

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD
B.TECH. BIO-TECHNOLOGY
I Year
COURSE STRUCTURE**

CODE	SUBJECT	T P C
CS05143	Computer Programming for Biotechnologists	3+1* - 6
HS05231	English	2+1* - 4
EE05066	Basic Electrical and Electronics Engineering	3+1* - 6
BT05273	Fundamentals of Biology	4+2* - 8
MA05367	Mathematics for Biotechnologists	3+1* - 6
BT05483	Process Engineering Principles	3+1* - 6
ME05230	Engineering Workshop Practice	- 3 4
CS05144	Computer Programming Lab	- 3 4
EE05067	Basic Electrical and Electronics Engineering Lab	- 3 4
HS05232	English Language Communication Skills Lab	- 3 4
ME05220	Engineering Drawing Practice Lab	- 3 4
Total		25 15 56

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
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B.TECH. BIO-TECHNOLOGY
II B.Tech
COURSE STRUCTURE**

II Year		I Semester
CODE	SUBJECT	T P C
BT05080	Biochemistry	4+1* - 4
BT05079	Biochemical Thermodynamics	4+1* - 4
BT05113	Cell Biology	4+1* - 4
BT05276	Genetics	4+1* - 4
BT05402	Microbiology	4+1* - 4
BT05559	Transport Phenomena in Bio Process	4+1* - 4
BT05081	Biochemistry Lab	- 3 2
BT05114	Cell Biology And Microbiology Lab	- 3 2
TOTAL		30 6 28

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II B.Tech
COURSE STRUCTURE**

II Year		II Semester
CODE	SUBJECT	T P C
BT05096	Bioprocess Engineering	4+1* 4
CE05239	Environmental Studies	4+1* 4
BT05319	Instrumental Methods of Analysis	4+1* 4
HS05353	Managerial Economics and Financial Analysis	4+1* 4
BT05413	Molecular Biology	4+1* 4
MA05476	Probability and Statistics	4+1* 4
BT05097	Bioprocess Engineering Lab	-1 3 2
BT05320	Instrumental Methods of Analysis Lab	3 2
TOTAL		30 6 28

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B.TECH. BIO-TECHNOLOGY
III B.Tech
COURSE STRUCTURE

III Year		I Semester
CODE	SUBJECT	T P C
BT05078	Biochemical Reaction Engineering	4+1* 4
BT05071	Basic Industrial Biotechnology	4+1* 4
BT05234	Environmental Biotechnology	4+1* 4
BT05275	Genetic Engineering	4+1* 4
BT05354	Mass Transfer and Separation	4+1* 4
BT05454	Plant Biotechnology	4+1* 4
BT05414	Molecular Biology And Genetic Engineering Lab	3 2
BT05455	Plant Tissue Culture Lab	3 2
TOTAL		30 6 28

III Year		II Semester
CODE	SUBJECT	T P C
BT05084	Bioinformatics	4+1* 4
BT05240	Enzyme Engineering	4+1* 4
BT05286	Heat Transfer in Bioprocesses	4+1* 4
BT05325	Instrumentation and Process Control	4+1* 4
BT05304	Immunology	4+1* 4
BT05502	Regulatory Affairs and Clinical Trials	4+1* 4
BT05098	Bioprocess Engineering Lab-II	3 2
BT05305	Immunology Lab	3 2
TOTAL		30 6 28

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B.TECH. BIO-TECHNOLOGY
IV B.Tech
COURSE STRUCTURE

IV Year		I Semester
CODE	SUBJECT	T P C
BT05134	Computational Molecular Biology	4+1* - 4
BT05076	Bio Ethics, Bio Safety And Intellectual Property Rights	4+1* - 4
BT05099	Biosensors and Bioelectronics	4+1* - 4
BT05181	Downstream Processing	4+1* - 4
ELECTIVE –I		4+1* - 4
BT05100	Biotechnology for Crop Improvement	
BT05112	Cancer Biology	
BT05533	Structural Biology	
ELECTIVE –II		4+1* - 4
BT05155	Creativity Innovation and Product Development	
BT05416	Molecular Pathogenesis	
BT05383	Metabolic Engineering	
BT05085	Bioinformatics Lab 3 2	
BT05182	Downstream Processing Lab 3 2	
TOTAL		30 6 28

CODE	SUBJECT	T P C
BT05041	Animal Cell Science and Technology	4+1* - 4
ELECTIVE –III		4+1* - 4
BT05262	Food Science and Technology	
BT05262	Food Science and Technology	
BT05077	Bio Process Economics And Plant Design	
ELECTIVE –IV		4+1* - 4
BT05095	Biopharmaceutical Technology	
BT05453	Phytochemicals and Herbal Medicine	
BT05426	Neuro Biology & Cognitive Sciences	
CA05315	Industry Oriented Mini Project	2
CA05495	Project Work	12
CA05515	Seminar	2
TOTAL		15 - 28

(CS05143) COMPUTER PROGRAMMING FOR BIOTECHNOLOGISTS

UNIT – I: Hardware

Parts of a computer: Processor, memory, I/O devices, storage devices, Types of computer systems: Super computer, Mainframe computer, Minicomputer, workstations, Microcomputers, Personal computers, desktop handheld computers. Input Devices: keyboard, mouse, hand devices, optical devices, audiovisual devices Output devices: monitor, projectors, sound devices, printers, storage devices, files.

UNIT-II: Software

Principles of software Engineering operating systems and their applications. DOS, WINDOWS, UNIX, LINUX.

UNIT - III

Algorithm, flowchart, program development steps, basic structures of C language, data types, declaration of variables, assigning values, arithmetic, relational and logical operators, increment and decrement operators, WHILE, DO-WHILE and FOR statements.

UNIT – IV

One dimensional & two dimensional arrays, initialization, string variables, declaration reading and writing.

UNIT-V

Functions, Basics of functions variables & storage classes, example C programs.

UNIT – VI

Structure definition, initializing, assigning values, passing of structures as arguments, unions. Databases: 1) RDBMS and DBMS 2) CODD's Rules 3) Normalisation.

UNIT – VII

Infix, programs, recursion in C, Queue & it's sequential representation, Circular queue, Sequence.

UNIT-VIII: Biopackages

1) Biopearl 2) BioJava 3) Systems Biology Markup Lanaguage.(SBML)

REFERENCE:

1. E. Balaguru Swamy, *C & Data Structures*, TMH, 2002.
2. A.M. Tanenbaum, *Data Structures using C*, PHI.
3. Horowitz and Sahani, *Fundamentals of Data Structures*, Wiley.
4. Mastering Perl for Bioinformatics by James D. Tisdall , O' Reilly publications. Objective of this course is to enable the student to apply the knowledge gained here for Bioinformatics Applications

(HS 05231) 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, to encourage them to develop their language skills. The two textbooks identified by the Board of Studies serve the purpose of illustrating the conceptual framework within which the syllabus is to be administered in the classroom. When a textbook is prescribed content is generally paid attention to. However, the stress in this syllabus is on language acquisition and skill development, calling for both the teacher and the taught to go beyond the prescribed texts and innovate exercises and tasks.

2. OBJECTIVES :

1. To promote the language proficiency of the students with emphasis on improving their LSRW skills.
2. To impart training to the students through the syllabus and its theoretical and practical components.
3. To improve communication skills in formal and informal situations.

3. SYLLABUS :

Listening Skills :

- Listening for general content
- Listening to fill up information gaps
- Intensive listening
- Listening for specific information
- Note-taking - guided and unguided
- Post-listening testing

Speaking Skills :

- Oral practice
- Developing confidence
- Introducing oneself/others
- Asking for/ giving information
- Describing objects/offering solutions
- Describing situations
- Role play
- Expressing agreement/disagreement

Reading Comprehension

- 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 student, through the training imparted to him/her by means of the text-based approach, will be examined in answering questions on an unseen passage.

Writing Skills :

- Writing a sentence
- Use of appropriate vocabulary
- Paragraph writing
- Coherence and cohesiveness
- Narration / description
- Interpreting data

- Formal and informal letter writing
- Sending e-mails
- Information transfer
- 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:

1. LEARNING ENGLISH: A Communicative Approach, Hyderabad: Orient Longman, 2005.(Selected Lessons)

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

The following lessons from the prescribed texts are recommended for study:

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

Reading and Writing Skills

Reading Comprehension

Situational dialogues

Report writing

Letter writing

Essay writing

Information transfer

Unit – VIII

Remedial English

Common errors

Subject-Verb agreement

Use of Articles and Prepositions

Tense and aspect

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

TEXT BOOKS

1. Effective Technical Communication, M Ashraf Rizvi, Tata McGraw-Hill Publishing Company Ltd.

2. Everyday Dialogues in English, Robert J Dixon, Prentice Hall of India Pvt Ltd., New Delhi.

REFERENCES

1. Strengthen Your English, Bhaskaran & Horsburgh, Oxford University Press

2. English for Technical Communication, K R Lakshminarayana, SCITECH

3. Strategies for Engineering Communication, Susan Stevenson & Steve Whitmore (John Wiley and sons).

4. English for Engineers: With CD, Sirish Chaudhary, Vikas Publishing House Pvt. Ltd. With CD.

5. Basic Communication Skills for Technology, Andrea J Rutherford, Pearson Education Asia.

6. Murphy's English Grammar with CD, Murphy, Cambridge University Press

7. A Practical Course in English Pronunciation, (with two Audio cassettes), Sethi, Sadanand & Jindal , Prentice –Hall of India Pvt Ltd., New Delhi.

8. English for Professional Students, by S S Prabhakara Rao.

9. The Oxford Guide to Writing and Speaking, John Seely, Oxford.

10. Grammar Games, Renvolucris Mario, Cambridge University Press.

**(EE05066) BASIC ELECTRICAL & ELECTRONICS ENGINEERING
(BIO-TECHNOLOGY)**

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.

(BT05273) 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: Introduction to Biotechnology

Biotechnology – definition, history, scope and importance, Drugs and Chemicals from Plants & Animals. Definition and importance (in general) of Biofuels, Biofertilizers, Biopesticides, Bioindicators & Biosensors.

Unit VIII: Applications of Biotechnology

Microbial enzymes; Single Cell Protein (SCP); Monoclonal Antibodies. Introduction to Transgenic Plants & Animals; Advantages and limitations of Genetically modified crops and foods.

TEXT BOOKS:

1. Microbiology Pelczar M.J. Chan ECS and Krieg N.R, Tata McGraw Hill.
2. Basic Biotechnology, Second Edition, by Colin Ratledge and Bjorm Kristiansen, Cambridge University Press.

REFERENCES

- 1) Plant Physiology F.B Salisbury & C.W. Ross 4th edition Thomson Wadsworth
- 2) General Microbiology by Hons. G. Schlege, Cambridge University Press.
- 3) A Textbook of Biotechnology by R.C. Dubey, S.Chand Publishers.
- 4) Dr. C.C. Chatterjee, *Human Physiology (11th Edition) Vol I and II*, Medical Allied Agency, Kolkata, 1987.
- 5) Anatomy and Physiology In Health and Disease, K. J.W. Wilison and A. Waugh, Churchill & Livingston.

(MA05367) MATHEMATICS FOR BIOTECHNOLOGISTS

UNIT I: Differential Calculus

Introduction to Sets, Relations, Functions. Concepts of limit, continuity, differentiation, product rule, quotient rule. Differentiation of trigonometric, logarithmic, exponential functions. Applications of differentiation – problems on tangent, sub tangent normal, sub normal. Introduction to partial differentiation, Euler's theorem.

Unit II: Integral Calculus

Introduction, Integration of different functions, methods of Integration, Integration by parts. Concept of definite integrals. Applications of definite integrals – problems on areas.

Unit III: Matrices

Types of matrices, determinants, Inverse of a square matrix, Solving of simultaneous equations by Cramer's method Matrix inversion method and Gauss Jordan methods.

Rank of a matrix, Echelon form. Solutions for linear equations. Eigen values and Eigen vectors.

Unit IV: Ordinary Differential equations

Forming of differential equation by eliminating arbitrary constants, first order and first degree – variables and separables, exact, homogeneous, linear and Bernoulli's equations.

UNIT-V : Bernoulli's equations

Non-homogeneous Linear Differential Equations of Second and higher order with constant coefficients with RHS term of the type $-eax \sin ax \cos ax$ Polynomials in x , $eax V(x)$, $xV(x)$ Applications to first order differential equations to growth and decay problems

UNIT VI: Numerical Methods

Iterative Methods: Bisection, Newton Raphson, Successive approximation, Gauss Jordan and Gauss sieedel methods.

UNIT-VII:

Interpolation, Lagrange interpolation, Newton's forward difference, backward difference and central difference interpolation methods. Numerical Integration by Trapezoidal and Simpson's rules, numerical solution to differential equations, Euler, Ranga kutta methods.

Unit – VIII

Laplace Transforms

Laplace transforms of some standard functions, linear property, shifting theorems, change of scale property, multiplication by powers of t , division by t . Inverse Laplace Transforms - Shifting property, finding inverse laplace by partial fractions, multiplication by powers of s , division by s . Applications of laplace transforms for solving ordinary differential equations.

Mathematical Modelling in Biotechnology.

TEXT BOOKS:

1. A Text Book of Engineering Mathematics Volume-II, 2005 T,K.V.Iyengar, B.Krishna Gandhi and others, S. Chand and Company.
2. Engineering Mathematics, B.V.Ramana, Tata McGraw-Hill 2003.

REFERENCES:

1. Engineering Mathematics-II, 2002, P.Nageswara Rao, Y.Narsimhulu, Prabhakara Rao.
2. Engineering Mathematics, S.K.V.S. Sri Rama Chary, M.Bhujanga Rao, Shankar, B.S.Publications 2000.
3. Advanced Engineering Mathematics (eighth edition), Erwin Kreyszig, John Wiley & Sons (ASIA) Pvt. Ltd.2001.
4. Advanced Engineering Peter V.O'Neil Thomson Brooks/Cole.
5. Advanced Engineering Mathematics, Merle C.Potter, J.L.Goldberg, E.F. Arbufadel, oxford University Press. Third Edition 2005.
6. Numerical Methods: V N Vedamurthy, Iyengar N Ch N Vikas Pub. Reprint 2005.
7. Numerical Methods: S.Arumugam & others. Scitech Pub.
8. Elementary Numerical Analysis: An Algorithmic Approach: S.D.Conte and Carl.D.E.Boor, Tata Mac-Graw Hill

(BT05483) 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 g_c and its utility. Various equations of state including ideal gas law to evaluate P-V.T data, their application in process calculations by solving some 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 etc.

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, concept of fluidization, mechanism of fluidization, fluidized beds and pressure drop in fluidized beds. Correlating the concept of packed beds and fluidized beds with immobilized bioreactors.

UNIT-VII

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

REFERENCES:

1. Unit operations of chemical engineering, Mc Cabe, W.L, Smith J.C., and Harriot, P., Mc-Graw Hill, 3rd Ed. (1993).
2. "Technical aspects of the rheological properties of microbial cultures", - Charles, M (1978) in Advances in Biochemical Engineering, Ghose, T.K., Fiechter, A and Blakebrough, N.(Eds), Springer-Verlag, Berlin, pp. 1-62
3. Non-Newtonian Flow and Heat Transfer, Skelland, A.H.P. (1967), John Wiley and Sons, Inc., Newyork, 27-49.
4. Unit operation in Food processing, Earle, R.L. (1996) Pergamon Press, Oxford, PP. 212-282.

**I Year B-TECH B.T.
(ME05230) ENGINEERING WORKSHOP PRACTICE
SYLLABUS**

1. TRADES FOR EXERCISES:

(Any seven trades from the following with minimum of three simple exercises in each trade and also study of Tools used).

1. Carpentry
2. Fitting
3. Tin-Smithy and Development of jobs carried out and soldering.
4. Black Smithy
5. House-wiring
6. Foundry
7. Plumbing.
8. IT Workshop-I
9. IT workshop-II

II TRADES FOR DEMONSTRATION & EXPOSURE:

1. Demonstration of power tools – Pneumatic Tools, Electrical Tools
2. Welding - ARC Welding/Gas Welding/Plasma Welding
3. Machine Shop
4. Metal Cutting - Hacksaw, Power Saw, Gas Cutting, Arc Cutting.

Objective : The objective of this subject is to provide the basic concepts about different manufacturing processes and also study of hardware used in IT industry. The tools used are demonstration and simple exercises are given.

Question Paper pattern :

Lab record tools, procedure of usage etc. any two trades in end examination.

(CS05144) COMPUTER PROGRAMMING LAB

1. Write a C program to evaluate the following algebraic expressions after reading necessary values from the user:

- a) $ax+b/ax-b$
- b) $2.5 \log x + \cos 320 + |x^2 - y^2| + v \cdot 2xy$
- c) $1/\sqrt{2}e^{-(x-m/\sqrt{2})^2}$

2. Write a C program for the following

- a) Printing three given integers in ascending order
- b) Sum of $1 + 2 + 3 + \dots + n$
- c) $1 + x^2/2! + x^2/4! + \dots$ upto ten terms
- d) $x + x^3/3! + x^5/5! + \dots$ upto 7th digit accuracy
- e) Read x and compute $Y = 1$ for $x > 0$
 $Y = 0$ for $x = 0$
 $Y = -1$ for $x < 0$

3. Write C program using FOR statement to find the following from a given set of 20 integers.

- i) Total number of even integers. ii) Total number of odd integers.
- iii) Sum of all even integers. iv) Sum of all odd integers.

4. Write a C program to obtain the product of two matrices A of size (3X3) and B of size (3X2). The resultant matrix C is to be printed out along with A and B. Assume suitable values for A & B.

5. Using switch-case statement, write a C program that takes two operands and one operator from the user, performs the operation and then prints the answer. (consider operators +, -, /, * and %).

6. Write C procedures to add, subtract, multiply and divide two complex numbers $(x+iy)$ and $(a+ib)$. Also write the main program that uses these procedures.

7. The total distance traveled 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 traveled 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'.

8. A cloth show room has announced the following seasonal discounts on purchase of items.

Discount (Percentage)

Amount Mill Cloth Handloom items

1-100 - 5.0

101-200 5.0 7.5

201-300 7.5 10.0

Above 300 10.0 15.0

PURCHASE

Write a C program using Switch and If statements to complete the net amount to be paid by a customer.

9. Given a number, write a C program using while loop to reverse the digits of the number. Example 1234 to be written as 4321.

10. The Fibonacci sequence of numbers is 1, 1, 2, 3, 5, 8... based on the recurrence relation

$$f(n) = f(n-1) + f(n-2) \text{ for } n > 2.$$

Write a C program using do-while to calculate and print the first n fibonacci numbers.

11. Write C programs to print the following outputs using For loop.

1
2 2
3 3 3
4 4 4 4
5 5 5 5 5
1
2 2
3 3 3
4 4 4 4
5 5 5 5 5

12. Write a C program to extract a portion of a character string and print the extracted string. Assume that m characters are extracted starting with the nth character.

13. A Maruthi Car dealer maintains a record of sales of various vehicles in the following form:

**Vehicle type Month of
Sales Price (Rs).**

Maruthi – 800 02/87 75,000

Maruthi – DX 07/87 95,000

Gypsy 04/88 1,10,000

Maruthi Van 08/88 85,000

Write a C program to read this data into a table of strings and output the details of a particular vehicle sold during a specified period. The program should request the user to input the vehicle type and the period (Starting month & ending month).

14. Write a function that will scan a character string passed as an argument and covert all lower case characters into their upper case equivalents.

15. Implement the following data structures using Arrays

i) Stacks ii) Linear Queues iii) Circular queues

16. Implement binary search tree using linked list and perform the following operations.

i) Insertion ii) Deletion iii) Inorder Traversal iv) Preorder Traversal

v) Post Order Traversal.

17. Singly linked list and doubly linked lists

i) Insertion ii) Deletion iii) Lookup

18. i) Implement stack using singly linked list.

ii) Implement queue using singly linked list.

19. Implement the following sorting techniques.

i) Bubble sort ii) Insertion Sort iii) Quick Sort iv) Heap Sort.

20. Implement the following searching method.

i) Sequential Search ii) Binary Search

21. i) Conversion of Infix expression to Postfix notation.

ii) Simple expression evaluator, that can handle +, -, / and *.

22. Implement the algorithms for the following iterative methods using C to find one root of the equation

$$9x^1 + 2x^2 + 4x^3 = 0$$

$$x^1 + 10x^2 + 4x^3 = 6$$

$$2x^1 - 4x^2 + 10x^3 = -15.$$

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

24. Implement in 'C' the linear regression and polynomial regression algorithms.

25. Implement Traezoidal and Simpson methods.

(EE05067) BASIC ELECTRICAL & 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 potentiometer.
- 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.

(HS 05232) ENGLISH LANGUAGE COMMUNICATION SKILLS LAB

The language Lab focuses computer-aided multi-media instruction and language acquisition to achieve the following targets :

- To expose the students to a variety of self-instructional, learner-friendly modes of language learning.
- 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.
- To enable them to learn better pronunciation through stress on word accent, intonation, and rhythm.
- To train them to use language effectively to face interviews, group discussions, public speaking.
- To initiate them into greater use of the computer in resume preparation, report writing, format-making etc.

However, depending upon the available infrastructure and budget, the above targets can also be achieved by procuring the minimum required equipment suggested for the establishment of a Conventional Lab the details of which are given below. The lab should cater to the needs of the students to build up their confidence to help them develop leadership qualities through their communicative competence.

SYLLABUS :

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

1. Introduction to Phonetics.
2. Introduction to Vowels and Consonants and associated Phonetic symbols.
3. Introduction to Accent, Intonation and Rhythm.
4. Situational Dialogues / Role Play.
5. Public Speaking.
6. Debate
7. Group discussions
8. Facing Interviews
9. Resume preparation
10. e-correspondence

Minimum Requirement :

- Computer aided multi media language lab with 30 systems with LAN facility.
- Conventional Language Lab. with audio and video systems, speakers, head phones and a teacher console to accommodate 30 students.

Suggested Software :

- Cambridge Advanced Learners' Dictionary with exercises
- The Rosetta Stone English Library
- Clarity Pronunciation Power
- Mastering English in Vocabulary, Grammar, Spellings, Composition
- Dorling Kindersley series of Grammar, Punctuation, Composition etc.
- Language in Use, Foundation Books Pvt Ltd
- Learning to Speak English - 4 CDs
- Microsoft Encarta
- Murphy's English Grammar, Cambridge
- Time series of IQ Test, Brain-teasers, Aptitude Test etc.
- English in Mind, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.

BOOKS SUGGESTED FOR ENGLISH LAB :

1. Developing Communication Skills by Krishna Mohan & Meera Benerji

(Macmillan)

2. Speaking English Effectively by Krishna Mohan & NP Singh (Macmillan)
3. Better English Pronunciation by JDO Connor (UBS – Cambridge)
4. Oxford Practice Grammar with Answers, John Eastwood, Oxford
5. Handbook of English Grammar and Usage, Mark Lester and Larry Beason, Tata McGraw-Hill
6. A text book of English Phonetics for Indian Students by T.Balasubramanian (Macmillan)
7. Lingua TOEFL CBT Insider, by Dreamtech
8. TOEFL & GRE(KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
9. English Skills for Technical Students, WBSCTE with British Council, OL
10. A Handbook of English for Competitive Examinations, by B Shyamala Rao, Blakie Books, Chennai.

DISTRIBUTION AND WEIGHTAGE OF MARKS :

ENGLISH LANGUAGE LABORATORY PRACTICE

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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(ME05220) ENGINEERING DRAWING PRACTICE LAB

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

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(BT05080) 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: Carbohydrate Metabolism

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

UNIT III: Bioenergetics

Respiratory chain, Aerobic and anaerobic respiration; Fermentation.

UNIT IV: Proteins & Amino Acids Metabolism -I

Nitrogen Balance, Amino acids as building blocks of proteins; Protein structure, folding & function, N₂ Cycle, reductive amination & transamination & Urea cycle.

UNIT V: Proteins & Amino Acids Metabolism -II

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

Unit VI: 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 VII: Intermediary Metabolism

Interconnection of pathways & metabolic regulation

UNIT VIII: 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.

TEXT BOOKS:

1. Lehninger A.L, Nelson O.'L, M.M. Cox, Principles of Biochemistry, 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. Stryer L, Biochemistry, Fourth edition, 1994.
3. Biochemistry by K. Mathews, K.E. Van Holde, Kevin G Ahern, Pearson education.
4. Protein's Structure and function. Daviel Whitford John Wiley Publications.
5. Biochemistry by cristopher K.Mathews, K.E.Van Holde, Pearsons education.

(BT05079) BIO CHEMICAL THERMODYNAMICS

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

UNIT II: THERMODYNAMIC PROPERTIES OF FLUIDS-I

Volumetric properties of gases exhibiting non-ideal behaviour; Residual properties

UNIT III: THERMODYNAMIC PROPERTIES OF FLUIDS-II

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

UNIT IV: SOLUTION THERMODYNAMICS

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

UNIT V: PHASE EQUILIBRIA

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

UNIT VI: 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

UNIT VII: BIOCHEMICAL THERMODYNAMICS-I

Energetics of Metabolic Pathways; Energy Coupling (ATP & NADH); Stoichiometry and energetic analysis of Cell Growth and Product Formation- elemental Balances, Degree of reduction concepts; available -electron balances; yield coefficients;

UNIT VIII: BIOCHEMICAL THERMODYNAMICS-II

Oxygen consumption and heat evolution in aerobic cultures; thermodynamic efficiency of growth

TEXT BOOKS :

1. J M.Smith,H.C.Van Ness and M.M.Abbott. Introduction to Chemical Engineering Thermodynamics McGraw Hill
2. J.A. Roels, Kinetics and Energetics in Biotechnology, Elsevier, 1983

(BT05113) CELL BIOLOGY

Unit I: Cell structure and function

Discovery of cells; Basic properties of cells; Cell theory; Cell complexity; Different classes of cells; Prokaryotic & Eukaryotic system, 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.

Unit III: Intracellular Compartments

Structure and functions of Nucleus, Endoplasmic Reticulum, Golgi Complex, Lysosomes, Peroxisomes, Chloroplast & Mitochondria. Protein Glycosylation, Sorting and Transport.

Unit IV: Transport across Cell Membranes

Passive and Active Transport, Permeases, Na⁺/K⁺ Pump, ATPase pumps, Lysosomal & Vacuolar membrane ATP dependent Proton Pumps, Co-Transport Symport, Antiport, Transport into Prokaryotic Cells, Endocytosis and Exocytosis.

Unit V: Cell division

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

Unit VI: Cell differentiation

General Characteristics of Cell Differentiation, Historical events in Cell differentiation, Cytoplasmic determinants, Nucleoplasmic Interactions; Stem Cell differentiation and its Biological Importance.

Unit VII: Receptors

Cytosolic, Nuclear & Membrane bound receptors, Examples and types of receptors; Chemo receptors of Bacteria (Attractants & Repellents)

Unit VIII: Signal Transduction

Concept of Secondary messengers, cAMP, cGMP, Protein Kinases, G Proteins, Steroid / Peptide hormone regulation & Tissue specific regulation.

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

(BT05276) 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. Principles of Genetics, Gardner EJ, Snustad DP, 2002
2. Genetics by Strickberger.

REFERENCES:

1. Genetics, Goodenough U, Hold International 1985
2. Genetics by Griffith.
3. Genetics by Brookes.
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-Wiliam S.Klug, Michael R. Cummings.

(BT05402) 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, Cultivation and Growth kinetics

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.
3. Growth of microorganisms, Growth curve, mathematics of growth, measure

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, flageller straining.
4. Biochemical tests-Sugar fermentations, IMVIC tests, Catalase production etc.

Unit VIII: Control of Microorganisms

1. Control of microorganisms, Inhibition of growth and killing, sterilization and disinfection, physical (moist and dry heat, radiation and filtration), chemical agents (disinfectants,). Characteristics & mode of action of antimicrobial agent. Classes of disinfectants - phenol and phenolics, alcohol, halogens (Cl₂, Chloramines, Br₂, I₂, tinctures of iodine, iodophores), surfactants (soaps and detergents) alkylating agents (formaldehyde, glutaraldehyde, [3-propiolac.tone and ethylene oxide) Heavy metals. (Hg, Silver and copper containing compounds).

Factors affecting sterilization and disinfection. Evaluation of disinfectants.

2. Antimicrobial drugs - History of Chemotherapy, and antibiotics, mode of action of Antimicrobial drugs (acting on Cell wall, Protein synthesis & Nucleic acids), commonly used Antimicrobial drugs, tests to guide chemotherapy, the effectiveness of chemotherapeutic agents.

TEXT BOOKS :

1. Microbiology, Pelczar M.J. Chan ECS 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 Micro organisms. BROCK, Prentice Hall, International Inc.

2. General Microbiology. Hons. G.Schlege. Combridge 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

(BT05559)TRANSPORT PHENOMENA IN BIOPROCESS

UNIT-I : Momentum transfer:

Momentum transfer in bioprocess, comparison with other transport processes, effect of flow properties in momentum transfer and oxygen mass transfer.

UNIT-II: Oxygen transport-I

Oxygen transport to microbial cultures- Gas liquid mass transfer fundamentals, oxygen requirement

of microbial cultures. Oxygen requirements of microbial cultures oxygen mass transfer fundamentals. oxygen transfer and oxygen demand.

UNIT-III : Oxygen transport-II

Oxygen transfer by aeration and agitation. Determination of oxygen mass transfer coefficient

by various methods including dynamic gassing out and oxygen balance methods

UNIT-IV : Momentum transport by agitation:

Power requirements and mixing characteristics of ungasged and gasged systems. Concept of power number, use of monographs. Defining impeller Reynolds number for Newtonian and non-Newtonian fluids. Concept of aeration rate to calculate impeller power requirement of gasged systems.

UNIT-V: Mixing

Mixing and bioreaction interactions – Flow regimes with and without baffles, various types of

impellers and mixing equipment.

UNIT-VI : Scale-up

Scale-up criteria for mixing equipment. Application of mixing in bioprocessing.

UNIT-VII : Heat Transfer-I

Various modes of heat transfer, viz., conduction convection and radiation. Mechanism of heat transfer by conduction, Fourier's law. Conductive heat transfer through a series of resistances.

UNIT-VIII : Heat Transfer-II

Analogy between heat, mass and momentum transfer. Application of heat transfer in bioprocessing.

TEXT BOOKS :

1. Introduction to Biochemical Engineering, D.G.Rao, Tata Mc Hill (2005)
2. Bioprocess Engineering Principles Paul M. Doran, Academic press (1995).

REFERENCES

1. "Biochemical Engineering fundamentals "2nd edition by J E Bailey and D F Ollis, Mc Graw-Hill (1986).
2. "Biochemical Engineering" by S Aiba, A E Humphrey and N Millis, Prentice- Hall (1978).
3. Bio process Engineering : Basic concepts" 2nd ed., Michaeln L shuler and F Kargi, Prentice Hall of India (2003).

ment of microbial growth (cell numbers, cell mass), growth yields and the effect of limiting factors continuous growth, chemostat, turbidostat, balanced and unbalanced growth.

(BT05081) BIOCHEMISTRY LABORATORY

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.
11. Preparation of α -D Glucopyranose penta acetate from Glucose.

TEXT BOOK:

1. Laboratory manual in biochemistry by J.Jayaraman New age International Publications.

**(BT05114) CELL BIOLOGY AND MICROBIOLOGY
LABORATORY**

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

TEXT BOOKS:

1. Microbiological and applications, Laboratory, manual in general microbiology by Benson, Mc Graw Publications.
2. Laboratory manual in microbiology by P. Gunasekharan Newage international Publishers.

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(BT05096) BIOPROCESS ENGINEERING

Unit I: Introduction to Bioprocesses

Historical development of bioprocess technology, 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: Sterilization

Thermal death kinetics of microorganisms, batch and continuous heat. Sterilization of liquid media, filter sterilization of liquid media, Air. Design of sterilization equipment.

Unit VI: 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 VII: Energetics

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

Unit VIII: 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.

TEXT BOOKS

1. Biochemical Engineering Fundamentals Bailey and Ollis, McGraw Hill (2nd Ed.), 1986.
2. Bioprocess Engineering, Shule and Kargi, Prentice Hall, 1992.

REFERENCE:

1. Stanbury, P. F., Whitaker, A., & Hall, S. J., (1998), Principles of fermentation Technology, 2nd ed., Elsevier Science Publishers, BV, Amsterdam.

(CE 05239) 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.

(BT05319) 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 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,

Unit V: Spectroscopy-II

Spectrofluorimetry, Atomic absorption & Atomic emission spectroscopy, Circular Dichroism (CD)- principles, instrumentation and applications.

Unit VI: Spectroscopy-III

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

Unit VII: 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

Unit VIII: Spectroscopy

ESR principles - instrumentation-applications

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

**(HS05353)MANAGERIAL ECONOMICS AND
FINANCIAL ANALYSIS**

UNIT I

INTRODUCTION TO MANAGERIAL ECONOMICS

Definition, Nature and Scope 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, 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)-termination of Break-Even Point (simple problems)-Managerial Significance and limitations of BEA.

UNIT IV

INTRODUCTION TO MARKETS & PRICING STRATEGIES

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

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. Managerial Economics and Financial Analysis – Aryasri, TMH,2/E, 2005.
2. Managerial Economics - Varshney & Maheswari, Sultan Chand, 2003.

REFERENCES

1. Financial Accounting for Management - Ambrish Gupta, Pearson Education, New Delhi, 2004.
2. Financial Accounting - Schaum's Outlines, Shim & Siegel, TMH, 2/E, 2004
3. Production and Operations Management – Chary, TMH, 3/e, 2004.
4. Managerial Economics In a Global Economy - Domnick Salvatore, Thomson, 4th Edition 2003.
5. Financial Accounting—A Managerial Perspective – Narayanaswamy, PHI, 2005
6. Managerial Economics - Peterson & Lewis, Pearson Education, 4th Edition, 2004
7. Managerial Economics & Financial Analysis - Raghunatha Reddy & Narasimhachary, Scitech, 2005.
8. Financial Accounting - S.N. Maheswari & S.K. Maheswari, Vikas, 2005.
9. Managerial Economics: Analysis, Problems and Cases - Truet and Truet, Wiley, 2004.
10. Managerial Economics – Dwivedi, Vikas, 6th Ed., 2002
11. Managerial Economics - Yogesh Maheswari, PHI, 2nd Ed., 2nd Ed. 2005.

(BT05413) 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, 174),

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 translation modifications. Inhibitors of protein synthesis .

Unit VII : Mutagenesis

Mutations, spontaneous, induced, lethal, mutagens their types and actions, classifications of mutations, characters of mutations and applications.

Site - directed mutagenesis and reverse genetics. DNA damage and repair mechanisms. Mutagenicity testing using microbial systems, Ames TEST.

Unit – VIII Genetic Recombination In Bacteria

Transfer of Characters, Genetic Recombination, Gene Transfer mechanisms , Plasmids,

Phase Crosses, Insertion of phase chromosomes

TEXT BOOKS

1. Molecular Biology, David Friefeldur, Norasa Publishing Home
2. Benjamin Lewin - Gene – VIII, 2002

References:

1. Lodish, H., Berk A., Zipursky, S.L. Matsudaria, P. Baltimore, D. and Darnell, J.2003. Molecular Cell f Biology, Media connected, W.H. Freeman and Company.
2. Bio Chemistry and Molecular biology by William H. Ellioff. 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.

(MA05476) 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.

UNIT-III

Distribution - Binomial, Poisson and 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 and proportions – 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, test. Estimation of proportions.

UNIT –VIII

Curve fitting: The method of least squares – Inferences based on the least squares estimations - Curvilinear regression – multiple regressions – correlation for univariate and bivariate distributions.

TEXT BOOKS:

1. Engineering Mathematics-B.V. Ramana, Tata Mc Grill 2002 2nd Edition.
2. Mont Gomany-Design of Experiments- Wiley Publications.

REFERENCES:

1. Fundamentals of mathematical statistics-S.C.Gupta V.K.Kapur Chand Publications.
2. Probability and Statistics for Engineers. Miller and Trend Kreyszig. Prentice HALL of India 5th edition.
3. Schaum Outline’s Series Theory and problems of probability and statistics- Murray R. Spiegel.
4. Fundamental concepts of design of experiments- Hricks Oxford Publications.

(BT05320) INSTRUMENTAL METHODS OF ANALYSIS LAB

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

(BT05097)BIOPROCESS ENGINEERING LAB- I

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:

Culturing of different types of microorganisms (bacteria, yeast, fungi) used in the production of commercially important products; Formulation of simple and complex culture media; Estimation of biomass (dry weight); substrate and product analysis; Study of Growth substrate utilization and product formation kinetics in shake - flask cultures.

(BT05078) BIOCHEMICAL REACTION ENGINEERING

UNIT I:

Ideal reactors:

Concept of ideal reactors based on flow characteristics, design of ideal reactors using material and energy balance equations. Single reactors, with ideal flow condition, comparison of volumes of plug flow reactor and chemostat. Multiple reactors-methods to show how total volume is affected in multiple reactors.

Unit II:

Kinetics of homogeneous reactions - I

Searching for mechanism – Arrhenius equation – Batch reactor analysis for kinetics. (synchronous growth and its application in product production).

UNIT III: Kinetics of Homogeneous reactions- II

Growth Kinetics: Batch growth quantifying cell concentration, growth profiles and kinetics in batch culture, fed batch growth, continuous growth and their growth kinetic quantification, chemostat growth, semi-continuous / exponential feeding strategy.

UNIT IV: MULTIPLE REACTIONS

Parallel, series and series – parallel reactions-effect of thermodynamic parameters on the yield/selectivity of the desired product. Maximizing the yield of intermediate product in series reactions

UNIT V :

Design principles – Non isothermal reactions and pressure effects

UNIT VI:

Non-ideal flow in bioreactors-reasons for non-ideality, concept of RTD studies, characterization of non-ideality using RTD studies, various distribution functions, conversions using tracer studies. Diagnosing the ills of non ideal bioreactors, various models of non ideal flow.

UNIT VII:

Design and analysis of bioreactors-stability and analysis of bioreactors, biomass production and effect of dilution rate.

UNIT- VIII:

Design and operation of various bioreactors, viz CSTF, fed batch systems, air-lift bioreactors, fluidized bed bioreactors. Scale up of bioreactors. Criteria for selection of bioreactors.

TEXT BOOKS:

1. Introduction to Biochemical Engineering, D.G.Rao, Tata Mc Hill (2005)
2. Biochemical Engineering Fundamentals, 2nd edition, Bailey, J. E. and Ollis, D.F., Mc Gra- Hill.(1986)

REFERENCES:

1. H. Scott Fogler, Elements of Chemical Reaction Engineering, II Edition, Prentice Hall of India Pvt. Ltd.
2. O.Levenspiel, Chemical Reaction Engineering, Wiley Eastern, III ed, New Delhi.
3. Charles D. Holland, Fundamentals of Chemical Reaction Engineering, John Wiley and Sons, 1990.
4. J.M. Smith, Chemical Engineering Kinetics, Mc Graw Hill, 1981.

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(BT05071) BASIC INDUSTRIAL BIOTECHNOLOGY

UNIT I: Introduction To Industrial Bioprocesses

A historical overview of Industrial fermentation processes and products. Role of a bioprocess engineer in the Biotechnology Industry; Outline of the various unit operations involved in an integrated bioprocess; Process Flow-Sheeting; a brief survey of organisms, processes, products and market economics relating to modern industrial biotechnology.

UNIT II: Raw Materials for Fermentation Processes

Medium requirements for fermentation process- carbon, nitrogen, minerals, vitamins and other nutrients - examples of simple and complex media; Industrial substrates.

Unit III : Isolation, preservation of Microorganisms

Isolation, preservation and improvement of Industrial Micro- Organisms for over production of Primary and Secondary metabolites,

Unit IV: 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-butenediol)

UNIT V: Secondary Metabolites :

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

Unit VI: Production of Commercially Important Enzymes

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

UNIT VII : Recombinant Proteins

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

Stoichiometry of microbial growth and product formation. Strain improvement through physical and chemical mutation, molecular tools, protoplast fusion.

Unit VIII : Speciality Bioproducts for Agricultural, Food and Pharmaceutical Industries

Natural Biopreservatives (Nisin), and Biopolymers (Xanthan Gum and PHB); Single Cell Protein, interferons, vaccines, phages in human health care. Production of synthetic Penicillins and Cephalosporin; Racemically-pure Drug Intermediates: Steroid Bioconversions; High -Fructose Corn syrup; Bioconversion of Vegetable Oils;

TEXT BOOKS:

1. Biotechnology, 3rd edition by John E. Smith. Cambridge low price editions.
2. Industrial Microbiology: - J. E. Casida;

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.

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(BT05234) ENVIRONMENTAL BIOTECHNOLOGY

Unit I: Biological Treatment of Wastewater – Aerobic System

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,

UNIT II : Biological Treatment of Wastewater – Anaerobic System

Anaerobic biological treatment - contact digesters, packed column reactors, UASB.

Unit III: Bioremediation

Introduction, constraints and priorities of Bioremediation, Biostimulation of Naturally occurring microbial activities, Bioaugmentation, in situ, ex situ, intrinsic & engineered bioremediation,

Unit IV: Bioremediation- II

Solid phase bioremediation - land farming, prepared beds, soil piles, Phytoremediation. Composting, Bioventing & Biosparging; Liquid phase bioremediation - suspended bioreactors, fixed biofilm reactors.

Unit V: Metal Biotechnology

Mining and Metal biotechnology – with special reference to Copper & Iron. Microbial transformation, accumulation and concentration of metals, metal leaching, extraction and future prospects.

Unit VI: Bio Fuels

Microorganisms and energy requirements of mankind; Production of nonconventional fuels - Methane (Biogas), Hydrogen, Alcohols and algal hydrocarbons, Use of microorganisms in augmentation of petroleum recovery.

Unit VII: Hazardous Waste Management- I

Introduction - Xenobiotic compounds, recalcitrance. hazardous wastes - biodegradation of Xenobiotics . Biological detoxification - market for hazardous waste management –

Unit VIII: Hazardous Waste Management- II

biotechnology application to hazardous waste management - examples of biotechnological applications to hazardous waste management - cyanide detoxification - detoxification of oxalate, urea etc. - toxic organics - phenols.

TEXT BOOKS:

1. Environmental Biotechnology by S. K. Agarwal
2. Biodegradation & Bioremediation (1999), Martin Alexander, Academic press.

REFERENCES:

1. Stanier R. Y., Ingram J.L., Wheelis M.L., Painter R.R., General Microbiology, McMillan Publications, 1989.
2. Foster C.F., John Ware D.A., Environmental Biotechnology, Ellis Horwood Ltd., 1987.
3. Karrely D., Chakrabarty K., Omen G.S., Biotechnology and Biodegradation, Advances in Applied Biotechnology Series, Vol.4, Gulf Publications Co. London, 1989.
4. Bioremediation engineering; design and application 1995 John. T. cookson, Jr. Mc Graw Hill, Inc.
5. Environmental Biotechnology by A.K. Chatterjee
6. Environmental Biotechnology by S.N.Jogdand Himalaya Publishing

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(BT05275) 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-ANA 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 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. Anselm 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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(BT05354) 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 (MTC)

Definition of MTC, 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.

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.

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.
2. Christi J. Geankoplis, Transport process & Unit operations, III ed., Prentice Hall India Pvt. Ltd.

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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(BT05454) 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, 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, Antigens (edible vaccine) and plantibodies.

UNIT VIII METABOLIC ENGINEERING

Metabolic engineering for plant 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. Roberta Smith, Plant Tissue Culture: Techniques and Experiments, Academic Press; 2nd ed, 2000.
2. Crispeels, M.J. and Sadava, D.E., Plants, Genes and Crop Biotechnology, Jones and Bartlett Publishers (2nd Edition), 2003.
3. Bhowjwani, S.S., Plant Tissue Culture: Application and Limitations. Amsterdam, Elsevier, 1990.
4. Charles Cunningham and Andrew J.R. Porter, Recombinant Proteins from Plants: Production and Isolation of Clinically Useful Compounds (Methods in Biotechnology), Humana Press, 1997.
5. Bernard R. Glick and John E. Thompson, Methods in Plant Molecular Biology and Biotechnology, CRC Press, 1993.
6. I. Potrykus and G. Spangenberg, , Gene Transfer to Plants (Springer Lab Manual), Springer Verlag, 1997.
7. Peter M. Gresshoff, Plant Genome Analysis: Current Topics in Plant Molecular

Biology. CRC Press, 1994.

8. John Hammond, Peter McGarvey, Vidadi Yusibov, Plant Biotechnology: New Products and Applications, Springer Verlag, 1999.

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(BT05455) 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.

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**(BT05414) 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:

1. Old RW and Primrose SB, Principles of gene manipulation, Blackwell Scientific Publications, 1992.
2. Freifelder D, Molecular Biology, Jones and Bartlett Publishers inc. 1987.

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(BT05084) 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: Bio Chemical 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 Gusfield. 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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III Year B-TECH B.T. II-SEM

**T P C
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(BT05240) ENZYME ENGINEERING

Unit I: Applications of Enzymes

Classification of Enzymes; Purification and characterization of enzymes from natural

sources Comparison of chemical and enzyme catalysis.

Unit- II : Isolation of Enzymes:

Extraction and Purification of Crude Enzyme extracts from plant, animal and microbial

sources-some case studies; methods of characterization of enzymes; development of enzymatic assays.

Unit III: Mechanisms and Kinetics of Enzyme Action

Mechanisms of Enzyme Action; Concept of active site and energetics of enzyme substrate complex formation; Specificity of enzyme action; Kinetics of single substrate

reactions; turnover number; estimation of Michaelis-Menton parameters. Importance

of KM, Multi-substrate reaction mechanisms and kinetics.

UNIT IV : Enzyme Inhibition

Types of Inhibition- kinetic models; Substrate and Product Inhibition; Allosteric regulation of enzymes; Deactivation kinetics.

Unit V: 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.

Unit VI: 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

Unit VII: Enzyme Reactors:

Design of Immobilized Enzyme Reactors-Packed- bed, Fluidized-bed Membrane reactors; Bioconversion calculations in free- enzyme CSTRs and immobilized enzyme reactors.

Unit VII: Enzyme Biosensors

Applications of enzymes in analysis; Design of enzyme electrodes and their applications as biosensors in industry, health care and environment.

TEXT BOOKS:

1 Enzymes by Trevor palmer , East west Press

2. Biochemical engineering fundamentals, second edition. James E Bailey, David F., Ollis, Mc Graw Hill Intl. Edition.

REFERENCES:

1. Basic Biotechnology, Second Edition, by Colin Ratledge and Bjorm Kristiansen, Cambridge University Press.

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(BT05286) HEAT TRANSFER IN BIOPROCESSES

UNIT-I

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-II

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

UNIT-III

Natural convection - various correlation for evaluating heat transfer coefficients.

UNIT-IV

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

UNIT-V

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- VI

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

UNIT-VII

Sterilization:

General principles of sterilization, Methods to avoid contamination, sterilization of medium using HTST methods.

UNIT-VIII

Use of plate heat exchangers, effect of temperature on batch stabilization. Design of continuous sterilizers.

TEXT BOOKS:

1. Bio-process Engineering Principles, Pauline M.Doran. Academic press (1995).
2. Unit operations of chemical engineering, Mc Cabe, W.L, Smith J.C., and Harriot, P., Mc-Graw Hill, 5th Ed. (1993).

References:

1. Biochemical Engineering, Webb, F .C. (1964) D.Van Nostrand Co. Ltd. London,
2. Biochemical Engineering fundamentals, 2nd Bailey, J E., and Ollis, D.F. (1986) McGraw-Hill.
3. Unit operations in Food processing, Earle, R.L. (1966)Pergamon Press Oxford.
4. Biochemical Engineering, Blanch, H.W., and Clark, D.S. (1996) Marcel Dekkar, Inc., New york

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(BT05325) INSTRUMENTATION AND PROCESS CONTROL

Unit I: Process Dynamics

Process variables-Load variables-Dynamics of simple processes. Flow, level, emperature 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

Unit IV:

Problems on pneumatic, hydraulic and electronic controllers to realize various control actions.

Unit V: 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 VI:

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

Unit VII: 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.

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.

REFERENCES:

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

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(BT05304) 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 leafficking, T, B, Macrophases, Dendritic cells, Natural killer cells, Eosinophils, Neutrophils, Mast cells and Phasocytosis.

Unit III:

Organs of the I.S. : Primary and Secondary organs of I.S. (Thymus, Spleen, Lymphnode, lymphoid fo kicle, MALT, CALT, SALT

Unit IV: Humoral Immunity-I

B-lymphocytes, their lineage, Immunoglobulins, their structure function, classes, sub classes, genetic control of ab production. (Maturation of B cell) Isotype, allotypes, Idiotypes.

Unit V: Humoral Immunity -II

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

Unit VI: Cell mediated Immunity

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

Unit VII:

Antigen-Antibody interactions and their significance in diagnosis and Hypersensitivity,

Unit VIII: Tumor Immunology

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

TEXT BOOKS:

1. Riovett. Essential Immunology, Vaccines conventional, subunit and ecombinant, antidiotypic vaccine, Blackwell Scientific publications, Oxford, 1991.

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.
3. Kuby Immunology, 5th Edition . Richard A Goldsby, Thomas J Kindt Barbara A Osborne . W H Freeman and Company.

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(BT05502) REGULATORY AFFAIRS AND CLINICAL TRIALS

UNIT-I:

Licensing authorities-roles and responsibilities,ICH GCP,FDA, EU Clinical Trial Directive, Data Protection Act & Regulations relating to electronic signatures,Declaration of Helsinki 2000 amendment and financial disclosure ,Law, guidelines and codes of practiceRegulation of drug preparation and packaging,EMEA,European directives and MRECs,Ethics committees – history structure regulation impact of ICH GCP recent development with regard to the INDIA

/ USA / EU Clinical Trial directive

UNIT 2 :

- _ Ethics in all aspects of health care.
- _ Historical cases
- _ Negligence , informed consent , mental competence
- _ Up – to – date cases: cloning, human embryos and IVF
- _ Shared responsibilities for decisions and the understanding of risk

UNIT 3 :

- _ Definitions of GCP , auditing , monitoring and inspection
- _ GCP auditing requirements from a regulatory perspective
- _ GCP compliance and audit certificates
- _ GCP auditor training
- _ GCP audit team structure and SOPs
- _ GCP audit planning
- _ GCP audit conduct
- _ Reporting GCP audit findings
- _ Follow – up to GCP audit reports.

UNIT 4 :

- _ History and purpose of GCP development of ICH GCP
- _ Roles and responsibilities in clinical research according to ICH GCP
- _ Sponser
- _ Monitor
- _ Investigator
- _ IRB / IEC
- _ Essential documentation

The INDIAN / USA / EU Directives on GCP in Clinical Trials.

- _ Purpose
- _ How will the introduction affect clinical research
- _ Extracts from the guidance documents

Possible sanctions for non- compliance

- a) Legal and regulatory
- b) Commercial,
- c) Professional

UNIT 5:

- _ Regulations in clinical research
- _ The purpose of audits
- _ Types of audits.
- _ Preparing for audits.
- _ In company

- _ On site
- _ The audit process
- _ Typical audit finding
- _ What are they
- _ Resolution
- _ How can they be avoided

UNIT 6:

- _ History of regulatory affairs
- _ Main concepts QSE
- _ Sources of information
- _ Regulatory affairs for studies in human subjects
- _ What data is needed
- _ Current and future European requirements and procedures
- _ US perspective
- _ Recognizing why clinical research has to meet the needs of regulatory affairs

UNIT 7:

- _ Regulatory submissions for new products
- _ What data is needed ?
- _ Requirements for gaining approval
- _ US perspective
- _ Regulating control over marketing and sales of medical products
- _ Regulations
- _ Codes of practice
- _ Promotional materials

UNIT 8:

- _ Latest developments in ICH
- _ Purpose
- _ Implications
- _ Guidance notes
- _ Inspections

INDIAN / USA / EU Ethics approval system

- _ Overview
- _ Recent developments

Current issues in Clinical research

- _ Confidentiality issues
- _ Medicines for human use (clinical trials) regulations 2003
- _ Other relevant issues

TEXT BOOKS

1. Good Clinical Practices ,Central Drugs Standard Control Organisation, Govt. of India
2. Drugs and Cosmetics Act, 1940

REFERENCES

1. International Clinical Trial, Volume 1 &2 Dominique P.Brunier and Gerhardt Nahler, Interpharm Press, Denver, Colorado
2. Code of Federal Regulation by USFDA - Download
3. ICH-GCP Guidelines - Download
4. Biosafety issues related to genetically modified organism , Biotech Consortium India Limited, New Delhi

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(BT05098) BIOPROCESS ENGINEERING LAB-II

1. Isolation of useful microorganisms from natural samples.
2. Growth of microorganisms, estimation of Monod parameters
3. Temperature effect on growth-estimation of energy of activation and Arrhenius Constant for microorganisms.
4. Batch, fed batch and continuous cultures
 - a) Estimation of Monod parameters
 - b) Pure and mixed cultures
 - c) Production of secondary metabolites in synthetic and complex industrial media
5. Identification of growth factors transient pulse experiment.
6. Screening of process variables single dimensional search, placket, Surman design, design expert etc.
7. Study of rheology of fermentation, broth and power determination.

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(BT 05305) IMMUNOLOGY LABORATORY

- 1) Handling of animal, raising of antibodies, purification of antibodies, immunodiffusion, agglutination and precipitation,
- 2) *Enzyme* linked Immunoabsorbant assay (ELISA).
- 3) Purification of lymphocytes from peripheral blood, identification of cell populations by rosettes,
- 4) Immunofluorescence.
- 5) Preparation of various types of gels. Types of electrophoresis.
- 6) Blood typing, RBC and differential count.
- 7) Estimation of Haemoglobin by sahalis method.

REFERENCE

- 1) Talwar GP and Gupta SK, A handbook of practical and clinical immunology, vol 1 and 2 CBS publications, 1992.

(BT05134) COMPUTATIONAL MOLECULAR BIOLOGY

Unit I: Computational Molecular Biology-I

Natural Biological principles behind BLAST,

Unit II: Computational Molecular Biology-II

FASTA, MSA {Dynamic Programming, CLUSTAL W (Des Higgins)} Karlin - ALshultz
E -values Matrices PAM, BLOSUM.

Unit III: Methods in PHYLOGENIC Analysis

CLADISTICS, PHENETICS, EVOLUTIONARY PHYLOGENETICS

UNIT-IV: Maximum Likelihoods

Models of evolution 1) JUKES and CANTOR MODEL 2) KIMURA-2- PARAMETER
MODEL 3) LOGDET METHOD.

Unit V: Genomics

Sequence assembly and gene identification. Homology based gene prediction.
Restriction mapping analysis, coding region identification. SNPs and applications.
Methods of studying gene expression, EST approach,

Unit-VI Micro arrays

- a) Basics of Micro array
- b) Primer on comparative Genomics.

Unit-VII: Proteomics I

Introduction to proteins. Protein identification, structure and function determination.
Structure comparison methods. Prediction of secondary structure from sequence.
Secondary structure based fold and classification (CATH and SCOP), CASP
Experiments yearly updates 2001-2005

Unit VIII: Proteomics II

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

TEXT BOOKS:

1. David W Mount. Bioinformatics- Sequence and genome analysis. CSHL Press.
2. S. Sahai, Genomics and Proteomics, Functional and Computational Aspects, Plenum Publications, 1999.

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.

**(BT05076) BIOETHICS, BIO SAFETY AND INTELLECTUAL
PROPERTY RIGHTS**

Unit I: B

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.

(BT05099) BIOSENSORS & 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. Technol* 33 500A - 506A.
2. Bilitewski, U. Turner, A.P.F. 2000 *Biosensors for environmental monitoring* Harwood, msterdam.
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.

(BT05181) 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).

Unit III: 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, Chromato focusing 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. Bioseparations by Siva Shankar PHI publications

(BT05100) BIOTECHNOLOGY FOR CROP IMPROVEMENT

(Elective-I)

Unit 1: Conventional methods for crop improvement

Introduction to Conventional methods for crop improvement, Pedigree breeding, Heterosis breeding, Mutation breeding

Unit 2: Tissue culture in crop improvement

Micropropagation for virus-free plants, Somaclonal variation, Somatic Hybridization, Haploids in plant breeding,

Unit 3: Genetic engineering for increasing crop productivity: Abiotic factors

Genetic engineering for increasing crop productivity by manipulation of Photosynthesis, Nitrogen fixation, Nutrient uptake efficiency, Genetic engineering for abiotic stress, drought, flooding, salt and temperature

Unit 4: Genetic engineering for increasing crop productivity: Biotic factors

Genetic engineering for biotic stress tolerance, Insects, fungi, bacteria, viruses, weeds.

Unit 5: Genetic engineering for quality improvement

Genetic engineering for quality improvement, Protein, lipids, carbohydrates, vitamins & mineral nutrients.

Unit 6: Molecular Marker aided Breeding

Introduction to Molecular breeding, constructing molecular maps; Molecular markers, RFLP, RAPD, STS, SCAR, SSCP, AFLP.

Unit 7: Molecular Tagging

Molecular tagging of genes/traits

Unit 8: Marker Assisted selection

Molecular marker-assisted selection of qualitative and quantitative traits, Map based cloning.

Text Books:

1. Principles of crop production: Theory, and Technology by George Acquahh. PHI Publications, 2004
2. Plant tissue culture by Bhojwani SS and Razdan MK. Elsevier , 2004

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**(BT05112) 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. Dunmock N.J and Primrose.S.B., Introduction to modern Virology, Blackwel Scientific Publications. Oxford, 1988.

REFERENCE:

1. An Introduction to Cellular and Molecular Biology of Cancer, Oxford Medical publications, 1991.

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(BT05533) 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 I

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

**(BT05155) 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.

**(BT05416) MOLECULAR PATHOGENESIS
(Elective - II)**

UNIT I: INTRODUCTION

Introduction to pathogenesis, components of microbial pathogenicity. Population genetics of Microbial pathogenesis, methods to detect genetic diversity and structure in nature population, epidemiology, cryptic diseases.

UNIT II: HOST DEFENCES I

Host defense against pathogens, clinical importance of understanding host defense, components of the host surface defences systems like skin, mucosa, eye, mouth, respiratory tract.

UNIT III: HOST DEFENCES II

Components of the systemic defense like the tissues and blood.

UNIT IV HOST- PATHOGEN INTERACTION

Virulence and virulence factors, colonising virulence factors, virulence factors damaging the host tissues, virulence genes and regulation of the virulence genes.

UNIT V: EXPERIMENTAL METHODS

Experimental methods to study host-pathogen interaction, selecting the pathogen model, measurement of virulence, identification of potential virulence factors,

UNIT:VI MODULATION OF IMMUNE RESPONSE

modulation of immune response by vaccines, properties of vaccines, other immuno modulators.

UNIT VII: PARADIGMS OF PATHOGENESIS:

Diphtheria disease by colonisation; Disease without colonisation, *Clostridium botulinum* and *Staphylococcus aureus*; Intestinal infections, *Shigella* and *E.coli* infections; *Vibrio cholera* *Salmonella* infections; fungal infections

UNIT VIII: FUTURE CHALLENGES

Gastric and duodenal ulcers - are they due to infections? Lyme disease and Syphilis - unsolved mystery.

Legionnaires disease-aftermath of comforts. Tuberculosis and other mycobacterial infections reemerging

with vengeance. Rheumatic fever and glomerulo nephritis - still a question to be solved.

TEXT BOOKS:

1. Iglewski B.H. and Clark V.L. Molecular basis of Bacterial pathogenesis, Academic press, 1990.
2. Janeway C.A. Jr, and Travers P. T. Immunobiology. Blackwell J Scientific Publishers, 1994.

REFERENCES:

1. Talaro K. and Talaro A. Foundations in Microbiology, W.C. Brown Publishers, 1993.
2. Roitt I. Essentials of Immunology, 8th edition, Blackwell Scientific Publishers, 1994.
3. Austyn J.M. and Wood K.J. Principles Cellular and Molecular Immunology, OxfordUniversityPress, 1993.

**(BT05383) 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. Xperimental 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

(BT05085) 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)

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(BT05182) 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.

(BT05041) 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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IV Year B-TECH B.T. II-SEM**

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**(BT05262) FOOD SCIENCE & TECHNOLOGY
(Elective-III)**

Unit I: Introduction To Food Processing

Biotechnology in relation to the food industry, nutritive value of food, and types of microorganisms associated with food, its sources, types and behavior in foods.

Unit II: Food Preservation I

Bioprocessing of meat, fisheries, vegetables, dairy products, enzymes and chemicals used in food processing,

Unit III: Food Preservation II

biochemical engineering for flavor and food production, cryopreservation, irradiated foods.

Unit IV: Fermented Food Products

Dairy products, non-beverage plant products, beverages and related products of baking.

Unit V: Quality Control

Quality control, case studies on Biotechnology in the evolution of food quality.

Unit VI: Food Spoilage & Food Borne Diseases

Food -borne infections & intoxications.

Unit VII: Food Microbiology I

Utilization of microorganisms in food Industry, Single cell protein, Nutraceuticals etc.,

Unit VIII: Food Microbiology II

Natural and artificial sweeteners and their role in controlling diseases and deficiencies.

TEXT BOOKS

1. Roger A., Gordan B., and John T., Food Biotechnology, 1989.
2. Frazier, Food Microbiology,

REFERENCES

1. George J.B., Basic Food Microbiology, CBS Publishers Distributors, 1987.
2. James M .J. Modern Food Microbiology, CBS Publishers & Distributors, 1987.
3. Lindsay, Willis Biotechnology, Challenges for the flavor and food Industries, Elsevier Applied Science, 1988.

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**(BT05415) MOLECULAR MODELING & 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 III – 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.

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**(BT05077) 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 Timmerhkus, 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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**(BT05095) 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 & Co.
3. Theory & Practice of Industrial Pharmacy, (3rd ed.) Leon Lachman, Lea & Febiger (1986)

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**(BT05453) 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*, *Catharanthus 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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**(BT05426) NEUROBIOLOGY AND COGNITIVE SCIENCES
(Elective-IV)**

Unit I: Introduction To Nervous Systems

Central and Peripheral nervous systems

Unit II: Neuro Anatomy I

Structure and functions of neurons, synapse. their function, signals produced by neurons, sensors function, Glial cells,

Unit III: Neuro Anatomy II

Molecular and cellular organization of neuronal differentiation, characterization of neuronal cells.

Unit IV: Neurophysiology

Conduction of impulses by neurons, Correlation of sensory functions.

Unit V: Neuropharmacology

Pharmaceutical mediator, released by neurons. Hormones and their effect on neuronal function.

Unit VI: Neurological Disorders

Pathogenesis, Genetic basis of neurological disorders

Unit VII: Behavioural Science I

Neuronal mechanism of behaviour,

Unit VII: Behavioural Science II

Animal behaviour, Behaviour in various environments.

Reference:

1. A.B. Schiebel Neurobiology of higher cognitive function Guilford Press 1990,