



**ANNA UNIVERSITY**  
**Chennai-25.**  
**Syllabus for**

**B.Tech. Industrial Bio-Technology**

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**CM125 Chemistry I** **3** **0** **0** **100**

**1. CHEMICAL THERMODYNAMICS** **9**

Definition of free energy and spontaneity - Maxwell relations - Gibbs-Helmholtz equation - Van't Hoff equations - Stoichiometry and energy balances in Chemical reactions.

**2. DYNAMICS OF CHEMICAL PROCESSES** **10**

Basic concepts - composite reactions (opposing, parallel and consecutive reactions) - Collision theory - Thermodynamic formulation of reaction rates - unimolecular reactions - Chain reactions (Stationary and non-stationary) - Enzyme Kinetics - Michaelis - Menten Equation.

**3. ELECTRODICS** **8**

Types of electrodes and cells - Nernst Equation - emf measurement and its applications - Principles of chemical and electrochemical corrosion - corrosion control (Sacrificial anode and impressed current methods).

**4. WATER** **8**

Water quality parameters - Definition and expression - Estimation of hardness (EDTA method) - Alkalinity (Titrimetry) - Water softening (zeolite) - Demineralisation (Ion-exchangers) and desalination (RO) - Domestic water treatment.

**5. POLYMERS** **10**

Monomer - Functionality - Degree of polymerisation - Classification based on source and applications - Addition, Condensation and copolymerisation - Mechanism of free-radical polymerisation - Thermoplastics and thermosetting plastics - Processing of plastics - Injection moulding, blow moulding and extrusion processes.

**Total No of periods: 45**

*Text Books:*

1. Alkins P.W., " *Physical Chemistry* ", ELBS, IV Edition, 1998, London.

*References:*

1. Balasubramanian M.R., Krishnamoorthy S. and Murugesan V., " *Engineering Chemistry* ", Allied Publisher Limited., Chennai, 1993.
2. Karunanidhi M., Ayyaswamy N., Ramachandran T and Venkatraman H., " *Applied Chemistry* ", Anuradha Agencies, Kumbakonam , 1994.
3. Sadasivam V., " *Modern Engineering Chemistry - A Simplified Approach* ", Kamakya Publications, Chennai , 1999.
4. Kuriakose, J.C. and Rajaram J., " *Chemistry in Engineering and Technology* ", Vol. I and II, Tata McGraw-Hill Publications Co.Ltd, New Delhi ,1996.
5. Jain P.C. and Monica J., " *Engineering Chemistry* ", Dhanpat Rai Publications Co.,(P) Ltd., New Delhi, 1998.

**1. BASICS 5**

Introduction - Units and Dimensions - Laws of Mechanics - Vectors - Vectorial representation of forces and moments - Vector operations.

**2. STATICS OF PARTICLES 8**

Coplanar Forces - Resolution and Composition of forces - Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility - single equivalent force.

**3. EQUILIBRIUM OF RIGID BODIES 7**

Free body diagram - Types of supports and their reactions - requirements of stable equilibrium - Equilibrium of Rigid bodies in two dimensions - Equilibrium of rigid bodies in three dimensions.

**4. PROPERTIES OF SURFACES AND SOLIDS 12**

Determination of Areas and Volumes - First moment of area and the centroid - second and product moments of plane area - Parallel axis theorems and perpendicular axis theorems - Polar moment of inertia - Principal moments of inertia of plane areas - Principal axes of inertia - Mass moment of inertia - relation to area moments of inertia.

**5. FRICTION 4**

Frictional Force - Laws of Coloumb friction - Simple Contact friction - Rolling Resistance - Belt Friction.

**6. DYNAMICS OF PARTICLES 16**

Displacement, Velocity and acceleration their relationship - Relative motion - Curvilinear motion - Newton's Law - Work Energy Equation of particles - Impulse and Momentum - Impact of elastic bodies.

**7. ELEMENTS OF RIGID BODY DYNAMICS 8**

Translation and Rotation of Rigid Bodies - Velocity and acceleration - General Plane motion - Moment of Momentum Equations - Rotation of rigid Body - Work energy equation.

**Total No of periods: 60**

*Text Books:*

1. *Beer and Johnson, " Vector Mechanics for Engineers ", Vol. 1 " Statics " and Vol. 2 " Dynamics ", McGraw Hill International Edition, 1995.*
2. *Merriam, " Engineering Mechanics ", Vol.1 " Statics " and Vol.2 " Dynamics 2/e ", Wiley International, 1988.*

*References:*

1. *Rajasekaran S. and Sankara Subramanian, G., " Engineering Mechanics - Statics and Dynamics ".*
2. *Irving, H., Shames, " Engineering Mechanics - Statics and Dynamics ", Thrid Edition, Prentice-Hall of India Pvt.Ltd., 1993.*
3. *Mokoshi, V.S., " Engineering Mechanics ", Vol.1 " Statics " and Vol.2 " Dynamics ", Tata McGraw Hill Books, 1996.*
4. *Timoshenko and Young, " Engineering Mechanics ", 4/e, McGraw Hill, 1995.*
5. *McLean, " Engineering Mechancis ", 3/e, SCHAUM Series, 1995.*

(Revised Syllabus For B.E. / B.Tech. Programmes - Effective From June 2002)

<b>1. MATRICES</b>	<b>9</b>
Characteristic equation - Eigen values and eigen vectors of a real matrix. Some properties of eigen values, Cayley-Hamilton theorem, Orthogonal reduction of a symmetric matrix to diagonal form - Orthogonal matrices - Reduction of quadratic form to canonical form by orthogonal transformation.	
<b>2. THREE DIMENSIONAL ANALYTICAL GEOMETRY</b>	<b>9</b>
Direction cosines and ratios - Angle between two lines - Equation of a plane - Equation of a straight line - Coplaner lines - Shortest distance between skew lines - Sphere - Tangent plane - Plane section of a sphere - orthogonal spheres.	
<b>3. GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS</b>	<b>9</b>
Curvature - cartesian and polar coordinates - Circle of curvature - Involutives and Evolutes - Envelopes - properties of envelopes - Evolute as envelope of normals.	
<b>4. FUNCTIONS OF SEVERAL VARIABLES</b>	<b>9</b>
Functions of two variables - Partial derivatives - Total differential - Differentiation of implicit functions - Taylor's expansion - Maxima and Minima - Constrained Maxima and Minima by Lagrangean Multiplier method - Jacobians - differentiation under integral sign.	
<b>5. ORDINARY DIFFERENTIAL EQUATIONS</b>	<b>9</b>
Simultaneous first order linear equations with constant coefficients - Linear equations of second order with constant and variable coefficients - Homogeneous equation of Euler type - equations reducible to homogeneous form - Method of reduction of order - Method of variation of parameters.	
<b>6. TUTORIAL</b>	<b>15</b>
<b>Total No of periods: 60</b>	

*Text Books:*

1. Kreyszig, E., " *Advanced Engineering Mathematics* " (8th Edition), John Wiley and Sons (Asia) Pte Ltd., Singapore, 2001
2. Veerarajan, T., " *Engineering Mathematics* ", Tata McGraw Hill Publishing Co., NewDelhi, 1999.

*References:*

1. Grewal, B.S., " *Higher Engineering Mathematics* " (35th Edition), Khanna Publishers, Delhi , 2000.
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., " *Engineering Mathematics* ", Volume I (4th Revised Edition), S. Chand & Co., New Delhi, 2000.
3. Narayanan, S., Manicavachagom Pillay, T.K., Ramanaiah, G., " *Advanced Mathematics for Engineering Students* ", Volume I (2nd Edition), S. Viswanathan (Printers & Publishers), 1992.
4. Venkataraman, M.K. " *Engineering Mathematics - First year* " National Publishing Company, Chennai (2nd Edition), 2000.

<b>1. PROPERTIES OF MATTER</b>	<b>9</b>
Elasticity - stress-strain diagram-factors affecting elasticity - Twisting couple on a wire-Shafts-Torsion pendulum-Depression of a cantilever- Young's modulus by cantilever-Uniform and Non Uniform bending-I shape girders-Production and measurement of high vacuum-Rotary pump-Diffusion pump-Pirani Gauge-Penning gauge-Viscosity-Oswald Viscometer-Comparision of viscosities.	
<b>2. ACOUSTICS</b>	<b>9</b>
Acoustics of buildings-Absorption coefficient-Intensity-Loudness-Reverberation time-Sabine's formula-Noise pollution-Noise control in a machine-Ultrasonics-production-Magnetostriction and Piezoelectric methods-Applications of ultrasonics in Engineering and Medicine.	
<b>3. HEAT AND THERMODYNAMICS</b>	<b>9</b>
Thermal conductivity-Forbe's and Lee's Disc methods-Radial flow of heat-Thermal conductivity of rubber and glass-Thermal insulation in buildings-Laws of thermodynamics-Carnot's cycle as heat engine and refrigerator-Carnot's theorem-Ideal Otto and Diesel engines-Concept of entropy-Entropy Temperature diagram of carnot's cycle.	
<b>4. OPTICS</b>	<b>9</b>
Photometry-Lummer Brodhum photometer-Flicker Photometer-Antireflection coating-Air wedge-Testing of flat surfaces-Michelson's Interferometer and its applications-Photoelasticity and its applications-Sextant-Metallurgical microscope-Scanning electron microscope.	
<b>5. LASER AND FIBRE OPTICS</b>	<b>9</b>
Principle of lasers-laser characteristics-Ruby-NdYAG, He-Ne, CO <sub>2</sub> and semiconductor lasers-propagation of light through optical fibers-types of optical fibre-Applications of optical fibres as optical waveguides and sensors.	

**Total No of periods: 45**

*Text Books:*

*1. Arumugam.M., " Engineering Physics ", Anuradha Publications, 1998.*

*References:*

- 1. Resnik R. and Halliday D., " Physics ", Wiley Eastern, 1986.*
- 2. Nelkon M. and Parker.P., " Advanced Level Physics ", Arnold-Heinemann, 1986.*
- 3. Vasudeva A.S., " Modern Engineering Physics ", S. Chand and Co., 1998..*
- 4. Gaur, R.K., and Gupta, S.L., " Engineering Physics ", Dhanpat Rai and Sons, 1988.*
- 5. Mathur, D.S, " Elements of properties of Matter ", S.Chand & Co., 1989.*

- 1. Preparation of standard solutions.
- 2. Estimation of hardness of water by EDTA method
- 3. Estimation of different types and amounts of alkalinity in water - Indicator method
- 4. Determination of dissolved oxygen - Winkler's method.
- 5. Estimation of iron in water - Spectrophotometric method.
- 6. Estimation of sodium in water - Flame Photometric method
- 7. Determination of molecular weight of polymers-Viscometric method.
- 8. Determination of total dissolved solids in water.
- 9. Corrosion experiments:
  - \* Corrosion rate measurements
  - \* Inhibition efficiency.
- 10. Electrochemistry experiments:
  - \* Determination of emf.
  - \* Single electrode potential
  - \* Potentiometric and conductometric titration

**Total No of periods: 30**

**1. FUNDAMENTALS OF COMPUTERS AND OPERATING SYSTEMS 4**

Evolution of Computers - Organization of Modern Digital Computers-Single user Operating System-  
Multitasking OS-GUI

**2. OFFICE AUTOMATION 11**

- a) Word Processing
- b) Data Base Management System
- c) Spread Sheet Package
- d) Presentation Software

**3. PRACTICALS 45**

**Total No of periods: 60**

*Text Books:*

1. Ghosh Dastidar, Chattopadhyay and Sarkar, " Computers and Computation - A Beginner's Guide ",  
Prentice Hall of India, 1999.

*References:*

1. Nelson, Microsoft Office 97, Tata McGraw Hill, 1999.
2. Taxali, " PC Software for Windows Made Simple ", Tata McGraw Hill, 1999.

**GE133 Workshop Practice**

**0 0 4 100**

**1. SHEET METAL 10**

Tools and Equipments - Fabrication of tray, cone, etc., with sheet metal

**2. WELDING 10**

Tools and Equipments - Arc Welding of butt joint, Tap Joint, Tee fillet etc., Demonstration of gas welding.

**3. FITTING 10**

Tools and Equipments- Practice in Chipping, Filing, Drilling - making Vee joints, square and dove tail joints.

**4. CARPENTRY 10**

Tools and Equipments-Planning Practice-making halving joint and dove tail joint models.

**5. FOUNDRY 10**

Tools and Equipments Preparation of moulds of simple objects like flange, gear V- grooved pulley etc.

**6. SMITHY 10**

Tools and Equipments - Demonstration for making simple parts like keys, bolts etc.

**Total No of periods: 60**

*References:*

1. Venkatachalapathy V.S., " *First Year Engineering Workshop Practice* ", Raamalinga Publications, Madurai, 1999.
2. Kanaiah P.and Narayana K.C., " *Manual on Workshop Practice Scitech Publications* ", Chennai, 1999.

**1. PRACTICALS**

**30**

1. Young's modulus by non uniform bending.
2. Rigidity modulus and moment of inertia using Torsion Pendulum
3. Viscosity of a liquid by Poiseuille's method.
4. Wavelength determination using grating by Spectrometer.
5. Particle size determination by Laser
6. Thermal conductivity by Lees' disc.
7. Thickness of wire by Air wedge.
8. Thermo emf measurement by potentiometer.

**Total No of periods: 30**

<b>1. SEMICONDUCTORS AND RECTIFIERS</b>	<b>9</b>
Classification of solids based on energy band theory - Intrinsic semiconductors - Extrinsic semiconductors - P type and N type - P-N junction - VI characteristic of PN junction diode - Zener effect - Zener diode - Zener diode characteristic - Half wave and full wave rectifiers - Voltage regulation.	
<b>2. TRANSISTORS AND AMPLIFIERS</b>	<b>9</b>
Bipolar Junction Transistor - CB, CE, CC - Configurations and characteristics - Biasing circuits - Elementary treatment of voltage amplifier - Class A, B and C power amplifiers - principles of Tuned amplifiers.	
<b>3. POWER AND CONTROL ELECTRONIC DEVICES</b>	<b>9</b>
Field Effect Transistor - Configurations and characteristics - FET amplifier - SCR, Diac, Triac, UJI - Characteristics and simple applications - switching transistors - concept of feed back - negative feed back - application in temperature and motor speed control.	
<b>4. SIGNAL GENERATORS AND LINEAR IC'S</b>	<b>9</b>
Sinusoidal oscillators - positive feed back - RC phase shift, Hartley, Colpitt's, Wien bridge Oscillators - multivibrators - operational amplifier - adder, multiplier, integrator and differentiators - Integrated circuits.	
<b>5. DIGITAL ELECTRONICS</b>	<b>9</b>
Binary number system - AND, OR, NOT, NAND, NOR circuits - Boolean algebra - Exclusive or gate - Half and full adders - flip flops - registers and counters - A/D, D/A conversion - Digital computer principle.	
<b>6. TUTORIAL</b>	<b>15</b>

**Total No of periods: 60**

*Text Books:*

1. *Milman and Halkias, " Integrated Electronics ", McGraw Hill, 1979.*

*References:*

1. *Mehta,V.K., " Principles of Electronics ", S.Chand and Company Ltd., 1994.*

2. *Malvino & Leach, " Digital Principles and Applications ", McGraw Hill, 1986.*

**1. ELECTRICAL CIRCUITS 9**

Ohms Law - Kirchoff's Laws - steady state solution of DC circuits - Introduction to AC circuits - Waveforms and RMS value - power and power factor, single phase and 3 phase balanced circuits.

**2. ELECTRICAL MACHINES 15**

Principles of operation and characteristics of DC machines, Transformers (single phase and three phase) - Synchronous Machines - 3 Phase and single phase Induction motors - (op. principles).

**3. ELECTRICAL MEASUREMENTS 6**

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

**4. PRACTICAL 30****Total No of periods: 60***Text Books:*

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

*References:*

1. Jimmie J.Cathey and Nasar, S.A., " Basic Electrical Engineering ", Schaurn outline series in Engineering, McGraw Hill Book Co.1987.
2. Deshpande, N.V., " Electrical Machines " A.A.Wheeler and Co. Ltd., New Delhi, 1994.

**1. CELL STRUCTURE AND FUNCTION OF THE ORGANELLES 9**

Eukaryotic and Prokaryotic cells, Principles of membrane organisation, membrane proteins, cytoskeletal proteins, types of cell function, cell division, mitosis and meiosis, Extra cellular matrix, cell cycle and molecules that control cell cycle.

**2. TRANSPORT ACROSS CELL MEMBRANES 9**

Passive and Active transport, permeases, sodium potassium pump, Ca<sup>2+</sup> ATPase pumps, lysomal and vacuolar membrane ATP dependent proton pumps, Co Transport Symport, Antiport, transport into Prokaryotic cells endocytosis and Exocytosis. Entry of viruses and toxins into cells.

**3. RECEPTORS AND MODELS OF EXTRA CELLULAR SIGNALLING 12**

Cytosolic, nuclear and membrane bound receptors, Examples of receptors, Autocrine, Paracrine and Endocrine models of action, Quantitation of Characterisation of receptors.

**4. SIGNAL TRANSDUCTION 10**

Signal amplification, Different models of signal amplifications, Cyclic AMP, Role of inositol phosphates as messengers, biosynthesis of inositol triphosphates, cyclic GMP and G proteins role in signal transduction, Calcium ion flux and its role in cell signalling, current models of signal amplification, Phosphorylation of proteins Kinases.

**5. CELL CULTURE 5**

Techniques for the propagation of prokaryotic and Eukaryotic cells. Cell line, generation of cell lines, maintenance of stock cells, Characterisation of cells, Immuno cytochemistry, morphological analysis techniques, in cell culture, explant cultures primary cultures, contamination, Differentiation, Three Dimensional cultures, role of matrix in cell growth.

**6. CELL BIOLOGY LAB 30**

Introduction to principles of sterile technique and cell propagation. Preparation of media and media components. Identification of plant animal and bacterial cells and their components. Crypreservation of cells and recovery of frozen stocks into culture. Passaging of cells, Principles of microscopy, phase contrast and fluroscent microscopy staining, Gram, Gremsa Trypan blue, Cell, Cytotoxic assays-L3HJ Thymidine, Constituents of blood, Blood smear, separation of plant pigments by TLC, Osmosis & Tonicity, slide identification of different cells, mitosis in onion root tip.

**Total No of periods: 75**

*Text Books:*

1. *Darnell J., Lodish H., Baltimore D., " Molecular Cell Biology ", Freeman W.H., 1990.*
2. *Kimball T.W., " Cell Biology ", Wesley Publishers, 1989.*

(Revised Syllabus For B.E. / B.Tech. Programmes - Effective From June 2002)

- 1. MULTIPLE INTEGRALS 9**  
Double integration in Cartesian and polar coordinates - Change of order of integration - Area as a double integral - Triple integration in Cartesian coordinates - Change of variables - Gamma and Beta functions.
- 2. VECTOR CALCULUS 9**  
Curvilinear coordinates - Gradient, Divergence, Curl - Line, surface & volume integrals - Statements of Green's, Gauss divergence and Stokes' theorems - Verification and applications.
- 3. ANALYTIC FUNCTIONS 9**  
Cauchy Riemann equations - Properties of analytic functions - Determination of harmonic conjugate - Milne-Thomson's method - Conformal mappings : Mappings  $w = z + a$ ,  $az$ ,  $1/z$ ,  $z^2$  and bilinear transformation.
- 4. COMPLEX INTEGRATION 9**  
Cauchy's theorem - Statement and application of Cauchy's integral formulae - Taylor's and Laurent's expansions - Singularities - Classification - Residues - Cauchy's residue theorem - Contour integration - Circular and semi Circular contours (excluding poles on real axis).
- 5. STATISTICS 9**  
Moments - Coefficient of correlation - Lines of regression - Tests based on Normal and t distributions, for means and difference of means - Chi Square test for goodness of fit.

**Total No of periods: 45**

*Text Books:*

1. Kreyszig, E., " *Advanced Engineering Mathematics* " (8th Edition), John Wiley and Sons, (Asia) Pte Ltd., Singapore, 2000.
2. Grewal, B.S., " *Higher Engineering Mathematics* " (36th Edition), Khanna Publishers, Delhi 2001

*References:*

1. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., " *Engineering Mathematics* ", Volumes I & II (4th Revised Edition), S. Chand & Co., New Delhi, 2001.
2. Narayanan, S., Manicavachagom Pillay, T.K., Ramanaiah, G., " *Advanced Mathematics for Engineering Students* ", Volumes I & II (2nd Edition), S. Viswanathan (Printers & Publishers, Pvt, Ltd.), 1992.
3. Venkataraman, M.K. " *Engineering Mathematics III - A* ", National Publishing Company, Chennai, (13th Edition), 1998.

**1. ELECTROSTATICS AND ELECTROMAGNETISM 9**

Electric field and potential - Gauss theorem - Applications - dielectrics - capacitance - energy stored in a dielectric medium - types of capacitors - Loss of energy due to sharing of charges by the capacitors - electrical conductivity in conductors - Carey Foster's bridge - Maxwell's equations - Free space wave equation - Characteristic impedance.

**2. QUANTUM PHYSICS 9**

Development of quantum theory - Dual nature of matter and radiation - Compton effect - Pair production - Uncertainty principle - Equivalence of mass and energy Schrodinger's wave equation - Particle in a box - Electrons in a metal.

**3. ATOMIC AND NUCLEAR PHYSICS 9**

Characteristics of atomic spectra - molecular spectra - vector atom model - Stern and Gerlach experiment - Raman Effect and its applications - Liquid drop model - Explanation for Nuclear fusion - Shell model - Chain reaction - Criticality - Four factor formula - Q value - Power reactors - Laser induced Nuclear fusion.

**4. ELEMENTARY CRYSTALLOGRAPHY 9**

Crystalline and non-crystalline materials - Bravais lattices - Crystal systems - Symmetry elements - Simple crystal structures - Packing factor for sc, bcc, fcc, hcp structures - Miller Indices - Imperfections in crystals - Bragg's law and x-ray diffraction methods to study crystal structures.

**5. NON DESTRUCTIVE TESTING 9**

Liquid penetrant, Magnetic particle and eddy current methods - X-ray radiography - Fluoroscopy - Gamma ray radiography - Ultrasonic scanning methods - Ultrasonic flaw detector - Thermography.

**6. PRACTICALS 30**

1. Meter Bridge - Temp. Coefficient
2. Field along the axis of coil - Determination of H
3. Carey Foster's Bridge - Resistivity
4. X-ray diffraction - calculation of cell parameters
5. Newton's rings - Wavelength measurement
6. Spectrometer - Dispersive power of a prism
7. Rigidity modulus - static torsion
8. Ammeter & voltmeter calibration using potentiometer

**Total No of periods: 75**

*Text Books:*

1. Arumugam, M., " *Engineering Physics* ", Anuradha Publications, 1998.

*References:*

1. Beiser, A., " *Perspective of Modern Physics* ", John Wiley, 1985
2. Tayal, D.S., " *Nuclear Physics* ", Himalayan Publishers, 1998
3. Vasudeva, D.N., " *Fundamentals of Electricity and Magnetism* ", S.Chand & Co., 1985.
4. Hull, B. and John V., " *Nondestructive Testing* ", McMillan Education Ltd, London, 1988

**1. PRINCIPLES OF GRAPHICS 16**

Two dimensional geometrical construction - Conic sections, involutes and cycloids - Representation of three dimensional objects - Principles of projections - standard codes of principles.

**2. ORTHOGRAPHIC PROJECTIONS 28**

Projections of points, straight line and planes - ' Auxiliary projections ' - Projection and sectioning of solids - Intersection of surfaces - Development of surfaces.

**3. PICTORIAL PROJECTIONS 8**

Isometric projections - ' Perspectives ' - Free hand sketching.

**4. COMPUTER GRAPHICS 8**

Hardware - Display technology - Software - Introduction to drafting software.

**Total No of periods: 60**

*Text Books:*

1. Narayanan, K.L., and Kannaiah, P., " Engineering Graphics ", Tata McGraw-Hill Publishers Co., Ltd., 1992.

*References:*

1. William M. Neumann and Robert F. Sproul, " Principles of Computer Graphics ", McGraw Hill, 1989.
2. Warren J. Luzzadder and John M. Duff, " Fundamentals of Engineering Drawing ", Prentice-Hall of India Private Ltd., Eastern Economy Edition, 1995.
3. Natarajan K.V., " A Text Book of Engineering Drawing ", Private Publication, Madras, 1990.
4. Mathur, M.L. and Vaishwanar, R.S., " Engineering Drawing and Graphics ", Jain Brothers, New Delhi, 1993.

<b>1. MULTIUSER OPERATING SYSTEM</b>	<b>4</b>
Unix: Introduction - Basic Commands - Vi editor - filters - Input/output redirection - piping - transfer of data between devices - shell scripts.	
<b>2. FUNDAMENTALS OF NETWORKING</b>	<b>3</b>
Working on a networked environment - Accessing different machines from one node - concept of E-mail - Uses of Internet.	
<b>3. HIGH LEVEL LANGUAGE PROGRAMMING</b>	<b>8</b>
C Language: Introduction - Operator - Expressions - Variables - Input/output statements - control statements - function arrays - pointer - structures - unions - file handling - case studies.	
<b>4. TUTORIAL</b>	<b>45</b>

**Total No of periods: 60**

*Text Books and References:*

1. *Stephan J. Kochen & Patrick H. Wood, "Exploring the UNIX System", Techmedia, 1999.*
2. *Maurice J. Bach, "The design of UNIX Operating Systems", Prentice Hall of India, 1999.*
3. *Ramos, "Computer Networking Concepts", Prentice Hall International, 1999.*
4. *Balagurusamy, "Programming in ANSI C", Tata McGraw Hill, 1999.*
5. *Kernighan and Ritchie, "The C Programming Language", Prentice Hall of India, 1999.*
6. *Gottfried, "Programming with C", Tata McGraw Hill, 1999.*
7. *Kutti, "C and UNIX Programming: A Conceptual Perspective", Tata McGraw Hill, 1999.*
8. *Eric Nagler, "Learning C++", M/s. Jaico Publishing Co., 1998-99.*

<b>1. INTRODUCTION TO BIOMOLECULES</b>	<b>5</b>
Structure and properties of Mono, Di, Oligo and polysaccharides, complex carbohydrates, Structure and properties of Fatty acids, Glycerolipids, phospholipids, sphingolipids, glycolipids, steroids, Structure and properties of amino acids, Peptides, proteins and conjugated proteins. Structure and properties of purines, pyrimidines, nucleosides, nucleotides, polynucleotides, Ribonucleic acids and deoxy ribonucleic acids, nucleoprotein complexes.	
<b>2. METABOLISM</b>	<b>10</b>
Biosyntheses and degradation of fatty acids and cholesterol, Biosyntheses and degradation of amino acids, peptides and proteins; Biosynthesis and degradation of amino acids, peptides and proteins, Biosyntheses and degradation of Purines, pyrimidines and nucleic acids.	
<b>3. INTERMEDIARY METABOLISM</b>	<b>10</b>
TCA Cycle, glycolysis, gluconeogenesis, Pentose phosphate shunt, Embden Meyerhof pathway, urea cycle, interconnection of pathways, Metabolic regulation, Bioenergetics: Respiratory chain, TP cycle, energy rich compounds.	
<b>4. STRUCTURE FUNCTION RELATIONSHIP</b>	<b>10</b>
Complex carbohydrates, proteins and nucleic acids.	
<b>5. TUTORIAL</b>	<b>10</b>

**Total No of periods: 45**

*Text Books:*

1. *Lehninger A.L., Nelson D.L., Cox M.M., " Principles of Biochemistry ", CBS Publications, 1993.*
2. *Voet D., Voet G., " Biochemistry ", Second Edition, John Wiley and Sons, 1994.*
3. *Stryer L., " Biochemistry ", Fourth Edition, 1994.*

**1. INTRODUCTION TO BIO-ORGANIC CHEMISTRY 9**

Basic considerations - Proximity effects in organic chemistry - Molecular Adaptation - Molecular recognition and the supramolecular level.

**2. BIO-ORGANIC CHEMISTRY OF AMINO ACIDS & PEPTIDES 9**

Chemistry of living cells, Analogy between organic reactions and Biochemical Transformations, Chemistry of the peptide bond Asymmetric, Synthesis of amino acids, Transition state Analogues Chemical mutations, Molecular Recognition and Drug Design.

**3. ENZYME CHEMISTRY 9**

Introduction to Catalysis - introduction to enzymes - Multifunctional catalysis and simple models - alpha chymotrypsin - Hydrolytic Enzymes, Stereo electronic control - Immobilised enzymes - Enzymes in synthetic organic chemistry - Design of molecular clefts.

**4. METAL IONS IN BIOLOGICAL SYSTEMS 9**

Metal ions in proteins and biological molecules - Carboxypeptidase and role of zinc. Hydrolysis of Amides and peptides, Iron and oxygen transport - Copper ion - Biomodels for photosynthesis and Energy transfer Cobalt and vitamin B12 actions - oxidation's and reduction reactions.

**5. ENZYME MODELS 9**

Host guest complexation Chemistry, Developments in Crown ether chemistry, membrane chemistry and micelles - Cyclodextrin - Enzyme design using steroid templates - Remote functionalisation reaction - Biomimetic polyene cyclisations.

**Total No of periods: 45**

*Text Books:*

1. Zubay G., " *Biochemistry* ", Maxwell Macmillan International Editions, Second Edition, 1987.
2. Dugas H., " *Bio-Organic Chemistry - A Chemical approach to enzyme action* ", Springer Verlag, 1989.

**IB233 Genetics**

**2 1 0 100**

**45**

- 1. Classical Genetics Mendelian Laws, monohybrid, and dihybrid inheritance
- 2. Chromosome structure and organisation in prokaryotes and eukaryotes.
- 3. Multiple alleles and blood group antigens
- 4. Sex chromosomes and sex linked inherited disorders.
- 5. Linkage, crossing over and genetic mapping of chromosomes.
- 6. Identification of the genetic material - classical experiments, Hershey Chase, Avery McLeod etc.
- 7. Genetic transfer: Conjugation, Transduction and Transformation.

**Total No of periods: 45**

*Text Books:*

- 1. Goodenough U., " Genetics ", Hold Saunders International, 1985.
- 2. Gardner EJ, Simmons MJ, Slustad DP, " Principles of Genetics ", 1991.

<b>1. WORLD OF MICRO ORGANISMS</b>	<b>6</b>
Characteristic of Microorganism, Historical review of the foundation of microbiology. Taxonomy methods of studying microorganisms, Microscopy, light and laser optic systems.	
<b>2. MICROBIAL FLORA AND FUNCTION</b>	<b>10</b>
General structural organisation of bacterial, viral, bacilli, Actinomycetes Differentiation and Development.	
<b>3. REPLICATION OF MICRO ORGANISMS</b>	<b>6</b>
Multiplication of bacteriophages, bacteria and differentiation organisms such as yeast, fungi and actinomycetes.	
<b>4. MICROBIAL NUTRITION AND ENVIRONMENT</b>	<b>6</b>
Growth of Microorganisms in different media - growth curve of microbes and different methods of enumeration of multiplying microorganisms. Effect of temperature, pH, and osmotic pressure on the growth of bacteria.	
<b>5. MICROBIAL METABOLISM</b>	<b>6</b>
Metabolic pathways and bioenergetics. Aerobic and anaerobic growth. Production of secondary metabolites and their application in industry, Beneficial microorganisms and products. Clinically important microorganisms and their effects on infections and immunity. Formation of toxic materials by microorganisms. Their role in clinical microbiology and food preservation.	
<b>6. PHYSICAL AND CHEMICAL CONTROL OF MICRO ORGANISMS</b>	<b>6</b>
Drugs, Chemotherapy, antimicrobial agents and disinfectants, Diseases caused by microorganism and control.	
<b>7. ENVIRONMENTAL APPLICATIONS AND MICROBIOLOGY</b>	<b>5</b>
Ecology, Recycling of biomaterials. Production of bio gas. Leaching of ores by microorganism. Application of biofertilizers and biopesticides. Pollution control through use of consortium of microorganisms.	
<b>Total No of periods:</b>	<b>45</b>

*Text Books:*

1. *Talaro K., Talaro A Cassida Pelzar and Reid, " Foundations in Microbiology ", W.C. Brown Publishers, 1993.*
2. *Pelczar M.J., Chan ECS and Krieg NR, " Microbiology ", Tata McGraw Hill Edition, New Delhi, India.*

**1.        BASIC CONCEPTS IN ENGINEERING THERMODYNAMICS**                      **6**

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

**2.        THERMODYNAMIC PROPERTIES OF FLUIDS**                      **9**

Volumetric properties of gases exhibiting non-ideal behaviour; Residual properties; Estimation of thermodynamic properties using equations of state; Maxwell relationships and their applications; Calculation of flow processes based on actual property changes.

**3.        SOLUTION THERMODYNAMICS**                      **9**

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

**4.        PHASE EQUILIBRIA**                      **6**

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

**5.        CHEMICAL REACTION EQUILIBRIA**                      **6**

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

**6.        BIOCHEMICAL THERMODYNAMICS**                      **9**

Energetics of Metabolic Pathways; Energy Coupling (ATP & NADH); Stoichiometry and energetic analysis of Cell Growth and Product Formation - elemental Balances, Degree of reduction concepts; available-electron balances; yield coefficients; Oxygen consumption and heat evolution in aerobic cultures; thermodynamic efficiency of growth.

**Total No of periods:        45**

*Text Books and References:*

1. *Smith J.M., Van Ness H.C. and Abbott M.M., " Introduction to Chemical Engineering Thermodynamics ", McGraw Hill, 1995.*
2. *Roels J.A., " Kinetics and Energetics in Biotechnology ", Elsevier, 1983.*

**1. OVERVIEW OF PROCESS INDUSTRY 5**

Unit Operations and Process Conservation of mass and energy - SI Units and conversion factors.

**2. MATERIAL AND ENERGY BALANCES 18**

Overall and component material balances - Material balances without chemical reactions - Chemical reactions - stoichiometry - conversion and yield - Material balance calculations with chemical reactions - combustion calculations - recycle operations.

Energy balances - Entropy - Latent heat - Chemical reactions - combustion.

**3. MOMENTUM TRANSPORT 22**

Fluids - Types - Nature of flow - Momentum balance - Mechanical energy balance - Macroscopic - differential balances - concepts- Pressure losses in flow systems - incompressible and compressible fluid flows.

Dimensional analysis - Mixing and agitation - Power consumption - scale up. Pumps and gas moving machinery - Pump characteristics - Work of Consumption.

**Total No of periods: 45**

*Text Books:*

1. Bhat & Vora, " Stoichiometry ", III Ed., Tata McGraw-Hill Ltd.
2. Christie J.Geankoplis, " Transport Process & Unit Operations ", III Edition., Prentice-Hall of India Pvt.Ltd.

*References:*

1. McCabe W.L. & Smith J.C., " Unit Operations in Chemical Engineering ", V Ed., McGraw Hill Int. Ed.,
2. Foust CH. Durgaprasad & Murthy DVS, " Process Calculation for Chemical Engineers ".
3. Holland F.A., " Pumping of Liquids ".
4. Noel de Nevers, " Fluid Mechanics for Chemical Engineers ", II ed., McGraw Hill, Puldi.
5. Raghu Raman J., " Chemical Process Calculations ".
6. Reynolds and Colbum, " Momentum, Heat and Mass Transfer ".

**LIST OF EXPERIMENTS****60**

1. Synthesis of Asprin
2. Hydrolysis of sucrose
3. Preparation of pyruvic acid from tartaric acid
4. Preparation of oleic acid from olive oil
5. Preparation of alpha D glucopyramose pentacetate
6. Preparation of 1,2,5,6 diocyclohexylidene alpha-D glucofuranose
7. Preparation of 5,10,15,20 Tetrakisphenly porphyrin
8. Isolation of lycopene from Tomato paste
9. Preparation of L-proline
10. Preparation of L-cystine from hair
11. Preparation of S-ethyl hydroxybutanoate from ethyl acetoacetate using yeast
12. Resolution of S-ethyl hydroxy butanoate using 3,5 Dinitrobenzoate.

\* Minimum of TEN experiments shall be offered

**Total No of periods: 60**

*References:*

1. *Fummi B.S., Hannaford A.J., Smith P.W.G., "Text Book of Practical Organic Chemistry", Longman edition, 1995.*

**1. HEAT TRANSPORT****36**

1. Mechanism of Heat Transfer - Heat Conduction - Conduction through series resistances - Combined conduction - Convection - extended surfaces - Two dimensional conduction - shape factors.
2. Convection - Dimensional Analysis - Forced Convection in pipe and other geometries - Natural convection - Boiling and condensation - Heat transfer to Non Newtonian Fluids.
3. Heat Exchange - design - Evaporators - Overall heat transfer coefficients - Calculation for single and multiple effects.
4. Drying - Air Properties - Drying Equipments - Drying rates and drying time - Drying and Thermal Processing of biological materials.

**2. MECHANICAL SEPARATIONS****9**

Filtration - Industrial Filters - Design - Centrifugal separation - Settling and sedimentation.

**Total No of periods: 45***Text Books:*

1. Christie J. Geankoplis, " Transport Processes and Unit Operations ", III Edition, Prentice Hall India Pvt. Ltd.

*References:*

1. Robert E.Treybal, " Mass Transfer Operations ", III edition, McGraw-Hill International Editions.
2. McCabe W.L. & Smith J.C., " Unit Operations in Chemical Engineering ", V Edition, McGraw Hill International Edition.
3. Frank P. Incropera, " Fundamentals of Heat and Mass Transfer and Interactive Heat Transfer ", John Wiley Sons, 1998.

**1. PROKARYOTES 30**

1. Structure of DNA, different forms of DNA and RNA, secondary structure in single stranded nucleic acids.
2. Replication, models, DNA binding proteins
3. Transcription, role of rho factors
4. Translation, codon usage, inhibitors of transcription and translation.
5. Mutation, physical and chemical agents - mechanism of action of mutagens - UV repair.
6. Gene regulation, operon concept, lac, trp., feedback inhibition, Allosteric enzymes.

**2. EUKARYOTES 15**

1. Organization of genome, interaction with histones.
2. Transcription: Exon, intron concepts, transcription initiation factors and characteristic motifs in these factors, promoters and enhancers.
3. RNA Splicing
4. Retroviruses, retrotransposons and oncogenes

**Total No of periods: 45***Text Books:*

1. Benjamin Lewin, "Genes V", Oxford University Press, Oxford, New York, 1994.
2. Freifelder D., "Molecular Biology", Jones and Bartlett Publishers Inc., 1987.

**1. ABSORPTION OF RADIATION 9**

Absorptivity, Lambert Beers law, Deviations, Instrumentation, Double beam and single beam spectrometers, sources of radiation detectors, photometric accuracy, spectrophotometer operation, instrumentation optical materials sources, detectors spectrophotometers, Fourier transform, spectrophotometers, calibration and standardisation, atomisation, flame atomisation, sources of radiation, background correction, detection limits, inferences and applications.

**2. SCATTERING OF RADIATION 9**

Rayleigh scattering, instruments, analytical, applications molecular weights and particle sizes, scattering in gases, turbidimetric and nephelometric titrations.

**3. X-RAY METHODS 9**

The absorption of x-rays, monochromatic X-ray sources, X-ray detectors, x-ray diffraction, x-ray fluorescence.

**4. ELECTRONS AND ION SPECTROSCOPY 9**

X-ray photoelectron spectroscopy (XPS) ultraviolet photo electron spectroscopy (UPS), electron impact spectroscopy and auger electron spectroscopy, instrumentation radiation sources, energy analysis, detectors and auxiliary systems.

**5. THERMOMETRIC METHODS 9**

Thermogravimetric analysis, thermobalance, derivative thermogravimetric analysis, differential thermal analysis, DTA apparatus scanning calorimetric DTA.

**Total No of periods: 45**

*Text Books:*

1. *Willard and Merrit, " Instrumental Methods and Analysis ", VI Edition, CBS Publishers and Distributors.*

*References:*

1. *Ewing GW, " Instrumental Methods of Chemical Analysis ", McGraw Hill Book Company, 1989.*
2. *Braun H., " Introduction to Chemical Analysis ", McGraw Hill, 1987.*

**1. INTRODUCTION TO BIOPROCESSES 7**

Historical development of bioprocess technology, An overview of traditional and modern applications of biotechnological processes, role of bioprocess engineer in the biotechnology industry, outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses, generalised process flow sheets.

**2. FERMENTATION PROCESSES 7**

General requirements of fermentation processes, Basic design and construction of fermentor and ancillaries, Main parameters to be monitored and controlled in fermentation processes, An overview of aerobic and anaerobic fermentation processes and their application in the biotechnology industry, solid-substrate fermentation and its applications.

**3. ENZYMATIC BIOCONVERSION PROCESSES 7**

Kinetics and thermodynamics of enzyme-catalyzed reactions, techniques of enzyme immobilisation, basic design and configuration of immobilised enzyme reactors, applications of immobilised enzyme technology.

**4. MEDIA DESIGN AND STERILISATION FOR FERMENTATION PROCESSES. 8**

Medium requirements for fermentation processes, Carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design and usage of various commercial media for industrial fermentations, thermal death kinetics of microorganisms, batch and continuous heat, sterilisation of liquid media, filter sterilisation of liquid media, Air, Design of sterilisation equipment.

**5. METABOLIC STOICHIOMETRY AND ENERGETICS 8**

Stoichiometry of Cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients Energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

**6. KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION 8**

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

**Total No of periods: 45**

*Text Books:*

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

**1. PROBABILITY AND RANDOM VARIABLES 9**

Probability concepts, Random variables, Moment, Moment Generating function, Binomial, Poisson, Geometric, Negative binomial, Exponential, Gamma, Weibull distributions, Functions of Random variable, Chebychev inequality.

**2. TWO-DIMENSIONAL RANDOM VARIABLES 9**

Marginal and Conditional distributions, Covariance, Correlation and regression, Transformation of random variables, Central Limit theorem.

**3. RANDOM PROCESS 9**

Classification, Stationary and Markov Processes, Poisson Process, Pure birth Process, Birth and death Process, Markov Chains, Markovian queueing models.

**4. RELIABILITY ENGINEERING 9**

Concepts of reliability, Hazard function, Series and parallel systems, Reliability and Availability of Markovian systems, Maintainability, Preventive Maintenance.

**5. DESIGN OF EXPERIMENTS AND QUALITY CONTROL 9**

Completely randomised design, Randomised block design, Latin square design, Process control, Control charts of measurements and attributes, Tolerance limits.

**6. TUTORIAL 15****Total No of periods: 60**

*References:*

1. *Mille I.R. and Freund J.E., " Probability and Statistics for Engineers ", Prentice-Hall, 1995.*
2. *Kapur J.N. and Saxena H.C., " Mathematical Statistics ", S Chand and Company Ltd., New Delhi, 1997.*
3. *Balagurusamy E., " Reliability Engineering ", Tata McGraw Hill Publishers, New Delhi, 1984.*
4. *Bhat U.N., " Elements of Applied Stochastic processes ", Wiley Series in Probability and Mathematical Statistics, New York, 1983.*

**60**

1. Sterilisation techniques (lecture/demonstrations).
2. Preparation of culture media (a) broth type of media (b) Agar.
3. Culturing of Microorganisms: Pure culture techniques: Streak plate, pour plate, isolation and preservation of bacterial culture.
4. Identification of microorganisms. (a) Staining techniques (b) Biochemical testing.
5. Quantitation of micro-organisms (a) counting microscopy (b) Nephelometry/Turbidimetry (c) Total N or dry weight. (d) Serial dilution plating.
6. Environmental sample analysis  
Quantitative estimation of pathogenic and non pathogenic microbes from sewage and soil samples.
7. Food microbiology (a) milk (b) Fermented Food (c) Salmonella in poultry.
8. Clinical microbiology: Normal mouth flora, blood and urine culture, antibiotic disc test assay.

**Total No of periods: 60**

**60**

1. Validating Lambert-Beers Law using  $\text{KmnO}_4$
2. Precision and validity of the experiment.
3. Finding the  $\lambda_{\text{max}}$  and stoichiometry of the Fe (-1,10 phenanthroline complex) using absorption spectrometry.
4. Finding  $\text{pK}_a$  of 4-nitrophenol using absorption spectroscopy
5. UV-spectra of nucleic acids and spectra
6. Chemical actinometry using potassium ferrioxalate
7. Estimation of  $\text{SO}_4^{2-}$  by Nephelometry
8. Emission spectrum of Alizarin Aluminium complex, limit of detection
9. Estimating  $\text{Al}^{3+}$  concentration using alizarin in the spectrometer
10. Operating principles of IR spectrum of hydrocarbons
11. Estimation of trace elements by flame photometry
12. Operation principles of DTA

\*Minimum of TEN experiments shall be offered.

**Total No of periods: 60**