University of Pune

B. Tech Biotechnology S. E. Sem (I)

215461: Applied Chemistry

Teaching Scheme:	**Exam Scheme:**
Theory: 4 hr/week	**Paper: 100 Marks**
Practical: 2 hr/week	**Term Work: 50 Marks**

UNIT 1 **[8Hrs]**

Structural Effect and Reactivity : Benzene and aromaticity, concept of aromaticity (4n+2), condition's necessary for delocalization, breaking and formation of bonds (Reaction intermediate). Factors affecting electron availability –Inductive effect, Resonance effect (resonance structures of naphthalene, anthracene, aniline, phenoxide ion, benzaldehyde, nitrobenzene, etc..), hyper conjugation, steric effect, tautomerism. Effects of resonance, inductive effect, steric effect on pKa, and pKb value of simple acid and bases. Types of reactions, types of reagents.

UNIT 2 **[8 Hrs]**

Reaction Mechanism of reaction involving carbonium ion intermediates:

1. Nucleophilic substitution –Hydrolysis of alkyl halide (SN^1 Mechanism). Also discuss SN^2 mechanism and factors affecting SN reactions.
2. Electrophilic substitution in benzene and mono-substituted benzene nitration, sulphonation, halogenation, Friedel Craft alkylation and acylation.
3. Electrophilic addition to C=C, polar addition of hydrogen halides and water, alkylation, dimerisation.
4. Elimination's - E1 reaction s in acid catalyzed dehydration of alcohols, base catalyzed dehydro-halogenation of alkyl halides, comparison of elimination with substitution. Also cover E2 mechanism.
5. Rearrangement-Beckman rearrangement.

Mechanism of reactions involving carbanion intermediates:

1. Addition of carbon nucleophilic to C=O- Grignard reaction for preparation of primary, secondary, and tertiary alcohol's and carboxylic acids.
2. Nucleophilic substitution by carbon nucleophile- Wurtz reaction.
3. Carbanion involves in condensation- Aldol condensation and Claisen ester condensation.
4. Rearrangement involving carbanion-Favorskii rearrangement.

Reaction involving free radical intermediates:

1. Addition of hydrogen halides to C=C in presence of peroxides
2. Substitution reaction- Halogenation of methane
3. Dimerisation- Kolbe synthesis.

UNIT 3 [8 Hrs]

Stereochemistry: Basic concepts of Stereochemistry, conformational isomerism of ethane, propane, butane, cyclohexane, monosubstituted cyclohexane. Optical isomerism with one, two chiral centres (AA and AB types), erythro, threo, meso distereoisomers. Geometrical isomerism (compounds containing one double bond).

Heterocyclic compounds

Structure, preparations and reactions, five membered rings- Furan, Pyrolle thiophene, Six membered ring- Pyridine, Fused rings-Indole, Quinoline.

UNIT 4 [8 Hrs]

Solid and Liquid State : Solid state- Introduction, characteristics of solids melting point, sublimation, atomic and molar heat of solids, X-ray crystallography-Bragg's equation, measurement of diffraction of angle.

Liquid state- introduction, intermolecular forces, structure of liquids, general properties of liquids. Evaporation, vapor pressure, measurement of vapor pressure, Trouton's rule, boiling point, heat of vaporization, freezing point, surface tension and it's measurement.

Parachor, viscosity and its measurement. Factors affecting viscosity, molecular viscosity and optical activity. Numericals on all above (solids and liquids both).

UNIT 5 **[8 Hrs]**

Gaseous state : Gaseous state I- Behavior of ideal gases, kinetic molecular theory of gases. The kinetic gas equation. Derivation of gas laws from gas equation, kinetic energy and temperature. Types of molecular velocities and their calculations mean free path and collision frequency, collision diameter, and degrees of freedom. Law of equipartition of energies, specific heat and molar heats of gases.

Gaseous state II- behavior of real gases- ideal and real gases, deviation from ideal behavior, Vander Wall's equation of state and it's limitations, intermolecular forces. The critical phenomenon, experimental determination of critical constants of a gas, critical phenomenon and Andrews experiments, Vander Wall's equation and critical state, calculation of critical constants.

UNIT 6 **[8 Hrs]**

Solution : Solution-definition, why substances dissolve, temperature and solubility, solution of gas in gas, gases in liquid, Henry law, the ideal solution, Raoult'1s law of ideal solution, solutions of liquids in liquids, theory f dilute solution. Colligative properties, osmosis, osmotic pressure, measurement of osmotic pressure.

Colligative properties of dilute solution- lowering of vapor pressure, elevation of boiling point and thermodynamic derivation, depression in freezing point and thermodynamic derivation. Abnormal behavior of solutions of electrolytes.

Numericals on all above.

Practical: Any 10 experiments

1. Volumetric estimation of ester from the given ester solution of ester.
2. Purification of organic compound by recrystalization and sublimation and to find their physical constants (any four compounds).
3. Preparation of benzoic acid from Benz amide.
4. Preparation of osazone derivatives of glucose.
5. To determine the percentage composition of a given mixture of two liquids by stalagmometer.
6. To determine relative viscosities of liquids A and b by Oswald's viscometer. Ton find percentage composition of mixture C of A and B by using graphical method using viscosity data
7. To determine radius of macromolecule by Ostwald's viscometer.
8. To determine molecular weight of non volatile solute by depression in freezing point method
9. To determine molecular weight of solid y elevation in boiling point method.
10. To determine distribution coefficient of iodine between water and carbon tetrachloride and hence to determine the molecular condition of iodine.
11. To determine molecular weight of given immiscible liquid by steam distillation method.
12. To determine amount of hydrochloric acid and phosphoric acid from the given mixture by using pH meter.
13. To determine heat of solution of potassium nitrate or ammonium chloride by studying their solubility in water.

Text Books:

1. **Jerry March**; Advanced Organic Chemistry; McGraw Hill International Book Company.
2. **Peter Sykes**; A Guide To Mechanism in Organic Chemistry; Orient Longman.
3. **Morrison and Boyd**; Organic Chemistry; Prentice Hall of India Private Ltd.
4. **Samuel Glasstone**; Textbook of Physical Chemistry, Mcmillian and Co. Ltd.
5. **G.M. Barrow**; Physical Chemistry; McGraw Hill Publications.
6. **P.W. Atkins**; Physical Chemistry; ELBS Publications.

S. E. (Sem. I)

207004 ENGINEERING MATHEMATICS – III (2008 Course)

Teaching Scheme: Examination Scheme:
Lectures: 4 hrs./week Paper: 100 marks
Duration: 3 hrs.

Section I

Unit I: Linear Differential Equations (**LDE**) (09 Hours)
Solution of n^{th} order LDE with Constant Coefficients, Method of Variation of Parameters, Cauchy's & Legendre's DE, Solution of Simultaneous & Symmetric Simultaneous DE.

Unit II: Applications of DE (09 Hours)
Applications of LDE to chemical engineering problems involving batch reactions and mass spring systems.
Solution of Partial Differential Equations (**PDE**)
(1) $\partial u/\partial t = a^2 (\partial^2 u/\partial x^2)$, (2) $\partial^2 u/\partial t^2 = a^2 (\partial^2 u/\partial x^2)$ and
(3) $(\partial^2 u/\partial x^2) + (\partial^2 u/\partial y^2) = 0$
by separating variables only. Applications of PDE to problems of Chemical and allied engineering.

Unit III: Fourier Transform (**FT**) (09 Hours)
Fourier Integral theorem. Sine & Cosine Integrals. Fourier Transform, Fourier Cosine Transform, Fourier Sine Transforms and their inverses. Finite FT, Application of FT to problems on one and two dimensional heat flow problems.

Section II

Unit IV: Laplace Transform (**LT**) (09 Hours)
Definition of LT, Inverse LT. Properties & theorems. LT of standard functions. LT of some special functions viz. error, 1^{st} order Bessel's, Periodic, Unit Step, Unit Impulse, ramp, jump, parabolic, Si(t) and Ei(t). Problems on finding LT & inverse LT.

Unit V: Vector Calculus (09 Hours)
Physical Interpretation of Vector Differentiation. Radial, Transverse, Tangential & Normal components of Velocity and Acceleration. Vector differential operator. Gradient, Divergence & Curl. Directional derivative. Vector identities. Line, Surface & Volume integrals. Work done. Conservative, Irrotational & Solenoidal fields. Scalar potential. Green's Lemma, Gauss's Divergence and Stoke's Theorem.

Unit VI: Applications of Laplace Transforms & Vector Calculus (09 Hours)
Applications of Vectors to problems in Fluid Mechanics, Continuity equations, Stream lines, Equations of motion, Bernoulli's equations.
Applications of LT for solving ordinary differential equations, liquid level systems, consisting of single tank and two tanks in series (interacting and non-interacting systems), second order systems (damped vibrator).

Text Books:

1. Advanced Engineering Mathematics by Peter V. O'Neil (Cengage Learning).
2. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.).

Reference Books:

1. Engineering Mathematics by B.V. Raman (Tata McGraw-Hill).
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics, Wylie C.R. & Barrett L.C. (McGraw-Hill, Inc.)
4. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).
5. Applied Mathematics (Volumes I and II) by P. N. Wartikar & J. N. Wartikar
   (Pune Vidyarthi Griha Prakashan, Pune).
6. Advanced Engineering Mathematics with MATLAB, 2e, by Thomas L. Harman, James Dabney and Norman Richert (Brooks/Cole, Thomson Learning).

S. E. (Sem. I)
215462: Fluid Flow & Unit Operations

Teaching scheme:	**Exam scheme:**
Lectures: 4 Hrs / week	**Paper: 100 Marks**
Practicals: 2 Hrs / week	**TermWork: 50Marks**

UNIT 1 **[8 Hrs]**

Fluid – Definition and important properties, pressure and its measurements, , types of flow, viscosity, Newton's law, boundary layer, continuity equation, Bernoulli's equation, Applications of Bernoulli's equation: venturi meter, orifice meter, pitot tube.

UNIT 2 **[8 Hrs]**

Shell balance based solutions for laminar flow through circular pipes (Hagen Poiseuelle equation), on inclined plane, through annular space (concentric pipes), turbulent flow in pipes and closed channels, effect of roughness, friction from changes in velocity or direction, effect of fittings and valves.

UNIT 3 **[8Hrs]**

a. Pipe fittings and valves, fluid moving machinery, NPSH, types of pumps, positive displacement pump and centrifugal pumps.

b. Mixing and Agitation: Necessity of mixing & agitation in chemical industries, Types of Impellers & propellers, Different flow patterns in mixing, Calculation of power requirement of mixing equipment, Mixing equipment of pastes & viscous material, Solid – Solid Mixing, Agitator selection.

UNIT 4 **[8Hrs]**

Fluid – Solid systems:

a. Motion of particles in liquid, drag force, drag coefficients

b. Gravity settling method: Terminal velocity, Stoke's law and Newton's law, free settling, sink and float method, differential settling.

c. Sedimentation and thickening: Batch sedimentation, equipments for sedimentation, Kynch theory of sedimentation, calculation of area and depth of

continuous thickeners, batch thickeners, and continuous thickeners
d. centrifugal settling processes, cyclones, hydrocyclones, centrifugal decanters, centrifugal sedimentation

UNIT 5 **[8Hrs]**

Fluidization and Filtration: Fluidization: flow through packed beds, characteristics of fluidized systems, minimum fluidization velocity, types of fluidization, applications of fluidization technique, spouted beds and fixed bed.
Filtration: Filter media and filter aids, classification of filtration, pressure drop through filter cake, filter medium resistance, specific cake resistance, Continuous Filtration, Washing and dewatering of filter cakes, Centrifugal filtration.

UNIT 6 **[8Hrs]**

Particle Technology and size reduction: Particle size and shape, Mixtures of particles, Determination of particle size, Standard screen series, screen analysis, Screen effectiveness and capacity, Industrial screening equipments.
Crushing efficiency, energy requirements calculations by using different crushing laws, Size reduction equipments: Primary crushers, secondary crushers, Intermediate & fine grinders, Ultra fine grinders, Cutting machines, Open circuit & Closed circuit grinding.

Practical:

1. Determination of viscosity.
2. Flow through pipes. Analysis for laminar and turbulent regions.
3. Flow through packed bed
4. Flow through venturimeter
5. Flow through orifice meter
6. Flow through pipe fitting
7. Verification of Darcy's law
8. Pump and blower specification writing in a format routinely used by process industry
9. Verification of stokes law
10. To determine mixing Index of a mixture in Ribbon Blender.
11. To determine mixing Index of mixture in Sigma Mixer.

Text Books:

1.McCabe and Smith, “Unit operations in Chemical Engineering”. McGraw Hill Publications
2. Coulson J. M. & Richardson J.F. “Chemical Engineering Vol. 2”, Pergamon Press.
3. Morton M. Den., “Process fluid mechanics” Prentice Hall 1989.
4. R.W.Fox, Allan T. McDonald., “Introduction to fluid mechanics” John Willey and sons 1995.
5. Jack B. Evett and Cheng Lin., “Fundamentals of Fluid mechanics” McGraw Hill 1987.
6. Bird, Stewart, Lightfoot, “Transport Phenomena”, John Wiley and Sons.
7. Badger W. L & Banchero J.T. “Introduction to Chemical Engineering”, McGraw Hill Publications.
6 Foust A. S “Principles of Unit Operation”.
7 George G. Brown, “Unit operations”, CBS publishers and distributors.

S. E. Biotechnology Sem (I)
215463: Microbiology

Teaching Scheme:	**Exam Scheme:**
Theory: 3 hr/week	**Paper: 100 Marks**
Practical: 2 hr/week	**Oral: 50 Marks**
	Term Work: 25 Marks

UNIT 1 **[10 Hrs]**

Hostory and scope of microbiology, Types of Microorganisms: Bacteria- Structure, morphology, classification, actinomycetes, fungi, viruses, pure cultures, enrichment of bacterial cultures, growth requirements, growth media

UNIT 2 **[6 Hrs]**

Microbial nutrition, Nutritinal types if microorganisms. Growth and reproduction of bacteria, enumeration of bacteria, growth media, growth curve, batch culture, continuous cultures, synchronous culture, factors affecting growth, extremophiles

UNIT 3 **[8 Hrs]**

Sterilization, disinfection and control of microorganisms, wet and dry heat, filtration, antimicrobial agents, antibiotics, drug resistance

UNIT 4 **[8 Hrs]**

Viruses: classification, structure, animal viruses, plant viruses, DNA viruses, RNA viruses, replication of viruses, life cycle, lysogeny, lytic cycle, lambda phage, T4 phages, methods of cultivation, reverse transcriptase, oncogenic viruses

UNIT 5 **[8 Hrs]**

Microbiology of air, water- fresh water, waste water, potability of water,, soil, rhizosphere, microbial interactions in environment, commensalisms, antagonism, symbiosis etc. milk, Pasterurization, HT, UHT, food microbiology

UNIT 6 **[8 Hrs]**

Medical microbiology, infectious diseases, Bacterial diseases-tuberculosis, leprosy, cholera, diarrhea, rabies,viral diseases: HIV, influenza,, pox, fungal diseases

Practicals:

1. Preparation of nutrient media and sterilization.
2. Inoculation of agar slants, agar plate and nutrient broth. Culture of Microorganisms using various techniques.
3. Simple and Differential staining procedures
4. Enumeration of Bacteria- microscopic method and colony counting.
5. Pour plate methos for isolation of baxcteria
6. Spread plate method for isolation of bacteria
7. Observation of different bacteria and fungi, actimomycetes under microscope.
8. Isolation and characterization of microbes from soil samples
   (U.V. spectrophotometer, Colony Counter etc.)
9. Study of Growth curve of E. Coli.

Text Books:

1. Prescott, Harley and Kelvin – Microbiology, 2nd ed.
2. Peleczar, Microbiology, TMH Publication.
3. Tauro, K.K. Kapoor, K.S. Yadav An introduction to Microbiology

Reference Books:

1. Roger Y. Stainier et al. – General Microbiology, 5th ed., PHI Publication.
2. Schlegel H.G. – General Microbiology, 8th ed.
3. U.P. Guts, Chick et. Al. Microbes and Engineers Aspects, Springer Verlag
4. Wistreich and Lechman – Microbiology, Macmillan Co.
5. Medical Microbiology by Cruikshank
6. Murry Moo Young Comprehensive Biotechnology, 1st Vol

S. E. Biotechnology SEM (I)
215464: Biochemistry I

Teaching Scheme:	**Exam Scheme:**
Theory: 4 hr/week	**Paper: 100 Marks**
Practical: 2 hr/week	**Practical: 50 Marks**
	Term Work: 25 Marks

UNIT I [6 Hrs]

Introduction to biochemistry, Chemical reactions in living cells, hierarchy of the molecular organization of cells, acids and bases, buffers, fitness of the aqueous environment for living organisms, carbohydrate-monosaccharides, disaccharides, polysaccharides. Identification and analysis of monosaccharides and oligosaccharides, storage polysaccharides, structural

polysaccharides, glycolysis and gluconeogenesis, carbohydrate as information molecule (exa. lignin)

UNIT II [8 Hrs]

Synthesis of glycogen and starch and the role of nucleoside diphosphate sugars, glycogen break down, TCA cycle and pentose phosphate pathway: flow sheet of respiration, discovery of TCA cycle,intracellular location of the enzymes of the TCA cycle, reactions of the TCA cycle, regulation of the TCA cycle, electron transport chain, oxidative phosphorylation, , cori cycle

UNIT III [8 Hrs]

Proteins – Common amino acids, rare amino acids, non protein amino acids, classification of amino acids (on the basis of R groups and essential, non essential amino acids) acid base properties of amino acids. The structure of peptides, protein purification (molecular size, solubility difference, electric charge, selective adsorption, affinity chromatography),digestion and absorption of proteins, Metabolism of amino acids and proteins, transamination, deamination, urea cycle, polyamines

UNIT IV [8 Hrs]

Basic chemistry of lipids, classification of lipids, lipoproteins, membrane lipids, Digestion and absorption of lipids beta oxidation of fatty acid, ketone bodies, ketoacidosis biosynthesis of lipids: biosynthesis of saturated fatty acid, carbon source for fatty acid synthesis, formation of malonyl –CoA,elongation of saturated fatty acids in mitochondria and microsomes, formation of monoenoic acids , formation of polyenoic acids, biosynthesis of triacyl glycerol, biosynthesis of phosphoglycerides, biosynthesis of sphingomyelin and other sphingolipids, pathway of cholesterol biosynthesis, regulation of cholesterol synthesis, synthesis of cholesterol esters, formation of other steroids,

UNIT V [8 Hrs]

Nucleotides and the covalent structure of nucleic acids: general structure of the nucleotides,pyrimidines and purines,nucleosides, nucleotides,nucleic acids, hydrolysis of nucleic acids, analysis of nucleotide sequence, nucleic acid protein supramolecular complexes, biosynthesis of nucleotides.

UNIT VI [8 Hrs]

Nutritional Biochemistry, General principles of nutrition, energy requirement, balanced diet, dietary fibers, vitamins ,classification and functions of vitamins, (vit B_1, B_2 ,B_6 , B_{12}, vit C), fat soluble vitamins (vit A, D, E, K), recommended dietary alleowances, minerals and its functions,

Practicals:

1. Preparation of percent and molar solutions
2. Preparation of phosphate buffer and testing buffering capacity
3. Measurement of pH
3. Qualitative testing of glucose using Benedict's reagent
4. Estimation of glucose using ortho-Toluedine method
5. Extractions of proteins from sprouted seeds
6. Protein estimations by Folins method
7. Estimation of protein by Biuret assay method

8. Estimation of concentration of cholesterol
9. SDS PAGE

Text Books

1. Lubert stryer Biochemistry, Freeman WH & Company, New York,
2. Conn and Stumph, Outlines of Biochemistry

Reference Books

1. JH Weil, General Biochemistry, New Ages International (P) Ltd. 1997.

2. David T. Plummer, An Introduction to practical biochemistry, Tata McGraw Publishing Company Ltd.
3. I.A.L. Lehninger, DL Netson, MM Cox Principles of Biochemistry, CBS Publishers and Distributors.

S. E. Biotechnology SEM (II)
215465: Biochemistry II

Teaching Scheme:	**Exam Scheme:**
Theory: 4 hr/week	**Paper: 100 Marks**
Practical: 2 hr/week	**Practical: 50 Marks**
	Term Work: 25 Marks

UNIT I **[8 Hrs]**

Protein and structure- Primary structure, secondary structure (alpha helix, beta sheets, turns and loops), tertiary structure (myoglobin), quaternary structure (hemoglobin), determination of three dimensional structure of protein from its amino acid sequence, correlation between protein misfolding and certain neurological diseases.

UNIT II **[9 Hrs]**

Enzymes – naming and classification of enzymes, enzyme cofactors, kinetics of enzyme catalyzed reactions, Michaelis Mentan equation, effect of pH, temperature on enzyme activity, purification of enzyme, substrate specificity of enzyme, factors contributing to the catalytic efficiency of enzymes, regulatory enzyme, allosteric enzymes, isozymes, multienzymes

UNIT III **[8 Hrs]**

Coenzyme I -Coenzyme A, Thiamine diphosphate, pyridine nucleotides, flavins and lipoic acid Coenzyme II Biotin and pyridoxal phosphate. Enzyme inhibition: feedback inhibition, irreversible and reversible inhibition (competitive, non competitive, un competitive), allosteric inhibition.

UNIT IV **[8 Hrs]**

Basic physiology, hormone cascade, hormones (insulin, glucagons, epinephrine, growth hormone, thyroid, parathyroid and ca metabolism, glucocorticoid), glucose homeostasis, signal transduction , role of heterotrimeric G protein, 7TM receptors, and signaling pathways, insulin signaling, EGF signaling, defects in signal transduction pathways.

UNIT V **[7 Hrs]**

Membrane channels and pumps, active or passive transport of molecules across membrane, ATP dependent pumping of ions and molecules across membrane, (Na/k pumps), Muscle contraction: motor proteins, myosin and actin, kinesin and dynein, bacterial motion, nerve conduction, action potential, P-450 drug metabolizing enzymes and metabolism of drugs.

UNIT VI **[8 Hrs]**

Clinical Biochemistry, hyper glycemia, hypoglycemia, LDL, HDL, VLDL, cholesterol, application of biochemistry in monitoring systemic diseases. Vitamins defeciencies (night blind ness, keratomalacia, rickets, osteomalacia prolonged clotting time etc.)clinical manifestations of mineral deficiency (termatitis, dementia, diarrhoea, pernicious anaemia, scurvey etc) , protein energy malneutrition (Kwashiokar,marasmus) , water and electrolyte,balance, in borne errors of metabolism

Practical:

1. Isolation of complex polysaccharides using solvent extraction
2. Isolation of enzyme
3. Quantitative assay for enzyme using enzyme substrate reaction
4. To study enzyme kinetics and calculate K_m and V_{max}
5. Effect of inhibitor on enzyme activity
6. To calculate K_i
7. To study the effect of pH on enzyme activity
8. Effect of temperature on enzyme activity
9. To study specific activity of enzyme

Text Books

1. Lubert stryer Biochemistry, Freeman WH & Company, New York,
2. Conn and Stumph, Outlines of Biochemistry

Reference Books

1. JH Weil, General Biochemistry, New Ages International (P) Ltd. 1997.
2. David T. Plummer, An Introduction to practical biochemistry, Tata McGraw Publishing Company Ltd.
3. I.A.L. Lehninger, DL Netson, MM Cox Principles of Biochemistry, CBS Publishers and Distributors.

S. E. Biotechnology (Sem. II)
215466: Material Balances and Stoicheometry

Teaching scheme: **Exam scheme:**
Lectures: 4 Hrs / week **Paper: 100 Marks**

UNIT 1 **[6 Hrs]**

Basic Chemical Calculations: Introduction to unit processes and operations and their symbols, process flow sheet, Dimensions and Units, Basic Chemical Calculations including mole, equivalent weights, solids, liquids, solutions and their properties, properties of gases.

UNIT 2 **[10 Hrs]**

Material Balances without Chemical Reactions : Concept, material balance calculations, recycling and bypassing operations, introduction to unsteady state processes.

UNIT 3 **[8 Hrs]**

Material Balances involving Chemical Reactions: Concept, material balance calculations, electrochemical reactions, recycling and bypassing operations, metallurgical operations.

UNIT 4 **[8 Hrs]**

Energy Balances : Concept, energy and Thermochemistry, energy balances, heat capacity of pure substances and mixtures, latent heats, enthalpy of pure substances and mixtures, absolute enthalpy, heat of reaction, adiabatic reactions, thermochemistry of mixing processes, dissolution, liquid-liquid mixtures, gas-liquid systems.

UNIT 5 **[8 Hrs]**

Stoichiometry and Unit Operations: Distillation, absorption and stripping, extraction and leaching, crystallization, psychrometry, drying, evaporation, introduction to stoichiometry and industrial problems.

UNIT 6 **[8 Hrs]**

Combustion: Calorific values, coal, liquid fuels, gaseous fuels, air requirement and flue gases, combustion calculations.

Text Books:

1. Stoichiometry by Bhatt & Vora
2. Basic Principles & Calculations in Chemical Engineering by Himmelblau.
3. Chemical Process Priciples Part I by Hougen & Watson

S. E. (Sem. II)
215467: Cell biology & Tissue Culture

Teaching Scheme:	**Exam Scheme:**
Lecture: 3 hr/ week	**Paper: 100 Marks**
Practical: 4 hr/week	**Oral: 50 Marks**
	Term Work: 50 Marks

UNIT 1 **[8 Hrs]**

The Cell, Structure of eukaryotic cell, chemical constituents of the cell, sub-cellular compartmentalization and organelles such as Cytoplasmic matrix, cytoskeleton, mitochondria, endoplasmic reticulum, Golgi complex, lysosomes, cellular dynamics, vacuoles, microfilaments, microtubules,nucleas.

UNIT 2 **[8 Hrs]**

Biomembranes, structure and function, endocytosis, exocytosis, ion channels, Transport of molecules across the membrane. Membrane proteins: Carrier proteins and active membrane transport, Electrical properties of membranes, action potential, transport of molecules in and out of nucleus.

UNIT 3 **[8Hrs]**

Itracellular signalling and communication. Extracellular Matrix (ECM)
General principles of communication : ion channels, morphogen, ion channels.
Signalling through GPCR and intracellular mediator, enzyme coupled cell surface receptor and regulated proteolysis of latent gene regulatory protein.

UNIT 4 **[8 Hrs]**

Cell cycle, Overview, Cell cycle control system, Karyokinesis, Cytokinesis, Control of cell division and growth, Mitosis, Meiosis, Apoptosis.

UNIT 5 **[8 Hrs]**

Tissues: Epithelial tissue, connective tissue, muscle tissue, nervous tissue, blood. Hematopoiesis, heamatopoeitic stem cells, blood cells, cells of the immune and their functions in body, blood groups. Stem cells

UNIT 6 **[8 Hrs]**

Plant tissue culture:
Basics: Internal organization of plant, Plant growth hormones, Totipotency.
Types of culture: Callus culture, Pollen culture, Anther culture, Protoplast fusion.
Application: Production of secondary metabolites, Transgenic plants.

Animal tissue culture: tissue culture media, Types of culture: Primary, explant, organ and continuous culture. Adherent cell lines and suspension cell cultures, Routine characterization of cells. Passaging, Preservation of animal cells

Practicals (B.Tech. Biotechnology): (any 8)

1. Microscope, inverted microscope
2. Cell counting using hemocytometer: RBC and WBC count.
3. Differential count
4. Preparation and filter sterilization of media for animal cell culture
5. Passage of adherent animal cell cultures.
6. Cryopreservation of animal cells.
7. Revival of animal cell line.
8. Cellular metabolic activity assessment using MTT assay
9. Plant tissue culture

Text Books:

1. Cell and Molecular Biology by Karp. John Wiley & SONS.
2. Sudha Gangal, ‘Animal tissue culture’, Orient Longman, 2006

Reference Books:

1. Molecular Biology of cell by Bruce Albert et al, John Wiley & Sons
2. Cell Biology. by Lodish
3. Cell biology by Cooper G.M. & Hausman, ASM Press
4. Gilbert S.F. Seventh edition, Developmental Biology. Sinai Associates
5. Howell S.H., Molecular Genetics of plant development, Cambridge University Press
6. Slack, Essential Developmental Biology, Blackwell Scientific
7. Slack JM. Egg and Ego.
8. Plants Molecular Biology
9. Animal tissue culture. by Freshney Ian
10. Human anatomy and physiology. By Tortora and Grabowasky. Wiley publication.

S. E. Sem (II)
215468: Thermodynamics

Teaching Scheme:	**Exam. Scheme:**
Lectures: 3 hrs/week	**Theory: 100 Marks**

UNIT 1 **[9 Hrs]**

Introduction to engineering thermodynamic, first and second law: The scope of thermodynamics, fundamental and derived quantities, first law of thermodynamics: state and path functions, thermodynamic systems, steady state flow system, phase rule, reversible process heat capacity. entropy, mathematical statement of 2^{nd} law. Maxwell relationships, Clausius- Clapeyron equation

UNIT 2 **[6 Hrs]**

Heat Effects: sensible heat effects, temperature dependence of heat capacity, standard heat of reaction, standard heat of formation, standard heat of combustion and temperature dependence of standard heat of reaction, heat effects of industrial reactions

UNIT 3 **[8 Hrs]**

Solution Thermodynamics: Fundamental property relations, chemical potential, criteria for phase equilibrium, partial properties, ideal gas mixtures, fugacity and fugacity coefficients for pure species, for species in solution, generalized correlations, ideal solutions

Solution Thermodynamic applications: excess properties, VLE data- fugacity, activity coefficients, excess Gibb's energy, Margules equation, van Laar equation, property changes of mixing

UNIT 4 **[10Hrs]**

Vapour – liquid and liquid – liquid equilibria: The nature of equilibrium, criteria of equilibrium, the phase rule, Duham's theorem, Raoult's law, VLE by

modified Raoult's law, dew point and bubble point calculations.

UNIT 5 **[10Hrs]**

Chemical Reaction Equilibria: Application of the criteria for equilibrium to chemical reactions, the standard Gibbs free energy change and the equilibrium constant. Equilibrium constant: effect of temperature on equilibrium constant, evaluation of the equilibrium constant, relation of equilibrium constant to composition, calculation of equilibrium conversion for single reaction. The phase rule and Duhem's theorem for reacting systems, multireaction Equilibria

UNIT 6 **[8 Hrs]**

Thermodynamics of biochemical changes : Bioenergetics, Types of biochemical reactions, Gibb's free energy concept for biochanges, energy concept and generation of high energy molecules and their transformations, biochemical pathways and feasibility of individual steps and overall reactions, enviro

modifications such as redox, electron transfer etc, enzyme participation.

Text Books:

1. Introduction to Chemical Engineering Thermodynamics: J. M. Smith & H. C. Vanness
2. Chemical Engineering Thermodynamics: Narayanan
3. Chemical engineering thermodynamics: Arora
4. Bioenergetics

Reference Books:

1. Principles of Chemical Equilibrium : Kenneth Denbigh
2. Chemical Engineering thermodynamics: Y.V.C. Rao
3. Chemical Engineering Thermodynamics : T. E. Daubert
4. Applications to Advanced thermodynamics: Goats
5. Chemical and Process Thermodynamics: B. G. Kyle

S. E. Sem (II)
215469: Genetics & Molecular Biology

Teaching Scheme:	**Exam Scheme:**
Theory: 4 hr/week	**Paper: 100 Marks**
Practical: 4 hr/week	**Oral: 50 Marks**
	TermWork: 25Marks

UNIT 1 **[8 Hrs]**

Discovery of DNA as a genetic material: Mendelian inheritance pattern and laws of heredity, Co-dominance, linkage, linkage maps, Mendel's pea plant experiment, MacLeod and MacCarty's experiment, Hershey and Chase's experiment, Chargaff's rule, Watson-Crick's discovery of structure of DNA.
DNA packaging: Chromosome, Chromatin, Chromatid, Euchromatin and Heterochromatin. Model systems like Drossophila, C. elegans, Zebra fish

UNIT 2 **[8 Hrs]**

Structure of DNA: A, B (Watson-crick model), and Z structure.
Physicochemical properties of DNA, UV absorption, Thermal denaturation, Tm, hyperchromicity. DNA supercoiling. Nucleic acids in mitochondria, chloroplasts, viruses and bacteria.

UNIT 3 **[8 Hrs]**

DNA replication, semiconservative replication model, rolling circle model, enzymes in replication gyrases etc. repair enzymes, DNA unwinding, recombination, telomeres, telomerases, Types of mutations such as frame-shift mutation, point mutation, addition, deletions.

UNIT 4 **[8 Hrs]**

RNA types, RNA types: Coding and non-coding RNAs, tRNA, mRNA, rRNA, and small RNAs. Structural features of mRNA, including RNA binding site, Translation initiation and stop site, introns and exons, ribozyme, post-transcriptional modifications, inhibitors of transcription, reverse transcriptase

UNIT 5 **[8 Hrs]**

Transcription, structure of gene, regulation of gene expression, operon concept (lac, trp, his operon), repression, promoters, enhancers, silencers, hormone responsive elements, transcription factors, effect of steroid hormones, gene amplification,oncogenes,transposons, mutations

UNIT 6 **[8 Hrs]**

Genetic code, Protein biosynthesis, translation, factors required for translation, inhibitors, regulation, post-translational modifications, protein synthesis in prokaryots and eukaryotes, chaperones, heat shock proteins.
Genetic disorders: Thalassamia and Diabetes.

Practicals: (Any 8)

1. Isolation of genomic DNA
2. Quantitation and purity check of DNA by spectrophotometer
3. Agarose gel electrophoresis
4. Removal of RNA and gel electrophoresis
5. Molecular weight of DNA
6. Plasmid isolation by miniprep.
7. Visualization of plasmid on agarose gel.
8. Preparation of competent cells
9. Transformation of bacteria using plasmid.
10. systems like Drossophila, C. elegans, Zebra fish

Text Books:

1. Benjamin Lewin: Gene VII, Oxford University Press, Oxford, New York, 2000
2. Freifelder D. Molecular Biology, Jones and Barrtlett Publishers 1987
3. Old R W and Primrose SB, Principles of Gene manipulations. An introduction to Genetic Engineering' Blackwell Science publications, 1993.
4. Harvey Lodish et al 'Molecular Cell Biology' 1999
5. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Molecular Biology of the Cell, 4th edition, Garland Publishing, New York, London, 2002

6. Sambrook and Russell. Molecular Cloning-A Laboratory Manual Vol 1, 2, 3. Third Edition, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York 2001

Reference Books:

1. T.A. Brown, 'Genomes' John Wiley and Sons PTE Ltd.
2. Ansumbel F.M, Brent R, Kingston R.E, Moore D.D., 'Curernt protocols in Molecular Biology' Green Publishing Associates, NY 1988
3. Berger S.L., Kimmer A.R, 'Methods in Enzymology' vol 152, Academic Press. 1987.
4. I Edward Alcamo, HAR court Academic Press'DNA Technology'