University of Pune

SE (Biotechnology)
Syllabus for 2012 Course

SE (Biotechnology) Syllabus Structure for 2012 Course

Subject Code	Subject	Teaching Scheme Hrs/Week			Examination Scheme					Mark
		Lect	Tut	Pr	Theory Online	TW	Pr	Or	Theory Paper	Total
SEM – I										
215461	Applied Chemistry	3	-	2	50	-	50	-	50	150
207004	Engineering Mathematics –III	4	1	-	50	25	-	-	50	125
215462	Fluid Flow & Unit Operations	4	-	2	50	-	-	50	50	150
215463	Material Balances & Stoichiometry	4	1	-	50	25	-	-	50	125
215464	Microbiology	4	-	2	50	25	50	-	50	175
215465	Technical Communications	1	-	2	-	25	-	-	-	25
		20	02	08	250	100	100	50	250	750
215466	Biochemistry – I	4	-	2	50	-	50	-	50	150
215467	Heat Transfer	4	-	2	50	25	-	-	50	125
215468	Cell Biology & Tissue Culture	4	-	4	50	25	-	50	50	175
215469	Thermodynamics	3	1	-	50	-	-	50	50	150
215470	Genetics & Molecular Biology	4	-	2	50	50	-	-	50	150
	Total →	19	01	10	250	100	50	100	250	750

S.E. Biotechnology Sem. I

215461: Applied Chemistry

Teaching Scheme:
Theory: 3 hr/week
Practical: 2 hr/week

Exam Scheme:
Online: 50 Marks
Paper: 50 Marks
Practical: 50 Marks
Total marks: 150

UNIT 1 **[8Hrs]**

Structural Effect and Reactivity :

Benzene and aromaticity, concept of aromaticity (4n+2), conditions 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). SN_2 mechanism and factors affecting SN reactions.
2. Electrophilic substitution in benzene and monosubstituted 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 dehydrohalogenation 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:
5. Addition of hydrogen halides to C=C in presence of peroxides
6. Substitution reaction- Halogenation of methane
7. 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. Numerical 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
3. physical constants (any four compounds).
4. Preparation of benzoic acid from Benz amide.
5. Preparation of osazone derivatives of glucose.
6. To determine the percentage composition of a given mixture of two liquids by stalagmometer.

7. To determine relative viscosities of liquids A and b by Oswald's viscometer. To find percentage composition of mixture C of A and B by using graphical method using viscosity data
8. To determine radius of macromolecule by Ostwald's viscometer.
9. To determine molecular weight of non volatile solute by depression in freezing point method
10. To determine molecular weight of solid elevation in boiling point method.
11. To determine distribution coefficient of iodine between water and carbon tetrachloride and hence to determine the molecular condition of iodine.
12. To determine molecular weight of given immiscible liquid by steam distillation method.
13. To determine amount of hydrochloric acid and phosphoric acid from the given mixture by using pH meter.
14. 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.

UNIVERSITY OF PUNE

For Chemical /Bio Tech/Printing Engineering (Sem I)

For Petroleum/Petrochemical/Polymer Engineering (Sem II)

207004 ENGINEERING MATHEMATICS – III (2012 Course)

Teaching Scheme:
Lectures – 4 Hrs./Week
Tutorials – 1 Hr./Week

Examination Scheme:
Paper – 50 Marks (2 Hrs.)
Online – 50 Marks
Term work: 25 Marks

Section I

Unit I: Linear Differential Equations **(LDE)** and Applications (09 Hours)
LDE of n^{th} order with constant coefficients, Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous & Symmetric simultaneous DE. Applications of LDE to chemical engineering problems and mass spring system.

Unit II: 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.

Unit III: Laplace Transform **(LT)** and Applications: (09 Hours)
Definition of LT, Inverse LT, Properties & theorems, LT of standard functions, LT of some special functions viz. error, First order Bessel's, Periodic, Unit Step, Unit Impulse, ramp, jump, parabolic, Si(t) and Ei(t).
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).

Section II

Unit IV: Vector Differential 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, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Unit V: Vector Integral Calculus and Applications (09 Hours)
Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications of vectors to problems in Fluid Mechanics, Continuity equations, Stream lines, Equations of motion, Bernoulli's equations.

Unit VI: Applications of Partial Differential Equations **(PDE)** (09 Hours)
Basic concepts, modeling of Vibrating string, Wave equation, one and two dimensional Heat flow equations, method of separation of variables, use of Fourier series. Applications of PDE to problems of Chemical and allied engineering.

Text Books:

1. Advanced Engineering Mathematics, 9e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).

Reference Books:

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

Tutorial and Term Work:

i) Tutorial for the subject shall be engaged in minimum of four batches (batch size of 20 students maximum) per division.
ii) Term work shall consist of six assignments (one per each unit) based on performance and continuous internal assessment.

A S Mujumdar

S.E. Biotechnology Sem. I

215462: Fluid Flow & Unit Operations

Teaching Scheme:	**Exam Scheme:**
Theory: 4 hr/week	**Online: 50 Marks**
Practical: 2 hr/week	**Paper: 50 Marks**
	Oral: 50 Marks
	Total marks: 150

UNIT 1 **[8Hrs]**

System of units and conversions; Fluid – Definition and important properties, viscosity, temperature and pressure dependence, Newton's law, Classification of fluids; Fluid statics: hydrostatic forces on surface, Pressure and its measurements; Types of flow, Laminar and turbulent flow – Concept of Reynold's number; Formation and separation of boundary layer; Laws of incompressible potential flow: Mass balances - Continuity equation and its applications to fluid dynamics

UNIT 2 **[8 Hrs]**

Energy balances in fluid dynamics: Euler's equation, Bernoulli's equation and its applications, Flow measurement using venturimeter, orificemeter and pitot tube; Introduction to viscous flow in conduits: Shear stress distribution, Hagen Poiseuelle equation, turbulent flow in pipes, effect of roughness, friction in flowing fluid, Moody,s diagram; Minor losses in pipe flow, effect of fittings and valves

UNIT 3 **[8 Hrs]**

Introduction to the dynamics of suspended particles: Lift and drag forces, drag coefficients; Flow of solids through fluids: Gravity settling of particles, Terminal velocity, Stoke's law and Newton's law, Free and hindered settling, Sink and float method, Differential settling method; Sedimentation: Batch and continuous, equipments for sedimentation, Kynch theory of sedimentation, calculation of area and depth of continuous thickeners; Centrifugal settling: Advantages and equipments – cyclones and hydrocyclones

UNIT 4 **[8 Hrs]**

Flow of fluid through solids: Characteristics of flow through packed beds - Darcy's equation, Equations for laminar flow (Kozeny Carmen) and turbulent flow (Burke Plummer), Ergun equation; Introduction of fluidization, minimum fluidization velocity, characteristics of fluidized systems, types of fluidization and their applications, spouted beds

UNIT 5 **[8 Hrs]**

Fluid moving machinery – pumps, Types of pumps: positive displacement pump and centrifugal pumps, NPSH; Valves and their types; Mixing and Agitation - Necessity of mixing and agitation, Types of Impellers – Radial and axial flow, Different flow patterns in mixing, Agitator selection, Calculation of power requirement, Mixing equipment; Mixing equipments for pastes and viscous material

UNIT 6 **[8 Hrs]**

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

Practical (Any 8):

1. Determination of viscosity
2. Flow through venturimeter
3. Flow through pipes - Analysis for laminar and turbulent regime
4. Friction during flow through pipe
5. Effect of pipe fitting
6. Verification of Stoke's law
7. Sedimentation technique using jar experiment
8. Flow through packed bed
9. Verification of Darcy's law
10. Demonstration of fluidization
11. To determine mixing Index of mixture in Sigma Mixer
12. To determine effectiveness of given set of standard screens
13. To determine performance of a ball mill

Text Books:

1. R K Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", 9th ed., Laxmi Publications, New Delhi, 2004
2. McCabe, Smith, Harriot, "Unit Operations in Chemical Engineering", 7th ed., Tata McGraw Hill Publications
3. C M Narayanan, B C Bhattacharya, "Mechanical Operations for Chemical Engineers", Khanna. Publications

Reference Books:

1. J M Coulson, J F Richardson, with J R. Backhurst and J H Harker, "Chemical Engineering, Volume-1", 6th ed., Butterworth-Heinemann, 1999
2. R K Rajput, "A Textbook of Fluid Mechanics", S. Chand Ltd., 2008
3. George Granger Brown, "Unit Operation"; Asia Publishing House', First Edition
4. Bird R.B., Stewart W.E., Lightfoot E.N. "Transport phenomena" 2ed., Wiley Publications, 2002

S.E. Biotechnology Sem. I

215463: Material Balances and Stoichiometry

Teaching Scheme:	**Exam Scheme:**
Theory: 4 hr/week	**Online: 50 Marks**
Tutorial: 1 hr/week	**Paper: 50 Marks**
	Term Work: 25 Marks
	Total marks: 125

UNIT 1 **[6 Hrs]**

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

UNIT 2 **[10 Hrs]**

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

UNIT 3 **[10 Hrs]**

Material Balances involving Biological/ Chemical Reactions: Concept, material balance calculations, electrochemical reactions, recycling and bypassing 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 **[6 Hrs]**

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

UNIT 6 **[6 Hrs]**

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

Text Books:

1. B. I. Bhatt, S.B. Thakore, “Stoichiometry” 5th Edition, Tata McGraw Hill Publications, New Delhi (2011)
2. David M. Himmelblau “ Basic Principles and Calculations in Chemical Engineering” 6th Edition, Eastern Economy Edition, Prentice Hall of India

S.E. Biotechnology Sem. I

215464: Microbiology

Teaching scheme:
Theory - 4 hrs/week
Practical – 2 hrs/week

Examination scheme:
Online: 50 Marks
Paper: 50 Marks
Term work: 25 Marks
Practical – 50 Marks
Total marks: 175

UNIT 1 **[8 Hrs]**

Introduction to Microbiology: The History and scope of microbiology, Types of Microorganisms: Bacteria, fungi, algae, protozoa, actinomycetes, viruses. The Study of Microbial Structure: Prokaryotic & Eukaryotic Cell Structure and Function. Microscopy and Specimen Preparation: Types of Microscopes. Microbial classification, Taxonomy.

UNIT 2 **[8 Hrs]**

Microbial nutrition and growth: Nutritional types of microorganisms, Growth and reproduction of bacteria: growth requirements, growth media, pure cultures, growth curve. Enumeration of bacteria, enrichment of bacterial cultures, batch culture, continuous cultures, synchronous culture, factors affecting growth, extremophiles.

UNIT 3 **[8 Hrs]**

Control of Microorganisms by Physical and Chemical Agents: Sterilization and disinfection, Wet and dry heat, filtration, Antimicrobial agents, antibiotics. Drug resistance.

UNIT 4 **[8 Hrs]**

The Viruses: Introduction and General Characteristics: Classification and structure: Animal viruses, plant viruses, DNA viruses, RNA viruses, oncogenic viruses. Replication of viruses, life cycle, lysogeny, lytic cycle, lambda phage, T4 phages. Methods of cultivation. Antiviral Drugs

UNIT 5 **[8 Hrs]**

Microbiology of air, water, soil, food, milk: waste water, potability of water, microbial interactions in environment, commensalisms, antagonism, symbiosis

UNIT 6 **[8 Hrs]**

Medical microbiology: The Epidemiology of Infectious Diseases, Human diseases caused by bacteria - tuberculosis, leprosy, cholera, diarrhea, viral diseases- Rabies, HIV, influenza, fungal diseases – candidiasis, dermatophytes.

Practical (Any 8):

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

Text Books:

1. Prescott Harley Klein, Microbiology, Fifth Edition, "Microbiology", 5th Edition, The McGraw Hill Companies, 2002
2. Michael Pelczar, "Microbiology", 5th Edition, Tata McGraw-Hill Education, 1993
3. Michael T., Madigan, John M. Martinko, Jack Parker, "Brock biology of microorganisms**",** Prentice Hall, 2000.

Reference Books:

1. A. J. Salle, "Fundamental Principles of Bacteriology", 7th edition, Tata McGraw-Hill education.
2. Roger Y. Stainier et al. "General Microbiology" , 5th edition., PHI Publication.
3. Tortora, "Microbiology: An Introduction", 9th edition, Pearson Education India, 2008.
4. Schlegel H.G. – "General Microbiology" , 8th edition, Cambridge University Press, 1995.
5. Robert Cruikshank, "Medical Microbiology", Churchill Livingstone, 1975
6. Thomas Jones Mackie, et al, "Mackie & McCartney medical microbiology: a guide to the laboratory diagnosis and control of infection", Churchill Livingstone, 1989

S.E. Biotechnology Sem. I

215465: Technical Communications

Teaching Scheme: **Exam Scheme:**
Theory - 1 hr/week **Term work: 25 Marks**
Practical: 2 hr/week

Introduction

Language and Communication: Linguistic communication, barriers to communication, importance of communication

Non verbal Communication: Body language, personal appearance, posture, gestures, facial expression, eye contact, space distancing

Communication in organizations: Pattern of communication, management information,

Personal communication: Face to face communication, telephonic communication, interviews, instruction and dictation

Public speaking and oral presentation; Active Listening

Meetings: Purpose, procedure, chairmanship, participation, physical arrangements

Seminars and Conferences: Types of discussion groups, regulating speech, conducting seminars, organizing conferences, evaluating oral presentations

Group Discussion: Group dynamics, purposes and organization.

Audiovisual Aids: Basic principles and guidelines, types of aids and their use, graphic aids

Formal reports: Definition, preparatory steps, types, structure, style, copy editing

Technical proposals: Definition, key factors, types, contents, format and evaluation

Research papers and articles: Literature survey, reference, writing, and abstract articles etc.

Business correspondence, notices, agenda, advertising etc; email writing

Term work:

Term work shall consist of a journal consisting of regular assignments and presentation completed in the practical class and at home. The total number of assignments should not be less than 10, generally covering the topics mentioned above. As far as possible, submission should be word processed on a computer using a standard package by the student himself.

For the purpose of assignments, extensive use of research papers published in technical journals and articles published in magazines and newspapers may be made so that there is no repetition by the individuals.

Oral presentations exercises and group discussions should be conducted batch wise so that there is a closer interaction.

Text Books:

1. Krishna Mohan and Meera Banerji "Developing Communication Skills" 2nd Edition, Macmillan Publishers India, 2009.
2. Day (1995), How to write and publish scientific paper, Cambridge Low-priced Edition

S.E. Biotechnology Sem II

215466: Biochemistry I

Teaching Scheme:
Theory: 4 hr/week
Practical: 2 hr/week

Exam Scheme:
Online: 50 Marks
Paper: 50 Marks
Practical: 50 Marks
Total Marks: 150

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

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

UNIT III **[8 Hrs]**

Electron transport chain, oxidative phosphorylation, cori cycle.
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, removal of nitrogen in amino acid degradation, ammonia toxicity, Inherited defects of the urea cycle.

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, oxidation of fatty acid in peroxisomes, degradation of odd chain fatty acid, oxidation of PUFA. Synthesis of fatty acid: Formation of malonyl CoA, role of fatty acid synthase in synthesis of fatty acids, transfer of acetyl CoA to the cytoplasm, sources of NADPH for fatty acid synthesis.

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, nucleotides biosynthesis.

UNIT VI [8 Hrs]

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 allowance, minerals and its functions, In borne errors of carbohydrate, lipid and protein metabolism.

Practical: (Any 10)

1. Preparation of percent and molar solutions
2. Preparation of phosphate buffer and measurement of pH
3. Testing buffering capacity of a buffer
4. Qualitative testing of glucose using Benedict's reagent
5. Determination of λmax
6. Estimation of glucose using ortho-Toluedine method
7. Extractions of proteins from sprouted seeds
8. Protein estimations by Folins method
9. Estimation of protein by Biuret assay method
10. Extraction of cholesterol
11. Estimation of cholesterol concentration
12. Isolation of polysaccharide

Text Books:

1. Conn and Stumph, "Outlines of Biochemistry"

Reference Books:

1. David L. Nelson "Principles of Biochemistry" 4th edition, W.H. Freeman and company, New york, 2006.
2. David T. Plummer, "An Introduction to practical biochemistry", 3rd edition, Tata McGraw-Hill Publishing Company Ltd., 1988.
3. Jeremy M. Berg , John L. Tymoczko , Lubert Stryer, "Biochemistry" 6th edition, W.H. Freeman and company, 2007

S.E. Biotechnology Sem. II

215467:Heat Transfer

Teaching Scheme:
Theory: 4 hr/week
Practical: 2 hr/week

Exam Scheme:
Online: 50 Marks
Paper: 50 Marks
Term work: 25 Marks
Total Marks: 125

UNIT 1 **[8Hrs]**

Introduction: Modes of heat transfer, conduction, convection, and radiation, Fourier's law of heat conduction, thermal conductivity of liquid, gases and solids, Concept of thermal resistance, thermal conductance and contact resistance, Convection: Types, Newton's law of cooling, Radiation: Fundamental facts and definition of terms: Emissivity, absorptivity, black body, gray body, opaque body, Stefan Boltzman law, Kirchoffs law, Planks law, Wien's law, Analogy between heat and momentum transfer, Applications of heat transfer in biotechnology

UNIT 2 **[8 Hrs]**

Conduction: Differential equation from shell balance for unsteady and steady state conduction. Introduction to unsteady state conduction, Steady state conduction in infinitely long slab, infinitely long hollow cylinder and hollow spheres, Thermal resistance in composite slab and cylinder, Heat losses through pipe, thermal insulation and optimum thickness of insulation, properties of insulator, Heat transfer from extended surfaces with uniform cross section, classification of extended surfaces, efficiency of longitudinal fin.

UNIT 3 **[8 Hrs]**

Convection: individual and overall heat transfer coefficient, Natural and forced convection in laminar and turbulent flow. Principal and heat balance equation in laminar flow and empirical equations for turbulent flow through tube, through annulus, over the plate, Concept of thermal boundary layer and its significance. Heat transfer with phase changes: Condensation: Modes and features; Heat transfer in boiling liquids: Pool boiling of saturated liquid, Concept of maximum heat flux and critical temperature drop.

UNIT 4 **[8 Hrs]**

Heat exchange equipment: Types of heat exchangers including compact heat exchangers, parallel flow arrangement, fouling factor, LMTD in parallel and counter flow, Effectiveness NTU method, shell and tube heat exchanger.

UNIT 5 **[8 Hrs]**

Evaporation: Types of evaporators, performance, capacity and economy, Boiling point elevation, heat transfer coefficients, Material balance calculations, Multiple effect evaporators: Methods of feeding, capacity and economy, effect of liquid head and boiling point elevation

UNIT 6 **[8 Hrs]**

Dimensional analysis, Significance of dimensional analysis in heat transfer, units of various quantities used in heat transfer dimensional analysis, Importance of dimensional analysis in experimental design and data reduction, simple calculations for design of heat transfer systems, various cases of radiation between two surfaces, the shape factor,

Practical (Any 8):

1. Thermal conductivity of a metal rod
2. Heat transfer from fin in a natural convection
3. Heat transfer in forced convection
4. Composite wall apparatus
5. Pool boiling
6. Thermal conductivity of insulating powder
7. Concurrent and countercurrent heat exchanger
8. Determination of heat transfer coefficient in turbulent system
9. Double effect evaporator
10. Open pan evaporator

Text Books:

1. S. P. Sukhatme, “A Textbook on Heat Transfer”, 4th ed, Universities Press (India), 2005
2. W.L. McCabe, J.C. Smith, P. Harriott, “Unit Operations of Chemical Engineering” 7th Edition. McGraw Hill Publication (2005)

Reference Books:

1. Frank Kreith, Mark Bohn, “Principles of Heat Transfer” 5th edition, PWS Publishing company, Boston (1997)
2. D. Q. Kern, “Process Heat Transfer”, 11th ed., Tata Mc Graw Hill Publication, New Delhi
3. Bird R.B., Stewart W.E., Lightfoot E.N. “Transport phenomena” 2ed., Wiley Publications,2002
4. Sinnout R.K. “Coulson Richardson’s chemical engineering vol.6” Pergamon Press, 1993

S.E. Biotechnology Sem. II

215468: Cell biology & Tissue Culture

Teaching Scheme:
Theory: 4 hr/week
Practical: 4 hr/week

Exam Scheme:
Online: 50 Marks
Paper: 50 Marks
Term Work: 25 Marks
Oral: 50 Marks
Total Marks: 175

UNIT 1 **[8Hrs]**

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

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 **[8 Hrs]**

Intracellular signaling and communication. Extra cellular Matrix (ECM) General principles of communication: ion channels, morphogen, ion channels. Types of receptors GPCR, nuclear receptors and 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. Stem cells: Heamatopoeitic stem cells & embryonic stem cells. Cancer: Development of Cancer and properties of Cancer.

UNIT 6

[8Hrs]

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.

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.

Practical (Any 8):

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

Text Books:

1. Karp, “Cell and Molecular Biology” John Wiley and Sons Pvt. Ltd
2. Sudha Gangal, ‘Animal tissue culture’, Orient Longman, 2006

Reference Books:

1. Cooper G.M. & Hausman, “The Cell”,fifth edition, ASM Press.
2. 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)
3. Harvey Lodish etal “Molecular Cell Biology”, 4th edition,New York
4. Gilbert S.F., “Developmental Biology”, Seventh edition, 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. M.K. Razdan , “Introduction to Plant Tissue culture”.
9. Freshney Ian ,”Animal tissue culture”
10. Tortora and Grabowasky “Human anatomy and physiology”, Wiley publication.

S.E. Biotechnology Sem. II

215469: Thermodynamics

Teaching Scheme:
Theory: 3 hr/week
Tutorial: 1 hr/week

Exam Scheme:
Paper: 50 Marks
Online: 50 Marks
Orals: 50 Marks
Total Marks: 150

UNIT 1 **[8Hrs]**

Introduction to engineering thermodynamic – Scope and importance, Important definitions: system, surrounding, state and path functions, process etc.; Laws of thermodynamics - First and second laws, reversible and irreversible processes, expansion and compression processes, mathematical statement of first law; Second law of thermodynamics, Carnot cycle and theorems, the concept of entropy, mathematical statement; Phase rule for non reacting systems

UNIT 2 **[6Hrs]**

Heat Effects: sensible and latent heat effects, temperature dependence of heat capacity, standard heat of reaction, standard heat of formation, standard heat of combustion, Hess's law; Temperature dependence of standard heat of reaction, heat effects of industrial reactions

UNIT 3 **[8 Hrs]**

Solution Thermodynamics: Fundamental property relations, Maxwell relationships, Clausius-Clapeyron equation; Chemical potential, criteria for phase equilibrium, ideal solution, partial properties; Fugacity and fugacity coefficients for pure species, for species in solution, generalized correlations; Property changes of mixing, Excess properties, excess Gibb's energy, activity and activity coefficients, Margules equation, van Laar equation

UNIT 4 **[8 Hrs]**

Vapour – liquid and liquid – liquid equilibria: The nature of equilibrium, criteria of equilibrium, Duhem's theorem, Henry's law, Raoult's law, Boiling point diagram, VLE by modified Raoult's law, dew point and bubble point calculations

UNIT 5 **[8 Hrs]**

Chemical Reaction Equilibria: Application of the criteria for equilibrium to chemical reactions, the standard Gibbs free energy change and the 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

UNIT 6 **[6 Hrs]**

Application of thermodynamics to biological systems: Energy transformations in biological systems, Examples of applications of laws of thermodynamics to bio-systems, Gibb's free energy concept for bio-changes and its applications; Thermodynamics of

biochemical changes - Energy Yielding and Energy Requiring Reactions, feasibility of individual steps and overall reactions

Text Books:

1. K V Narayanan, “A Textbook of Chemical Engineering Thermodynamics”, PHI Learning Pvt. Ltd., 2004
2. Y V C Rao, “Chemical Engineering Thermodynamics”, University Press, 1997
3. D T Hayne, “Biological Thermodynamics”, Cambridge University Press

Reference Books:

1. J M Smith, H C Van Ness, “Introduction to Chemical Engineering Thermodynamics”, 7th ed., McGraw-Hill Education, 2005
2. T E Daubert, “Chemical Engineering Thermodynamics”, McGraw-Hill Inc., 1985

S.E. Biotechnology Sem. II

215470: Genetics and Molecular Biology

Teaching Scheme:
Theory: 4 hr/week
Practical: 2 hr/week

Exam Scheme:
Paper: 50 Marks
Online: 50 Marks
Term work: 50 Marks
Total Marks: 150

UNIT 1 **[8 Hrs]**

Introduction, Mendelian inheritance pattern study and laws of heredity, Co-dominance, linkage, linkage maps, MacLeod and McCarty's experiment, Hershey and Chase's experiment, Watson-Crick's discovery of structure of DNA, Chargaff's rule, Discovery of RNA, Model systems like *Drosophila*, *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, Melting Temperature, hyperchromicity DNA supercoiling, Nucleic acids in mitochondria, chloroplasts, viruses and bacteria DNA packaging: Chromosome, Chromatin, Chromatid, Euchromatin and Heterochromatin.

UNIT 3 **[8Hrs]**

Introduction to replication of DNA, Chemistry of DNA synthesis, Mechanism of DNA polymerase, Replication Fork, DNA synthesis at the replication fork, Initiation of DNA replication, binding and unwinding DNA by protein-protein and protein-DNA interaction to initiate replication, Finishing replication

UNIT 4 **[8 Hrs]**

Types of RNA, Coding and non-coding RNAs, tRNA, mRNA, rRNA, and small RNAs, introns and exons, chemistry of RNA splicing, splicing pathways, alternative splicing, ribozyme, importance of RNA

UNIT 5 **[8 Hrs]**

Transcription, RNA polymerase, Transcription cycle in bacteria, concept of Operon, Transcription cycle in eukaryotes, Mutation and Repair, Reverse Transcriptase, Study of oncogenes, Introduction to recombination

UNIT 6 **[8 Hrs]**

Genetic code, Protein biosynthesis, Initiation of translation, Translation elongation, Termination of Translation, regulation, posttranslational modifications, protein synthesis in prokaryotes and eukaryotes, chaperones, heat shock proteins
Genetic disorders: Thalassamia and Diabetes

Practical: (Any 8)

1. Isolation of genomic DNA
2. Quantification 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. Study experiments: systems like Drossophila, *C. elegans, Zebra fish*

Text Books:

1. James D. Watson, Tania A. Baker, Stephen P. Bell, "Molecular Biology of the Gene" 5th edition, Dorling Kindersley (India) Pvt.Ltd.
2. Freifelder D. , "Molecular Biology", Jones and Bartlett Publishers, (1987)

Reference Books:

1. Benjamin Lewin, "Gene VII", Oxford University Press, Oxford, New York, (2000)
2. 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)
3. T.A. Brown, "Genomes" John Wiley and Sons Pvt. Ltd
4. Ansumbel F.M, Brent R, Kingston R.E, Moore D.D., 'Curernt protocols in Molecular Biology' Green Publishing Associates, (1988)
5. Old R W and Primrose SB, "Principles of Gene manipulations: An introduction to Genetic Engineering" Blackwell Science publications, (1993)
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