

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY

LUCKNOW



Study & Evaluation Scheme with Syllabus

for

B.Tech. Second Year

Biotechnology

On

Choice Based Credit System

(Effective from the Session: 2017-18)

2nd Year III-SEMESTER

S. No.	Subject Code	Subject Name	L-T-P	ESE Marks	Sessional		Total	Credit
					CT	TA		
1.	ROE030 to 039/ RAS303	Science Based Open Elective/ Elementary Mathematics-III	3-1-0	70	20	10	100	4
2.	RVE301/ RAS302	Universal Human Values & Professional Ethics/ Environment & Ecology	3-0-0	70	20	10	100	3
3.	RCH305	Fluid Mechanics for Biotechnology	3-0-0	70	20	10	100	3
4.	RBT301	Analytical Techniques in Biotechnology	3-0-0	70	20	10	100	3
5.	RBT302	Microbiology	3-0-0	70	20	10	100	3
6.	RBT303	Biochemistry	3-1-0	70	20	10	100	4
7.	RCH351	Fluid Mechanics for Biotechnology Lab	0-0-2	50	30	20	100	1
8.	RBT351	Analytical Techniques in Biotechnology Lab	0-0-2	50	30	20	100	1
9.	RBT352	Microbiology Lab	0-0-2	50	30	20	100	1
10.	RBT353	Biochemistry Lab	0-0-2	50	30	20	100	1
Total							1000	24

CT: Class Test

TA: Teacher Assessment

L/T/P: Lecture/ Tutorial/ Practical

Science Based Open Electives:

- a. ROE030/ROE040 Manufacturing Process
- b. ROE031/ROE041 Introduction to soft computing
- c. ROE032/ROE042 Nano Science
- d. ROE033/ROE043 Laser System and Application
- e. ROE034/ROE044 Space Science
- f. ROE035/ROE045 Polymer Science & Technology
- g. ROE036/ROE046 Nuclear Science
- h. ROE037/ROE047 Material Science
- i. ROE038/ROE048 Discrete Mathematics
- j. ROE039/ROE049 Applied Linear Algebra

2nd Year IV-SEMESTER

S. No.	Subject Code	Subject Name	L-T-P	ESE Marks	Sessional		Total	Credit
					CT	TA		
1.	RAS403/ ROE040 to 049	Elementary Mathematics-III/ Science Based Open Elective	3-1-0	70	20	10	100	4
2.	RAS402/ RVE401	Environment & Ecology/ Universal Human Values & Professional Ethics	3-0-0	70	20	10	100	3
3.	RCH405	Heat & Mass Transfer	3-0-0	70	20	10	100	3
4.	RBT401	Genetics & Molecular Biology	3-0-0	70	20	10	100	3
5.	RBT402	Immunology	3-0-0	70	20	10	100	3
6.	RBT403	Enzyme Engineering	3-1-0	70	20	10	100	4
7.	RCH455	Heat & Mass Transfer Lab	0-0-2	50	30	20	100	1
8.	RBT451	Genetics & Molecular Biology Lab	0-0-2	50	30	20	100	1
9.	RBT452	Immunology Lab	0-0-2	50	30	20	100	1
10.	RBT453	Enzyme Engineering Lab	0-0-2	50	30	20	100	1
Total							1000	24

CT: Class Test

TA: Teacher Assessment

L/T/P: Lecture/ Tutorial/ Practical

Science Based Open Electives:

- a. ROE030/ROE040 Manufacturing Process
- b. ROE031/ROE041 Introduction to soft computing
- c. ROE032/ROE042 Nano Science
- d. ROE033/ROE043 Laser System and Application
- e. ROE034/ROE044 Space Science
- f. ROE035/ROE045 Polymer Science & Technology
- g. ROE036/ROE046 Nuclear Science
- h. ROE037/ROE047 Material Science
- i. ROE038/ROE048 Discrete Mathematics
- j. ROE039/ROE049 Applied Linear Algebra

RAS303/RAS403: ELEMENTARY MATHEMATICS-III

UNIT-I

Data and classification: Data type, Classification and summarization of data. Diagrams and graphs, Measures of central tendency, Measures of dispersion, Moments, Skewness, Kurtosis

UNIT-II

Probability and Distributions: Definitions of probability, Additive law of probability, Conditional probability, Multiplicative law of probability, Binomial distribution, Poisson distribution, Normal distribution.

UNIT-III

Correlation, Regression and Tests: Correlation, Karl Pearson's coefficient of correlation, Rank Correlation, Lines of regression, Non –Parametric tests Sign Test, Mann Whitene Wilcoxon test.

UNIT-IV

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

UNIT-V

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

Text Books:

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

Reference Books:

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

RCH305: FLUID MECHANICS FOR BIOTECHNOLOGY

UNIT-I

Definitions and Fluid Properties: Viscosity, Newton's Law of viscosity, Kinematic Viscosity, Rheological Diagram, Euler Equation and its application, Derivation of Bernoulli Equation from Euler Equation, Applications of Bernoulli's Theorem, Pascal's Law, Hydrostatic Law

UNIT-II

Measurement of Pressure: Definition of Gauge and Absolute Pressure, Barometer, Various Manometers (Piezometer, U-tube manometer, Single column manometers, U-tube & Inverted U-tube differential manometers) & their industrial applications.

UNIT-III

Flow Measuring Equipment: Head Flow Meters, Nozzle Meter, Orifice Meter, Venturi Meter, Area Flow Meters, Rotameter, Pitot Tube & Applications of these equipments

UNIT-IV

Pipe fittings, major and minor losses in pipe flow, Calculation of Pressure Drop in a Pipe, Equivalent Length & 'K' factor, Methods of finding dimensional numbers - methods of governing equations, Method of force ratios and Buckingham's π method, Outline of procedure for Buckingham Pi method, Physical significance of dimensionless numbers

UNIT-V

Pumps: Reciprocating Pumps, working of reciprocating pump, work done by reciprocating pump & its applications. Centrifugal Pumps, Main parts of centrifugal pump, Characteristic Curves of Centrifugal Pumps, NPSH, Advantages and Disadvantages of Centrifugal Pumps, applications of centrifugal pumps

Text Books and Reference Books

1. Fluid Mechanics & Hydraulic Machines by Dr. RK Bansal.
2. McCabe Smith: Unit Operations in Chemical Engineering, McGraw Hill
3. Fox, RA & McDonald, AT, "Introduction to Fluid Mechanics", 5th ed: John Wiley (1998).
4. Kumar, DS, "Fluid Mechanics", SK Katria and Sons, Delhi (1998.)
5. Rajput RK "Text book of Fluid Mechanics", S. Chand and Co., New Delhi, (1998)
6. Gupta, Vijay and SK Gupta, "Fluid Mechanics and its Applications", Wiley Eastern, New Delhi

RBT301: ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY

UNIT-I

Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM and Atomic force microscopy.

UNIT-II

Principle and Operations of Chromatography, Thin layer chromatography, Ion Exchange Chromatography, High Performance Liquid Chromatography (HPLC), Gas Liquid Chromatography (GLC), Gel Filtration Chromatography, Affinity Chromatography.

UNIT III

Theory of Electrophoresis, Factors affecting the migration of substances, supporting media in electrophoresis, Boundary electrophoresis, Paper electrophoresis, Gel electrophoresis, PAGE, SDS-PAGE, Agarose Electrophoresis of Nucleic Acid, Isoelectric Focusing of Protein Pulse Gel Electrophoresis and Western Blotting.

UNIT IV

General principles of electromagnetic radiation, Types of spectra and their biochemical usefulness; Electromagnetic radiation and spectrum, UV-VIS spectrophotometer, Atomic absorption and Atomic emission spectroscopy, X-Ray spectroscopy, NMR and ESR. Circular dichorism (CD) principles, Basics of IR and X-Ray diffraction analysis.

UNIT-V

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

Text Books and Reference Books

1. Wilson, K, Walker, J.: Principles and Techniques of Practical Biochemistry. 5th Ed. - Cambridge University Press,. Cambridge 1999.
2. Biotechniques: Theory & Practice: Second Edition by SVS Rana, Rustogi Publications.
3. Biochemical Methods of Analysis : Saroj Dua And Neera Garg : Narosa Publishing House,New Delhi.
4. Bioanalytical Techniques : M.L. Srivastava ; Narosa Publishing House, New Delhi.

RBT302: MICROBIOLOGY

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

Genetic recombination: basic features of transduction, conjugation and transformation, Genotypic changes: mutations (occurrence of mutations, repair, mutation rate, phenotype and designation of bacterial mutant), Cell organelles, Biology of cancerous cells.

Text books:

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

Reference books:

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

RBT303: BIOCHEMISTRY

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Text books:

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

Reference books & web sources:

1. Biochemistry: Stryer, W. H. Freeman
2. Biochemistry: Voet and Voet, John Wiley and Sons, Inc. USA
3. Biochemistry: Zubey, WCB.
4. Biochemistry: Garrett and Grisham, Harcourt.

RCH351: FLUID MECHANICS FOR BIOTECHNOLOGY LAB

1. To determine the local velocity pressure with the help of pilot tube.
2. To determine the viscosity of a given viscous liquid by capillary tube flow method.
3. To differentiate between laminar and turbulent flow using Reynolds experiment.
4. To study the characteristics of an air compressor.
5. To study the characteristics of a centrifugal pump.
6. To determine velocity through orifice meter, venturimeter.
7. Study and verification of the flow pattern in a Bernoulli's apparatus.
8. To determine the minimum fluidization velocity in a fluidized bed and verify experimentally.
9. To find the friction losses in a Straight pipe
10. Study of Pipe fittings and Valves.

RBT351: ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY LAB

1. Precision, accuracy and validity of an experiment. Analysis and presentation of data.
2. Absorption maxima– change in absorbance in potassium permanganate with wavelength.
3. Verification of Beer-Lambert's law-using UV-Vis spectrophotometer.
4. To study the structure & function of basic microscope.
5. To study the paper chromatography for plant pigments
6. To study the thin layer chromatography for Amino acids
7. To study the column chromatography for separates the mix samples.
8. To study the analysis of DNA by agarose gel electrophoresis method.
9. To study the analysis of protein by SDS- PAGE method
10. To study the structure & function of laboratory centrifuge and its principle.
11. To study the separation of compounds using liquid-liquid extraction experiments.
12. To study the separation of biological compounds using various membrane separation techniques like filtration, osmosis, dialysis and reverse osmosis.
13. To carry out Protein precipitation using various techniques.

Reference book:

1. Wilson and Walker, "Principles and Techniques of Practical Biochemistry" 4 Edn., Cambridge Knew pros 1997.
2. Biotechniques: Theory & Practice: Second Edition by SVS Rana, Rustogi Publications.
3. Biochemical Methods of Analysis: Saroj Dua And Neera Garg: Narosa Publishing House, New Delhi.
4. Bioanalytical Techniques : ML Srivastava; Narosa Publishing House, New Delhi.

RBT352: MICROBIOLOGY LAB

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

Practical Books and References

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

RBT353: BIOCHEMISTRY LAB

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

Reference books

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

RCH405: HEAT & MASS TRANSFER

UNIT-I

Conduction and Convection: Introduction, Conduction: Basic concepts of conduction in solids, liquids and gases, Fourier law of heat conduction. Material properties of importance in heat transfer: Thermal conductivity, Specific heat capacity. General equation of heat conduction in cartesian co-ordinate, heat conduction through plane and composite walls, cylinders and spheres Critical and optimum insulation thickness.. Principles of convection, Newton's law of cooling.

UNIT-II

Radiation: Basic laws of heat transfer by radiation, Absorptivity, reflectivity and transmissivity, black, white and grey body, emissive power and emissivity, laws of radiation – Planck, Stefan-Boltzmann, Wien's displacement, Kirchhoff's law. Introduction to Heat Transfer Equipments: Classification of heat exchangers, Double pipe, Shell & tube and Plate type heat exchanger, Evaporators.

UNIT-III

Diffusion: Classification of mass transfer operation, choice of separation method, Definition of molecular and eddy diffusion, Ficks first law of diffusion, Concept of N & J Flux, Diffusion coefficient, Dependence of diffusion coefficient on temperature, pressure and composition. Mass Transfer Coefficients: Mass transfer in laminar and turbulent regions, F and k type mass transfer coefficients, Film, Penetration and surface renewal theories.

UNIT-IV

Drying: Drying, Different modes of drying operation, Types of batch and continuous dryer Definitions of moisture contents, Rate of batch drying, Time of drying, Continuous drying.,

UNIT-V

Crystallization: Crystallization, Crystallization equipment, Classification of crystallizers Theories of crystallization, Factors governing nucleation and crystal growth rates, controlled growth of crystal.

Books Recommended

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

Reference Books

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

RBT401: GENETICS & MOLECULAR BIOLOGY

UNIT-I

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

UNIT-II

Genome organization: Genome organization in prokaryotes and eukaryotes - special features of eukaryotic gene structure and organization, genome organization in mitochondria and chloroplast, DNA content and C-value paradox. Methods to measure DNA content variation - Various types of DNA sequences (simple sequences, repetitive sequences, nonsense sequences, tandem gene clusters, satellites)

UNIT-III

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

UNIT-IV

Genetic mutation, micro-deletion, Genetic syndrome, Techniques to detect mutation, Transcription in prokaryotes and eukaryotes, genetic code, reverse transcription, mRNA processing. Role of sigma factor in transcription, role of promoters and enhancers, mechanism and regulation of transcription in prokaryotes and eukaryotes,

UNIT-V

DNA replication process in prokaryotes & Eukaryotes, Activity of DNA polymerases and topoisomerases, Reverse transcriptase, Translation in prokaryotes and eukaryotes Basic principles of gene cloning and r-DNA technology, genetic code, properties of genetic code, wobble hypothesis, Molecular chaperones.

Text books:

1. Genetics a conceptual approach, 2nd Edition Benjamin A. Pierc WH freeman and, company, New York.
2. Benjamin Levin – Genes VIII, 8 th ed.

Reference books:

1. Albert B, Bray Denis et al.: Molecular Biology of The Cell, latest ed.
2. Watson, Hopkins, Roberts et al.: Molecular Biology of the Gene, 4 th ed.
3. Genetics- Strickberger, 2nd.
4. Baltimore- Molecular Biology of the Cell.
5. Advance Genetics by G.S. Miglani, Narosa Publishing House.

RBT402: IMMUNOLOGY

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

Immunity against infectious diseases (virus, bacteria and protozoan), Vaccines. Hypersensitivity, Autoimmunity, Immune responses and immune therapies for Cancer and AIDS; Transplantation immunology.

Text books:

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

Reference books:

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

RBT403: ENZYME ENGINEERING

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Text books:

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

Reference books:

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

RCH455: HEAT AND MASS TRANSFER LAB

1. To find out the thermal conductivities of Metal rod.
2. To find the thermal conductivity of Composite cylinder.
3. To find out the thermal conductivity of insulating powder.
4. To find the thermal conductivity of liquid / gases.
5. To determine the overall heat transfer coefficient in Parallel flow heat exchanger
6. To determine the overall heat transfer coefficient in Counter flow heat exchanger
7. To determine the overall heat transfer coefficient in Shell and Tube heat exchanger
8. Any Experiment on natural convection
9. Determination of diffusivity of acetone in air.
10. To determine the drying characteristics of given sample.

RBT451: GENETICS & MOLECULAR BIOLOGY LAB

1. How to calculate genetics and allelic frequencies numeric problem analysis.
2. Isolation of Plasmid DNA
3. Isolation of Plant DNA
4. Estimation of DNA content in the given sample by spectrophotometer
5. Determination of T_m of DNA.
6. Isolation of bacterial genomic DNA.
7. Purification of DNA through Electrophoresis & visualization under UV transilluminator.
8. Polyacrylamide gel electrophoresis of DNA.
9. PCR amplification of DNA and visualization by gel electrophoresis.
10. Isolation and study of polytene chromosome in *Drosophila*.

RBT452: IMMUNOLOGY LAB

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

RBT453: ENZYME ENGINEERING LAB

1. Production of commercially important enzymes from microbial sources.
2. Isolation of alpha amylase from plant source
3. Determination of enzyme activity and specific activity.
4. Partial purification of isolated enzymes.
5. Method of checking the purity of the enzyme -SDS-PAGE
6. Characterization of enzymes-effect of pH , temperature and inhibitors on enzyme activity etc.
7. Identification of Enzyme by different assay
8. Purification of enzymes by different methods
9. Immobilization of enzymes –Different Techniques such as adsorption, entrapment, encapsulation and cross- linking.
10. Strain improvement techniques- physical, chemical and genetic manipulation methods.
11. Formulation of enzyme stability.
12. Enzyme inhibition

Reference books

1. “An Introduction to Practical Enzyme Engineering”, Tata McGraw-Hill.
2. R. Eienthal and M.J. Dansen, “Enzyme Assays –A Practical Approach”, IRL Press, Oxford University Press, Oxford, 1993
3. <http://www.eng.umd.edu/~nsw/ench485/ench485.htm>