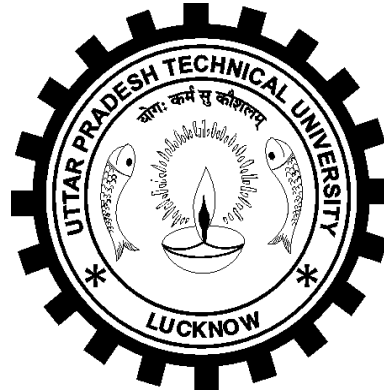


A. K. TECHNICAL UNIVERSITY, LUCKNOW



Syllabus

BIO TECHNOLOGY

S. No.	Subject Code	Name of the Subject	Periods			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Assessment			ESE		
						CT	TA	Total			
THEORY SUBJECT											
1	NAS 103/ NBT-101	Engg. Mathematics-I/ Remedial Biology-I	3	1	0	30	20	50	100	150	4
2	NEC-101/ NAS-104	Electronics Engg./ Professional Communication	3	1	0	30	20	50	100	150	4
3	NAS102/ NME102	Engg. Chemistry/Engg. Mechanics	3	1	0	30	20	50	100	150	4
4	NEE-101/ NCS 101	Basic Electrical Engg./Computer System and Programming in C	3	1	0	30	20	50	100	150	4
5	NAS-101	Engg. Physics-I	2	1	0	15	10	25	50	75	3
6	NME-101/ NAS-105	Basic Manufacturing Processes/Environment & Ecology	2	0	0	15	10	25	50	75	2
PRACTICAL/DESIGN/DRAWING											
7	NAS-152/ NME-152	Engg. Chemistry Lab/ Engg. Mechanics Lab	0	0	2	10	10	20	30	50	1
8	NEE-151/ NCS-151	Basic Electrical Engg. Lab/ Computer Programming Lab	0	0	2	10	10	20	30	50	1
9	NEW-151/ NCE-151	Workshop Practice/ Computer Aided Engg. Graphics	0	1	3	10	10	20	30	50	2
10	NAS-151/ NAS-154	Engg. Physics Lab/ Professional Communication Lab	0	0	2	10	10	20	30	50	1
11	GP-101	GP						50		50	
		TOTAL	16	6	9					1000	26

L- Lecture

T -Tutorial

P-Practical

CT-Cumulative Test

TA-Teacher's Assessment

ESE-End Semester Examination

Semester-II

S. No.	Subject Code	Name of the Subject	Periods			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Assesment			ESE		
						CT	TA	Total			
THEORY SUBJECT											
1	NAS-203/ NBT-201	Engg. Mathematics-II/ Remedial Biology-II	3	1	0	30	20	50	100	150	4
2	NEC-201/ NAS-204	Electronics Engg./ Professional Communication	3	1	0	30	20	50	100	150	4
3	NAS-202/ NME-202	Engg. Chemistry/ Engg. Mechanics	3	1	0	30	20	50	100	150	4
4	NEE-201/ NCS-201	Basic Electrical Engg./ Computer System and Programming in C	3	1	0	30	20	50	100	150	4
5	NAS-201	Engg. Physics-II	2	1	0	15	10	25	50	75	3
6	NME-201 / NAS-205	Basic Manufacturing Processes / Environment & Ecology	2	0	0	15	10	25	50	75	2
PRACTICAL/DESIGN/DRAWING											
7	NAS-252/ NME-252	Engg. Chemistry Lab/ Engg. Mechanics Lab	0	0	2	10	10	20	30	50	1
8	NEE-251/ NCS-251	Basic Electrical Engg. Lab/ Computer Programming Lab	0	0	2	10	10	20	30	50	1
9	NWS-251/ NCE-251	Workshop Practice / Computer Aided Engg. Graphics	0	1	3	10	10	20	30	50	2
10	NAS-251/ NAS-254	Engg. Physics Lab / Professional Communication Lab	0	0	2	10	10	20	30	50	1
11	GP-201	GP						50		50	
		TOTAL	16	6	9					1000	26

Engineering Mathematics - I
(NAS-103)

L	T	P
3	1	0

Unit - 1: Differential Calculus - I

Leibnitz's theorem, Partial derivatives, Euler's theorem for homogeneous functions, Total derivatives, Change of variables, Curve tracing: Cartesian and Polar coordinates.

Unit - 2: Differential Calculus - II

Taylor's and Maclaurin's Theorems, Expansion of function of several variables, Jacobian, Approximation of errors, Extrema of functions of several variables, Lagrange's method of multipliers (Simple applications).

Unit - 3: Linear Algebra

Inverse of a matrix by elementary transformations, Rank of a matrix (Echelon & Normal form), Linear dependence, Consistency of linear system of equations and their solution,. Characteristic equation, Eigen values and eigen vectors, Cayley-Hamilton Theorem,A brief introduction to Vector Spaces,Subspaces. Rank & Nullity. Linear transformations.

Unit - 4: Multiple Integrals

Double and triple integrals, Change of order of integration, Change of variables, Application of integration to lengths, Volumes and Surface areas – Cartesian and Polar coordinates. Beta and Gamma functions, Dirichlet's integral and applications.

Unit - 5: Vector Calculus

Point function, Gradient,Divergence and Curl and their physical interpretations, Vector identities, Directional derivatives. Line,Surface and Volume integrals, Applications of Green's, Stoke's and Gauss divergence theorems (without proofs),

Text Books:

- 1. E. Kreyszig :Advanced Engineering Mathematics-Volume-I,JohnWiley & Sons**
- 2. B. V. Ramana, Higher Engineering Mathematics, Tata Mc Graw- Hill Publishing Company Ltd.**
- 3. R.K.Jain & S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House.**

Reference Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
2. Peter V. O' Neil, Advanced Engineering Mathematics, Thomas (Cengage) Learning.
3. Thomas & Finley, Calculus, Narosa Publishing House
4. Rukmangadachari, Engineering Mathematics – I, Pearson Education.

NBT-102: Remedial Biology-I

Unit-I:

The cell concept, structure of prokaryotic, eukaryotic cells, plant cells and animal cells, Structure and function of cell membrane, cell organelles and their function. Structure and use of compound microscope, Macro and micro molecules, Basic chemical constituents of living body.

Unit-II:

Tissues in animal and plants, Morphology, anatomy and functions of different parts of plants: Root, stem, leaf, inflorescence, flower, fruit and seed, Concepts of botanical garden, herbaria, zoological park and museums.

Unit-III:

Classification of living organisms (Five kingdom classification, major groups and principles of classification in each kingdom), Systematic and binomial system of nomenclature, Concept of animal and plant classification.

Unit-IV:

Concepts of alleles and genes, Mendelian Experiments, Cell cycle (Elementary Idea), mitosis and meiosis, techniques to study mitosis and meiosis.

Unit-V:

Plant Physiology: Concepts of diffusion, osmosis, imbibitions, Movement of water, food, nutrients and gases, Photosynthesis, plant growth and development.

Recommended Text Book:

1. Biology-Textbook of Class XI, NCERT Publication
2. Biology-Textbook of Class XII, NCERT Publication

Reference Book:

Biology by Peter H Raven, George b Johnson, Kenneth A., Mason, Jonathan Losos, Susan Singer (MacGraw Hill Publication)

NEC-101/NEC-201: ELECTRONICS ENGINEERING

Chapters/ Books L T P 3 1 0

Unit -1	1 st Book	10 Lecture
Semiconductor Diode Depletion layer, V-I characteristics, ideal and practical, diode resistance, capacitance, Diode Equivalent Circuits, Transition and Diffusion Capacitance, Zener Diodes breakdown mechanism (Zener and avalanche)	Chapter 1/1	2
Diode Application Series , Parallel and Series, Parallel Diode Configuration, Half and Full Wave rectification, Clippers, Clampers, Zener diode as shunt regulator, Voltage-Multiplier Circuits	Chapter 2/1	6
Special Purpose two terminal Devices Light-Emitting Diodes, Varactor (Varicap) Diodes, Tunnel Diodes, Liquid-Crystal Displays.	Chapter 16/1	2
Unit II	1 st Book	12 Lecture
Bipolar Junction Transistor Transistor Construction, Operation, Amplification action. Common Base, Common Emitter, Common Collector Configuration	Chapter 3/1	2
DC Biasing BJTs Operating Point, Fixed-Bias, Emitter Bias, Voltage-Divider Bias Configuration. Collector Feedback, Emitter-Follower Configuration. Bias Stabilization. CE,CB,CC amplifiers and analysis of single stage CE amplifier	Chapter 4/1	6
Field Effect Transistor Construction and Characteristic of JFETs. Transfer Characteristic. CS,CD,CG amplifier and analysis of CS amplifier MOSFET (Depletion and Enhancement)Type, Transfer Characteristic,	Chapter 6/1	4
Unit III	1 st Book	6 Lecture
Operational Amplifiers Introduction, Differential Amplifier Circuits, Op-Amp Basic, Practical Op-Amp Circuits (Inverting Amplifier, Noninverting Amplifier, Unit Follower, Summing Amplifier, Integrator, Differentiator). Differential and Common-Mode Operation	Chapter 10 10.1,10.4, 10.5, 10.9 1 st Book	6
Unit IV	2 nd Book	4 Lecture
Digital Voltmeter : Introduction, RAMP Techniques	5.1, 5.2 2 nd Book	4
Digital Multimeters:	6.2 2 nd Book	
Oscilloscope: Introduction, Basic Principle, CRT , Block Diagram of Oscilloscope, Simple CRO, Measurement of voltage , current phase and frequency using CRO	7.1,7.2,7.3, 7.4,7.5,7.20 2 nd Books	
Unit V	3 rd Book	8 Lecture
Fundamentals of Communication Engineering : Elements of a Communication System, Need of modulation, electromagnetic spectrum and typical applications, terminologies in communication systems, Basics of signal representation and analysis, Fundamentals of amplitude and angle modulation, modulation and demodulation techniques.	Chapter 1, 2 3 rd Book	8

Text Books

1. Robert L. Boylestad & Louis Nashelsky “**Electronic Devices and Circuit Theory**”, Tenth Edition, Pearson Education, 2013
2. H S Kalsi, “**Electronics Instrumentation**,” Third Edition, TMH Publication 2012

3. George Kennedy, “**Electronic Communication System**”, Fifth Edition , TMH Publication, 2012

Reference Books

4. Devid A. Bell “ **Electronics Devices and Circuits**”, 5th Edition, OXFORD University Press 2008
5. Jacob Millman/ Christos C. Halkias/ Satyabrata Jit “**Electronics Devices and Circuits**”, 3rd Edition , TMH 2008

Unit-1 Fundamentals of Communication

Technical Communication: features: Distinction between General and Technical communication; Language as a tool of communication; Levels of communication: Interpersonal, Organizational, Mass communications; The flow of Communication: Downward, Upward, Lateral of Horizontal (Peer group): Importance of technical communication; Barriers to Communication.

Unit-II Constituents of Technical Written Communication

Words and Phrases: Word formation. Synonyms and Antonyms; Homophones; Select vocabulary of about 500-1000 New words; **Correct Usage:** all Parts of Speech; Modals; Concord; Articles; Infinitives; Requisites of Sentence Construction: Paragraph Development: Techniques and Methods- Inductive, Deductive, Spatial, Linear, Chronological etc; The Art of Condensation-various steps.

Unit-III Business Communication

Principles, Sales & Credit letters;

Claim and Adjustment Letters; Job application and Resumes.

Reports: Types; Significance; Structure, Style & Writing of Reports.

Technical Proposal; Parts; Types; Writing of Proposal; Significance.

Negotiation & Business Presentation skills.

Unit-IV Presentation Strategies and Listening Skills.

Defining Purpose; Audience & Local; Organizing Contents; Preparing Outline; Audio-visual Aids; Nuances of Delivery; Body Language; Dimensions of Speech: Syllable; Accent; Pitch; Rhythm; Intonation; Paralinguistic features of voice; Listening Skills: Active Listening, Passive Listening. methods for improving Listening Skills.

Unit-V Value-Based Text Readings

Following essays form the suggested text book with emphasis on Mechanics of writing.

(i) Humanistic and Scientific Approaches to Human Activity by Moody E. Prior

(ii) The Language of Literature and Science by A. Huxley

(iii) Man and Nature by J.Bronowski

(iv) The Social Function of Literature by Ian Watt

(v) Science and Survival by Barry Commoner

(vi) The Mother of the Sciences by A.J.Bahm

(vii) The Effect of Scientific Temper on Man by Bertrand Russell.

Text Book

1. Improve Your Writing ed. V.N.Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi..
2. Technical Communication: A Practical Approach: Madhu Rani and Seema Verma- Acme Learning, New Delhi-2011
3. Technical Communication- Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press,2007, New Delhi.

Reference Books

1. Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt.Ltd,2011, New Delhi.
2. Business Correspondence and Report Writing by Prof. R.C.Sharma & Krishna Mohan, Tata McGraw Hill & Co.Ltd.,2001, New Delhi.
3. Word Power Made Easy by Norman Lewis, W.R.Goyal Pub. &Distributors, 2009,Delhi.
4. Developing Communication Skills by Krishna Mohan, Mecra Bannerji- Macmillan India Ltd. 1990, Delhi.
5. Manual of Practical Communication by L.U.B.Pandey: A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2013, Delhi.
6. English Grammar and Usage by R.P.Sinha, Oxford University Press, 2005, New Delhi.
7. Spoken English- A manual of Speech and Phonetics by R.K.Bansal & J.B.Harrison, Orient Blackswan, 2013, New Delhi.
8. Business English by Ken Taylor, Orient Blackswan, 2011, New Delhi.

NAS 102/ NAS 202
ENGINEERING CHEMISTRY

L T P
3 1 0

UNIT-I

Molecular orbital theory and its applications in diatomic molecules. Band theory of solids. Liquid crystals. Application of liquid crystals. Types of unit cell, space lattice (only cubes), Bragg's equation. Calculation of density of unit cell. One and two dimensional imperfections in solids. Structure and applications of Graphite and Fullerenes.

UNIT-II

Polymers, its classification and their applications. Chain and Step growth polymerization. Thermoplastic and Thermosetting resins. Elastomers and synthetic fibres. Conducting and biodegradable polymers. General methods of synthesis of organometallic compound (Grignard Reagent) and their applications in polymerization and catalysis.

UNIT-III

Stereochemistry with special reference to optical isomerism. Types of organic reactions with special reference to elimination and substitution reaction. Elementary ideas and simple applications of UV, Visible, IR and ¹H NMR spectral Techniques.

UNIT-IV

Hardness of water. Disadvantage of hard water. Techniques for water softening; Calgon, Zeolite, Lime-Soda, Ion exchange resin, Reverse osmosis. Water treatment method for boiler feed by internal process. Phase Rule and its application to one component system (water and sulphur).

UNIT-V

Fuels; Classification of fuels. Analysis of Coal. Determination of Calorific values. Biogas and Biomass. Cement and its application. Plaster of paris. Lubricant. Corrosion; causes and prevention.

Textbook

1. Chemistry for Engineers, by S. Vairam and Suba Ramesh; Wiley India

Reference Books

1. Textbook of Engineering Chemistry by Dr. Gopal Krishna Bhatt, Acme Publishers
2. Chemistry (9th ed), by Raymond Chang, Tata McGraw-Hill
3. Chemistry Concepts and Applications by Steven S. Zumdahl; Cengage Learning
4. Engineering Chemistry, Wiley India
5. Engineering Chemistry Author: Abhijit Mallick, Viva Books
6. Text Book of Engineering Chemistry by Harsh Malhotra; Sonali Publications
7. Concise Inorganic Chemistry by J.D. Lee; Wiley India
8. Organic Chemistry (6 ed) by Morrison & Boyd; Pearson Education
9. Physical Chemistry by Gordon M. Barrow; Mc-Graw Hill
10. Organic Chemistry, Volume 1(6 ed)& 2 (5ed) by I. L. Finar; Pearson Education
11. Atkins' Physical Chemistry by Peter Atkins & Julio De Paula; Oxford University Press

NME-102/202: Engineering Mechanics: L T P [3 1 0]

Unit	Topic	Contact Hours
I	<p>Force Systems:</p> <ul style="list-style-type: none"> • Basic concepts: Definitions, Basic assumptions, Scalar & Vector quantities, Free, Forced and fixed vectors. • Force System: Force, Classification & Representation, Force as a Vector, Composition of forces, Parallelogram Law, Resolution, Principle of Transmissibility of forces • Moment of a force, Vector representation, Moment for coplanar force system, Varignon's theorem • Couple, Vector representation, Resolution of a force into a force and a couple. • Force Systems: Coplanar Concurrent Force system and Coplanar Non Concurrent force systems, Resultant of coplanar force system. • Equilibrium of coplanar force system, Free body diagrams, Determination of reactions, Equilibrium of a body under three forces, Lami's theorem. <p>Friction:</p> <ul style="list-style-type: none"> • Introduction, Wet and Dry friction, Theory of Dry friction, Angle of friction, Angle of Repose, Cone of friction, Coulomb's laws of friction. 	8
II	<p>Basic Structural Analysis:</p> <ul style="list-style-type: none"> • Plane Truss, Difference between truss and frame, Perfect and imperfect truss, Assumptions and Analysis of Plane Truss, Method of joints, Method of section, Zero force members. • Beams, Types of beams, Statically Determinate Beams, Shear force and bending moment in beams, Shear force and bending moment diagrams, Relationships between load, shear and bending moment. 	8
III	<p>Centroid and Moment of Inertia:</p> <ul style="list-style-type: none"> • Center of Gravity, Center of Mass and Centroid of curves, areas, volumes, Determination of centroid by integration, Centroid of composite bodies. • Definition of Moment of inertia of area, Perpendicular axis theorem and Polar moment of Inertia, Parallel axis theorem, Moment of inertia of simple areas by integration, Moment of Inertia of Composite Areas. • Moment of Inertia of masses, Parallel axis theorem for mass moment of inertia, Mass moment of inertia of simple bodies by integration, Mass moment of inertia of composite bodies. 	8
IV	<p>Kinematics of Rigid Body:</p> <ul style="list-style-type: none"> • Introduction, Absolute motion, Plane rectilinear motion of rigid body, Plane curvilinear Motion of rigid body, x-y and n-t components, Rotation of rigid bodies, Relative Motion, Plane Motion of rigid bodies, Instantaneous center of zero velocity <p>Kinetics of Rigid Body:</p> <ul style="list-style-type: none"> • Introduction, Force, Mass and Acceleration, Newton's law of 	9

	<p>motion, D'Alembert's Principles and Dynamic Equilibrium, Laws of motion applied to planar translation, rotation and plane motion.</p> <ul style="list-style-type: none"> • Work and Energy, Kinetic energy, Principle of work and energy, Conservative forces, Law of conservation of energy, • Linear Impulse and Momentum, Conservation of linear momentum. 	
V	<p>Mechanics of Deformable Solids:</p> <ul style="list-style-type: none"> • Simple stress and strain: Normal and shear stresses. One Dimensional Loading; members of varying cross section, bars in series. Tensile Test diagram for ductile and brittle materials, Elastic constants, Strain energy. • Bending of Beams: theory of pure bending, neutral surface and neutral axis, stresses in beams of different cross sections. • Theory of Torsion, Torque and twist, Shear stress due to torsion circular sections. 	08

References:

1. "Engineering Mechanics: Statics", J.L Meriam , Wiley
2. "Engineering Mechanics: Dynamics", J.L Meriam , Wiley
3. "Engineering Mechanics", F L Singer
4. "Engineering Mechanics : Statics and Dynamics", R. C. Hibbler, Pearson
5. "Engineering Mechanics", Thimoshenko & Young , 4ed, Tata McGraw Hill
6. "Engineering Mechanics: Statics and Dynamics", A. Nelason, McGraw-Hill
7. "Engineering Mechanics : Statics and Dynamics", Shames and Rao, Pearson
8. "Engineering Mechanics : Statics and Dynamics", S. Rajasekaran and G. Sankarasubramanian, Vikas
9. "Engineering Mechanics", V. Jayakumar and M. Kumar, PHI
10. "Engineering Mechanics", D. P. Sharma, PHI
11. "Engineering Mechanics", M. V. Sheshagiri Rao, and D. Rama Durgaiyah, University Press.
12. "Engineering Mechanics", K L Kumar and V. Kumar, McGraw Hill
13. "Engineering Mechanics", Bhattacharya , Oxford Press
14. "Engineering Mechanics", Dr Sadhu Singh , Umesh Publications
15. "Engineering Mechanics", Bhavikatti , New Age
16. "Strength of Materials" F. L.Singer
17. "Strength of Materials" Thimoshenko & Young
18. "Mechanics of Solids", R. C. Hibbler, Pearson
19. "Mechanics of Solids", A. Mubeen, Pearson

Unit-I

1. D C Circuit Analysis and Network Theorems:

Circuit Concepts: Concepts of network, Active and passive elements, Voltage and current sources, Concept of linearity and linear network, Unilateral and bilateral elements, R, L and C as linear elements, Source transformation

Kirchhoff's laws; Loop and nodal methods of analysis; Star-delta transformation

Network theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem (Simple numerical problems) 9

Unit-II

2. Steady- State Analysis of Single Phase AC Circuits:

AC fundamentals: Sinusoidal, square and triangular waveforms – Average and effective values, Form and peak factors, Concept of phasors, phasor representation of sinusoidally varying voltage and current, Analysis of series, parallel and series-parallel RLC Circuits, Resonance in series and parallel circuits, bandwidth and quality factor; Apparent, active & reactive powers, Power factor, Causes and problems of low power factor, Concept of power factor improvement (Simple numerical problems) 8

Unit-III

3. Three Phase AC Circuits:

Three phase system-its necessity and advantages, Star and delta connections, Balanced supply and balanced load, Line and phase voltage/current relations, Three-phase power and its measurement (simple numerical problems). 3

4. Measuring Instruments:

Types of instruments, Construction and working principles of PMMC and moving iron type voltmeters & ammeters, Single phase dynamometer wattmeter, Use of shunts and multipliers (Simple numerical problems on shunts and multipliers) 4

Unit-IV

5. Introduction to Earthing and Electrical Safety:

Need of Earthing of equipment and devices, important electrical safety issues. 2

6. Magnetic Circuit:

Magnetic circuit concepts, analogy between electric & magnetic circuits, B-H curve, Hysteresis and eddy current losses, Mutual coupling with dot convention, Magnetic circuit calculations. 3

7. Single Phase Transformer:

Principle of operation, Construction, EMF equation, Equivalent circuit, Power losses, Efficiency (Simple numerical problems), Introduction to auto transformer. 3

Unit-V

8. Electrical Machines:

Concept of electro mechanical energy conversion

DC machines: Types, EMF equation of generator and torque equation of motor, Characteristics and applications of DC motors (simple numerical problems)

Three Phase Induction Motor: Types, Principle of operation, Slip-torque characteristics, Applications (Numerical problems related to slip only)

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor and their applications. 8

Text Books:

1. "Principles of Electrical Engineering", V. Del Toro,; Prentice Hall International
2. "Basic Electrical Engineering", D P Kothari, I.J. Nagarath; Tata McGraw Hill
3. "Basic Electrical Engineering", S N Singh; Prentice Hall International
4. "Fundamentals of Electrical Engineering", B Dwivedi, A Tripathi; Wiley India
5. "Basic Electrical Engineering", Kuldeep Sahay, New Age International Publishers

Reference Books:

1. "Electrical and Electronics Technology", Edward Hughes; Pearson
2. "Engineering Circuit Analysis", W.H. Hayt & J.E. Kimerly; Mc Graw Hill
3. "Basic Electrical Engineering", C L Wadhwa; New Age International
4. "Basic Electrical Engineering", T.K. Nagsarkar, M.S. Shukhija; Oxford University Press

NCS-101/NCS-201 Computer System and Programming in C

L	T	P
3	1	0

Unit1 (10 Lectures)

Basics of Computer: Introduction to digital computer, basic operations of computer, functional components of computer, Classification of computers.

Introduction to operating system: [DOS, Windows, Linux and Android] purpose, function, services and types.

Number system : Binary, octal and hexadecimal number systems, their mutual conversions, Binary arithmetic.

Basics of programming: Approaches to Problem Solving, Concept of algorithm and flow charts, Types of computer languages:- Machine Language, Assembly Language and High Level Language, Concept of Assembler, Compiler, Loader and Linker.

Unit2 (8 Lectures)

Standard I/O in C, Fundamental data types- Character type, integer, short, long, unsigned, single and double floating point, Storage classes- automatic, register, static and external, Operators and expression using numeric and relational operators, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and associativity.

Fundamentals of C programming: Structure of C program, writing and executing the first C program, components of C language. Standard I/O in C.

Unit3 (10 Lectures)

Conditional program execution: Applying if and switch statements, nesting if and else, use of break and default with switch, program loops and iterations: use of while, do while and for loops, multiple loop variables, use of break and continue statements.

Functions: Introduction, types of functions, functions with array, passing values to functions, recursive functions.

Unit 4 (6 Lectures)

Arrays: Array notation and representation, manipulating array elements, using multi dimensional arrays. Structure, union, enumerated data types

Unit 5 (8 Lectures)

Pointers: Introduction, declaration, applications

File handling, standard C preprocessors, defining and calling macros, conditional compilation, passing values to the compiler.

Text Books:

1. Computer Concepts and Programming in C by Vikas Gupta, Wiley India Publication
2. Computer Concepts and Programming by Anami, Angadi and Manvi, PHI Publication
3. C programming by Kernighan and Ritchie, PHI
4. Computer Fundamentals and Programming in C. Reema Thareja, Oxford Publication
5. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill
6. Computer Concepts and Programming in C by D.S. Yadav and Rajeev Khanna, New Age International Publication
7. Programming in C A Practical approach by Ajay Mittal, Pearson Publication
8. Computer Fundamental and C programming by K K Gupta, Acme Learning Publication

Reference:

1. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006.
2. Computer Science- A Structured Programming Approach Using C, by Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Third Edition [India Edition], 2007.

NAS-101: ENGINEERING PHYSICS-I

Unit - I

Relativistic Mechanics

06 Hrs.

Inertial & non-inertial frames, Michelson- Morley experiment, Einsteins postulates, Lorentz transformation equations, Length contraction & Time dilation, Addition of velocities; Variation of mass with velocity, Mass energy equivalence.

Unit - II

06 Hrs.

Modern Physics

Wave Mechanics: Wave- particle duality, de-Broglie matter waves, Phase and Group velocities, Davisson-Germer experiment, Heisenberg uncertainty principle and its applications, Wave function and its significance, Schrödinger's wave equation – particle in one dimensional potential box, Eigen values and Eigen function.

Unit - III

10 Hrs.

Wave Optics

Interference: Interference of light, Interference in thin films (parallel and wedge shaped film), Newton's rings.

Diffraction: Single, double and N- Slit Diffraction, Diffraction grating, Grating spectra, dispersive power, Rayleigh's criterion and resolving power of grating.

Polarization: Phenomena of double refraction, Nicol prism, Production and analysis of plane, circular and elliptical polarized light, Retardation Plate.

Unit - IV

08 Hrs.

Modern Optics

Laser: Spontaneous and stimulated emission of radiation, population inversion, concept of 3 and 4 level Laser, construction and working of Ruby, He-Ne lasers and laser applications.

Fiber Optics: Fundamental ideas about optical fiber, Propagation mechanism, Acceptance angle and cone, Numerical aperture, Single and Multi Mode Fibers

Holography: Basic Principle of Holography, Construction and reconstruction of Image on hologram and applications of holography.

Reference Books:

1. Concepts of Modern Physics - Aurthur Beiser (Mc-Graw Hill)
2. Introduction to Special theory of - Robert Resnick - WIELLY
3. Optical Fibre & Laser - Anuradha De. (New Age)
4. Optics –Aloy Ghatak (Tata McGraw Hill Education Private Ltd. New Delhi)
5. Optics - Brijlal & Subramanian (S. Chand)
6. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New Delhi)

Unit-I Engineering Materials

Materials and Civilization, their socio economic impact. Engineering Materials their classification and applications. **1**

Metals & Alloys: Properties and Applications

Mechanical Properties of Materials: Strength, elasticity, plasticity, stiffness, malleability, ductility, brittleness, malleability, toughness, hardness, resilience, hardness, machine ability, formability, weld ability. Elementary ideas of fracture fatigue & creep. **2**

Steels and Cast Irons: Carbon steels, their classification based on percentage of carbon as low, mild, medium & high carbon steel, their properties & applications. Wrought iron. Cast iron. Alloy steels: stainless steel, tool steel. **2**

Alloys of Non Ferrous Metals: Common uses of various non-ferrous metals (Copper, Zinc, Tin, Magnesium, Lead, Aluminum etc.) & alloys and its composition such as Cu-alloys: Brass, Bronze, Al-alloys. **2**

Unit-II Basic Metal Forming & Casting Processes.

Forming Processes: Basic metal forming operations & uses of such as: Forging, Rolling, Wire & Tube-drawing/making and Extrusion, and their uses.

Press-work: Die & Punch assembly, cutting and forming, its applications.

Hot-working versus cold-working

4

Casting: Pattern: Materials, types and allowances. Type and composition of Molding sands and their desirable properties. Mould making with the use of a core. Gating system. Casting defects & remedies. Cupola Furnace. Die-casting and its uses. **3**

Unit-III Machining and Welding Operations and their Applications

Machining: Basic principles of Lathe-machine and operations performed on it. Basic description of machines and operations of Shaper-Planer, Drilling, Milling & Grinding. **4**

Welding: Introduction, classification of welding processes. Gas-welding, types of flames and their applications. Electric-Arc welding. Resistance welding. Soldering & Brazing processes and their uses. **3**

Unit-IV Misc. Topics/ Processes

Heat Treatment Processes: Introduction to Heat- treatment of carbon steels: annealing, normalizing, quenching, tempering and case-hardening.

Manufacturing Establishment: Plant location. Plant layout–its types. Types of Production. Production versus Productivity. **1**

Non-Metallic Materials: Common types & uses of Wood, Cement-concrete, Ceramics, Rubber, Plastics and Composite-materials. **3**

Misc. Processes: Introduction to Galvanizing and Electroplating. **1**

Reference Books:

1. "Processes and Materials of Manufacture", Lindberg, PHI
2. "Manufacturing Engineering And Technology", Kalpakjian and Schmid, Pearson
3. "Manufacturing Processes", Kalpakjian and Schmid, Pearson
4. "Manufacturing Processes", H. N .Gupta, R. C. Gupta, Arun Mital, New Age

UNIT-I: Nature of Environment

Introduction to Environmental Science - Definition and scope and need for public awareness Ecosystems Concept, structure and functions, restoration of damaged ecosystems

Biodiversity – Definition, description at national and global level, threats and conservation Natural Resources - Renewable and non-renewable and their equitable use for sustainability, Material cycles – carbon, nitrogen and sulphur cycle.

Conventional and Non-conventional Energy Sources – fossil fuel-based, hydroelectric, wind, -nuclear and solar energy, biomass, biodiesel, hydrogen as an alternative fuel

UNIT-II: Impact of Human Activity on Environment

Human Population and Environment – Population growth, population explosion and migration; Impact of farming, housing, mining, transportation and industrial growth

Social Issues Related to Environment– Sustainable development, urban problems (related to water and energy conservation and waste management), resettlement and rehabilitation Environmental ethics

UNIT-III: Environmental Changes and Human Health

Environmental Pollution–Definition, causes and effects, control measures for water, air, soil, marine, land, noise, thermal pollution,

Climate change– Greenhouse effect and global warming, acid rain, ozone layer formation and depletion Impact on human health – water and air borne diseases, diseases induced by residual impurities in drinking water (fluoride and arsenic); Toxic wastes and carcinogens; Nuclear hazards

UNIT- IV: Environmental Protection through Assessment and Education

Indicators and Impact Assessment – Bio-indicators, Natural disasters and disaster management, Impact assessment through inventorying and monitoring

Environmental Protection– Role of individuals, organizations and government in pollution control

Laws, Conventions and Treaties–National legislation, issues in the enforcement of environmental legislation, initiatives by non- governmental organizations, global efforts in environmental protection

Environmental education–women and value education

Recommended Textbook:

Environmental Studies, J Krishnawamy , R J Ranjit Daniels, Wiley India.

Recommended Reference Books:

1. Environmental Science, Bernard J. Nebel, Richard T. Right, 9780132854467, Prentice Hall Professional 1993.
2. Environment and Ecology, R K Khandal, 978-81-265-4277-2, Wiley India.
3. Environmental Science, 8th Ed ISV, Botkin and Keller, 9788126534142, Wiley India.
4. Environmental Studies, R Rajagopalan, 978-0195673937, Oxford University Press
5. Textbook of Environmental Science and Technology, M.Anjireddy, BS Publications
6. Environmental Studies, Soli. J Arceivala, Shyam, R Asolekar, 9781259006050, McGrawHill India, 2012.
7. Environmental Studies, D.L. Manjunath, 9788131709122 Pearson Education India, 2007
8. Textbook of Environment Ecology , Singh, Acme Learning
9. Perspective in Environmental Studies, Kaushik, New Age International
10. Environmental Studies, B. Joseph, 2nd Ed, 978-0070648134, Tata McGraw Hill

NAS-203 : Engineering Mathematics - II

L	T	P
3	1	0

Unit - 1: Differential Equations

Linear differential equations of n^{th} order with constant coefficients, Complementary function and Particular integral, Simultaneous linear differential equations, Solution of second order differential equations by changing dependent & independent variables, Normal form, Method of variation of parameters, Applications to engineering problems (without derivation).

Unit - 2: Series Solution and Special Functions

Series solution of second order ordinary differential equations with variable coefficient (Frobenius method), Bessel and Legendre equations and their series solutions, Properties of Bessel function and Legendre polynomials.

Unit - 3: Laplace Transform

Laplace transform, Existence theorem, Laplace transforms of derivatives and integrals, Initial and final value theorems, Unit step function, Dirac- delta function, Laplace transform of periodic function, Inverse Laplace transform, Convolution theorem, Application to solve simple linear and simultaneous differential equations.

Unit - 4: Fourier Series and Partial Differential Equations

Periodic functions, Fourier series of period 2π , Euler's Formulae, Functions having arbitrary periods, Change of interval, Even and odd functions, Half range sine and cosine series, Harmonic analysis. Solution of first order partial differential equations by Lagrange's method, Solution of second order linear partial differential equations with constant coefficients.

Unit - 5: Applications of Partial Differential Equations

Classification of second order partial differential equations, Method of separation of variables for solving partial differential equations, Solution of one and two dimensional wave and heat conduction equations, Laplace equation in two dimension, Equation of transmission lines.

Text Books:

1. **E. Kreyszig, : Advanced Engineering Mathematics, Volume-II, John Wiley & Sons**
2. **B. V. Ramana, Higher Engineering Mathematics, Tata Mc Graw- Hill Publishing Company Ltd.**
3. **R.K.Jain & S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House.**

Reference Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
2. Peter V. O' Neil, Advanced Engineering Mathematics, Thomas (Cengage) Learning.
3. Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudranalaya
4. A. C. Srivastava & P. K. Srivastava, Engineering Mathematics, Vol. – II, PHI Learning Pvt. Ltd.
5. Rukmangadachari, Engineering Mathematics – II, Pearson Education.

NBT-202: Remedial Biology-II

Unit-I:

Brief history of microbiology, Types of microorganisms, Basic idea of domain bacteria, proteobacteria, nonproteobacteria Gram –ve and Gram +ve bacteria, lichens, algae, protozoa, helminthes, viral structures, Viral multiplication, Role of microorganisms in the production of industrial chemicals and pharmaceuticals.

Unit-II:

Functional Anatomy of Prokaryotic and Eukaryotic Cells: Size, shape, and arrangement of bacterial cells. Structure and function of cells.

Unit-III:

Catabolic & anabolic reactions: enzymes, energy production and carbohydrate metabolism. Lipid & protein catabolism, Energy production mechanism, metabolic diversity & pathways of energy use. Integration of metabolism.

Unit-IV:

Energy Utilization: Structure of mitochondria, cellular respiration, relationship of carbohydrate metabolism to other compounds, Glycolysis, formation of acetyl co-A, Krebs cycle, Electron Transport System and Oxidative Phosphorylation, ATP, factors affecting respiration.

Unit-V:

Reproductive health and human welfare: Population and birth control, sexually transmitted diseases, infertility, Cancer and AIDS, Basic concepts of immunology, vaccines.

Recommended Text Book:

1. Biology-Textbook of Class XI, NCERT Publication
2. Biology-Textbook of Class XII, NCERT Publication
3. Microbiology- Pelzar, Tata Mcgraw- Hill Publishing Com. Ltd., 2002
4. An introduction to immunology by C.V. Rao, Narosa publishing house

Reference Book:

Biology by Peter H Raven, George b Johnson, Kenneth A., Mason, Jonathan Losos, Susan Singer (MacGraw Hill Publication)

General Microbiology: Stainier, Adelberq and Ingraham.

NAS-202: ENGINEERING PHYSICS- II

Unit - I

07 Hrs

Crystal Structures and X-ray Diffraction:

Space lattice, basis, Unit cell, Lattice parameter, Seven crystal systems and Fourteen Bravais lattices, Crystal-System Structure, Packing factor (cubic, body and face), Crystal structure of NaCl and diamond, Lattice planes and Miller Indices, Reciprocal Lattice, Diffraction of X-rays by crystal, Laue's experiment, Bragg's Law, Bragg's spectrometer.

Unit - II

08 Hrs

Dielectric and Magnetic Properties of Materials:

Dielectric Properties: Dielectric constant and Polarization of dielectric materials, Types of Polarization (Polarizability). Equation of internal fields in liquid and solid (One- Dimensional), Clausius Mussoiti-Equation, Frequency dependence of dielectric constant, Dielectric Losses, Important applications of dielectric material,

Magnetic Properties: Magnetization, Origin of magnetic moment, Dia, para and ferro magnetism, Langevin's theory for diamagnetic material, Phenomena of hysteresis and its applications.

Unit - III

06 Hrs.

Electromagnetic Theory

Displacement

Current, Equation of continuity, Maxwell's Equations (Integral and Differential Forms), Poynting theorem and Poynting vectors, EM - Wave equation and its propagation characteristics in free space, non-conducting and in conducting media, Skin depth.

Unit - IV

09 Hrs

Physics of some Technologically important Materials

Semiconductors: Band Theory of Solids, density of states, Fermi-Dirac distribution, free carrier density (electrons and holes), conductivity of semiconductors, Position of Fermi level in intrinsic and in extrinsic semiconductors.

Superconductors: Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Temperature dependence of critical field, Type I and Type II superconductors, BCS theory (Qualitative), High temperature superconductors and Applications of Superconductors.

Nano-Materials: Basic principle of nanoscience and technology, structure, properties and uses of Fullerene and Carbon nanotubes, Applications of nanotechnology.

Reference books:

1. Concept of Modern Physics - by Beiser (Tata Mc-Graw Hill)
2. Solid State Physics - by C. Kittel, 7th edition (Wiley Eastern)
3. Materials Science and Engineering - by V. Raghavan (Prentice- Hall India)
4. Solid State Physics - by S.O. Pillai, 5th edition (New Age International)
5. Introduction to Electrodynamics - by David J. Griffith (PH I)
6. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New Delhi)

NAS 152/ NAS 252 : ENGINEERING CHEMISTRY PRACTICALS

LIST OF EXPERIMENTS

1. Determination of alkalinity in the given water sample.
2. Determination of temporary and permanent hardness in water sample using EDTA as standard solution.
3. Determination of available chlorine in bleaching powder.
4. Determination of chloride content in water sample.
5. Determination of iron content in the given water sample by Mohr's method.
6. pH- metric titration.
7. Viscosity of an addition polymer like polyester by viscometer.
8. Determination of iron concentration in sample of water by calorimetric method. The method involves the use of KCN as a colour developing agent and the measurements are carried out at λ_{max} 480nm.
9. Element detection and functional group identification in organic compounds.
10. Preparation of Bakelite and Urea formaldehyde resin.

(Any 10 experiments of the following or similar experiments suitably designed)

1. To verify the law of parallelogram of forces.
2. To study the equilibrium of a body under three forces.
3. To determine the coefficient of friction of a flat surface.
4. Friction experiment on screw-jack.
5. Experiment based on analysis of truss.
6. To determine the mass moment of inertia of a rotating disc.
7. To conduct the tensile test and determine the ultimate tensile strength, percentage elongation for a mild steel specimen.
8. To conduct the Impact-tests (Izod / Charpy) on Impact-testing machine to find the Impact Strength of the specimen.
9. To determine the hardness of the given specimen using Vicker/Brinell/Rockwell hardness testing machine.
10. Simple & compound gear-train experiment.
11. Worm & worm-wheel experiment for load lifting.
12. Belt-Pulley experiment.
13. Bending of simply-supported and cantilever beams for theoretical & experimental deflection.
14. Dynamics experiment on momentum conservation
15. Dynamics experiment on collision for determining coefficient of restitution.
16. Experiment on Torsion of Rod/wire

List of Experiments

Note : A minimum of 10 experiments from the following should be performed

1. Verification of Kirchhoff's laws
2. Verification of (i) Superposition theorem (ii) Thevenin's Theorem (iii) Maximum Power Transfer Theorem.
3. Measurement of power and power factor in a single phase ac series inductive circuit and study improvement of power factor using capacitor
4. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
5. Measurement of power in 3- phase circuit by two wattmeter method and determination of its power factor.
6. Determination of parameters of ac single phase series RLC circuit
7. Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a single phase transformer
8. To study speed control of dc shunt motor using (i) armature voltage control (ii) field flux control.
9. Determination of efficiency of a dc shunt motor by load test \
10. To study running and speed reversal of a three phase induction motor and record speed in both directions.
11. To measure energy by a single phase energy meter and determine error.
12. To study P-N diode characteristics
13. To study full wave and half wave rectifier circuits with and without capacitor and determine ripple factors.
14. To study various logic gates (TTL)
15. To study Operational Amplifier as Adder and Subtractor
16. To study transistor as a switch

NCS-151/NCS-252 : Computer Programming Lab

7-5-13

1. WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained by the student.
2. WAP that calculates the Simple Interest and Compound Interest. The Principal , Amount, Rate of Interest and Time are entered through the keyboard.
3. WAP to calculate the area and circumference of a circle.
4. WAP that accepts the temperature in Centigrade and converts into Fahrenheit using the formula $C/5=(F-32)/9$.
5. WAP that swaps values of two variables using a third variable.
6. WAP that checks whether the two numbers entered by the user are equal or not.
7. WAP to find the greatest of three numbers.
8. WAP that finds whether a given number is even or odd.
9. WAP that tells whether a given year is a leap year or not.
10. WAP that accepts marks of five subjects and finds percentage and prints grades according to the following criteria:

Between 90-100%-----Print 'A'

80-90%-----Print 'B'

60-80%-----Print 'C'

Below 60%-----Print 'D'

11. WAP that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.
12. WAP to print the sum of all numbers up to a given number.
13. WAP to find the factorial of a given number.
14. WAP to print sum of even and odd numbers from 1 to N numbers.
15. WAP to print the Fibonacci series.
16. WAP to check whether the entered number is prime or not.
17. WAP to find the sum of digits of the entered number.
18. WAP to find the reverse of a number.
19. WAP to print Armstrong numbers from 1 to 100.
20. WAP to convert binary number into decimal number and vice versa.
21. WAP that simply takes elements of the array from the user and finds the sum of these elements.
22. WAP that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.
23. WAP to find the minimum and maximum element of the array.
24. WAP to search an element in a array using Linear Search.
25. WAP to sort the elements of the array in ascending order using Bubble Sort technique.
26. WAP to add and multiply two matrices of order nxn.
27. WAP that finds the sum of diagonal elements of a mxn matrix.
28. WAP to implement strlen (), strcat (),strcpy () using the concept of Functions.

29. Define a structure data type TRAIN_INFO. The type contain

Train No.: integer type

Train name: string

Departure Time: aggregate type TIME

Arrival Time : aggregate type TIME

Start station: string

End station : string

The structure type Time contains two integer members: hour and minute. Maintain a train timetable and implement the following operations:

- (i) List all the trains (sorted according to train number) that depart from a particular section.
- (ii) List all the trains that depart from a particular station at a particular time.
- (iii) List all the trains that depart from a particular station within the next one hour of a given time.
- (iv) List all the trains between a pair of start station and end station.

30. WAP to swap two elements using the concept of pointers.

31. WAP to compare the contents of two files and determine whether they are same or not.

32. WAP to check whether a given word exists in a file or not. If yes then find the number of times it occurs.

NEW-151/251 : WORKSHOP PRACTICE

L T P
[0 1 3]

- 1. Carpentry Shop:** 1. Study of tools & operations and carpentry joints. 2. Simple exercise using jack plane. 3. To prepare half-lap corner joint, mortise & tennon joints. 4. Simple exercise on woodworking lathe.
- 2. Fitting (Bench Working) Shop:** 1. Study of tools & operations 2. Simple exercises involving fitting work. 3. Make perfect male-female joint. 4. Simple exercises involving drilling/tapping/dieing.
- 3. Black Smithy Shop:** 1. Study of tools & operations 2. Simple exercises based on black smithy operations such as upsetting, drawing down, punching, bending, fullering & swaging.
- 4. Welding Shop:** 1. Study of tools & operations of Gas welding & Arc welding 2. Simple butt and Lap welded joints. 3. Oxy-acetylene flame cutting.
- 5. Sheet-metal Shop:** 1. Study of tools & operations. 2. Making Funnel complete with 'soldering'. 3. Fabrication of tool-box, tray, electric panel box etc.
- 6. Machine Shop:** 1. Study of Single point cutting tool, machine tools and operations. 2. Plane turning. 3. Step turning 4. Taper turning. 5. Threading
- 7. Foundry Shop:** 1. Study of tools & operations 2. Pattern making. 3. Mould making with the use of a core. 4. Casting

NCE-151/251 : Computer Aided Engineering Graphics

L T P

0 1 3

Introduction Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning line conventions and free hand practicing,

AUTO CAD, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP & LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints. **2 - Sheets**

Orthographic Projections

Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes **2 - Sheets**

Orthographic Projections of Plane Surfaces (First Angle Projection Only)

Introduction, Definitions—projections of plane surfaces—triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only. **1 - Sheet**

Projections of Solids (First Angle Projection Only)

Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions. **2-Sheets**

Sections And Development of Lateral Surfaces of Solids

Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP. **1 - Sheet**

Isometric Projection (Using Isometric Scale Only)

Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projection of tetrahedron, hexahedron(cube), right regular prisms, pyramids, cylinders, cones, spheres, cut spheres. **1-Sheet**

Text Books

1. Engineering Drawing - N.D. Bhatt & V.M. Panchal, 48th edition, 2005-Charotar Publishing House, Gujarat.
2. Computer Aided Engineering Drawing - S. Trymbaka Murthy, -I.K. International Publishing House Pvt. Ltd., New Delhi, 3rd revised edition- 2006.

Reference Books

1. Engineering Graphics - K.R. Gopalakrishna, 32nd edition, 2005- Subash Publishers Bangalore.
2. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production-Luzadder Warren J., Duff John M., Eastern Economy Edition, 2005-Prentice-Hall of India Pvt. Ltd., New Delhi.

Engineering Drawing – M.B. Shah, B.C.Rana, 2ndEdition,2

List of Experiments

Any ten experiments, at least four from each group.

Group -A

1. To determine the wavelength of monochromatic light by Newton's ring.
2. To determine the wavelength of monochromatic light with the help of Fresnel's biprism.
3. To determine the focal length of two lenses by nodal slide and locate the position of cardinal points.
4. To determine the specific rotation of cane sugar solution using polarimeter.
5. To determine the wavelength of spectral lines using plane transmission grating.
6. To study the polarization of light by simple reflection using laser.
7. Measurement of Wavelength of a laser (He- Ne) light using single slit diffraction.

Group – B

8. To determine the specific resistance of a given wire using Carey Foster's bridge.
9. To study the variation of magnetic field along the axis of current carrying - Circular coil and then to estimate the radius of the coil.
10. To verify Stefan's Law by electrical method.
11. To calibrate the given ammeter and voltmeter by potentiometer.
12. To study the Hall effect and determine Hall coefficient, carrier density and - mobility of a given semiconductor using Hall effect set up.
13. To determine the energy band gap of a given semiconductor material.
- 14 To determine E.C.E. of copper using Tangent or Helmholtz galvanometer.
15. To draw hysteresis curve of a given sample of ferromagnetic material and from - this to determine magnetic susceptibility and permeability of the given specimen.
16. To determine the ballistic constant of a ballistic galvanometer.
17. To determine the coefficient of viscosity of a liquid.
18. Measurement of fiber attenuation and aperture of fiber.
19. High resistance by leakage method.
20. Magnetic Susceptibility of paramagnetic solution.

NAS-154/NAS-254 : PROFESSIONAL COMMUNICATION LABORATORY PRACTICALS

L T P

0 0 2

Interactive and Communicative Practical with emphasis on Oral Presentation/Spoken Communication based on International Phonetic Alphabets (I.P.A.)

LIST OF PRACTICALS

1. Group Discussion: Practical based on Accurate and Current Grammatical Patterns.
2. Conversational Skills for Interviews under suitable Professional Communication Lab conditions with emphasis on Kinesics.
3. Communication Skills for Seminars/Conferences/Workshops with emphasis on Paralinguistics/ Kinesics.
4. Presentation Skills for Technical Paper/Project Reports/ Professional Reports based on proper Stress and Intonation Mechanics.
5. Official/Public Speaking based on suitable Rhythmic Patterns.
6. Theme- Presentation/ Key-Note Presentation based on correct argumentation methodologies.
7. Individual Speech Delivery/Conferences with skills to defend Interjections/Quizzes.
8. Argumentative Skills/Role Play Presentation with Stress and Intonation.
9. Comprehension Skills based on Reading and Listening Practicals on a model Audio-Visual Usage.

Reference Books

1. Bansal R.K. & Harrison: Phonetics in English, Orient Longman, New Delhi.
2. Sethi & Dhamija: A Course in Phonetics and Spoken English, Prentice Hall, New Delhi.
3. L.U.B.Pandey & R.P.Singh, A Manual of Practical Communication, A.I.T.B.S. Pub. India Ltd. Krishan Nagar, Delhi.
4. Joans Daniel, English Pronouncing Dictionary, Cambridge Univ. Press.

STUDY AND EVALUATION SCHEME
B.TECH. BIO-TECHNOLOGY
(Effective from the session: 2014-15)

2nd Year, Semester-III

S. No.	Subject Code	Name of Subject	Periods			Evaluation Scheme			Subject Total	Credit	
			L	T	P	Sessional Assessment		ESE			
						CT	TA				Total
THEORY SUBJECT											
1	NBT-301/ NOE-031-039	Elementary Mathematics-III/ Science based Elective	3	1	0	30	20	50	100	150	4
2	NBT-302	Fluid Flow and Solid Handling	3	1	0	30	20	50	100	150	4
3	NBT-303	Biochemistry	3	1	0	30	20	50	100	150	4
4	NBT-304	Microbiology & Cell Biology	3	1	0	30	20	50	100	150	4
5	NHU-301/ NHU-302	Industrial Psychology/ Industrial Sociology	2	0	0	15	10	25	50	75	2
6	NBT-305	Genetics & Molecular Biology	2	1	0	15	10	25	50	75	3
7	AUC-001/ AUC-002	<i>Human Values & Professional Ethics/Cyber Security</i>	2	0	0	15	10	25	50	75*	
PRACTICAL/DESIGN/DRAWING											
7	NBT-351	Fluid Flow and Solid Handling Lab	0	0	3	10	10	20	30	50	1
8	NBT-352	Biochemistry Lab	0	0	3	10	10	20	30	50	1
9	NBT-353	Microbiology & Cell Biology Lab	0	0	2	10	10	20	30	50	1
10	NBT-354	Genetics & Molecular Biology Lab	0	0	2	10	10	20	30	50	1
11	NGP-301	NGP						50		50	
		TOTAL	18	5	10					1000	25

L: Lecture T: Tutorial P: Practical/Project CT: Class Test TA: Teacher's Assessment, ESE: End Semester Examination

TA = 10 (5 for teachers assessment plus 5 for attendance)

TA = 20 (10 for teachers assessment plus 10 for attendance)

ESE (Practical) = 30 (10 marks for practical exam. 10 marks viva. 4 marks for lab records and 6 marks for quiz)

Science Based Open Elective:

NOE031 Introduction to Soft Computing (Neural Network, Fuzzy Logic and Genetic Algorithm)

NOE032 Nano Sciences

NOE033 Laser Systems and Applications

NOE034 Space Sciences

NOE035 Polymer Science & Technology

NOE036 Nuclear Science

NOE037 Material Science

NOE038 Discrete Mathematics

NOE039 Applied Linear Algebra

* Human Values & Professional Ethics will be offered as compulsory Audit Course for which passing marks are 40% in theory & 50% in aggregate. Student will be required to audit it within the period of their study. There will not be carry over facility for this course and a failed student will be required to repeat this course.

STUDY AND EVALUATION SCHEME
B.TECH. BIO-TECHNOLOGY
(Effective from the session: 2014-15)

2nd Year, Semester-IV

S. No.	Subject Code	Name of Subject	Periods			Evaluation Scheme			Subject Total	Credit	
			L	T	P	Sessional Assessment		ESE			
						CT	TA				Total
THEORY SUBJECT											
1	NOE-041-049/ NBT-401	Science based Elective/ Elementary Mathematics-III	3	1	0	30	20	50	100	150	4
2	NBT-402	Heat & Mass Transfer	3	1	0	30	20	50	100	150	4
3	NBT-403	Enzyme Engineering	3	1	0	30	20	50	100	150	4
4	NBT-404	Immunology	3	1	0	30	20	50	100	150	4
5	NHU-402/ NHU-401	Industrial Sociology/ Industrial Psychology	2	0	0	15	10	25	50	75	2
6	NBT-405	Molecular Dynamics & Bioenergetics	2	1	0	15	10	25	50	75	3
	AUC-002/ AUC-001	<i>Cyber Security/ Human Values & Professional Ethics</i>	2	0	0	15	10	25	50	75*	
PRACTICAL/DESIGN/DRAWING											
7	NBT-452	Heat & Mass Transfer Lab	0	0	3	10	10	20	30	50	1
8	NBT-453	Enzyme Engineering Lab	0	0	3	10	10	20	30	50	1
9	NBT-454	Immunology Lab	0	0	2	10	10	20	30	50	1
10	NBT-455	Molecular Dynamics & Bioenergetics Lab	0	0	2	10	10	20	30	50	1
11	NGP-401	GP						50		50	
		TOTAL	18	5	10					1000	25

L: Lecture T: Tutorial P: Practical/Project CT: Class Test TA: Teacher's Assessment, ESE: End Semester Examination

TA = 10 (5 for teachers assessment plus 5 for attendance)

TA = 20 (10 for teachers assessment plus 10 for attendance)

ESE (Practical) = 30 (10 marks for practical exam. 10 marks viva. 4 marks for lab records and 6 marks for quiz)

Science Based Open Elective:

NOE-041 Introduction to Soft Computing (Neural Network, Fuzzy Logic and Genetic Algorithm)

NOE-042 Nano Sciences

NOE-043 Laser Systems and Applications

NOE-044 Space Sciences

NOE-045 Polymer Science & Technology

NOE-046 Nuclear Science

NOE-047 Material Science

NOE-048 Discrete Mathematics

NOE-049 Applied Linear Algebra

* Human Values & Professional Ethics will be offered as compulsory Audit Course for which passing marks are 40% in theory & 50% in aggregate. Student will be required to audit it within the period of their study. There will not be carry over facility for this course and a failed student will be required to repeat this course.

DEPARTMENTAL ELECTIVES

Elective-I:

1. NBT-011: Nano Biotechnology
2. NBT-012: Molecular Modeling & Drug Design

Elective-II:

1. NBT-021: Pharmaceutical Biotechnology
2. NBT-022: Biofuel & Alcohol Technology

Elective-III:

1. NBT-031: Animal Biotechnology
2. NBT-032: Biomedical Instrumentation

Elective-IV:

1. NBT-041: Waste Treatment & Management
2. NBT-042: Agriculture Biotechnology

Elective-V:

1. NBT-051: Vaccine Technology & Immunoinformatics
2. NBT-052: Genomics & Proteomics

3rd Semester B.Tech. Biotechnology

NBT-301: Elementary Mathematics-III

L	T	P
3	1	0

Unit-I [08]

Data and Classification: Data type, Classification and summarization of data, Diagrams and Graphs, Measures of central tendency, Measures of dispersion, Moments, Skewness, kurtosis

Unit-II [08]

Probability and Distributions: Introduction to probability, Laws of probability, Baye's theorem, Expectation and Random variable, Binomial distribution, Poison distribution, Normal distribution

Unit-III [08]

Correlation, Regression and Tests: Correlation, Pearson and Mathew correlation, Coefficient, Co-efficient of correlation, Rank Correlation, Lines of regression, Linear and Non linear regression, Multiple regression, Non-Parametric tests, Sign test, Mann-Whitene Wilcoxon test

Unit-IV [08]

Tests of Hypothesis and ANOVA: Hypothesis tests, Student's t-test, Chi square test, F-test and ANOVA, One way and two way analysis of variants.

Unit-V [08]

Design and Quality Control: Principles of experimental design and analysis, Completely randomized design, Randomized block design, Latin square design, Statistical quality control, Types of quality control, Control chart for variables, Control chart for attributes

Text Books:

1. S. P. Gupta, Statistical Methods; Sultan Chand & Sons Publishers.
2. Geogr W. and William G., Statistical Methods; IBH Publication.
3. Ipsen J et al; Introduction to Biostatistics, Harper & Row Publication.
4. B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.

Reference Books:

1. N. T. J. Baily; Statistical methods in Biology; English University Press.
2. R. Rangaswami; A Text book of Agricultural statistics; New Age Int.Publication.
3. P. S. S. Sundar Rao; An Introduction to Biostatics; Prentice Hall.
4. Zar J; Biostatistics; Prentice Hall, London.

NBT-302: Fluid Flow and Solid Handling

L	T	P
3	1	0

Unit-I [08]

Properties of fluids, Fluid statics: Euler's equation, Hydrostatic Law, Fluid pressure and its measurement, Hydrostatic forces on surfaces, Transport of fluids, energy relationships, pipe fittings, major and minor losses in pipe flow.

Unit-II [08]

Fundamentals of fluid flow, Types of fluid flows, Fluid flow measurements: Orifice meter, Nozzel, Venturi meters, Rotameter and Pitot tube, Fluid flow through pipes.

Unit-III [08]

Methods of finding dimensional numbers - methods of governing equations, Method of force ratios and Buckingham's method, Outline of procedure for Buckingham Pi method, Physical significance of dimensionless numbers

Unit-IV [08]

Filtration: Theory, continuous and batch equipments. Flow of solids through fluids, clarification and sedimentation, Pumping and compressing: reciprocating pumps, rotary pumps, centrifugal Pumps and blowers, Introduction of fluidization

Unit-V [08]

Solids Handling: Properties of solids, screening, industrial screening equipment. Determination of particle size, screen analysis, size reduction of solids, stages of reduction, operating variables, intermediate and fine size reduction, power requirement and mechanism. Power driven machines: Crushers, grinders and conveyers.

Reference Book

1. Introduction of Fluid Mechanics by Robert W. Fox and Slan T. McDonald, John Willey & Sons, Ny. Fourth Ed.
2. Unit Operation in Chemical Engg., McCabe Smith Vth Ed.

Text Book

1. Hydraulics and Fluid Mechanics by Modi & Seth, Standard Book House, Delhi

NBT-351: Fluid Flow and Solid Handling Lab

L	T	P
0	0	3

1. Fluid flow measurement by Venturi meter
2. Fluid flow measurement by Orifice meter
3. Fluid flow measurement by Notches
4. Fluid flow measurement by Rotameter
5. Velocity measurement by Pitot tube
6. Experiment for justification of Bernoulli's theorem
7. Measurement of Vortex
8. Measurement of friction factor
9. Determination of equivalent length of fittings
10. Determination of pump characteristics
11. Measurement of Streamline flow

NBT-303: Biochemistry

L	T	P
3	1	0

UNIT-I (8)

Water - Structure, unusual properties, non-covalent interactions, role in biological processes. Ionization of Water, pH scale, Weak Acids, and Weak Bases. Buffers and buffering mechanism, Henderson Hasselbalch equation. Buffering against pH Changes in Biological Systems: Phosphate buffer, Bicarbonate buffer, Protein buffer, Amino acid Buffer & Hemoglobin Buffer System.

UNIT-II (8)

Carbohydrates – classification, structure and functions of monosaccharides, disaccharides and polysaccharides. Ring structure and mutarotation, stereo isomers and structural isomers. Metabolism – Glycolysis & oxidation of Pyruvate, TCA cycle, Gluconeogenesis, Pentose Phosphate Pathway, Oxidative phosphorylation, Disorder/ diseases of carbohydrate metabolism.

UNIT –III (8)

Fats and lipids – Classification, structure and function: Simple, Compound & Derived lipids, Essential fatty acids. Fatty acid synthesis, origin of acetyl-Co A for fat synthesis, Elongation & desaturation of Fatty Acids. Activation & transport of fatty acid from cytosol to mitochondria for oxidation. Oxidation of saturated & unsaturated fatty acids. , , oxidation. Formation and utilization of ketone bodies. Disorder/ diseases of lipid metabolism.

UNIT –IV (8)

Amino acids and proteins - Classification & structure of amino acids. Essential amino acids. Peptide bond formation, Ramachandran plot, Primary, secondary, tertiary & quaternary structure of proteins. Biosynthesis of amino acids from intermediates of Citric Acid Cycle & other major pathways. Biodegradation of amino acids: Deamination, transamination. Urea Cycle, Glucose-Alanine cycle. Disorder/ diseases of amino acids metabolism.

UNIT –V (8)

Purines and pyrimidines – Structure and properties. Metabolism of Nucleotides: Purines & Pyrimidines synthesis : de Novo & salvage pathway, Conversion of nucleoside monophosphates to nucleoside triphosphates, Formation of deoxyribonucleotides. Catabolism & salvage of Purine and Pyrimidine nucleotides. Disorder of purines and pyrimidines metabolism.

Text books:

1. Principles of Biochemistry: A.L. Lehninger, Nelson and Cox, McMillan Worth Publishers.
2. Harper's Biochemistry-Rober K. Murray, Daryl K. Grammer, McGraw Hill, Lange. Medical Books. 25th edition.
3. Biochemistry : S.C. Rastogi – Third Edition ; Tata McGraw Hill Education Pvt. Ltd. New Delhi.

Reference books & web sources:

1. Biochemistry: Stryer, W. H. Freeman
2. Biochemistry: Voet and Voet, John Wiley and Sons, Inc. USA
3. Biochemistry: Zubey, WCB.
4. Biochemistry: Garrett and Grisham, Harcourt.
5. <http://themedicalbiochemistrypage.org>
6. ull.chemistry.uakron.edu/biochem

NBT-352: Biochemistry Lab

L T P
0 0 3

1. Preparation of solutions: 1)percentage solutions, 2) molar solutions, 3) normal solutions
2. Standardization of pH meter, preparation of buffers, emulsions.
3. Spectroscopy: determination of absorption maxima (λ_{max}) of a given solution
4. Titration of weak acid-weak base
5. Quantitative estimation of carbohydrates
6. Distinguish reducing and non-reducing sugars
7. Quantitative estimation of proteins
8. Estimation of nucleic acids
9. Isoelectric precipitation
10. Separation of sugars, fatty acids and amino acids by paper chromatography
11. Extraction of lipids from plant material
12. Thin layer chromatography
13. Gel electrophoresis

Reference books

1. Wilson and Walker "Principles and Techniques of Practical Biochemistry" 4 Edn., Cambridge Knew pros 1997.
2. Plummer DT "An Introduction to Practical Biochemistry" III Edn., Tata McGrawhill

NBT-304: Microbiology & Cell Biology

L T P
3 1 0

UNIT – I

(8)

Morphology and Classification of bacteria. Culture media. Isolation and identification of microbes, culture techniques. Preservation of cultures.

UNIT-II

(8)

Physical and chemical methods for the control of microbes. Enumeration of bacteria. Microbial growth kinetics. Cell cultivation system. Strain improvement.

UNIT-III

(10)

Biological nitrogen fixation. Biofertilizers. Bacterial Photosynthesis :Photosynthetic structures, types of bacterial photosynthesis, photosynthesis pigments, photosynthetic electron transport system, photophosphorylation, dark phase of photosynthesis; CO₂ utilization.

UNIT-IV

(8)

Applications of microbiology. Environmental; Microbiology of domestic water and waste water. Microbes in bioremediation. Medical Microbiology: tuberculosis, typhoid, diarrhoea, amoebiosis, Rabies and Other applications.

UNIT-V

(6)

Cell organelles. Protein targeting, cell aging. Biology of cancerous cells.

Text books:

1. Microbiology by Pelczar (W C Brown publication)
2. Genral Microbiology by stainer (Mac Millan Publication)
3. Microbiology by Pawar and Dagniwala (Himalaya publishing House)

Reference books:

1. Microbiology –an introduction by Tortora (Pierson education Publication)
2. Industrial microbiology by Prescott and Dunn

NBT-353: Microbiology & Cell Biology Lab

L T P
0 0 2

1. Preparation of nutrient agar slants, plates and nutrient broth and their sterilization. (Microwave Oven, Heating mantles, Fridge, Heating Oven, Tube racks)
2. Inoculation of agar slants, agar plate and nutrient broth (Incubators, Water bath, Laminar hood, dry heat sterilizer i.e. bead sterilizer)
3. Culture of microorganisms using various techniques. (Shakers i.e. Cooling and Open shaker).
4. Simple and differential staining procedures, endospore staining, flageller staining, cell wallstaining, capsular staining, negative staining. (Moist chambers, spirit lamps, slides, loops & microscopes, haemocytometer)
5. Bacterial colony counting. (Moist chambers, spirit lamps, slides, loops & microscopes, haemocytometer)
6. Observation of different vegetative, capsular and spore forms of bacteria & fungus under various microscopes.
7. Isolation of microbes from soil samples and determination of the number of colony forming units. (U.V. spectrophotometer, Colony counter etc.)
8. Study of growth curve of *E. coli*
9. Microscopy
10. Identification and staining of different types of cells.
11. Measurement of various Cell Organelles.
12. Detection of Mitosis with the help of microscope.

Practical Books and References

1. Lab Manual in microbiology by P Gunasekaran (New Age Int. Pub.)

NBT-305: Genetics & Molecular Biology

L	T	P
2	1	0

UNIT I

Fundamental principles of genetics, gene interaction, multiple alleles, complementation, linkage, recombination and linkage mapping, extra-chromosomal inheritance, chromosomes basis of heredity, Sex determination, sex linked, sex limited and sex, influenced inheritance.

UNIT II

Gene structure, DNA & RNA as a genetic material, packaging of DNA as chromosome, central dogma of molecular biology, DNA replication, DNA repair. Linkage and recombination, crossing over and genetic mapping, gene mapping by two point and three point test crosses, Cell cycle regulation and apoptosis.

UNIT III

Genetic mutation, micro-deletion, Genetic syndrome, Techniques to detect mutation, Transcription, genetic code, translation, reverse transcription, mRNA processing. DNA replication process in prokaryotes & Eukaryotes, Activity of DNA polymerases and topoisomerases, Reverse transcriptase, Basic principles of gene cloning and r-DNA technology.

UNIT IV

Synthesizing mRNA from a DNA template, transcription unit, substrate for transcription, transcription apparatus, RNA polymerases, mechanism and regulation of transcription in prokaryotes and eukaryotes, Role of sigma factor in transcription, role of promoters and enhancers. The genetic code, properties of genetic code, wobble hypothesis, Molecular chaperones.

Text books:

1. Genetics a conceptual approach, 2ndEdition Benjamin A. Pierc W. H. freeman and company, New York.
2. Benjamin Levin – Genes VIII, 8 th ed.

Reference books:

1. Albert B, Bray Denis et al.: Molecular Biology of The Cell, latest ed.
2. Watson, Hopkin, Roberts et al.: Molecular Biology of the Gene, 4 th ed.
3. Genetics- Strickberger, 2 nd.
4. Baltimore- Molecular Biology of the Cell.
5. Advance Genetics by G.S. Miglani, Narosa Publishing House
6. Essentials of Molecular Biology 4thed, Malacinski, G. M. Jones & Bartlet publishers, Boston
7. Genetics A molecular approach 2ndEdition Peter J. Russell Pearson.
8. Concepts of Genetics seventh edition William S.Klug and Michael R. Cummings, Pearson.
9. Genetics 3rd edition by Monroe W. Strickberger PHI Learning Private Ltd.

NBT-354: Genetics & Molecular Biology Lab

L	T	P
0	0	2

1. Squash preparation of polytene chromosomes from insects' salivary gland
2. How to calculate genetics and allelic frequencies numeric problem analysis
3. Estimation of DNA content in the given sample by diphenylamine method.
(Nitrogen cylinders, -200C fridge, grinders, cooling centrifuges, etc.)
4. Estimation of RNA content by the Orcinol method.
5. Determination of T_m of DNA and RNA.
6. Isolation of Plasmid DAN.
7. Isolation of bacterial/fungal genomic DNA.
8. Isolation of plant DNA.
9. Purification of DNA through columns. (Sorval, Cyclomixer, Electrophoresis units both vertical & horizontal, transilluminator, U.V. Torch, Gel documentation system, Thermal cyclers etc.)
10. Polyacrylamide gel electrophoresis of DNA
11. PCR amplification of DNA and visualization by gel electrophoresis

4th Semester B.Tech. Biotechnology

NBT-401: Elementary Mathematics-III

L	T	P
3	1	0

Unit-I [08]

Data and Classification: Data type, Classification and summarization of data, Diagrams and Graphs, Measures of central tendency, Measures of dispersion, Moments, Skewness, kurtosis

Unit-II [08]

Probability and Distributions: Introduction to probability, Laws of probability, Baye's theorem, Expectation and Random variable, Binomial distribution, Poison distribution, Normal distribution

Unit-III [08]

Correlation, Regression and Tests: Correlation, Pearson and Mathew correlation, Coefficient, Coefficient of correlation, Rank Correlation, Lines of regression, Linear and Non linear regression, Multiple regression, Non-Parametric tests, Sign test, Mann-Whitene Wilcoxon test

Unit-IV [08]

Tests of Hypothesis and ANOVA: Hypothesis tests, Student's t-test, Chi squire test, F-test and ANOVA, One way and two way analysis of variants.

Unit-V [08]

Design and Quality Control: Principles of experimental design and analysis, Completely randomized design, Randomized block design, Latin square design, Statistical quality control, Types of quality control, Control chart for variables, Control chart for attributes

Text Books:

1. S. P. Gupta, Statistical Methods; Sultan Chand & Sons Publishers.
2. Geogr W. and William G., Statistical Methods; IBH Publication.
3. Ipsen J et al; Introduction to Biostatistics, Harper & Row Publication.
4. B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.

Reference Books:

1. N. T. J. Baily; Statistical methods in Biology; English University Press.
2. R. Rangaswami; A Text book of Agricultural statistics; New Age Int.Publication.
3. P. S. S. Sundar Rao; An Introduction to Biostatics; Prentice Hall.
4. Zar J; Biostatistics; Prentice Hall, London.

NBT-402: HEAT AND MASS TRANSFER

L	T	P
3	1	0

Unit I Conduction and Convection

Introduction, Conduction: Basic concepts of conduction in solids, liquids and gases, One and two dimensional heat conduction. Critical and optimum insulation thickness. Introduction to unsteady state heat transfer. Principles of convection, Equations of forced and free convection, Heat flow due to conduction & convection

Unit II Radiation

Basic laws of heat transfer by radiation, black body and gray body concepts, solar radiations, combined heat transfer coefficients by convection and radiation. Heat Transfer Equipments: Double pipe, Shell & tube and Plate type heat exchanger, Evaporator, Condenser.

Unit III Diffusion

Molecular and turbulent diffusion, Diffusion coefficient, Flick's Law of diffusion, Dependence of diffusion coefficient on temperature, pressure and composition, Diffusion in multi-component gas mixtures. Diffusion in solids: Molecular, Knudsen & surface diffusion Inter-phase mass transfer, Mass transfer coefficients, Mass transfer in fluidized bed reactor, flow past solids and boundary layers, Simultaneous heat and mass transfer system.

Unit IV Drying and Crystallization

Solid-gas equilibria, Different modes of drying operation, Types of batch and continuous dryer Definitions of moisture contents, Rate of batch drying, Time of drying, Mechanism of batch drying, Continuous drying. Classification of crystallizers, Equilibrium yield of crystallization, Heat and mass transfer rates in crystallization, Theories of crystallization, Factors governing nucleation and crystal growth rates, controlled growth of crystal.

Unit V Absorption and Adsorption

Gas-Liquid equilibrium, Henry's Law, Selection of solvents, Absorption in tray column, Graphical and analytical methods, Absorption in packed column, Design equation for packed column, HTU, NTU and HTEP concepts, Description of adsorption process and their application, Types of adsorption nature of adsorbents, Adsorption equilibrium isotherm and its kinetics, Stage wise and continuous contact adsorption operation operations, Determination of number of stages, Equipments.

Books Recommended

1. Holman, J.P.: "Heat Transfer" 9 th ed. McGraw Hill (1989).
2. Treybal, R "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, (1980).

Reference Books

1. McCabe Smith: Unit Operations in Chemical Engineering, McGraw Hill
2. Foust A. S. et.al., "Principles of Unit Operations" John Wiley (1980).

NBT-452: Heat and Mass Transfer Lab

L T P
0 0 3

List of Experiments

1. To find out the thermal conductivities of Metal rod.
2. To find the thermal conductivity of Composite cylinder.
3. To find out the thermal conductivity of Insulating powder.
4. To find the thermal conductivity of liquid / gases.
5. To determine the overall heat transfer coefficient in Parallel flow heat exchanger
6. To determine the overall heat transfer coefficient in Counter flow heat exchanger
7. To determine the overall heat transfer coefficient in Shell and Tube heat exchanger
8. To determine the overall heat transfer coefficient in Plate type heat exchanger
9. Any Experiment on natural convection
10. Any experiment on determination of emissivity
11. To visualize pool boiling apparatus to find out the heat transfer coefficient of boiling
12. To determine the drying characteristics of given sample

NBT-403: Enzyme Engineering

L T P
3 1 0

Unit-I (8)

Introduction to enzymes: Holoenzyme, apoenzyme, prosthetic group. Interaction between enzyme and substrate- lock and key model, induced fit model. Features of active site, activation energy, enzyme specificity and types. IUB system of classification and nomenclature of enzymes. Kinetics of single substrate reactions; Derivation of Michaelis -Menten equation, turnover number; determination of K_m and V_{max} (LB plot, ED plot), Importance of K_m & V_{max} ; Multi-Substrate reaction mechanisms.

UNIT-II (8)

Factors affecting the velocity of enzyme catalyzed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators. Enzyme inhibition: irreversible; reversible (competitive, uncompetitive and non competitive inhibition); Substrate and Product inhibition, Allosteric regulation of enzymes, concerted & sequential model; Deactivation Kinetics.

Unit-III (8)

Extraction of crude enzyme from plant, animal and microbial source; some case study. Purification of enzymes by the help of different methods. Methods of characterization of enzymes; criteria of purity. Unit of enzyme activity - definition and importance. Development of enzyme assays.

UNIT-IV (8)

Enzyme Immobilization: Adsorption, Matrix entrapment, Encapsulation, Cross linking, Covalent binding and their examples; Advantages and disadvantages of different immobilization techniques. Structure & stability of immobilized enzymes, kinetic properties of immobilized enzymes- partition effect, diffusion effect. Overview of applications of immobilized enzyme systems.

UNIT-V (8)

Enzyme Biosensors: elements of biosensors, three generations of biosensors, Types of biosensors: calorimetric, potentiometric, amperometric, optical and piezoelectric. Design of enzyme electrodes and their applications as biosensors in industry, health care and environment. Design of Immobilized Enzyme Reactors- Stirred tank reactors (STR), Continuous Flow Stirred Tank Reactors (CSTR), Packed- bed reactors (PBR), Fluidized-bed Reactors (FBR); Membrane reactors.

Text books:

1. Fundamentals of enzymology by Nicolas C. price and Lewis stevens . Oxford University Press
2. Enzymes by Trevor palmer, East west Press
3. Enzyme Technology by Messing

Reference books:

1. Enzymes: Dixon and Webb. (IRL Press)
2. Enzyme technology by Chaplin and Bucke. Cambridge Univerity Press
3. Biochemical engineering fundamentals, second edition. James E Bailey, David F., Ollis, McGraw Hill Intl. Edition

NBT-453: Enzyme Engineering Lab

L T P
0 0 3

1. Isolation of Enzyme from different microorganism
2. Isolation of alpha amylase from plant source
3. Determination of Enzyme activity
4. Effect of pH on Enzyme kinetics
5. Effect of temperature on Enzyme kinetics
6. Identification of Enzyme by different assay
7. Purification of enzymes by different methods
8. Immobilization of Enzyme by sodium Alginate method
9. Enzyme inhibition

Reference books

1. "An Introduction to Practical Enzyme Engineering" Tata McGraw-Hill.
2. <http://www.eng.umd.edu/~nsw/ench485/ench485.htm>

NBT-404: Immunology

L T P
3 1 0

UNIT I **(8)**

Introduction to immunity, Characteristics of innate and adaptive immunity, Humoral and Cell mediated immune response, Hematopoiesis, Cells and Molecules of the immune system, Primary and Secondary lymphoid organs, Inflammation, Characteristics of T&B cell epitopes, T &B cell maturation, activation and differentiation.

UNIT II **(8)**

Characteristics and types of Antigens, Factors affecting the immunogenicity, Haptens and adjuvants, ABO blood group antigens, Epitopes, Structure, functions and characteristics of different classes of antibodies, Antigenic Determinants on Immunoglobulins.

UNIT III **(8)**

Structure and Function of MHC molecules, Exogenous and Endogenous pathways of antigen processing and presentation, Complement system, Structure, function and application of cytokines, regulation of immune response, immune tolerance.

UNIT IV **(8)**

Antigen and antibody interactions, cross reactivity, precipitation reactions, serological techniques – ELISA, RIA and western blotting Production and application of monoclonal antibodies, Vaccines.

UNIT V **(8)**

Immunity against infectious diseases (virus, bacteria and protozoan), Hyper-sensitivity, Autoimmunity, Cancer, AIDS and Transplantation immunology.

Text books:

1. Immunology and immunotechnology by Ashim k. Chakravarty (Oxford university Press)
2. Immunology by C. Fatima
3. Immunology by Kuby (Free man publication)

Reference books:

1. Essentials of immunology by Roitt (Blackwell scientific publication)
2. Immunology by Benacera

NBT-454: Immunology Lab

L	T	P
0	0	2

1. To determine the blood group of given blood
2. To determine the Rh factor of given blood
3. To perform single radial immunodiffusion
4. To perform double immunodiffusion
5. To perform rocket immune electrophoresis
6. To perform counter current immune electrophoresis
7. To perform Sand-witch ELISA
8. To perform Indirect ELISA
9. To perform Competitive ELISA
10. To prepare the blood smear and stain with leishman stain
11. To identify the blood cells/ immune cell with the help of leishman stain
12. To perform differential count (DLC) of given sample

Reference books

1. Handbook of Experimental Immunology, Vol. I & II, IV- Blackwell Scientific Publications.
2. Practical Immunology- Hudson L. and Hay H. C. Blackwell Scientific Publications.
3. Hybridoma Techniques: A Lab Course- Muthukkaruppan Vr, Basker S and F. Singilia. Macmillan India Ltd.

NBT-405: Molecular Dynamics & Bioenergetics

L T P
2 1 0

Unit-I (8)

Biological membrane: structure, permeability, properties, passive transport and active transport, facilitated transport, energy requirement, mechanism of Na⁺/ K⁺, glucose and amino acid transport; Organization of transport activity in cell; Active potentials; Role of transport in signal transduction processes, Signal Transduction.

Unit II (8)

Cell Movement: Structure and organization of Actin Filament. Association of actin filament with Plasma Membrane. Protrusions of cell surface Actin, Myosin and Cell Movement, Muscle Contraction, Cell Crawling

Unit III (10)

Metabolism and bioenergetics; Generation and utilization of ATP; Metabolism of Nitrogen containing compounds, nitrogen fixation, amino acids and nucleotides; Energetics of Metabolic Pathways; Electron- Transferring Reactions, Energy Coupling (ATP & NADH).

UNIT IV (14)

Stoichiometry and energetic analysis of Cell Growth and Product Formation, Electron Flow as source of ATP Energy, Site of Oxidative Phosphorylation, ATP synthetase, Electron- Transferring Reactions, Standard Oxidation, Electron Carrier, electron transport, Complexes Incomplete reduction of Oxygen, Mechanism of Oxidative Phosphorylation

Text books to be used:

- 1-Cell – A molecular approach: Geoffrey M. Cooper.
- 2-Biochemical Engineering Fundamentals: Bailey & Ollis, Tata McGraw –Hill.

Reference books & web sources:

1. Biochemistry: Stryer, W. H. Freeman
2. Biochemistry: Voet and Voet, John Wiley and Sons, Inc. USA
3. Cell: Bruce Albert.
4. Biochemistry: Garrett and Grisham, Harcourt.
5. <http://themedicalbiochemistrypage.org>
6. ull.chemistry.uakron.edu/biochem

NBT-455: Molecular Dynamics & Bioenergetics Lab

L T P
0 0 2

1. Selective Permeability of an Artificial Membrane.
2. Demonstration of the process of Active Transport.
3. To study the Demonstration of osmosis.
4. Effect of molecular size on permeability of the cell membrane.
5. Observation of osmosis under microscope.
6. Identifying the conditions needed for photosynthesis.
7. To study the extraction of starch. by green leaves.
8. Investigating factors affecting the rate of photosynthesis.
9. Investigating the light dependent reaction in photosynthesis.
10. To study the Isolation of Chloroplasts from spinach Leaves.
11. To study the structure & Function of refrigerated centrifuge
12. To study the structure & Function of Phase contrast microscope.

U.P. TECHNICAL UNIVERSITY, LUCKNOW

Study and Evaluation Scheme B.TECH. BIOTECHNOLOGY

(Effective from the session: 2015-16)

3rd Year, Semester-V

S. No.	Subject Code	Name of Subject	Periods			Evaluation Scheme			Subject Total	Credit	
			L	T	P	Sessional Assessment					ESE
						CT	TA	Total			
THEORY SUBJECT											
1	NBT-501	Genetic Engineering	3	1	0	30	20	50	100	150	4
2	NBT-502	Bioinformatics-I	3	1	0	30	20	50	100	150	4
3	NBT-503	Bioprocess Engineering	3	1	0	30	20	50	100	150	4
4	NBT-504	Plant Biotechnology	3	1	0	30	20	50	100	150	4
5	NBT-505	Modern Analytical Techniques	2	1	0	15	10	25	50	75	3
6	NHU-501	Engineering Economics	2	0	0	15	10	25	50	75	2
PRACTICAL/DESIGN/DRAWING											
7	NBT-551	Genetic Engineering Lab	0	0	3	10	10	20	30	50	1
8	NBT-552	Bioinformatics-I Lab	0	0	2	10	10	20	30	50	1
9	NBT-553	Bioprocess Engineering Lab	0	0	3	10	10	20	30	50	1
10	NBT-554	Plant Biotechnology Lab	0	0	2	10	10	20	30	50	1
11	NGP-501	GP						50		50	
		TOTAL	16	5	10					1000	25

L: Lecture T: Tutorial P: Practical/Project CT: Class Test TA: Teacher's Assessment, ESE: End Semester Examination

TA = 10 (5 for teachers assessment plus 5 for attendance)

TA = 20 (10 for teachers assessment plus 10 for attendance)

ESE (Practical) = 30 (10 marks for practical exam. 10 marks viva. 4 marks for lab records and 6 marks for quiz)

U.P. TECHNICAL UNIVERSITY, LUCKNOW

Study and Evaluation Scheme B.TECH. BIOTECHNOLOGY

(Effective from the session: 2015-16)

3rd Year, Semester-VI

S. No.	Subject Code	Name of Subject	Periods			Evaluation Scheme			Subject Total	Credit	
			L	T	P	Sessional Assessment					ESE
						CT	TA	Total			
THEORY SUBJECT											
1	NBT-601	Fermentation Biotechnology	3	1	0	30	20	50	100	150	4
2	NBT-602	Environmental Biotechnology	3	1	0	30	20	50	100	150	4
3	NBT-603	Bioinformatics-II	3	1	0	30	20	50	100	150	4
4	NBT-011/NBT-012/NBT-013	Departmental Elective-I	3	1	0	30	20	50	100	150	4
5	NBT-021/NBT-022/NBT-023	Departmental Elective-II	2	1	0	15	10	25	50	75	3
6	NHU-601	Industrial Management	2	0	0	15	10	25	50	75	2
PRACTICAL/DESIGN/DRAWING											
7	NBT-651	Fermentation Biotechnology Lab	0	0	3	10	10	20	30	50	1
8	NBT-652	Environmental Biotechnology Lab	0	0	2	10	10	20	30	50	1
9	NBT-653	Bioinformatics-II Lab	0	0	2	10	10	20	30	50	1
10	NBT-654	Seminar	0	0	3		50	50		50	1
11	NGP-601	GP						50		50	
		TOTAL	16	5	10					1000	25

L: Lecture T: Tutorial P: Practical/Project CT: Class Test TA: Teacher's Assessment, ESE: End Semester Examination

TA = 10 (5 for teachers assessment plus 5 for attendance)

TA = 20 (10 for teachers assessment plus 10 for attendance)

ESE (Practical) = 30 (10 marks for practical exam. 10 marks viva. 4 marks for lab records and 6 marks for quiz)

DEPARTMENTAL ELECTIVES

Elective-I:

1. NBT-011: Nano Biotechnology
2. NBT-012: Biotechnology in Health Care
3. NBT-013: Molecular Modeling & Drug Design

Elective-II:

1. NBT-021: Pharmaceutical Biotechnology
2. NBT-022: Developmental Biology
3. NBT-023: Biofuels & Alcohol Technology

5th Semester B.Tech. Biotechnology

NBT-501: Genetic Engineering

L	T	P
3	1	0

Unit I (6)

Gene cloning -concept and basic steps; application of bacteria and viruses in genetic engineering; Molecular biology of *E. coli* and bacteriophages in the context of their use in genetic engineering,

Unit II (10)

Restriction modification enzymes used in recombinant DNA technology, endonucleases, ligases and other enzymes useful in gene cloning, Vectors: plasmid, bacteriophage and other viral vectors, cosmids, Ti plasmid, yeast artificial chromosome, Bacterial Artificial Chromosome, Use of *Agrobacterium* for genetic engineering in plants; PCR technology for gene/DNA detection, cDNA and genomic DNA library: DNA delivery methods -physical methods and biological methods, Genetic transformation of prokaryotes: Transferring DNA into *E. coli* –Chemical induction and Electroporation.

Unit III (10)

DNA hybridization, DNA labeling , DNA fingerprinting; Southern and northern blotting; In-situ hybridization immunological assay and protein activity, Marker genes: Selectable markers and Screenable markers, nonantibiotic markers, Gene expression in prokaryotes & eukaryotes, Tissue specific promoter, wound inducible promoters, Strong and regulatable promoters; increasing protein production, Transposons and gene targeting, DNA sequencing methods Molecular markers: RAPD; RFLP; AFLP, SNP Sitedirected mutagenesis.

Unit IV (6)

Gene isolation; Gene cloning; Expression of cloned gene Single cell nuclear transfer (SCNT) procedures and the cloning of sheep (Dolly) & other mammals; applications in conservation; therapeutic vs. reproductive cloning; ethical issues and the prospects for human cloning, Gene therapy

Unit V (8)

Basic concepts of cell signaling, Extracellular signal molecule and their receptors, Operation of signaling molecules over various distances, Cellular response to specific combinations of extracellular signal molecules; Nuclear receptor; Ion channel linked, G-protein mediated receptors, Relay of signal by activated cell surface receptors via intracellular signaling proteins, Intracellular signaling proteins as molecular switches.

Text books and references:

1. DNA cloning 1 and 2. Glover, D.M. and Hames, B.D. 1995. IRL Press (Oxford University Press, USA).
2. Molecular Cloning, A laboratory Manual. Sambrook, J., Fritsch, E.F., Mariatis.3rd edition.

2001. Cold Spring Harbor Laboratory, USA.
3. Recombinant DNA. Watson, 1992.
4. Molecular Biology of the Cell (4th edition). Alberts, Johnson, Lewis, Raff, Roberts and Walter.
5. Advanced Genetics, G.S. Miglani, Narosa Publishing House, 2002.
6. DNA Science, David A. Micklos, Grog. A Freyer, I.K. International Pvt. Ltd, 2005.
7. Frontiers in Plant Science, K.G. Mukerji etal, I.K. International Pvt. Ltd, 2005.
8. Schaum's - Molecular & Cell Biology, Gregory B. Ralston, William D. Stan's field, TMH Publication, 2005.
9. Schaum's – Genetics, Susan Elrod, William Stan's field, TMH Publication, 2005.
10. Principle of Genetics, Robert H. Tamarin, TMH Publication, 2006.
11. Genetics, C. Sarin, TMH Publication, 2001.

NBT-551: Genetic Engineering Lab

L	T	P
0	0	3

1. Estimation of DNA by diphenylamine reaction
2. Determination of RNA by orcinol method
3. To isolate plant DNA using CTAB.
4. Elution of plant DNA fragment from agarose gel
5. To perform restriction digestion of λ DNA
6. Dephosphorylation of restriction enzyme digested vector pUC18.
7. To make bacterial cells competent for transformation
8. To perform of transformation of the desired bacterial strain with plasmid DNA
9. SDS-PAGE of proteins under reducing conditions (SDS-PAGE)
10. To perform Southern Hybridization
11. To perform ligation of λ *EcoRI* digest using T₄ DNA *ligase*

NBT-502: Bioinformatics-I

L	T	P
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Unit I

Introduction to Bioinformatics; Biological databases: Nucleotide databases, Protein databases, Specialized databases; Laboratory data submission and data retrieval; Various file formats for bio-molecular sequences: Genbank, EMBL, Fasta, GCG, msf, nbrf-pir etc.; Basic concepts of sequence similarity: identity and homology, definitions of homologues, orthologues, paralogues; Sequence patterns and profiles: Basic concept and definition of sequence patterns, motifs, domains and profiles; various types of pattern representations viz. consensus, regular expression (prosite-type) and profiles. [10]

Unit II

Sequence Alignment: Pairwise sequence alignments: Dot matrix for sequence alignment, Dynamic programming for Local and Global alignment; Multiple sequence alignment: progressive method and Iterative method; Applications of pairwise and multiple sequence alignment; Tools for multiple sequence alignment: CLUSTALW and Pileup (Algorithmic concepts). [08]

Unit III

Scoring Matrices: Basic concept of a scoring matrix, Similarity and distance matrix, Substitution matrices: Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, principles based on which these matrices are derived; Sequence-based database searches: Need of sequence-based database search, BLAST and FASTA algorithms, Various versions of basic BLAST and FASTA, Advance version of BLAST: PHI-BLAST and profile-based database searches using PSI-BLAST. [10]

Unit IV

Phylogenetics: Phylogeny and concepts in molecular evolution; nature of data used in taxonomy and phylogeny; definition and description of Phylogenetic trees and various types of trees; Concept of dendrograms and their interpretation, Different methods of Phylogenetic tree construction: UPGMA and Fitch-Margoliash Algorithm; case studies in phylogenetic sequence analysis. [06]

Unit V

Protein structure prediction: Secondary structure prediction (Statistical method: Chou Fasman and GOR method, Neural Network and Nearest neighbor method) and Tertiary structures prediction (Homology Modeling); Structure visualization methods (RASMOL, CHIME etc.); Protein Structure alignment and analysis. Application of bioinformatics in drug discovery and drug designing. [08]

Text books and References

1. O' Reilly; Developing Bioinformatics computer skills- 1st Indian edition, SPD publication.
2. Anthony J.F. Griffiths et al; An introduction to genetic analysis, 1st Ed.
3. Michael Starkey and Ramnath Elasarapu; Genomics protocols, Humana press.

4. Stephen Misner & Stephen Kraetz; bioinformatics- Methods and protocols, Humana press.
5. Lawrence Hunter –Artificial intelligence & Molecular Biology, free on web
6. Westhead, P; instant notes in bioinformatics; viva publications.
7. Hooman H Rasid; Bioinformatics basics- Application in biological science and medicine; CRC press.
8. D.W.Mount; Bioinformatics- Sequence and genome analysis; Cold Spring Harbour Lab press.

NBT-552: Bioinformatics-I Lab

L	T	P
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1. Get five nucleotide and five protein sequences in FASTA format from NCBI and EMBL.
2. To find out five similar sequences for any nucleotide and protein query sequence using BLAST and FASTA.
3. Access and use of different online nucleotide and protein alignment tools (Pairwise and Multiple sequence alignment).
4. Genes and Exons identification related search for a given genome sequence in order to predict the gene.
5. ORF prediction in the given nucleotide sequence.
6. Secondary structure prediction for given amino acid sequences of a given protein using Chou Fasman, GOR method and Neural Network method.
7. Visualize tertiary structure of any given protein sequence.
8. Carry out the alignment of genomes of given organisms.
9. Predict the homology model of any protein sequence.

Text books and References

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by *Andreas D. Baxevanis*
2. Structural Bioinformatics by Philip E Bourne, John Wiley & Sons
3. Analytical Tools for DNA, Genes & Genomes: by Arseni Markoff, New Age.

NBT-503: Bioprocess Engineering

L **T** **P**
3 **1** **0**

Unit I (8)

Media Preparation, Media design and optimization. Microbial growth patterns and kinetics in batch culture, Microbial growth parameters, Environmental conditions affect growth kinetics, Kinetics of thermal death of microorganisms, Heat Generation by microbial growth, Quantitative analysis of microbial growth by direct & indirect methods.

Unit II (8)

Sterilization: concept and methods. Type of Sterilizations, Batch heat sterilization of liquids, Estimation of sterilizer efficiency, Continuous heat sterilization of liquids, Sterilization of air: Methods & Mechanism, Design of depth filter and estimation of its efficiency. Stoichiometric calculations, Theoretical prediction of yield coefficients, Stoichiometry of growth and product formation, Maximum possible yield, Theoretical oxygen demand, Stoichiometry of single-cell protein synthesis.

Unit III (8)

Ideal Reactor Operation: Batch, Fed Batch & Continuous operation of mixed bioreactors, Microbial pellet formation, Kinetics and dynamics of pellet formation. Chemostate with immobilized cells, Chemostate with cell recycle, substrate utilization and product formation in bioreactor.

Unit IV (8)

Role of diffusion in Bioprocessing, Convective mass transfer, Gas-liquid mass transfer, Oxygen uptake in cell cultures, Factor affecting cellular oxygen demand, Oxygen transfer in bioreactors, Measurement of volumetric oxygen transfer coefficient, Oxygen transfer in large bioreactor.

Unit V (8)

Bioreactor control mechanism, Physical, Chemical and Biological environment of bioreactor, Manual control system, Role of physical, chemical & biological sensors, Advanced control strategies viz. PID controllers, Fuzzy logic based controllers and artificial neural network based Controllers. Basic concepts of computer modeling and optimization in bioprocess applications.

Text Books and Reference Books

1. Principles of Microbe and cell cultivation- S. John Pirt, Butterworth Publication.
2. Bioprocess Engineering Principles – P. M. Doran, 5th ed.
3. Hand Book Of Bioengineering- Skalak R & Shu Chien, 4th ed.
4. Biochemical Engg. Bailly & Ollis, Academic Press
5. Introduction to Chemical Engg. Series, MCH Int. Series.
6. Biochemical & Biological Engg. Science, N. Blakebraugh, Academic Press
7. "Principles of fermentation technology" by P F Stanbury and A Whitaker, Pergamon press.

8. "Bioprocess Technology - Kinetics & Reactors" by A Moser, Springer-Verlag.
9. "Biochemical Engineering and Biotechnology Handbook" by B. Atkinson & F. Mavituna, 2nd Ed. Stockton Press.
10. Biochemical Engineering- S. Aiba , A.E. Humphray, University of Tokyo Press.
11. Bioreactor Design & Product Yield, BIOTOL Series
12. Bioreactors in Biotechnology: A Practical approach by Scragg
13. Process Biotechnology Fundamentals by S.N. Mukopadhyay
14. Bioprocess Engineering: Basic Concepts by Shular & Kargi
15. Fermentation Microbiology & Biotechnology by Mansi

NBT-553: Bioprocess Engineering Lab

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1. Determine the growth patterns and specific growth rate of *E.coli*
2. Determine the effect of peptone concentration on *E.coli.* growth
3. Determination of specific thermal death rate constant (k_d) for *E.Coli*
4. Determine the effects of temperature & pH on *Pseodomonas putida*
5. Upstream and Downstream of bioprocess for the production of Citric acid by *Aspergillus niger*
6. Citric acid production from whey with glucose as supplementary carbon source by *Aspergillus niger*
7. Upstream and Downstream of bioprocess for the production of α -amylase by *Aspergillus nudulans*
8. Estimation of volumetric liquid mass transfer coefficient (K_{La}) using sodium sulphite method.
9. Preparation of immobilized enzymes & cells and evaluation of kinetic parameters.
10. Computational Design of Fermentative Process for l-Lysine production

NBT-504: Plant Biotechnology

L T P
3 1 0

Unit I (8)

Introduction, history & importance of Plant tissue culture techniques. Principles of Plant Tissue Culture. Concepts of totipotency, competency, determinism, explants, inoculums, Acclimatization. Requirements for a Plant Tissue Culture lab.

Unit II (10)

Nutrient media: Composition of commonly used nutrient culture media with respect to their contents like inorganic chemicals, organic constituents, vitamins, amino acids, Unidentified supplements, carbohydrate for energy source, phytohormones, complex substances, Activate charcoal etc. An appraisal of different media, selection of media, Hormones: Auxins, cytokinins, Gibberellins, Abscisic Acid, ethylene. Surface sterilization. Basic procedure for Aseptic Tissue transfer. Sterilisation of the media. Inoculation of culture.

Unit III (8)

Culture of plant materials- explants selection and technique of culturing the same. Growth conditions. Harvesting and Growth Measurements, organogenesis, Embryogenesis, Somaclonal variation, germiclonal variation, Androgenesis and Gynogenesis, protoplast culture. Callus and cell culture, Dynamics of callus growth, callus subculture and maintenance. Methods of sub culturing and transfer of regenerated plants to the field.

Unit IV (6)

Micro propagation: Proliferation of axillary buds, induction of adventitious buds and bulbs, callus regeneration, somatic embryogenesis, continuous culture, immobilized cultures, estimation of growth and artificial seeds.

Unit V (8)

Cloning: Isolation of single cells, culturing of single cell- different methods, culture cell viability test. Cryopreservation and slow growth cultures, Freezing and storage, thawing, reculture. Application of plant tissue culture in transgenic plants and production of secondary metabolites and industrial products.

References:

1. Hudson T Hartmann: Plant Propagation-Principle and Practices
2. Principles of Plant Biotechnology- An Introduction of Genetic Engineering in Plants by S.H. Mantell, J.W. Mathews and R.A. Mckee, Blackwell Scientific Publications.
3. Chopra V L, Sharma R P & Swaminathan M S: Agricultural Biotechnology
4. Hamish A, Collin & Sue Edwards: Plant Cell Culture
5. Razdan M K: An Introduction to Plant Tissue Culture
6. Introduction to Plant Tissue Culture, Bhojwani and Rozdan.

NBT-554: Plant Biotechnology Lab

L T P
0 0 2

1. Study of laboratory equipments used in plant tissue culture lab.
2. Sterilization techniques in plant tissue culture
3. Preparation of Stocks solution.
4. Preparation of Plant Tissue Culture Media.
5. Explant selection, treatment and inoculation
6. Subculture of initiated cultures
7. Acclimatization of cultures
8. Extraction of proteins from plants and its estimation
9. Extraction of DNA/RNA from plants and its estimation
10. Estimation of peroxidase activity in plants

NBT-505: Modern Analytical Techniques

L T P
2 1 0

Unit-I (8)

Separation Techniques, Principle and Operations of Ion Exchange Chromatography, High Performance Liquid Chromatography (HPLC), Gas Liquid Chromatography (GLC), Gel Filtration Chromatography, Affinity Chromatography, Membrane Separation, Ultrafiltration.

Unit II (8)

Electrophoresis, Theory of Electrophoresis, Electrophoresis of Protein, PAGE, SDS-PAGE, Agarose Electrophoresis of Nucleic Acid, Isoelectric Focusing of Protein Pulse Gel Electrophoresis and Western Blotting.

Unit III (12)

Spectroscopy: General Principles, Types of spectra and their biochemical usefulness; Electromagnetic radiation and spectrum, Beer-Lamberts law, UV-VIS spectrophotometer, Atomic absorption and Atomic emission spectroscopy, Circular Dichroism (CD)-Principles, instrumentation and applications, Basics of IR and NMR, Basics of X-Ray diffraction Analysis

Unit IV (12)

Centrifugation: Theory of centrifugation and sedimentation, use and design of different types of rotors; Types of centrifuges, Preparative and analytical centrifugation; Density gradient centrifugation (zonal and isopycnic), Differential Centrifugation, Application of centrifugation for preparative and analytical purpose.

Text Books and Reference Books

1. Wilson, K, Walker, J.: Principles and Techniques of Practical Biochemistry. 5th Ed. - Cambridge University Press,. Cambridge 1999.
2. Biotechniques: Theory & Practice: Second Edition by SVS Rana, Rustogi Publications.
3. Biochemical Methods of Analysis : Saroj Dua And Neera Garg : Narosa Publishing House, New Delhi.
4. Bioanalytical Techniques : M.L. Srivastava ; Narosa Publishing House, New Delhi.
5. Hobert H Willard, D.L. Merritt and J.R.J.A. Dean, instrumental methods of analysis, CBS Publishers and Distributors, 1992
6. Handbook of Analytical Techniques Published Online: 2008. Helmut Günzler, Alex Williams. Wiley Interscience.

6th Semester B.Tech. Biotechnology

NBT-601: Fermentation Biotechnology

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3	1	0

Unit I

(8)

Introduction to fermentation technology: Interaction between chemical engineering, Microbiology and Biochemistry. History and development of fermentation industry: Introduction to submerged and solid state fermentation, Microbial culture selection for fermentation processes. Bioprocess economics. Bioproduct regulation. General fermentation economics.

Unit II

(8)

Raw material availability, quality, processes and pretreatment of raw materials. Applications of the nonconventional raw materials (cellulosic material and hydrocarbons).

Unit III

(8)

Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes. Induction, nutritional repression, carbon catabolite repression, crabtree effect, feedback inhibition and feedback repression.

Unit IV

(8)

Creation/procedures for developing mutants of the desired microbes with the stable capacity of producing desired metabolites. Isolation and preservation of different types of mutants induction resistant, feedback inhibition resistant. Concept for overproduction of metabolites.

Unit V

(8)

General Concepts of Scale up & Scale down in fermentation process, Criterion of scale up of various fermentors, Details of the process, parameters and materials -for the industrial manufacture of Antibiotics (β -lactum), Solvents (acetone) Amino acid (Lysine), Organic acids (Citric acid), Alcohols (Ethanol), Ind. Enzymes (Protease/Amylase) and Biopharmaceuticals (Insulin/Interferon etc.)- Microbial Transformations, Microbial leaching.

Text books and references:

1. Murray Moo -Young , Comprehensive Biotechnology, Vol. 1 & III-latest ed.
2. Microbes & Fermentation, A. Lel and Kotlers Richard J. Mickey, Oriffin Publication
3. Industrial Fermentations- Leland, N. Y. Chemical Publishers.
4. Prescott and Dunn's- Industrial Microbiology, 4 th, ed.
5. Biotechnology Series, Rehm, Reed & Weinheim, Verlag-Chemie.
6. Biochemical Engg., Aiba, Humphrey & Miller, Academic Press.
7. Fermentations & Enzyme technology, Wang & Humphrey, Wiley & Inter Science

NBT-651: Fermentation Biotechnology Lab

L T P
0 0 3

1. Fermentative production of Penicillin Antibiotics using *Penicilium chrysogenum*.
2. To study the induction effect of β -galactosidase enzyme in *E.coli*.
3. Upstream and Downstream of bioprocess for the production of Citric acid by *Aspergillus niger*
4. Citric acid production from whey with glucose as supplementary carbon source by *Aspergillus niger*
5. Microbial production of citric acid by solid state fermentation process.
6. Microbial production of enzymes by (a) solid state and (b) submerged fermentation.
7. Fermentative production of Ethanol using *Saccharomyces cerevisiae*.
8. Wine Fermentation.
9. Microbial production of Biosurfactant using suitable strain.
10. Microbial production of Biopolymer using suitable Strain.
11. Computational Design of Fermentative Process

NBT-602: Environmental Biotechnology

L T P
3 1 0

Unit I **(8)**

Environment, Types of Environmental pollution: Air, Water, Land, Radioactive pollution, Measurement of environmental pollution, Microbiology and biochemistry of pollution abatement, Biodegradation methods, Aerobic and anaerobic treatment methods of solid and liquid wastes, Minimum National Standards for Waste Disposal.

Unit II **(8)**

Physico-chemical characteristics of waste material, Availability of waste material, Microbiological and biochemical aspects of anaerobic digestion, Microbial strain improvement for anaerobic processes, Factors influencing anaerobic digestion processes, Some important alternative fuels.

Unit III **(8)**

Analytical techniques for environmental monitoring: Introduction, estimation of total volatile solids, lignin, cellulose, hemicelluloses, Detection of bacteria, Bacteriological examination of water by multiple tube fermentation, Biomarkers.

Unit IV **(8)**

Design of bioreactors for liquid waste treatment: Introduction, Physical, Chemical and Biological methods: Activated sludge process, Trickling Filters, Rotating biological contactors, Anaerobic treatment of wastewater, Stoichiometry and design kinetics for waste treatment processes.

Unit V **(8)**

Solid waste management: Introduction, Treatment processes for solid wastes, Thermal conversion process, Biological conversion process, landfill bioreactor for solid waste treatment, Biodegradation methods, minimal national standards for waste disposal, Economical and social aspects of waste treatment

Recommended Books:

1. Environmental Biotechnology: Bhattacharyya & Banerjee-Oxford University Press
2. Waste Water Engineering- Metcalf & Fuddy, 3rd ed.
3. Environmental Processes I-III, J. Winter, 2nd ed., Wiley Publications
4. Introduction to Waste Water Treatment- R. S. Ramalho, Academic Press.
5. Environmental Studies- Dwivedi & Mishra, Ed. 2007.
6. Environmental Biotechnology, B.C. Bhattacharya & Ritu Banerjee, Oxford Press, 2007.
7. Essentials of Ecology & Environmental Science, S.V.S. Rana, Prentic-Hall India, 2006.
8. Perspectives in Environmental Studies, Anubha Kaushik & C P Kaushik, New Age International Publishers, 2004.
9. Environmental Biotech., Pradipta Krimar, I.K. International Pvt. Ltd., 2006.
11. Industrial & Environmental Biootechnology, Ahmed, Ane/Rout Publishers.

NBT-652: Environmental Biotechnology Lab

L T P
0 0 2

1. Dissolved Oxygen in waste water
2. Biochemical oxygen demand in waste water
3. Chemical Oxygen demand in waste water
4. Hardness of water
5. Total, dissolved and suspended solid in waste water
6. Alkalinity of waste water
7. Acidity of waste water
8. Hexavalent chromium in waste water
9. Nitrate in waste water
10. Sulphate in waste water
11. Estimation of optimum dosage of ferric chloride for removal of suspended matter
12. Nitrogen estimation by Kjeldahl method,
13. Determination of sodium and potassium by Atomic Absorption Spectrophotometer

NBT-603: Bioinformatics-II

L	T	P
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Unit I

Inference problems and techniques for molecular biology. Overview of key inference problems in biology: Homology identification, Genomic sequence annotation (Genes and ORFs identification), Protein structure prediction (Secondary and Tertiary structure prediction), Protein function prediction, Biological network identification, Next generation sequencing, Microarray data analysis. [10]

Unit II

Machine learning: Decision tree induction, Artificial Neural Networks, Hidden Markov Models, Genetic Algorithms, Simulated Annealing, Support vector machines; The relation between statistics and machine learning; Evaluation of prediction methods: Parametric and Non-parametric tests, cross-validation and empirical significance testing (empirical cycle), Clustering (Hierarchical and K-mean). [10]

Unit III

Basic concept of Force field in molecular modeling (Potential energy calculation); Overview of key computational simulation techniques: Introduction to simulation, Computer simulation techniques, Types of computer simulation (Continuous, Discrete-event and Hybrid simulation), Differential equation solvers, Parameter estimation, and Sensitivity analysis. [6]

Unit IV

Overview of key techniques for the management of large document collections and the biological literature: Document clustering, Information retrieval system; Natural Language Processing: Introduction, Major areas of NLP, Natural language information extraction; Insilico Drug Designing: Major steps in Drug Designing, Ligand and Structure based drug designing, Protein-ligand docking, QSAR Modeling, Pharmacodynamics (Efficacy & Potency) & Pharmacokinetics (ADME), Lipinski's rule of five, Pharmacogenomics. [8]

Unit V

Perl in Bioinformatics: Basic concepts, Strings, numbers, variables-Basic input & output- File handles-Conditional Blocks & loops- Pattern matching- Arrays-Hashes. Regular expressions: Concepts about regular expressions, simple uses of regular expressions, Bioperl: Introduction, Installation procedures, Architecture, Uses of Bioperl. [6]

Text Books & References

1. Computational Methods in Biotechnology – Salzberg S. L. et al., Elsevier Science.
2. Statistical Methods in Bioinformatics-Evens & Grants, Springer-Verlag, NY.
3. Computational Molecular Biology- Setubal and Meidanis, PWS publishing Co., 1997.

4. Protein Structure Prediction-A Practical Approach, MJE Sternberg, Oxford University Press.
5. Purifying Protein for Proteomics, Richard J. Simpson, I.K. International Pvt. Ltd.
6. Harshawardhan P Bal, Perl Programming for Bioinformatics, Tata McGraw Hill, 2003.
7. Michael Moorhouse, Paul Barry, *Bioinformatics Biocomputing and Perl*, Wiley, 2004.
8. D. Curtis Jamison, Perl Programming for Bioinformatics & Biologists, John Wiley & Sons, INC., 2004

NBT-653: Bioinformatics-II Lab

L	T	P
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1. Identification of Distantly related homologous sequences of a given query protein sequence using PSI-BLAST.
2. Construct Phylogenetic tree of five evolutionary related protein/nucleotide sequences.
3. Align two homologous protein structure and calculation the RMSD for the superposition result.
4. Comparative assessment of best available tools for genome annotation.
5. Construction of restriction maps for various vectors used in genetic engineering using tool “NEBcutter”.
6. Primer Design: Construct primers for the given DNA sequence using any suitable web based tool.
7. Generate 2D QSAR model of a set of legend descriptor data using any web based tool.
8. Addition, Concatenation, & similar type of Perl program.
9. Chop, Chomp based simple Perl program.

Text books and References

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by *Andreas D. Baxevanis*
2. Structural Bioinformatics by Philip E Bourne, John Wiley & Sons
3. Analytical Tools for DNA, Genes & Genomes: by Arseni Markoff, New Age.

NBT-011: Nano Biotechnology

L	T	P
3	1	0

Unit I

Basic biology principles and practice of micro fabrication techniques, Atomic force microscopy, biological production of metal nano particles, macro molecular assemblies.

Unit II

Application in Biomedical and biological research, nano particles, viruses as nano-particles, nano chemicals and application., tumor targeting and other diagnostic applications.

Unit III

Developing drug delivery tools through nano biotechnology, nano particle based immobilization assays, quantum dots technology and its application.

Unit IV

Synthesis and characterization of different classes of biomedical polymers- their uses in pharmaceutical, cardiovascular ophthalmologic orthopedic areas.

Unit V

Biosensors and nano biotechnology principles used in construction of micro electronic devices sensors and macro mechanical structures.and their functioning, immuno-nanotechnology

Recommended Books:

1. Nanobiotechnology- concepts, applications and perspectives, niemeyer, christofm. Mirkin, chad a., Wiley publishers.
2. Nanobiotechnology of biomimetic membranes, martin, donald (edt), springer verlag publishers.

NBT-012: Biotechnology in Health Care

L	T	P
3	1	0

Unit I

Therapeutic Aspects of Biomacromolecules: Introduction, Therapeutic index, Endogenous peptides and proteins, Modification of endogenous peptides and proteins, Immune System: Overview, Antibody-mediated response, Vaccines, Cell-mediated immune response, Cancer immunotherapy [10]

Unit II

Oligonucleotides: Overview, Gene therapy, Antisense therapy, Ribozymes Oligosaccharides: Overview, Oligosaccharide synthesis, Heparin, Glycoproteins, Polysaccharide bacterial vaccines, Approaches to carbohydrate-based cancer vaccines. [10]

Unit III

Radiological Agents: Radiosensitizers and Radioprotective agents, Cardiovascular Drugs: Myocardial infarction agents, Endogenous vasoactive peptides, Hematopoietic agents, Anticoagulants, ant thrombotics and hemostatics. [6]

Unit IV

Chemotherapeutic Agents: Synthetic antibacterial agents, Lactam antibiotics, Anthelmintic agents, Antiamebic agents, Antiviral agents. Endocrine Drugs: Female sex hormones and analogs, Agents affecting the immune Response. [8]

Unit V

Drug Targeting Organ-Specific Strategies: Basic concepts and novel advances, Brain-specific drug targeting strategies, Pulmonary drug delivery, Cell specific drug delivery

Text books and References:

1. Pharmaceutical Chemistry by Christine M. Bladon. John Wiley & Sons, Ltd. (2002).
2. Burger's Medicinal Chemistry and Drug Discovery (5th edition) by Manfred E. Wolff. A Wiley & Sons, Inc. (2000).
3. Drug Targeting Organ-Specific Strategies by Grietje Molema and Dirk K. F. Meijer. Wiley-VCH. (2002).

NBT-013: Molecular Modeling & Drug Design

L	T	P
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Unit I

Introduction to Molecular Modeling; 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; Postulates of quantum mechanics, Electronic structure calculations, Ab initio, Semi-empirical and Density functional theory calculations, Molecular size versus accuracy; Approximate molecular orbital theories. [10]

Unit II

Molecular Mechanisms: Introduction to Force field, Use of various parameters for force field calculation (Bond length, angle angle, torsion angle, Electrostatic interaction, Vander waals interactions, Miscellaneous interaction); Introduction Molecular Dynamics using simple models, Dynamics with continuous potentials, Constant temperature and constant dynamics, Conformation searching, Systematic search, Applications to protein folding. [10]

Unit III

Molecular Modeling by Homology, construction of frame work, selecting variable regions, Back bone and side chain placement and refinement, Optimization and validation of protein models. Threading and Ab-initio modeling, Ramchandran plot. [6]

Unit IV

Introduction to QSAR for lead module: Linear and nonlinear modeled equations, Biological activities, Physicochemical parameters and Molecular descriptors, Application of QSAR modeling in drug discovery. [6]

Unit V

3D pharmacophores modeling, molecular docking, De novo Ligand design, Free energies and solvation, electrostatic and non-electrostatic contribution to free energies; 3D data base searching and virtual screening, Sources of data, molecular similarity and similarity searching, combinatorial libraries – generation and utility. [8]

Text books and References:

1. Principles and applications of modelling by Leach
2. Molecular Modelling by Hans Pieter,Heltje & Gerd Folkens, VCH.
3. Chemical Applications of Molecular Modelling by Jonathan Goodman.
4. Computational Chemistry by Guy H, Grant & W. Graham Richards, Oxford University Press

NBT-021: Pharmaceutical Biotechnology

L	T	P
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Unit I (10)

Introduction: Therapeutic categories such as vitamins, laxatives, analgesics, Antibiotics, biologicals, hormones. non-steroidal contraceptives, male contraceptives, Use and applications of female contraceptives, Ethical aspects.

Unit II (8)

Bulk drug manufacturers, Type of reactions in bulk drug manufacture and processes. Special requirement for bulk drug manufacture.

Unit III (12)

Compressed table, wet granulation-dry granulation or slugging-direct compression-tablet presses, coating of tablets, capsules, sustained action dosage forms-parental solution-oral liquids-injections-ointment-topical applications, Preservation, analytical methods and test for various drug and pharmaceuticals, packing-packing techniques, quality management, GMP.

Unit IV (10)

Development of Drug and Pharmaceutical Industry: Therapeutic agents, their use and economics; Regulatory aspects. Drug metabolism: physico-chemical principles, radio activity pharmacokinetic action of drugs in human bodies.

Reference Books:

1. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
2. Remington's Pharmaceutical Science, Mark Publishing and Co.

NBT-022: Developmental Biology

L	T	P
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Unit I

Basic concepts of development: Differentiation, morphogenesis, growth, reproduction, evolution Comparative Embryology, Evolutionary Embryology, Medical Embryology and Teratology, Developmental patterns among metazoan, mathematical modeling of development.

Unit II

Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

Unit III

The genetic and epigenetic core of development: Differential gene expression, Environmental regulation of normal development and sex determination. Programmed cell death, aging and senescence.

Unit IV

Embryogenesis and Developmental cycle of model organisms: Caenorhabditis elegans, Drosophila, ambhibia, chick and mouse. An overview of Plant Developmental cycle.

Recommended Books

1. Developmental Biology, 8th Ed, Gilbert
2. Developmental Biology Paperback – 2008 by Werner A. Muller

NBT-023: Biofuels & Alcohol Technology

L	T	P
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Unit I

Introduction to Alcohol Technology, Raw Material of Alcohol Industry, Storage & handling of Raw material in detail, Study of different yeast strains used in alcohol industries, Study of yeast production as single protein cell.

Unit-II

Study of different alcoholic fermentation techniques, Batch fermentation, Continuous fermentation, Modern techniques of Continuous fermentation, Bio still fermentation, Encillium process, Wet milling of grain for alcohol production, Grain dry milling cooking for alcohol production, Use of cellulosic feed stocks for alcohol production, Scaling in distilleries, Fusel oil separation

Unit III

Study of different recycling process, Biochemistry of alcohol production, The management of fermentation in the production of alcohol. Alcohol distillation-The fundamental, Parameters & affecting alcoholic fermentations, By product of alcoholic fermentation, Distillery quality control, Alcoholometry

Unit IV

Various biofuels/ bioenergy from biomass. Biomass conversion to heat and power: thermal gasification of biomass, anaerobic digestion. Biomass conversion to biofuel: thermochemical conversion, syngas fermentation.

Recommended Books

1. Chemical Process Principles – Part I, Material and Energy Balances by Olaf A Hougen, Kwenneth M. Watson, and Roland A Ragatz, CBS Publishers and Distributors (1995).
2. Text books of alcohol tech by T. P. Lyons.
3. Product Recovery in Bioprocess Technology ", BIOTOL Series, VCH, 1990
4. Shreve's Chemical Process Industries , 5th Ed. Reference
5. Out lines of Chemical Technology by Chmles E.
6. Chemical Process Industries, 4th Ed. By shieve, Mc.Graw

U.P. TECHNICAL UNIVERSITY, LUCKNOW

Study and Evaluation Scheme
B.TECH BIO-TECHNOLOGY
 [Effective from the session 2011-12]
 YEAR 4th, SEMESTER-VII
 (Revised)

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credit
			L	T	P	SESSIONAL EXAM.			ESE		
						CT	TA	Total			
THEORY SUBJECTS											
1.	EOE-071- EOE-074	Open Elective-I	3	1	0	30	20	50	100	150	4
2.	EBT-031- EBT-032	Departmental Elective-III	3	1	0	30	20	50	100	150	4
3.	EBT-041- EBT-042	Departmental Elective-IV	3	1	0	30	20	50	100	150	4
4.	EBT-701	Down Stream Processing	3	1	0	30	20	50	100	150	4
5.	EBT-702	Bioethics, Biosafety & IPR	3	0	0	30	20	50	100	150	4
PRACTICAL/DESIGN/DRAWING											
6.	EBT-751	Down Stream Processing Lab	0	0	3	-	20	20	30	50	1
7.	EBT-752	Project	0	0	3	-	50	50	-	50	2
8.	EBT-753	Seminar	0	0	2	-	50	50	-	50	1
9.	EBT-754	Industrial Training Viva-Voce	0	0	2	-	50	50	-	50	1
10.	GP 701	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	15	3	10	150	270	470	530	1000	26

Open Electives-I

EOE-071 Entrepreneurship Development
 EOE-072 Quality Management
 EOE-073 Operation Research
 EOE-074 Introduction to Biotechnology

Note : Biotechnology students cannot take the Open Elective course EOE-074 Introduction to Biotechnology.

U.P. TECHNICAL UNIVERSITY, LUCKNOW

Study and Evaluation Scheme
B.TECH BIO-TECHNOLOGY
 [Effective from the session 2011-12]
 YEAR 4th , SEMESTER-VIII

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credit
			L	T	P	SESSIONAL EXAM.			ESE		
						CT	TA	Total			
THEORY SUBJECTS											
1.	EOE-081- EOE-084	Open Elective-II**	3	1	0	30	20	50	100	150	4
2.	EBT-051- EBT-052	Departmental Elective-V	3	1	0	30	20	50	100	150	4
3.	EBT-061- EBT-062	Departmental Elective-VI	3	1	0	30	20	50	100	150	4
4.	EBT-801	Environmental Biotechnology	3	0	0	30	20	50	100	150	3
PRACTICAL/DESIGN/DRAWING											
5.	EBT-851	Project	0	0	12	-	100	100	250	350	8
6.	GP 801	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	12	3	12	120	180	350	650	1000	24

Open Electives-II

Paper Code

Name

EOE-081	Non Conventional Energy Resources
EOE-082	Non Linear Dynamic System
EOE-083	Product Development
EOE-084	Automation and Robotics

5. Estimation of lactose from milk.
6. Quality characterization of pasteurized milk by MBRT method.
7. To judge efficiency of pasteurization of milk by Phosphatase test.
8. Detection of microbial count in Milk by SPC method.
9. Determination of Minimum Inhibitory Concentration (MIC) of Antibiotic.

References :-

1. Gaud R.S. (2000), Practical biotechnology, Nirali Prakashan.
2. Sadashivam S. and Manickam A. (1996), Biochemical Methods, 2nd Edi. New age International (P) Ltd., Publications, New Delhi.
3. Schmauder Hans Peter (1997), Methods in Biotechnology, Taylor and Francis, London.
4. Sharma P.K and Dandiya P.C (2004), Pharmaceutical Biochemistry: Theory and Practicals, Vallabh Prakashan , Delhi.
5. Thimmaiah S.K (2006), Standard Methods of Biochemical Analysis, Kalyani Publishers, New Delhi.

ECH 656 Heat Transfer Lab

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List of Experiments

Any 10 experiments are compulsory for lab work.

1. To find out the thermal conductivities of all layers of Composite wall.
2. To find the thermal conductivity of Composite cylinder.
3. To find out the thermal conductivity of insulating powder.
4. To find the thermal conductivity of liquid / gases.
5. To find the temperature profile of any regular shaped thermal conductor for steady and unsteady state conduction.
6. Any Experiment on natural convection.
7. Experiment on Heat Pipe.
8. Any experiment on determination of emissivity.
9. Heat load and Over all heat transfer coefficient for parallel flow condition.
10. Heat load and Over all heat transfer coefficient for Counter flow condition.
11. To study the Plate heat exchanger and Double Pipe Heat Exchanger.
12. To study the shell & Tube heat exchanger.

EBT-701 DOWN STREAM PROCESSING

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Unit I

An overview of Bioseparation. Role of Downstream Processing in Biotechnology. Problems and requirement of bioproduct purification. Cost cutting strategies.

Unit II

Primary separation and Recovery Process: Cell, Disruption methods (Physical, chemical and Enzymatic) for intracellular products. Removal of insoluble, biomass. Separation techniques – Flocculation, Sedimentation, Centrifugation and Filtration..

Unit III

Product Isolation - Extraction and Adsorption methods, Solid- Liquid , Liquid -liquid Separation, Distillation. Enrichment operation - Membrane based Separation - micro and ultrafiltration (Theory, Design and Configuration of the Equipment), Precipitation methods - Ammonium, Sulphate, organic solvents, High molecular weight polymers.

Unit IV

Product Purification: Electrophoresis and Chromatography principle for product purification, Different Electrophoresis technique –Isoelectric, focussing ,chromatographic technique with special reference to ion-exchange ,affinity, GLC, HPLC

Unit V

Product Polishing: Crystallization, Drying. A Few case studies: Citric acid, Glutamic acid, Penicillin G, Extracellular Enzymes, Intracellular enzymes, Antibodies

Recommended Books:

1. Comprehensive biotechnology- Murray Moo-Young, Vol. II-latest ed., Pergan Publishers.
2. H. J. Rehm and G. Reed, Biotechnology- Vol. 3, 4, 5, Verlag Publishers
3. Stanbury & Whitteker, Principles Of Fermentation Technology, Pergamon Press
4. A Biologist's Guide to Principles & Techniques of Practical Biochemistry- Wilson and Golding, Cambridge University Press
5. Humphrey, Aiba & Miller, Biochemical Engg., Academic Press.
6. Biochemical Engg. -Bailly & Ollis, Academic Press.
7. Product Recovery in Bioprocess Technology, Heinemann, Butterworth Publication.
8. Electrophoresis in Practice, Westermeier- Wiley Publications.
9. Handbook of Analytical techniques-H. Gunzler, Wiley Publications.
10. International Methods of Analysis- Willard et al., CBS Publication.
11. Bioseparation Techniques, Sivasankar, Prentice-Hall of India, 2004.
12. Bioseparations (Principles & techniques), B. Sivasankar, Prentice-Hall of India, 2005.
13. Citric Acid Biotechnology, Linden, Ane/Rout Publishers.

EBT-702 : Bioethics, Biosafety & IPR

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Unit I

Jurisprudential definition and concept of property, rights, duties and their correlation. History and evolution of IPR- like patent, design and copy right, Indian patent act 1970 (amendment 2000), international convention in IPR, major changes in Indian patent system as post TRIPS effects (i) obtaining patent (ii) geographical indiation.

Unit II

Distinction among various forms of IPR, Requirement of a patentable novelty, invention step and prior art and state of art, procedure

Unit III

Rights/protection, infringement or violation, remedies against infringement – civil and criminal.

Unit IV

Detailed information on patenting biological products, Biodiversity, Budapest treaty, Appropriate case studies.

Unit V

Biosafety and Bioethical issues in Biotechnology

Recommended Books:

1. Patent Strategy For Researches & Research Manegers- Knight, Wiley Publications.
2. Agriculture & Intellectual & Property Rights, V. Santaniello & R E Evenson, University Press.
3. Intellectual Property Protection & Sustainable Development, Phillipe Cullet, Ldexix Nexis Butterworths.
4. Biotechnology & Safety Assessment, Thomas, Ane/Rout Publishers.
5. Biotechnology in Comparative Perspective, Fuchs, Ane/Rout Publishers.

DOWN STREAM PROCESSING LAB – EBT 751

1. Cell disruption techniques.
2. Solid separation methods-filtration, sedimentation techniques.
3. Centrifugation techniques
3. Product enrichment operations (precipitation, ultra filtration, two-phase aqueous extraction)
4. High-resolution purification
5. Preparative liquid chromatographic techniques
6. Product crystallization and drying

EBT-801 ENVIRONMENTAL BIOTECHNOLOGY

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Unit I

Environmental pollution: Land, water , air , and noise (introduction , sources , effects and measurements). Types of wastes , properties and steps involved in aerobic and anaerobic treatments of solid waste ,sewage and industrial effluents and their reuse .

Unit II

Biological waste treatments and biofuel production. Methanogenesis: methanogenic , acetogenic , and fermentative bacteria – anaerobic and aerobic digestion processes and conditions . Minimal national standards for waste disposal .

Unit III

Principles and design aspects of various waste treatments methods, with advanced bioreactor configuration : activated sludge process , trickling filter, fluidized expanded bed reactor , upflow anaerobic sludge blanket reactor , contact process , fixed / packed bed reactor , hybrid reactor , sequential batch reactor .

Unit IV

Kinetic models for biological waste treatment :bioconversion of agricultural and other highly organic waste materials into gainfully utilizable products – biogas, H₂, cellulases and food and feed stocks. Economical and social aspects of waste treatment.

Unit V

Bioremediation : land , water , industries , organic contaminants , heavy metals and nitrogenous wastes .

Recommended Books:

1. Ecology & Environment- P. D. Sharma, 8th ed.
2. Waste Water Engineering- Metcalf & Fuddy, 3rd ed.
3. Environmental Processes I-III, J. Winter, 2nd ed., Wiley Publications
4. Introduction to Waste Water Treatment- R. S. Ramalho, Academic Press.
5. Environmental Studies- Dwivedi & Mishra, Ed. 2007.
6. Environmental Biotechnology, B.C. Bhattacharya & Ritu Banerjee, Oxford Press, 2007.
7. Essentials of Ecology & Environmental Science, S.V.S. Rana, Prentic-Hall India, 2006.
8. Perspectives in Environmental Studies, Anubha Kaushik & C P Kaushik, New Age International Publishers, 2004.
9. Environmental Biotech., Pradipta Krimar, I.K. International Pvt. Ltd., 2006.
10. Environmental Microbiology & Biotechnology, D.P. Singh, S.K. Dwivedi, New Age International Publishers, 2004.
11. Industrial & Environmental Biotechnology, Ahmed, Ane/Rout Publishers.
12. Environmental Biotechnology & Cleaner Bioprocesses, Olguin, Ane/Rout Publishers.
13. Global Environmental Biotechnology, Wise, Elsevier Ex. Pubishers

Unit II

Principle, Instrument Design, Methods & Applications of Free & Zone (Paper, gel, Pulsed-field, PAGE, SDS-PAGE, Capillary) Electrophoresis, isoelectric focusing, Potentiometry, pH meter, ion selective electrodes, conductometry.

Unit III

Principle, Instrument Design, of Polarimetry, ORD, CD, Light scattering, Refractometry, Flowcytometry, Cytophotometry, Compound, Phasecontrast, Interference, Fluorescence, Polarizing, Scanning & Transmission Electron Microscopy, CCD Camera, Introduction to Methods & Applications of Atomic Force Microscopy

Unit IV

Crystals, Molecular crystal symmetry, X ray diffraction by crystals, Bragg's Law, laue powder and rotation methods, Calculating electron density and patterson maps (Fourier transform and Structure factors, convolutions),phases, model building & evaluation, Neutron diffraction, Electron diffraction, Application in Biology.

Text Books / Reference books :

- 1) Text Book Of Biophysics Revised Edition (Hardcover) by R. N. Roy. New Central Book Agency (p) Ltd
- 2) Biophysics Principles & Techniques By Subramanian Ma. MJP PUBLISHERS
- 3) Principles Of Biochemistry And Biophysics by Dr. B. S. Chauhan. Usp
- 4) Biophysical Chemistry(Principles and Techniques) By Avinash Upadhyay, Kakoli Upadhyay ,Nirmalendu Nath. Himalaya

EBT-031 -Vaccine Technology & Immunoinformatics

Unit –I

Vaccines : Introduction to immunity, Fundamental concepts in vaccination and traditional methods of vaccine production (production of DPT and Rabies vaccine), Production of Modern Vaccines (production of Hepatitis vaccine)

Unit -II

Applications of immunological methods in diagnosis.

Unit - III

Reverse vaccinology and immunoinformatics . Databases in Immunology

Unit – IV

B-cell epitope prediction methods

T-cell epitope prediction methods

Resources to study antibodies, antigen-antibody interactions

Unit -V

Structure Activity Relationship – QSARs and QSPRs, QSAR Methodology, Various Descriptors used in QSARs: Electronics; Topology; Quantum Chemical based Descriptors. Use of Genetic Algorithms, Neural Networks and Principle Components Analysis in the QSAR equations

Text books/Reference Books

1: *Kuby Immunology 4e* by Richard A. Goldsby, Thomas J. Kindt and Barbara A. Osborne

2. Immunoinformatics: Predicting Immunogenicity in Silico By Darren R Flower

Publisher: Humana Press

3: Immunoinformatics (Immunomics Reviews:)By Shoba Ranganathan ,Vladimir Brusic,
Christian Schonbach. Publisher: Springer

EBT-032 - Biofuels & Alcohol Technology

Unit -I

Introduction to Alcohol Technology, Raw Material of Alcohol Industry, Storage & handling of Raw material in detail, Study of different yeast strains used in alcohol industries, Study of yeast production as single protein cell.

Unit-II

Study of different alcoholic fermentation techniques, Batch fermentation, Continuous fermentation, Modern techniques of Continuous fermentation, Bio still fermentation, Encillium process Wet milling of grain for alcohol production, Grain dry milling cooking for alcohol production, Use of cellulosic feed stocks for alcohol production, Scaling in distilleries, Fusel oil separation

Unit III

Study of different recycling process, Biochemistry of alcohol production, The management of fermentation in the production of alcohol.

Unit IV

Alcohol distillation-The fundamental, Parameters & affecting alcoholic fermentations, By product of alcoholic fermentation, Distillery quality control, Alcoholometry

Unit – V

Various biofuels/bioenergy from biomass. Biomass conversion to heat and power: thermal gasification of biomass, anaerobic digestion. Biomass conversion to biofuel: thermochemical conversion, syngas fermentation.

Recommended Books

1. Chemical Process Principles – Part I, Material and Energy Balances by Olaf A Hougen, Kenneth M. Watson, and Roland A Ragatz, CBS Publishers and Distributors (1995).
2. Text books of alcohol tech by T. P. Lyons.
3. Product Recovery in Bioprocess Technology ", BIOTOL Series, VCH, 1990
4. Shreve's Chemical Process Industries , 5th Ed. Reference
5. Out lines of Chemical Technology by Chmles E.
6. Chemical Process Industries, 4th Ed. By shieve, Mc.Graw

EBT-041 MOLECULAR MODELING AND DRUG DESIGN

UNIT I

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. 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 II

Molecular Mechanisms, energy calculations, Bond stretch, angle bending, torsional term. Electrostatic interaction- Van der waals interactions. Miscellaneous interaction. Introduction, Molecular Dynamics using simple models. Dynamics with continuous potentials. Constant temperature and constant dynamics. Conformation searching, Systematic search. Applications to protein folding

UNIT III

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 V

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

UNIT V

3D pharmacophores ,molecular docking, De novo Ligand design, Free energies and solvation, electrostatic and non-electrostatic contribution to free energies. 3D data base searching and virtual screening, Sources of data, molecular similarity and similarity searching, combinatorial libraries – generation and utility,

REFERENCES:

1. Principles and applications of modelling by Leach
2. Molecular Modelling by Hans Pieter,Heltje & Gerd Folkens, VCH.
3. Chemical Applications of Molecular Modelling by Jonathan Goodman.
4. Computational Chemistry by Guy H, Grant & W. Graham Richards, Oxford University Press

EBT-042 BIOPROCESS ENGINEERING-II

Unit I

Introduction to engineering calculations; unit conversion, measurement conventions, Errors in Data and Calculations, Presentation of Experimental Data, Data Analysis, General Procedures For Plotting Data, Process Flow Diagrams

Unit II

Material balances, Material balances with recycle, by-pass and purge streams, Stoichiometry of growth and product formation, electron balances, biomass yield, maximum possible yield, theoretical oxygen demand, stoichiometry of single-cell protein synthesis, Mass transfer; Role of diffusion in bioprocessing, convective mass transfer, oxygen uptake in cell cultures, factors affecting cellular oxygen demand

Unit III

Design and operation of various bioreactors, viz CSTR, fed batch systems, air-lift bioreactors, fluidized bed bioreactors. Scale up of bioreactors. Criteria for selection of bioreactors. Ideal Bioreactors; Fed-Batch Reactor, Enzyme-catalysed reactions in CSTRs, CSTR reactors with recycle and wall growth, the ideal plug-flow tubular reactor, Dynamics model and Stability of bioreactor,. Reactors with non-ideal mixing: Mixing time in agitated tanks, Resident time distributions, Models for no-ideal reactors, Mixing-Bio reaction interactions

Unit IV

Scale up of bioprocess; General aspects, Criteria and Basic principle of scale-up of bioreactor, Practical considerations for bioreactor construction

Unit V

Control of physical, chemical and biological environment of the bioreactor, Advanced control strategies viz. PID controllers, fuzzy logic based controllers and artificial neural network based controllers, Role of physical, chemical & biological sensors.

Text & References:

1. Principles of Microbial and cell cultivation by S.J.Pirt, Butterworth Publications
2. Bioprocess Engineering Principles by P.M.Doran
3. Principles of Fermentation Technology by Whitaker
4. Bioreactor Design & Product Yield, BIOTOL Series
5. Operational Models of Bioreactor, BIOTOL Series
6. Bioreactors in Biotechnology: A Practical approach by Scragg
7. Biochemical Engineering by Bailly & Ollis
8. Process Biotechnology Fundamentals by S.N. Mukopadhyay

9. Bioprocess Engineering: Basic Concepts by Shular & Kargi

10. Fermentation Microbiology & Biotechnology by Mansi

EBT-051 -BIOTECHNOLOGY IN HEALTH CARE

Unit-1

Therapeutic Aspects of Biomacromolecules: Introduction, Endogenous peptidases and proteins, Modification of endogenous peptides and proteins

Immune System: Overview, Antibody-mediated response, Vaccines, Cell-mediated immune response, Cancer immunotherapy

Unit -2

Oligonucleotides: Overview, Gene therapy, Antisense therapy, Ribozymes

Oligosaccharides: Overview, Oligosaccharide synthesis, Heparin, Glycoproteins, Polysaccharide bacterial vaccines, Approaches to carbohydrate-based cancer vaccines.

Unit -3

Radiological Agents: Radiosensitizers and Radioprotective agents

Cardiovascular Drugs: Myocardial infarction agents, Endogenous vasoactive peptides, Hematopoietic agents, Anticoagulants, antithrombotics and hemostatics

Unit -4

Chemotherapeutic Agents: Synthetic antibacterial agents, Lactam antibiotics, Anthelmintic agents, Anthelmintic agents, Antiamebic agents, Antiviral agents.

Endocrine Drugs: Female sex hormones and analogs, Agents affecting the immune Response

Unit -5

Drug Targeting Organ-Specific Strategies: Basic concepts and novel advances, Brain-specific drug targeting strategies, Pulmonary drug delivery, Cell specific drug delivery.

Text / Reference Books:

1. Pharmaceutical Chemistry by Christine M. Bladon. John Wiley & Sons, Ltd. (2002).
2. Burger's Medicinal Chemistry and Drug Discovery (5th edition) by Manfred E. Wolff. A Wiley & Sons, Inc. (2000).
3. Drug Targeting Organ-Specific Strategies by Grietje Molema and Dirk K. F. Meijer. Wiley-VCH. (2002).

EBT-052: NANOBIO TECHNOLOGY

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Unit I

Basic biology principles and practice of micro fabrication techniques, Atomic force microscopy, biological production of metal nano particles, macro molecular assemblies.

Unit II

Application in Biomedical and biological research, nano particles, viruses as nano-particles , nano chemicals and application., tumor targeting and other diagnostic applications.

Unit III

Developing drug delivery tools through nano biotechnology, nano particle based immobilization assays, quantum dots technology and its application.

Unit IV

Synthesis and characterization of different classes of biomedical polymers- their uses in pharmaceutical, cardiovascular ophthalmologic orthopedic areas.

Unit V

Biosensors and nano biotechnology principles used in construction of micro electronic devices sensors and macro mechanical structures.and their functioning, immuno-nanotechnology

Recommended Books:

1. **Nanobiotechnology- concepts, applications and perspectives, niemeyer, christof m. Mirkin, chad a., wiley publishers.**
2. **Nanobiotechnology of biomimetic membranes, martin, donald (edt), springer verlag publishers.**

EBT-061 : BIOMEDICAL INSTRUMENTATION

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Unit I

Introduction to biomedical instrumentation, Basic transducer principles, Sources of bioelectric potentials, Electrodes.

Unit II

The Cardiovascular system, Cardiovascular measurements, Patient care and monitoring, Measurements in the respiratory system.

Unit III

Noninvasive diagnostic instrumentation, The nervous system, Instrumentation for sensory measurements and the study of behaviors, Biotelemetry.

Unit IV

Instrumentation for the clinical laboratory, X-ray and radiosotope instrumentation.

Unit V

The computer in biomedical instrumentation, Electrical safety of medical equipment.

Recommended books:

1. Biomedical Instrumentation and Measurement by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer
2. Biomedical Instrumentation: Technology and Applications by Raghbir Singh
3. Medical Instrumentation for Health Care by Leslie Cromwell
4. Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation by Robert B. Northrop
5. Introduction to Bioinstrumentation: With Biological, Environmental, and Medical Application by Clifford D. Ferris.

EBT-062 GENOMICS & PROTEOMICS

Unit I

Introduction to Genomics

Structure and organization of prokaryotic and eukaryotic genomes nuclear, mitochondrial and chloroplast genomes; Computational analysis of sequences- finding genes and regulatory

regions; Gene annotation; Similarity searches; Pairwise and multiple alignments; Alignment statistics; Prediction of gene function using homology, context, structures, networks; Genetic variation-polymorphism, deleterious mutation; Phylogenetics; Tools for genome analysis-PCR, RFLP, DNA fingerprinting, RAPD, Automated DNA sequencing; Linkage and pedigree analysis; Construction of genetic maps; Physical maps, FISH to identify chromosome landmarks.

Unit II

Genome sequencing

Human genome project-landmarks on chromosomes generated by various mapping methods; BAC libraries and shotgun libraries preparation; Physical map-cytogenetic map, contig map, restriction map, DNA sequence; DNA sequencing and sequence assembly; Model organisms and other genome projects; Comparative genomics of relevant organisms such as pathogens and nonpathogens; Evolution of a pathogen e.g. Hepatitis C virus or a bacterial pathogen; Taxonomic classification of organisms using molecular markers- 16S rRNA typing/sequencing;

Unit III

DNA Microarray technology

Basic principles and design: cDNA and oligonucleotide arrays; Applications: Global gene expression analysis, Comparative transcriptomics, Differential gene expression; genotyping/SNP detection; Detection technology; Computational analysis of microarray data.

Unit IV

Proteomics

Overview of protein structure-primary, secondary, tertiary and quaternary structure; Relationship between protein structure and function; Outline of a typical proteomics experiment; Identification and analysis of proteins by 2D analysis; Spot visualization and picking; Tryptic digestion of protein and peptide fingerprinting; Mass spectrometry : ion source (MALDI, spray sources); analyzer (ToF, quadrupole, quadrupole ion trap) and detector; clinical proteomics and disease biomarkers; Prions; proteins in disease; Protein-protein interactions: Solid phase ELISA, pull-down assays (using GST-tagged protein), far western analysis, by surface plasmon resonance technique, Yeast two hybrid system, Phage display; Protein interaction maps; Protein arrays-definition, applications- diagnostics, expression profiling.

Unit V

Human disease genes; DNA polymorphism including those involved in disease; Hemoglobin and the anemias; Phenylketonuria (monogenic) and diabetes (multigenic) genetic disorders; 'disease' gene vs. 'susceptibility' gene; SNP detection: hybridization based assays (allele specific probes); Polymerization based assays (allele specific nucleotide incorporation, allele-specific PCR); Ligation based assays (allele specific oligonucleotide ligation); Polymorphism detection without sequence information: SSCP;

Proteomics and drug discovery; High throughput screening for drug discovery; Identification of drug targets; Pharmacogenomics and pharmacogenetics and drug development; Toxicogenomics; Metagenomics.

Texts/References:

1. Introduction to Genomics . Arthur Lesk. Oxford University Press, 2008
2. Brown TA, Genomes, 3rd Edition, Garland Science, 2006.
3. Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and
4. Bioinformatics, 2nd Edition, Benjamin Cummings, 2007.
- 5 Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006.
6. Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd Edition, ASM Press, 1998.