism of radiation Carcinogenesis.

UNIT V: MOLECULAR CELL BIOLOGY OF CANCER

Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes, detection of Oncogenes, Growth Factor and Growth Factor receptors that are Oncogenes. Oncogenes / Proto Oncogene activity. Growth factors related to transformations.

UNIT VI: PRINCIPLES OF CANCER METASTASIS

Clinical significances of invasion, heterogeneity of metastatic phenotype, Metastatic cascade, Basement Membrane disruption, Three-step theory of Invasion, Proteinases and tumour cell invasion.

UNIT VII: DETECTION OF CANCER

Detection of Cancers, Prediction of aggressiveness of Cancer, Advances in Cancer detection.

UNIT VIII: NEW MOLECULES FOR CANCER THERAPY

Different forms of therapy, Chemotherapy, radiation Therapy, and Immuno therapy: advantages and limitations.

TEXT BOOKS

1. Maly B.W.J. Virology a practical approach, IRL Press, Oxford, 1987.
2. Scientific Publications. Oxford, 1988. An Introduction to Cellular and Molecular Biology of Cancer, Oxford Medical publications, 1991.

REFERENCE:

1. Dunmock N.J and Primrose.S.B., Introduction to modern Virology, Blackwel

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**CREATIVITY, INNOVATION AND PRODUCT DEVELOPMENT
(Elective - II)**

UNIT I INTRODUCTION

The process of technological innovation, factors contributing to successful technological innovation

UNIT II CREATIVITY

The need for creativity and innovation, creativity and problem solving, brain storming- different techniques.

UNIT III PROJECT SELECTION AND EVALUATION

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

UNIT IV NEW PRODUCT DEVELOPMENT

Research and new product development Patents - patent search

UNIT V: PATENT LAWS

Patent laws International code for patents - Intellectual property rights (IPR).

UNIT VI NEW PRODUCT PLANNING I

Design of proto type - testing - quality standards

UNIT VII NEW PRODUCT PLANNING II

Marketing research - introducing new products. GMP

UNIT VIII LABORATORY

Creative design - Model Preparation - Testing – cost – evaluation, Patent application- GLP.

TEXT BOOKS

1. HARRY B.WATTON - New Product Planning. Prentice-Hall Inc. 1992.
2. P.N.KHANDWALLA - Fourth Eye (Excellence through Creativity) - Wheeler Publishing, Allahabad, 1992.

REFERENCES

1. HARRY NYSTROM - Creativity and innovation -John Wiley & Sons, 1979.
2. BRAIN TWISS, Managing technological innovation, Pitman Publishing Ltd, 1992.
3. I.P.R. Bulletins. TIFAC, New Delhi, 1997.

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**NANO BIOTECHNOLOGY
(Elective II)**

UNIT I: BASIC CONCEPT

Definition of nano scale with reference to biosystems, Scope and future prospects.

UNIT II: TOOLS OF NANOSCIENCE

Scanning probe instrument, spectroscopy, electron microscopy.

UNIT III: TOOLS FOR NANOSTRUCTRE

Molecular synthesis, Self assembly, Polymerisation, Nanoscale lithography, e-beam lithography.

UNIT IV: SMART MATERIALS

Heterogenous nano structre and composites, nanoscale biostructres.

UNIT V: HYBRID COMPUTERS

Protein-hybrid computers, role of genetically engineered polymer proteins.

UNIT VI: DIRECTED SYNTHESIS

Molecular biology of biosynthesis and molecular design.

UNIT VII: APPLICATIONS

Drugs-Photodynamic therapy, molecular motors, neuroelecronic interphases, development of nanoluminiscent tags.

UNIT VIII: BIOSYNTHESIS OF DESIGNER COMPOUNDS

Designer biopolymers, Procollagen, DNA Polynode, RNA topoisomerase, Protein –magnetic materials.

Textbooks:

1. M.Ratner and D.Ratner, Nanotechnology –a gentle introduction to the next big idea, Pearson education , 2007.
2. R.R.Birge, Proetin based computers, Scientific American , 1995.

References:

1. L.E.Foster, Nanotechnology-Science, Innovation and opportunity , Person eduction inc, 2007.

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**METABOLIC ENGINEERING
(Elective – II)**

UNIT I : INTRODUCTION

Identification of metabolic regulation is a key point in metabolic engineering.

Basic concepts of Metabolic Engineering – Overview of cellular metabolism – Different models for cellular reactions, induction – Jacob Monod model and its regulation, Differential regulation by isoenzymes, Feed back regulation.

UNIT II : SYNTHESIS OF PRIMARY METABOLITES

Amino acid synthesis pathways and its regulation at enzyme level and whole cell level, Alteration of feed back regulation, Limiting accumulation of endproducts.

UNIT III : BIOSYNTHESIS OF SECONDARY METABOLITES

Regulation of secondary metabolite pathways, precursor effects, prophase, idiophase relationship, Catabolite regulation by passing control of secondary metabolism, producers of secondary metabolites, applications of secondary metabolites.

UNIT IV : BIOCONVERSIONS

Applications of Bioconversions, Factors affecting bioconversions, Specificity, Yields, Co metabolism, Product inhibition, mixed or sequential bioconversions, Conversion of insoluble substances.

UNIT V : REGULATION OF ENZYME PRODUCTION

Strain selection, Genetic improvement of strains, Gene dosage, metabolic pathway manipulations to improve fermentation, Feed back repression, Catabolite Repression, optimization and control of metabolic activities. The modification of existing - or the introduction of entirely new - metabolic pathways

UNIT VI : METABOLIC FLUX

Integration of anabolism and catabolism, metabolic flux distribution analysis bioprocess, material balance, kinetic types, equilibrium reaction. Experimental determination method of flux distribution, Metabolic flux analysis and its applications, Thermodynamics of cellular processes

UNIT VII : METABOLIC ENGINEERING WITH BIOINFORMATICS

Metabolic pathway modeling, Analysis of metabolic control and the structure metabolic networks, Metabolic pathway synthesis algorithms,

UNIT VIII : APPLICATIONS OF METABOLIC ENGINEERING

Application in pharmaceuticals, chemical bioprocess, food technology, agriculture, environmental bioremediation and biomass conversion.

TEXT BOOKS:

1. Wang, D.I.C Cooney C.L., Demain A.L., Dunnill P. Humphrey A.E. Lilly M.D., Fermentation and Enzyme Technology, John Wiley and sons 1980.
2. Stanbury P.F., and Whitaker A., Principles of Fermentation Technology, Pergamon Press, 1984.

References :

- Zubay G., Biochemistry, Macmillan Publishers, 1989.
<http://ocw.osaka-u.ac.jp/contents/19/ME040512.pdf> For unit VI & VII
<http://ocw.osaka-u.ac.jp/contents/19/ME040421.pdf> For unit VI
<http://ocw.osaka-u.ac.jp/contents/19/ME040526.pdf> For unit VII
<http://ocw.osaka-u.ac.jp/contents/19/ME040602.pdf> For unit VI & VII
<http://www.bioinfo.de/isb/gcb01/poster/hurlebaus.html>
 How will bioinformatics influence metabolic engineering? Biotechnol Bioeng. 1998 Apr 20-May 5;58(2-3):162-9. For unit VII

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BIOINFORMATICS LAB

- 1) Demonstration of BLAST, FASTA and other search engines
- 2) Clustering and contig assembly tool
- 3) Multiple sequence alignment and phylogenetic analysis.
- 4) Gene finder (Prediction)
- 5) Restriction site analysis tools
- 6) Protein visualization tools (RASMOL)

EQUIPMENTS:

1. Computers
2. Internet facility
3. Bioinformatics software

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DOWNSTREAM PROCESSING LABORATORY

Cell disruption techniques.

Solid separation methods-filtration, sedimentation, centrifugation, product enrichment operations, precipitation, ultra filtration, two-phase aqueous extraction, high-resolution purification, preparative liquid chromatographic techniques, product crystallization and drying.

Equipments

1. Tangential flow filtration unit
2. Ultra filtration membrane
3. Centrifuge
4. Chromatographic matrix
5. Chromatographic columns
6. UV-Vis spectrophotometer
7. separating funnels
8. Lyophilizer
9. Magnetic stirrer

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ANIMAL CELL SCIENCE AND TECHNOLOGY

Unit I:

Structure and Organization of animal cell; Equipments and materials for animal cell culture technology; Primary and established cell line cultures; Introduction to the balanced salt solutions and simple growth medium,

Unit II:

Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide. Role of serum and supplements; Serum & protein free defined media and their application.

Unit III:

Measurement of viability and cytotoxicity; Biology and characterization of the cultured cells, measuring parameters of growth;

Unit IV:

Basic techniques of mammalian cell culture in vitro; disaggregation of tissue and primary culture, maintenance of cell culture; cell separation.

Unit V:

Cell synchronization; Cell cloning and micromanipulation; Cell transformation; Application of animal cell culture; Scaling-up of animal cell culture.

Unit VI:

Stem cell cultures, embryonic stem cells and their applications; Cell culture based vaccines, Somatic cell genetics.

Unit VII:

Organ and histotypic cultures; Measurement of cell death; Apoptosis;

Unit VIII:

Three dimensional culture and tissue engineering.

TEXT BOOKS:

1. Culture of Animal Cells, (3rd Edition), F1. Ian Froshney. Wiley-Liss.
2. Animal Cell Culture – Practical Approach, Ed. John R.W. Masters, OXFORD.

REFERENCES

1. Cell Culture Lab Fax. Eds. M. Butler & M. Dawson, Bios Scientific Publications Ltd., Oxford.
2. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
3. Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods. Ed. Jenni P. Mather and David Barnes. Academic Press.
4. Cell Growth and Division: A Practical Approach. Ed. R. Basega, IRL Press.

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**FOOD SCIENCE & TECHNOLOGY
(Elective-III)**

UNIT -1 INTRODUCTION TO FOOD SCIENCE & TECHNOLOGY

Fundamentals and Aims of food science and technology. Interdisciplinary approach, Nutritive value of foods, Food as a source of energy, Food Health and disease.

UNIT -2 FOOD CHEMISTRY

Food chemistry-definition and importance, water in food, water activity and shelf life of food. Carbohydrates- functional properties of sugars and polysaccharides in foods. Lipids: use of lipids in foods, physical and chemical properties, effects of processing on functional properties and nutritive value. Protein and amino acids: physical and chemical properties, distribution, amount and functions of proteins in foods, functional properties, effect of processing. -Losses of vitamins and minerals due to processing.

UNIT -3 FOOD MICROBIOLOGY

Microbial growth pattern, Types of micro-organism normally associated with food-mold, yeast, and bacteria. Micro-organisms in natural food products. Contaminants of foods-stuffs, Fisheries, milk and meat during handling and processing. Biochemical changes caused by micro-organisms, deterioration of various types of food product. Food poisoning and microbial toxins, standards for different foods. Food borne intoxicants and mycotoxins.

UNIT -4 FOOD Preservation

Principles of food preservation: Physical, chemical, and biological methods of preservations. Bioprocessing of meat, Fisheries, vegetables, dairy products. Irradiated foods.

UNIT -5 Food Biotechnology

Biotechnology in relation to food industry, Enzymes in foods and food industry, Nature and type of starters, Role of starters in Fermented foods, Fermentation of Milk products-Fermented soy and peanut milk, Fruit and cereal based beverages, Non beverage plant products. Mycoprotein production.

UNIT -6 FOOD Additives and ANALYSIS

Sampling techniques and theory and practice of chemical and physical methods of food analysis for determination of food composition; Pigments in food, food flavours, food additives and toxicants. Natural sweeteners and artificial sweeteners and their role in controlling diseases and deficiencies, Nutraceuticals, and Functional Foods

UNIT -7 FOOD PROCESSING

Basic principles, unit operations, and equipment involved in the commercially important food processing methods and unit operations; materials and containers used in food packaging.

UNIT -8 FOOD QUALITY ASSURANCE

Objectives, importance and functions of quality control. Methods of quality, assessment of food materials- fruits, vegetables, cereals, dairy products, meat, poultry. Food regulations, grades and standards, Concept of Codex Alimentarius/HACCP/USFDA/ISO 9000 series etc. Food laws and standards.

- 1 Jay J.M. 1986. Modern Food Microbiology. 3rd Edn. VNR, New York.
- 2 Food processing and Preservation PHI private ltd, New Delhi
- 3 Food Microbiology fourth edition William C.Frazier, Tata Mc Graw Hill
- 4 Food Microbiology 2nd Edition, Michael P.Doyle, ASM press
- 5 Fennema, O.R. Ed. 1976. Principles of Food Science: Part-I Food Chemistry. Marcel Dekker, New York.
- 6 Meyer, L.H. 1973. Food Chemistry. East-West Press Pvt. Ltd., New Delhi.
- 7 Charalambous, G. and Inglett, G. 1981. The Quality of Foods and Beverages. (2 vol. set). Academic Press, New York.
- 8 Krammer, A. and Twigg, B.A. 1970. Quality Control for the Food Industry. 3rd Edn. AVI, Westport.
- 9 Ranganna, S. 1986. Handbook of Analysis and Quality Control for Fruits and Vegetable Products. Tata McGraw Hill, New Delhi.

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**MOLECULAR MODELING AND DRUG DESIGN
(Elective III)**

UNIT I: INTRODUCTION TO MOLECULAR MODELLING

Introduction to Molecular Modelling. What are models used for? Areas of application – Single molecule calculation, assemblies of molecules. Reaction of the molecules. Drawbacks of mechanical models as compared to graphical models. Co-ordinate systems two – matrix, potential energy surface.

UNIT II – QUANTUM MECHANICS

Postulates of quantum mechanics, electronic structure calculations, ab initio, semi-empirical and density functional theory calculations, molecular size versus accuracy. Approximate molecular orbital theories.

UNIT III: EMPIRICAL FORCE FIELD MODELS

Molecular Mechanisms, energy calculations, Bond stretch, angle bending, torsional term. Electrostatic interaction- Van der waals interactions. Miscellaneous interaction.

UNIT IV – MOLECULAR DYNAMICS

Introduction, Molecular Dynamics using simple models. Dynamics with continuous potentials. Constant temperature and constant dynamics. Conformation searching, Systematic search. Applications to protein folding

UNIT V – COMPARATIVE PROTEIN MODELING

Modelling by Homology-the alignment, construction of frame work ,selecting variable regions, side chain placement and refinement, validation of protein models –Ramchandran plot, threading and ab initio modeling.

UNIT VI: ANALOG BASED DRUG DESIGN

Introduction to QSAR. lead module, linear and nonlinear modeled equations, biological activities, physicochemical parameter and molecular descriptors, molecular modelling in drug discovery.

UNIT VII: STRUCTURE BASED DRUG DESIGN

3D pharmacophores ,molecular docking, De novo Ligand design, Free energies and solvation, electrostatic and non-electrostatic contribution to free energies.

UNIT VIII: FURTHER APPLICATIONS ON THE DESIGN OF NEW MOLECULES

3D data base searching and virtual screening, Sources of data, molecular similarity and similarity searching, combinatorial libraries – generation and utility,

TEXTBOOKS

1. Principles and applications of modelling by Leach
2. Molecular Modelling by Hans Pieter,Heltje & Gerd Folkens, VCH.

REFERENCES:

1. Chemical Applications of Molecular Modelling by Jonathan Goodman.
2. Computational Chemistry by Guy H, Grant & W. Graham Richards, Oxford University Press. April 1985

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**BIOPROCESS ECONOMICS & PLANT DESIGN
(Elective - III)**

UNIT I: PROCESS DESIGN DEVELOPMENT

Technical feasibility survey, process development, flow diagrams, equipment design and specifications.

UNIT II: GENERAL DESIGN CONSIDERATION

Marketability of the product, availability of technology, raw materials, equipments, human resources, land and utilities, site characteristics, waste disposal, govt. regulations and other legal restrictions, community factors and other factors affecting investment and production costs.

UNIT III: COST ESTIMATION I

Capital investments- fixed capital investments including land, building, equipments and utilities, installation costs (including equipments, instrumentation, piping, electrical installation and other utilities), working capital investments.

UNIT IV: COST ESTIMATION II

Manufacturing costs- Direct Production costs (including raw materials, human resources, maintenance and repair, operating supplies, power and other utilities, royalties. etc.), fixed charges (including depreciation, taxes, insurance, rental costs etc.),

UNIT V: PLANT OVERHEADS

Administration, safety and other auxiliary services, payroll overheads, warehouse and storage facilities etc.

UNIT VI: PROFITABILITY ANALYSIS

Profitability Analysis- return on original investment, interest rate of return, accounting for uncertainty and variations and future developments.

UNIT VII: OPTIMIZATION

Optimization techniques - Linear and Dynamic programming, Optimization strategies.

UNIT VIII: PATENTS, IPR AND IPP

Patent concept and its composition and protection of right and their limitation and IPR (Intellectual property rights). Intellectual property protection.

TEXT BOOKS:

1. Peters and Timmerkus, Plant design and Economics for Chemical Engineers, McGraw Hill 4th Edition, 1989.
2. Rudd and Watson, Strategy of Process Engineering, Wiley. 1987

REFERENCE:

1. Gearing Up For Patents, The Indian Scenario, Universities Press By Ganguli.

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**BIOPHARMACEUTICAL TECHNOLOGY
Elective-IV**

UNIT I: INTRODUCTION TO PHARMACEUTICALS

History & Definition of Drugs. Sources of Drugs - Plant, Animals, Microbes and Minerals. Different dosage forms. Routes of drug administration.

UNIT II: PHARMACODYNAMICS

Physico-Chemical Principles, Pharmacodynamics- Mechanism of drug action, drug receptors, and Physiological receptors: structural and functional families.

UNIT III: PHARMACOKINETICS

Pharmacokinetics- Drug absorption, factors that affect the absorption of drugs, Distribution of drugs, Biotransformation of drugs, Bioavailability of drugs.

UNIT IV: DRUG MANUFACTURING PROCESSES I

Good manufacturing practices, manufacturing facilities, sources of Biopharmaceuticals,

UNIT V: DRUG MANUFACTURING PROCESSES II

Production & analysis of Biopharmaceuticals.

UNIT VI: PRODUCTION OF BIOPHARMACEUTICALS

Production of Therapeutic Proteins, Hormones, Cytokines - Interferons, Interleukins I & II, Tumor Necrosis Factor (TNF); Nucleic acids.

UNIT VII: APPLICATIONS OF BIOPHARMACEUTICALS

Role of Biopharmaceuticals in treatment of various health disorders

UNIT VIII: DRUG DELIVERY SYSTEMS, BIOMATERIALS AND THEIR APPLICATIONS

Controlled and sustained delivery of drugs. Biomaterial for the sustained drug delivery. Liposome mediated drug delivery. Drug delivery methods for therapeutic proteins.

Reference:

1. Biopharmaceuticals: Biochemistry & Biotechnology, Gary Walsh (1998), John Wiley & Sons Ltd.
2. Remington's Pharmaceutical sciences, (Mark Publications & Company eston PA) year 1980.
3. Theory & Practice of Industrial Pharmacy, (3rd ed.) Leon Lachman, Lea & Febiger (1986)

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**PHYTOCHEMICALS AND HERBAL MEDICINE
(ELECTIVE – IV)**

UNIT I: CRUDE DRUGS

Crude Drugs – Scope & Importance, Classification (Taxonomical, Morphological Chemical, Pharmacological); Cultivation, Collection & processing of Crude Drugs.

UNIT II: MEDICINAL & AROMATIC PLANTS

Cultivation and Utilization of Medicinal & Aromatic Plants in India. Genetics as applied to Medicinal herbs.

UNIT III: TISSUE CULTURE OF MEDICINAL PLANTS

Plant Tissue Culture as source of medicines, Plant Tissue Culture for enhancing secondary metabolite production (*Withania somnifera*, *Rauwolfia serpentina*, *Catheranthus roseus*, *Andrographis paniculata*, *Dioscorea* sp.); Anticancer drugs, Biogenesis of Phytopharmaceuticals.

UNIT IV: ANALYSIS OF PHYTOCHEMICALS

Methods of Drug evaluation (Morphological, Microscopic, Physical & Chemical). Preliminary screening, Assay of Drugs – Biological evaluation / assays, Microbiological methods

Unit V: Chemical Methods of Analysis and Detection of Adulterants: Chemical estimations, Spectrophotometry & Fluorescence analysis. Drug adulteration – Types of adulterants.

UNIT VI: TYPES OF PHYTOCHEMICALS_I

Carbohydrates & derived products; Glycosides - extraction methods (*Digitalis*, *Aloe*, *Dioscorea*.); Tannins (Hydrolysable & Condensed types); Volatile Oils - extraction methods (*Clove*, *Mentha*);

UNIT VII : TYPES OF PHYTOCHEMICALS_II

Alkaloids - extraction methods (*Taxus*, *Papaver*, *Cinchona*); Flavonoids- extraction methods, Resins- extraction methods.

UNIT VIII: APPLICATIONS OF PHYTOCHEMICALS

Application of phytochemicals in industry and healthcare; Biocides, Biofungicides, Biopesticides.

Text Books:

1. Pharmacognosy, C. K. Kokate, A. P. Purohit & S. B. Gokhale (1996), Nirali Prakashan, 4th Ed.
2. Natural Products in medicine: A Biosynthetic approach (1997), Wiley.

References

1. Hornok, L. (ed.) (1992). Cultivation & Processing of Medicinal Plants, Chichister, U. K: J. Wiley & Sons.
2. Trease & Evans, Pharmacognosy – William Charles Evans, 14th ed. (1989), Harcourt Brace & Company.

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**BIOPROCESS OPTIMIZATION
(Elective IV)**

UNIT I: BASIC CONCEPT

Overview of experimental design in biological processes, understanding of variables in biological processes.

UNIT II: OPTIMIZATION APPROACHES

Non-statistical, statistical and numerical optimization-fundamental theory.

UNIT III: STATISTICAL OPTIMIZATION

First order and second order designs, differences in approaches, general response surface analysis.

UNIT IV: FIRST ORDER DESIGNS

Statistical experimental procedures for plickett-burman taguchi's designs.

UNIT V: DETERMINATION OF OPTIMAL CONDITIONS

Method of Ridge analysis, Nelder-Mead simplex method, optimization of multi response biological systems.

UNIT VI: MIXTURE DESIGNS AND ANALYSIS

Simple, latis arrangement and their associated models.

UNIT VII: VARIANCE AND DESIGN

Variance minimizing design, mixed variable and multi response generalized distance function approaches for multiresponse optimization.

UNIT VIII: NON-STATISTICAL OPTIMIZATION AND EXAMPLES

Self-directing optimization, case studies with single response and multi response analysis.

BOOKS

1. B. Volesky and J. Votruba, Modelling optimization of fermentation processes, Elsevier, Amsterdam, 1992.
2. A. I. Khuri and J. A. Cornell, Response surface – design and optimization, New York, 1987.

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