B.Tech Bio Tech

THIRD SEMESTER EXAMINATION

SUB. CODE	PAPER	TEACHING			
THEORY		L	T	P	C
03BBT101	Microbiology	**3**	**1**	**0**	**4**
03BBT102	Bioenergetics-1	**3**	**1**	**0**	**4**
03BBT103	Cell Biology	**3**	**1**	**0**	**4**
03BBT104	Molecular Genetics	**3**	**1**	**0**	**4**
03BBT105	Biostatistics	**3**	**1**	**0**	**4**
03BBT106	Chemical Engneering-1	**3**	**1**	**0**	**4**
LABORATORY					
03BBT201	Microbiology -Lab	**0**	**0**	**1**	**1**
03BBT202	Bioenergetics-1-Lab	**0**	**0**	**1**	**1**
03BBT203	Cell Biology -Lab	**0**	**0**	**1**	**1**
03BBT204	Molecular Genetics.-Lab	**0**	**0**	**1**	**1**
03BBT301	Discipline &Extra Curricular activities	**0**	**0**	**1**	**1**
	Total	**18**	**6**	**5**	**29**

FOURTH SEMESTER EXAMINATION

SUB. CODE	PAPER	TEACHING			
THEORY		L	T	P	C
04BBT101	Immunology	**3**	**1**	**0**	**4**
04BBT102	Molecular Biology	**3**	**1**	**0**	**4**
04BBT103	Enzyme Technology	**3**	**1**	**0**	**4**
04BBT104	Bioenergetics-ii	**3**	**1**	**0**	**4**
04BBT105	Chemical Engineering-ii	**3**	**1**	**0**	**4**
04BBT106	Food and Dairy Technology	**3**	**1**	**0**	**4**
LABORATORY					
04BBT201	Immunology -Lab	**0**	**0**	**1**	**1**
04BBT202	Molecular Biology -Lab	**0**	**0**	**1**	**1**
04BBT203	Enzyme Technology -Lab	**0**	**0**	**1**	**1**
04BBT204	Bioenergetics-ii.-Lab	**0**	**0**	**1**	**1**
04BBT301	Discipline &Extra Curricular activities	**0**	**0**	**1**	**1**
	Total	**18**	**6**	**5**	**29**

FIFTH SEMESTER EXAMINATION

SUB. CODE	PAPER	TEACHING PERIOD			
THEORY		**L**	**T**	**P**	**C**
05BBT101	Recombinant DNA Technology	**3**	**1**	**0**	**4**
05BBT102	Object Oriented Programming Using C++	**3**	**1**	**0**	**4**
05BBT103	Plant Tissue Culture	**3**	**1**	**0**	**4**
05BBT104	Animal Biotechnology	**3**	**1**	**0**	**4**
05BBT105	Developmental Biology	**3**	**1**	**0**	**4**
05BBT106	Analytical Techniques in Biotechnology	**3**	**1**	**0**	**4**
LABORATORY					
05BBT201	Rec. DNA Tech. & Appl. Lab	**0**	**0**	**1**	**1**
05BBT202	Object Oriented Programming Using C++ Lab	**0**	**0**	**1**	**1**
05BBT203	Plant tissue Culture -Lab	**0**	**0**	**1**	**1**
05BBT204	Animal tissue Culture -Lab	**0**	**0**	**1**	**1**
05BBT301	Discipline &Extra Curricular activities	**0**	**0**	**1**	**1**
	Total	**18**	**6**	**5**	**29**

SIXTH SEMESTER EXAMINATION

SUB. CODE	PAPER	TEACHING PERIOD			
THEORY		**L**	**T**	**P**	**C**
06BBT101	Genome Analysis	**3**	**1**	**0**	**4**
06BBT102	Fermentation Technology and Downstream Processing	**3**	**1**	**0**	**4**
06BBT103	Food Biotechnology	**3**	**1**	**0**	**4**
06BBT104	Plant Biotechnology	**3**	**1**	**0**	**4**
06BBT105	Biosensor	**3**	**1**	**0**	**4**
06BBT106	Professional Communication Skills	**3**	**1**	**0**	**4**
LABORATORY					
06BBT201	Genome Analysis –Lab	**0**	**0**	**1**	**1**
06BBT202	Fermentation Technology and Downstream Processing	**0**	**0**	**1**	**1**
06BBT203	Food Biotechnology –Lab	**0**	**0**	**1**	**1**
06BBT204	Plant Biotechnology-Lab	**0**	**0**	**1**	**1**
06BBT31	Discipline &Extra Curricular activities	**0**	**0**	**1**	**1**
	Total	**18**	**6**	**5**	**29**

SEVENTH SEMESTER EXAMINATION

SUB. CODE	PAPER	TEACHING PERIOD			
THEORY		**L**	**T**	**P**	**C**
07BBT101	Environmental Biotechnology	**3**	**1**	**0**	**4**
07BBT102	Database Management System	**3**	**1**	**0**	**4**
07BBT103	Bioinformatics	**3**	**1**	**0**	**4**
07BBT104	Protein Engineering	**3**	**1**	**0**	**4**
07BBT105	Marketing Management	**3**	**1**	**0**	**4**
07BBT106	Stem Cells in Health Care	**3**	**1**	**0**	**4**
LABORATORY					
07BBT201	Environmental Biotechnology - Lab	**0**	**0**	**1**	**1**
07BBT202	Database Management System	**0**	**0**	**1**	**1**
07BBT203	Bioinformatics Lab	**0**	**0**	**1**	**1**
07BBT204	Protein Engineering -lab	**0**	**0**	**1**	**1**
07BBT301	Discipline &Extra Curricular activities	**0**	**0**	**1**	**1**
	Total	**18**	**6**	**5**	**29**

EIGHTH SEMESTER EXAMINATION

SUB. CODE	PAPER	TEACHING PERIOD			
THEORY		L	T	P	C
08BBT101	Industrial Biotechnology	**4**	**1**	**0**	**5**
08BBT102	Molecular & Cellular Diagnostics	**4**	**1**	**0**	**5**
08BBT103	Biosafety & Bioethics	**4**	**1**	**0**	**5**
08BBT104	Intellectual Property Rights in Biotechnology	**4**	**1**	**0**	**5**
Project Work	Project Work	**0**	**0**	**5**	**5**
Seminar		**0**	**0**	**0**	**0**
08BBT201	Industrial Biotechnology	**0**	**0**	**1**	**1**
08BBT202	Molecular and Cellular Diagnostics	**0**	**0**	**1**	**1**
08BBT203	Biosafety and Bioethics	**0**	**0**	**1**	**1**
08BBT301	Discipline &Extra Curricular activities	**0**	**0**	**1**	**1**
	Total	**16**	**4**	**9**	**29**

MICROBIOLOGY

Paper Code-03BBT101
THIRD SEMESTER

UNIT-1

Microbes in our lives: Types of microorganisms. Brief history of microbiology. Microbes & human warfare. Microbes & human disease.

A survey of the Microbial World: Classification of microorganism and methods of classifying and identification of microorganism.

The prokaryotes groups: domain bacteria, proteobacteria, nonproteobacteria Gram-ve and Gram+ve bacteria. Bacterial diversity.

Fungi, lichens, algae, protozoa, helminthes, arthropods as vectors

Viruses: viral structures, isolation, cultivation and identification of viruses, viral multiplication.

UNIT-2

Functional Anatomy of Prokaryotic and Eukaryotic Cells: Size, shape, and arrangement of bacterial cells. Structures external to cell wall, structures internal to cell wall.

UNIT-3

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

UNIT-4

Microbial Growth: Growth requirements, culture media, obtaining pure cultures and preservation of cultures, growth of bacterial cultures, Control of Microbial Growth, Action of microbial control agents, physical and chemical methods of microbial control.

UNIT-5

Antimicrobial Drugs. History, spectrum and action of antimicrobial drugs.

Applied & Industrial Microbiology: Industrial fermentation, primary and secondary metabolites, Role of microorganisms in the production of industrial chemicals and pharmaceuticals, Microbes as alternative energy sources and as industrial products.

Principles of disease and epidemiology: Mechanism of microbial pathogenicity.

Reference

1. Microbiology: An Introduction: Tortora, Funke & Case. 7th edition, 2001
2. Microbiology: Davis, Dulbecco, Eisen and Ginsburg.

3. Introduction to Microbiology: Ross
4. General Microbiology: Stainier, Adelberq and Ingraham.
5. Microbiology: S.S. Purohit
6. Microbiology; R.C. Dubey

BIOENERGETICS – I

Paper code-03BBT102
THIRD SEMESTER

UNIT-1

Biochemical Evolution: Chemogeny, Biogeny, and Evolution of Chromosome Organization and Genetic Regulatory Mechanisms, Time factors in evolution, Evolution of Enzyme Systems.

Biochemical Energetics: Energy Yielding and Energy Requiring Reactions, Calculations of Equilibrium Concentrations, Oxidation-Reduction Reactions, Metabolism and ATP Yield. Photosynthetic Phosphorylation, Active Transport, Second Law of Thermodynamics, Enthalpy and Entropy, Activation Energy.

UNIT-2

Amino Acids and Peptides: Structure, Function, Methods of Characterization, Separation Techniques based on their structure and properties, Clinical Significance, Biosynthesis.

UNIT-3

Carbohydrates: Mono and Polysaccharide, Classification, Structure, Function, Separation and Characterization Techniques, Clinical significance, Biosynthesis.

Lipids: Classification, Structure, Function, Separation and Characterization Techniques, Clinical Significance

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UNIT-4

Nucleic Acids: Nucleic Acids and Polynucleotides, Classification, Structure, Function, Separation and Characterization Techniques, Clinical Significance.

UNIT-5

Vitamins and Micro and Macro Nutrients: classification, Structure, Function, Separation and Characterization Techniques, Clinical Significance.

Reference

1. Biochemistry by Lubert Stryer. W. H. Freeman & Company, NY
2. Biochemistry by Lehninger. McMillan publishers
3. Biochemistry by Zubey. Wm. C. Brown publishers
4. Biochemistry by J.L. Jain

CELL BIOLOGY

Paper code-03BBT103
THIRD SEMESTER

UNIT-1

The Cell: a macromolecular assembly, cellular compartmentalization, organeller architecture

UNIT-2

The Nucleus: Chromosomal DNA and its Packaging, The Global Structure of Chromosomes, Chromosome Replication, RNA Synthesis and RNA Processing, The Organization and Evolution of the Nuclear Genome.

Cell Cycle and Division: The General Strategy of the cell Cycle, The Mechanics of Cell Division, The Early Embryonic Cell Cycle, Cell- Cycle control in Yeasts and Multicellular Animals.

UNIT-3

Cytoskeleton: The Nature of the Cytoskeleton, Intermediate Filaments, Microtubules, Cilia and Centrioles, Actin Filaments, Actin-binding Proteins, Muscle.

Cell Junctions, Cell Adhesion, and the Extracellular Matrix : Cell Junctions, Cell-Cell Adhesion, The Extracellular Matrix of Animals, Extracellular Matrix Receptors on Animal Cells- the Integrins, The Plant Cell Wall structure.

UNIT-4

Membrane Structure, Transport of Molecules and Membrane Excitability: The Lipid Bilayer, Membrane Proteins, Principles of Membrane Transport, Carrier Proteins and Active Membrane Transport, Ion channels and Electrical Properties of Membranes

Protein Sorting and Vesicular Trafficking in the Cell: The Compartmentalization of Cells, The Transport of Molecules into and out of the Nucleus, The Transport of Proteins into Mitochondria and Chloroplasts, Peroxisomes, The oplasmic reticulum. Transport from the ER through the Golgi Apparatus, Transport from the Trans Golgi Network to Lysosomes, Transport from the Plasma Membrane via Endosome: Endocytosis, The Molecular Mechanisms of Vesicular Transport and the Maintenance of Compartmental Diversity.

UNIT-5

Cell Signaling: General Principles of Cell Signaling, Signaling via G-Protein-linked Cell-Surface Receptors, Signaling via Enzyme-linked Cell-Surface Receptors, Kinase Receptors, Structural Features of Trans-membrane Receptors, Hormone Receptor Interaction, Two-component signaling, Second messengers.

Cancer: Cancer as a Microevolutionary Process, Tumor cells, Proto-oncogenes and viral oncogenes, Tumor suppessor genes.

Reference

1. Molecular Biology of Cell by Albert et.al. John Wiley & Sons
2. The Cell by Cooper. ASM Press
3. Cell and Molecular Biology by Karp. John Wiley & Sons
4. Cell Biology by P.S. Verma and V.K. Agarwal

MOLECULAR GENETICS

Paper code-03BBT104
THIRD SEMESTER

UNIT-1

Genetics and Biology, Genes and Environment, Techniques of genetic analysis.

Concept of chromosome theory of heredity, Sex hromosomes, Sex linkage, The parallel behaviour of autosomal genes and chromosomes.

.**Biochemical Genetics:** Inborn errors of metabolism, one gene – one enzyme hypothesis, one gene – one protein, one gene – one polypeptide, colinearity

UNIT-2

Mendelian Analysis: Mendel's laws of inheritance, Interaction of genes, Variations on dominance, Multiple alleles, Lethal alleles, Several genes affecting the same character, Penetrance and expressivity,

UNIT-3

Linkage: Basic eukaryotic chromosome mapping, The discovery of linkage, Recombination linkage symbolism, Linkage of genes on X chromosomes, Linkage maps, Three point testcross, Interference, Calculating recombinant frequencies from selfed dihybrids, examples of linkage maps, The X2 test mitotic segregation in humans.

UNIT-4

Fine Structure of Genes: The concept of promoter, Coding sequence, Terminator, Induction of gene for expression.

Recombination in Bacteria and Viruses: Conjugation recombination and mapping the *E. coli* chromosomes, Transformation, Transduction, Chromosome mapping.

UNIT-5

The Extranuclear Genome: The concept of extranuclear genome in higher plants and animals, Overview of mitrechondrial genome, Chloroplast genome.

Human Genome Project: Genetic diseases in humans, Genetics and society.

References

1. In Introduction to genetic analysis, Griffiths, Miller, Suzuki, Lewontin 2. Gelbart, Freeman and Company.
3. Genetics, A.V.S.S. Sambamurty, Narosa Publishing House.
4. Concepts of Genetics, Klug & Cummings, Prientice Hall.
5. Molecular Cloning, Moniatisetal, Cold Spring Harbor Laboratory.
6. Genetics by Veer Bala Rastogi
7. Genetics by P.S. Verma and V.K. Agarwal

BIOSTATISTICS

Pages code-03BBT105
THIRD SEMESTER

UNIT-1

Presentation of Data: Frequency distribution, graphical presentation of data by histogram, frequency curve and cumulative frequency curves.

Measure of Location and Dispersion: Mean, Medium, Mode and their simple properties (without derivation) and calculation of median by graphs: range, mean deviation, Standard deviation, Coefficient of variation.

UNIT-2

Probability and Distribution: Random distributions, events-exhaustive, mutually exclusive and equally likely, definition of probability (with simple exercises), definition of binomial, Poisson and normal distributions and their inter-relations, Simple properties of the above distributions (without derivation).

UNIT-3

Correlation and Regression: Bivariate data – simple correlation and regression coefficients and their relation, Limits of correlation coefficient, Effect of change of origin and scale on correlation coefficient, Linear regression and equations of line of regression, Association and independence of attributes.

UNIT-4

Sampling: Concept of population and sample, Random sample, Methods of taking a simple random sample.

Tests of Significance: Sampling distribution of mean and standard error, Large sample tests (test for an assumed mean and equality of two population means with known S.D.); small sample tests (t-test for an assumed mean and equality of means of two populations when sample observations are independent, Paired and unpaired t-test for correlation and regression coefficients, T-test for

comparison of variances of two populations, Chi-square test for independence of attributes, Goodness of fit and homogeneity of samples.

UNIT-5

Experimental Designs: Principles of experimental designs, Completely randomized, Randomized block and latin square designs, Simple factorial experiments of 22, 23, 24 and 32 types, Confounding in factorial experiments (mathematical derivations not required); Analysis of variance (ANOVA) and its use in the analysis of RBD

Reference:

1. Statistical methods in biology by Norman T.J. Bailey (3rd Edition), Cambridge University Press (1995).
2. Biostatistics by R.S.N. Pillai and Bagavathi

CHEMICAL ENGINEERING-I

Paper code-03BBT106

THIRD SEMSTER

UNIT-1

Stoichiometry and chemical equations. Units, dimensions and conversions. Phase rule, Henry's law, Rault's law and their applications to gas-liquid and vapor-liquid systems

UNIT-2

Material balance for non-reacting and reacting systems, recycle and by pass.

Heats of solution, mixing and reactions. Types of energy and first law of thermodynamics.

UNIT-3

Energy balance for non-reacting and reacting systems. Calculation of flame temperature and adiabatic reaction temperature

UNIT-4

Properties of fluids & fluid statics. Mechanical energy balance.

Stokes law and its applications

UNIT-5

Flow of incompressible fluids:

Laminar flows:-Intro,relation between shear and pressure graient , steady laminar flow in circular pipe,flow through incline pipe.
Turbulent flows:-Intro,shear stress,formation of boundary layer in pipe ,hydrodynemical smooth and rough boundaries,velocity distributuin in smooth and rough pipe
Reynolds number.
Flow measurement: Orifice & Venturi meter. Pumps and their characteristics.

Reference

1. Unit Operations of Chemical Engineering, McCabe W.L., Smith J.C. and Harriott P., McGraw Hill International Edition, Singapore, 5th Ed., 1993.
2. Chemical Engineering, Vol. 1, Coulson J.M. and Richardson J.F., Butterworth Heinemann, Oxford 6th Ed., 1999
3. Fluid Mechanics, Douglas J.F., Gasiorek J.M., Swaffield J.A., Addison-Wesley Longman, 3rd Ed., 1995.
4. Upadhay and Upadhay-S. Chand Pub.

THIRD SEMESTER LABORATORY WORK

03BBT201 MICROBIOLO0GY LAB

- Sterilization techniques with preparation of media.
- Perform gram staining of bacteria.
- Perform viable counting of microorganisms.
- Undertake total counting of microorganisms.
- Study factors affecting microbial growth.
- Study heat resistance of bacteria.
- Identification of bacteria through various techniques.
- Cultivation and enrichment techniques for microorganisms.

03BBT202 BIOENERGETICS LAB

- Biochemical testing, chemo taxonomical procedures.
- Alcoholic fermentation of fruit juice.
- Casein protein estimation.
- Spot test for carbohydrates.
- Estimation of reducing sugars by Benedict's method.
- Spot tests for Amino acids.

03BBT203 CELL BIOLOGY LAB

- Introduction to principles of sterile technique and cell propagation.
- Study of a typical prokaryotic cell.
- Study of a typical eukaryotic cell.
- Preparation of media and media components.
- Identification of plant cell.
- Identification of animal cell.
- Identification of bacterial cell.
- Study of the components of cells.
- Principles of microbiology.
- Study stages of mitosis and meiosis.
- Prepare permanent slides of stages of mitosis.
- Prepare permanent slides of stages of meiosis.
- Effect of chemicals on cell division.

03BBT204 GENETICS LAB

- Perform simple plant breeding experiment.
- Use of micropipettes and loading DNA gels.
- Isolation of DNA.
- Isolation of bacterial DNA.

FOURTH SEMESTER EXAMINATION

IMMUNOLOGY

Paper code-04BBT101
THIRD SEMESTER

UNIT-1

Introduction to Immunology: Properties of immune response, Innate and acquired immunity, active and passive immunity.

Cells & Tissues of Immune System: Lymphocytes, Classes of lymphocytes, antigen presenting cells, NK Cells, Mast Cells, Dendritic Cell, Organs of the Immune System, Bone marrow, Thymus, Lymph node, Spleen, CALT, MALT.

UNIT-2

Molecular Immunology: - Molecular structure of antibody, Classification, Isotypes, Synthesis assembly and expression of immunoglobulin molecules, Nature of antigens, function and diversity, Generation of anti-body diversity.

UNIT-3

Antigens: Different characteristics of antigens, mitogens, Hapten, Immunogen, Adjuvants.

MHC: Discovery of MHC complex, Role of MHC, Structure of MHC molecule, Binding of peptides to MHC molecules, MHC restriction.

Effecter Mechanism of Immune Response: Cytokines, T- cell receptors, cell activation, complement system, antigen processing and presentation, regulation of immune response.

UNIT-4

Immunological Techniques:- antigen- antibody reactions, Immuno diffusion, immunoelectro-phoresis, ELISA, RIA, fluorescence activated cell sorter,

UNIT-5

Applied Immunology:- Immune system in health and disease, autoimmunity, hypersensitivity, tumor immunity, tissue and organ transplant, Synthetic vaccines.

Hybridoma technology: - Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application.

Reference

1. Kuby- Immunology (4th Edition) by R. A. Goldsby, T.J. Kindt, B.A. Osborne.
2. Essentials of Immunology (6th Edition): Ivan Riot- Blakswell Scientific Publications, Oxford, 1988.

3. Fundamentals of Immunology: Paul W.E. (Eds.) Raven Press, New York, 1988.
4. Antibodies A laboratory Manual: Harlow and David Lane (1988), Cold spring harbor laboratory.
5. Essentials of Immunology-Abbas

MOLECULAR BIOLOGY

Paper code-04BBT102
THIRD SEMESTER

Unit 1

An introduction to Molecular genetics- Basis of life; Genetics and Biology; Genes and Environment; Techniques of genetic analysis; Central Dogma; Brief concept of Replication; Transcription & Translation and the enzymes & proteins involved in it; Identification of the genetic material-classical experiments of Hershey Chase, Avery McLeod etc.

Unit 2

Organization of genome & interaction with histones at its different levels- Molecular structure of nucleic acids & DNA; Packeging of DNA into chromosomes; DNA as the genetic material; DNA replication and its requirements; Transcription and Translation; Post transcriptional and post translational modifications; inhibitors of transcription and translation; Elementary idea of mutation and its types; genetic mapping of chromosomes.

Unit 3

Fine Structure of Genes- The concept of promoter, regulator, Enhancer, Operator & Structural genes; Coding sequence and non-coding sequences, Intron and Exons; Gene expression and regulation; Inducible and repressible gene expressions, operon concept-lac and trp operons; Complementary, Supplementary and other different types of genes.

Unit 4

Transfer of Genetic Information- Structure and functions of m-RNA, r-RNA and t-RNA; The genetic code and its features, deciphering of genetic code; Conjugation, transduction and transformation

.

Unit 5

Genetic Recombination- Basic steps of Gene cloning; Enzymes other requirements for gene cloning; Tools and techniques for RDT; Application of Genetic Engineering; Basic concepts of PCR, RFLP etc

Reference

1. Gene VII by B. Lewin.
2. Essentials of molecular Biology, Malacinski and Freifelder Jones and Bartlelt Publishers.
3. Genomes, T. A. Brown, John Wiley and Sons PTE Ltd.
4. Cell and molecular Biology, Concepts and experiments Gerald Karp, John Wiley and Sons.
5 The Cell - A molecular approach, Gm Cooper Asm Press.
6 Molecular Biology-PK Gupta

ENZYME TECHNOLOGY

Paper code-04BBT103
THIRD SEMESTER

UNIT-1

Introduction to enzymes: What are enzymes, brief history of enzymes, nomenclature and classification of enzymes.

Structural Features of Enzymes: Chemical nature of Enzymes: amino acids, the building blocks of protein, Levels of protein Structure: Primary, secondary, tertiary and quaternary structure

UNIT-2

Specificity of Enzymes: Types of specificity, the Koshland "induced fit" hypothesis, Strain or transition – state stabilization hypothesis.

Enzyme Catalysis and Kinetics: Factors affecting the rate of chemical reactions, kinetics of uncatalyzed chemical reactions, kinetics of enzyme-catalyzed reaction, methods for investigating the kinetics of enzyme-catalyzed reactions, nature of enzyme catalysis, inhibition of enzyme activity.

UNIT-3

The Investigation of Active Site Structure and Chemical nature of Enzyme Catalysis: The identification of binding sites and catalytic site, three dimensional structure of active site, mechanism of catalysis, mechanism of reaction catalyzed by enzyme without cofactors, metal-activated enzyme and metalloenzyme, coenzymes in enzyme catalyzed reactions.

UNIT-4

Immobilization of Enzymes: Concept, methods of immobilization, Kinetics of immobilized enzymes, effect of solute partition and diffusion on kinetics of immobilized enzymes, use of immobilized enzymes, bioreactors using immobilized enzyme.

UNIT-5

Industrial uses of enzymes: *Industrial enzymes:* Sales value of industrial enzymes, traditional (non-recombinant) sources of industrial enzymes, The impact of genetic engineering on enzyme

production, Engineered enzymes, *Extremophiles:* hyperthermophiles, enzymes from hyperthermophiles, enzymes from additional extremophiles, enzymes in organic solvent

Industrial enzymes: proteases and carbohydrases: Proteolytic enzymes: Carbohydrases, Lignocellulose degrading enzymes, Pectin and pectic enzymes.

Additional industrial enzymes: Lipases, Penicillin acylase, Amino acylase and amino acid production, cyclodextrins and cyclodextrin glycosyl transferase, enzymes in animal nutrition, Oxidoreductases, Enzymes in molecular biology.

Reference

1. Enzymes by Palmer (2001): Horwood Publishing Series.
2. Fundamentals of Enzymology by Price and Stevens (2002): Oxford University Press.
3. Enzyme Technology by Helmut uhling (1998): John Wiley
4. Introduction to Proteins Structure by Branden and Tooze (1998): Garland Publishing Group.
5. Biochemistry by Lehninger. McMillan publishers

BIOENERGETICS-II

Paper code-04BBT104
THIRD SEMESTER

UNIT-1

Catabolism and the Generation of Chemical Energy

Metabolic Strategies: General Principles of Intermediary Metabolism, Regulation of Pathways, Strategies for Pathway Analysis

UNIT2

Glycolysis, Gluconeogenesis, and the Pentose Phosphate Pathway : Glycolysis, Gluconeogenesis, Regulation of glycolysis and Gluconeogenesis, The pentose Phosphate Pathway

UNIT-3

The Tricarboxylic Acid Cycle: Discovery of the TCA Cycle, Steps in the TCA Cycle, Stereochemical Aspects of TCA Cycle Reactions, ATP Stoichiometry of the TCA Cycle, Thermodynamics of the TCA Cycle, The Amphibolic Nature of the TCA Cycle, The Glyoxylate Cycle, Oxidation of other Substrates by the TCA Cycle, Regulation of TCA Cycle Activity

UNIT-4

Electron Transport and Oxidative Phosphorylation: The itochondria Electron - Transport Chain, Oxidative Phosphorylation, Transport of Substrates, Pi, ADP and ATP into and out of Mitochondria, Electron Transport and ATP Synthesis in Bacteria,

Photosynthesis and other Processes Involving Light *:* Photosynthesis, Other Biochemical Processes Involving Light

UNIT-5

Metabolism of Fatty Acids : Fatty Acid Degradation, Biosynthesis of Saturated Fatty Acids, Regulation of Fatty Acid Metabolism

Reference

1. Biochemistry by Lubert Stryer. W. H. Freeman & Company, NY
2. Biochemistry by Lehninger. McMillan publishers
3. Biochemistry by Zubey. Wm. C. Brown publishers
4. Biochemistry by J.L. Jain

CHEMICAL ENGINEERING-II

Paper code-04BBT105
THIRD SEMESTER

UNIT-1

Mixing: types of agitators, flow patterns and power consumption.

Steady state conduction: Fourier's law, concept of resistance to heat transfer, critical insulation thickness, conduction with heat generation.

UNIT-2

Convection: Film theory and concept of heat transfer coefficient. Heat transfer in laminar and turbulent flows.

UNIT-3

Heat Exchanger: sizing of shell & tube heat exchangers. Heat transfer in agitated vessels.

UNIT-4

Boiling & Condensation: heat transfer to boiling liquids and from condensing vapours.

UNIT-5

Fundamentals of mass transfer: moleuclar diffusion in fluids and solids, concept of mass transfer coefficient. Equilirbium stage, multistage and contious contactors with applications to gas absoption, calculation of NTU, HTU and number of stages.
Psychrometric chart and its applications.

Reference

1. Transport Processes and Unit Operations, Geankoplis C.J., Prentice Hall of India, 3rd, 1999.
2. Heat Transfer, Holman J.P., McGraw Hill, New York, 8th Ed 1997.
3. Unit Operations of Chemical Engineering, McCabe W.L., Smith J.C. and Harriott P. McGraw Hill International edition, Singapore, 5th Ed., 993.
4. Chemical Engineering, Vol. I and II, Coulson J.M. and Richardson J.F. Butterworth Heinemann, Oxford, 6th Ed., 1999.

FOOD AND DAIRY TECHNOLOGY

Paper code-04BBT106
THIRD SEMESTER

UNIT-1

Milk : Definition, Composition, Chemical and functional properties of milk components: physicochemical properties of milk protein, aggregation of Casein, micelles, factors affecting milk composition, milk secretion and lactation.

UNIT-2

Micro-organisms: importance in dairy science and technology. microbial spoilage of milk, hydrolytic rancidity in milk and milk products, autooxidation of milk fats and effects on milk quality.

UNIT-3

Milk processing operations: Milk pasteurization, Homogenization & Sterilization. Effect of processing of milk components and their functional properties.

Skimming of milk, Cream & Cream characteristics, manufacture of yoghurt and other fermented milk products, Ice cream manufacture, Butter making technology, technology of cheese, processing of concentrated milks and dried milk powder.

UNIT-4

Milk quality control, sanitation in the dairy plant, adulteration of milk, dairy equipment maintenance and waste disposal.

UNIT-5

Fermentation, as a method for preparing and preserving foods.Alcoholic beverages,cheese,sourkrat,idli,vinegar.

Reference

1. Food Microbiology: Fundamentals and frontiers by M.P. Doyle, L.R. Beuchat and Thoma J. Montville, (2001), 2nd edition, ASM press, USA.
2. Food Science and Food Biotechnology by G.F.G. Lopez & G.V.B. Canovas (2003), CRC Press, Florida, USA.
3. Industrial Microbiology: L.E. Casida, Willey Eastern Ltd., 1989.
4. Industrial Microbiology: Prescott & Dunn, CBS Publishers, 1987.

FOURTH SEMESTER LABORATORY WORY

04BBT201 IMMUNOLOGY LAB

- Analysis of blood cells.
- Isolation of lymphocytes.

- SDS-PAGE.
- ELISA.
- Agglutination test for antigen-antibody interaction.]

04BBT202 MOLECULAR BIOLOGY

- Use of micropipettes and loading DNA gels.
- Isolation of DNA.
- Isolation of bacterial DNA.
- Quantitative estimation of DNA.
- Qualitative estimation of DNA.

04BBT203 ENZYME TECHNOLOGY LAB

- Protein separation: determination of concentration.
- Study of mechanism of enzyme action.
- Study of restriction digestion.
- Study of ligation.

04BBT204 BIOENERGETICS-II LAB

- Spot test for carbohydrates.
- Estimation of reducing sugars by Benedict's method.
- Spot tests for Amino acids.
- Quantitative methods for amino acids.
- Saponification of fats.
- Estimation of cholesterol.

FIFTH SEMESTER

RECOMBINANT DNA TECHNOLOGY

Paper code-05BBT101
FIFTH SEMESTER

UNIT-1:Introduction to gene cloning, tools and enzymes used in gene manipulation:-Restriction enzymes DNA ligases DNA Polymerase Reverse Trascriptase Polynucleotide kinase,End labeling and other process used in rDNA technology.

UNIT-2:Major cloning vehicle and their application-Plasmid vectors, cosmid, Phagemid, phage vector,YAC,BAC,Ti plasmids,expression vector, shuttle vectors binary vectors, Transposons

UNIT-3:Making of genomic and cDNA libraries, their screening and major application

UNIT-4:Production of transgenic microbes and their application in Biotechnology

UNIT-5:Production of transgenic Animals and their application in Biotechnology
Production of transgenic Plants and their application in Biotechnology.

Text / Reference Books:

1. From Genes to Clones by Winnacker. PANIMA
2. Molecular Biotechnology by Pasternack and Glick.
3. From Genes to Genomes: Concepts & Applications of DNA Technology by J.W. Dale & M.V. Schartz.
4. Gene Cloning & DNA Analysis: An Introduction (4th edition) by T.A. Brown.
5. Molecular Cloning by Sambrook, *et al*.

6. Principles of Gene Cloning by Old and Primrose.

OBJECT ORIENTED PROGRAMMING USING C++

Paper code-05BBT102
FIFTH SEMESTER

An overview of object Oriented Programming:Rationale for object programming,procedural vs.objected oriented approach;advantages of OOP; Characteristics of object oriented languages -objects, classes,inheritance, active data,message passing.

UNIT-1: Object Oriented Programming Tools and C++:An overview of C++ programming,simple program construction,functions,statements, inputs/outputs. Variables and manipulators, data types. Library functions.
Functions :function declaration, calling, passing arguments to functions and returning values from functions,reference arguments,overloaded functions, variable and storage classes.

UNIT-2: Objects and Classes :classes and objects, C++ objects and memory. Arrays:definition, multidimensional arrays, passing arrays to functions, arrays of structures.arrays as class members data,arrays of objects,arrays of strings.

UNIT-3: Operator overloading: Overloading unary,binary and arithmetic operators,adding polar coordinates.concatening strings.multiple overloading,pitfalls of operator overloading and conversation.

UNIT-4: Inheritance:derived class and base class, overriding memory functions, class hierarchy,public and private inheritance,multiple inheritance. Pointers:Addresses and pointers,pointer and arrays, pointer and functions use of pointers in strings, linked lists and memory management.

UNIT-5: Files and Streams:Streams,strings and objects I/O, I/O with multiple objects,file operations using pointers. Applications: Object oriented programming in simulation and artificial intelligence,Programming environments.

Reference:

1. OBJECT ORIENTED PROGRAMMING USING C++ by E.Balaguruswamy,TMH Publications,New Delhi
2. OBJECT ORIENTED PROGRAMMING USING C++ by Robert Lafore 4th ed.Galgotia Publications,New Delhi
3. OBJECT ORIENTED PROGRAMMING USING C++ by Sanjeev Sofat,Cyber Tech Publications
4. C++ Primer by Stephen parota,TMH publications,New Delhi
5. C++ Primer by SB Lipman and J Lajoie New Addison Wesley (Singapore) Pvt Ltd.New Delhi

PLANT TISSUE CULTURE

Paper code-05BBT103:
FIFTH SEMESTER

UNIT-1:History: Important events in the history of plant tissue culture.

Laboratory Requirements and General Techniques: Introduction, requirements, techniques.

UNIT-2:Cellular Totepotency: Introduction, cyto-differentiation, orgemogenic differentiation, loss of morphogenic potential in long-term cultures, practical applications of cellular totipotency
Tissue Culture Media: Introduction, media constituents, media selection, media preparation
Cell and Suspension Culture: Introduction, isolation of single cells, suspension cultures, culture of single cells, plant cell reactors, applications of cell culture.
Proloplast Culture: Proloplast isolation, culture and regeneration.

UNIT-3:Somatic Embryogenesis: Introduction, some examples of formatic embryogenesis, factors affecting somatic embryogenesis, induction and development, maturation
Haploid Production: Introduction, techniques, factor affecting androgenesis, ontogeny of androgenic haploids, plant regeneration from pollen embryos, gynogeresis, haploid production through disport hybridization idiptridization to raise homozygous diploids,applications, limitations.
Triploid Production: Introduction, callusing, histology and cytology of cells, organogenesis, applications of endosperm culture.

UNIT-4:Embryo Culture: Introduction, techniques, culture requirements role of the suspensor in embryo culture, precocious germination, morphogenesis in the culture of seeds with partially differentiated embryos, micronugical experiments, embryo and seed culture of parasitic angiosperms, morphogenic potential of the embryo callus, practial applications.
In-vitro pollination and fertilization: Introduction, terminology, in vitro pollination, in vitro fertilization, applications.
Micropropagation: Introduction, techniques, applications, production of pathogen free plants

UNIT-5:Production of secondary metabolites: Introduction, strategies used to optimize product yield, commercial aspects
Germplasm Storage: Introduction, long-term storages, short or medium term storage

Text / Reference Books:
1. Experiments in Plant Tissue Culture by John H. Dodds & Lorin W. Robert.
2. Plant tissue Culture : Theory and Practice by S.S. Bhojwani and M.K. Razdan (1996) Elsevier, Amsterdam.
3. An Introduction to Plant Biotechnology by H C Chawla Oxford and IBH 2002

ANIMAL BIOTECHNOLOGY

Paper code-05BBT104
FIFTH SEMESTER

UNIT-1:Introduction to Animal Tissue Culture: Background, Advantages, Limitations,Application, Culture Environment, Cell Adhesion, Cell Proliferation, Differentiation.
Design, Layout and Equipment: Planning, Construction, Layout, EssentialEquipments, Aseptic Technique, Objectives, Elements, Sterile Handling, Safety, RiskAssessment, General Safety, Fire, Radiation, Biohazards

UNIT-2:Media: Physicochemical Properties, Balanced Salt Solutions, Complete Media, Serum,Serum-Free Media, Disadvantages of Serum, Advantages of Serum-Free media
Primary Culture: Isolation of Tissue, Steps involved in primary cell culture, Cell Lines,Nomenclature, Subculture and Propagation, Immortalization of cell lines, Cell linedesignations, Routine maintenance

UNIT-3:Characterization & Quantitation of Cell Line: Need for characterization, Morphology,Chromosome Analysis, DNA Content, RNA and Protein, Enzyme Activity, AntigenicMarkers, Transformation, Immortalization, Aberrant Growth Control, Tumorigenicity, Cell
counting, DNA content, Protein, Rates of Synthesis, Cell Proliferation, Plating Efficiency,Labeling Index, Generation Time.

UNIT-4;Contamination: Source of contamination, Type of microbial contamination, Monitoring,Eradication of Contamination, Cross-Contamination
Cryopreservation: Need of Cryopreservation, Preservation, Cell banks, Transportingcells
Cytotoxicity: Introduction, In vitro limitations, Nature of assay, Viability assay, Survivalassay, Microtitration assay, Transformation assay

UNIT-5:Transgenic Animals: Methodology, Embryonic Stem Cell method, Microinjectionmethod, Retroviral vector method, Applications of transgenic animals
Gene Therapy: Ex-vivo gene therapy, In vivo gene therapy, Viral gene delivery system,Retrovirus vector system, Adenovirus vector system, Adeno-Associated virus vectorsystem, Herpex simplex virus vector system, Non-viral gene delivery system, Prodrugactivation therapy, Nucleic acid therapeutic agents
In Vitro Fertilization and Embryo Transfer: Composition of IVF media, Steps involvedin IVF, Fertilization by means of micro insemination, PZD, ICSI, SUZI, MESA

Reference

1. Animal Cell Culture by John R.W. Masters Oxford University Press
2. Introduction to Cell and Tissue Culture by Jennie P. Mather and Penelope E. Roberts Plenum Press, New York and London
3. Molecular Biotechnology: Primrose.
4. Animal Cell Biotechnology: R.E. Spier and J.B. Griffiths (1988), Academic press.
5. Biotechnology by B.D.Singh

DEVELOPMENTAL BIOLOGY

Paper code-05BBT105:
FIFTH SEMESTER

Unit I:Basic concepts- Cell fate and commitment, its mechanism, mosaic and regulative development, maintenance of differentiation, pattern formation and compartments, Apoptosis, Senescence and Ageing
.

Unit II:Morphogenesis- model organism, developmental mutantsnts, Transgenic organism in development, cellular and microsurgical techniques, Genes and their role in development, signal transduction in development cell division cycle,cytoskeleton.cell adhesion and the extra cellular matrix.

Unit III:Unicellular models sporulation in Bacillus subtilis- Mating type switching in yeast aggregation and culmination in dicyostelium discordeum, Sex gametes and fertilizationgerm line speciation, germ cell migration,gametogenesis,gastrulation in invertebrate and vertebrate, cell lineage, Axis specification in vertebrates, fate of ectoderm, measoderm and endoderm.

Unit IV:Cell differentiation mechanism and factors affecting it- Developmental gradients in hydra, axial gradients in Drosophila development, Organogenesis in invertebrates and vertebrates, plant development, plant versus animal development, development of plant embryo, development of seeding, root, shoot, leaf and flower.

Reference

1. Developmental Biology, by Scott F. Gilbert (1997), Sinauer Associates, Inc.
2. Developmental Biology,by Veer Bala Rastogi
3. Developmental Biology,by PD Sharma

ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY

Paper code-05BBT106

FIFTH SEMESTER

Unit I:Microscopy- Microscopic identification of various microorganisms; phase contrast and confocal microscopy; SEM-TEM microscopy.

Unit II:Electrophoretic Techniques- Basis and principle of Electrophoresis; Electrophoresis of proteins and nucleic acids; 1D & 2D Gels; pulsed field electrophoresis; capillary electrophoresis; western southern and northern blotting; dot and slot, gel documentation.

Unit III:Methods of biochemical analysis- Carbohydrates, lipids, proteins and nucleotides analysis; enzymatic assays of various metabolites; DNA purification and PCR-based analysis; DNA fingerprinting; DNA sequencing.

Unit IV:Immunological Techniques- Antiserum production, immunofluroscence, immuno histocompatibility ELISA; localization of cells in tissues immunoblotting; monoclonal antibodies.

Unit V:Spectroscopy- UV-Visible spectroscopy, infrared-spectroscopy, NMR & Mass spectroscopy; Principle and application.
Chromatography- Partition chromatography, Adsorption chromatography, Affinity chromatography (principle and application in biotechnology).

Reference

1. Analytical Techniques by Wilson and Walker.
2. Lab Manual by K.R.Aneja
3. Tietz Textbook of Clinical Chemistry, Carl A. Burtis, Edward R. Ashwood, Harcourt Brace & Company Aisa Pvt. Ltd.

LABORATORY WORK

Rec. DNA Tech. & Appl. Lab

- Use of micropipettes and loading DNA gels.
- Isolation of DNA.
- Isolation of bacterial DNA.
- Study of restriction digestion.
- Study of ligation.

Object Oriented Programming Using C++

- To write a simple program for understanding of C++ program structure without CLASS declaration. Program may be based on simple input output, understanding keyword using.
- Write a C++ program to demonstrate concept of declaration of class with public private member, constructors, object creation using constructors, access restrictions,

defining member functions within and outside a class. Scope resolution operators, accessing an object's data members and functions through different type of object handle name of object, reference to object, pointer to object, assigning class objects to each other.

- Program involving multiple classes (without inheritance) to accomplish a task. Demonstrate composition of class.
- Demonstration Friend function friend classes and this pointer.
- Demonstration dynamic memory management using new & delete & static class members.

Plant tissue Culture -Lab

- Preparation of culture media (a) broth type of media (b) Agar,
- Mechanism of drug resistance
- In vitro germination of seeds.
- Artificial seed production.
- Meristem culture.
- Micropropagation.

Animal tissue Culture -Lab

- Instruments demonstration
- Preparation of Standard solutions with given molality.
- Preparation of Standard solutions with given normality.
- Calibration of pH meter.
- To measure the pH of different solutions (acid and base)
- Preparation of buffer solutions of different pH.
- Performing experiments to detect the pH of solutions using various pH meters.
- ELISA.
- Agglutination test for antigen-antibody interaction

SIXTH SEMESTER

GENOME ANALYSIS

Paper code-06BBT101
SIXTH SEMESTER

UNIT-1. Basic structure of prokaryotic and eukaryotic genome. Human genome project and its application to future of mankind.

UNIT-2.Chromation model, concept of gene, linkage and crossing over, linkage analysis in drosophila and neurospora.

UNIT-3.Pedigree analysis in human.Genetic mapping and its tools,genetic mapping of complex character.

UNIT-4.Multigene families in human genome and repetitive DNA C-Value paradox and complexity of genome

UNIT-5 Physical mapping of genome-chromosome walking,chromosome painting,FISH, GISH,zoo biot. Dot blot, VNTR, RFLP, RAPD, RACE, SNPs, QtLs, EST, CpG island indentification.exon trapping and sequence analysis.

Reference

1. Commercial Biosensors: Graham Ramsay, John Wiley & Son, INC. (1998).
2. Essentials of Diagnostic Microbiology, Lisa Anne Shimeld.
3. Diagnostic Microbiology, Balley & Scott's.
4. Tietz Text book of Clinical Biochemistry, Burtis & Ashwood.
5. The Science of Laboratory Diagnosis, Crocker Burnett.

FERMENTATION TECHNOLOGY AND DOWNSTREAM PROCESSING

Paper code-06BBT102

SIXTH SEMESTER

UNIT-1. An introduction fermentation technology-basic microbial growth kinetics,Isolation,preservation and improvement of industrially important microorganism Sterlization process, media for industrial fermentation,development of inocula for Industrial fermentations.

UNIT-2. Designing of a fermentor,operation and application.Instrumentation and Control, fermentation kinetics, optimization of fermentation process by Quantitative analysis. Aeration and agitation.

UNIT3. Product recovery operations :-filteration, solvent extraction, adsorption-desorption process. Salt precipitation,Recovery of

UNIT-4. Memberane based seperation process :-Reverse osmosis, ultra filtration.Micro filtration,pervaporatio.memberane modules,flux expression,conceteration polarization. membrane characterization methods.

UNIT-5. Downstream processing Recovery and purification of fermentation products,Effluent treatment.

Reference:

1. Protein: Biochemistry and Biotechnology by Gary Walsh (2002 John Wiley & Sons Ltd.)
2. Process Biotechnology Fundamentals by S.N. Mukhopadhyay (2001). Viva Books Private Limited.
3. Bioprocess Engineering by Whittaker.
4. Industrial Microbiology: L.E. Casida, Willey Eastern Ltd., 1989.
5. Industrial Microbiology: Prescott & Dunn, CBS Publishers, 1987.

FOOD BIOTECHNOLOGY

Paper code-06BBT103
SIXTH SEMESTER

UNIT-1. Micro-organisms associated with food, factors affecting growth of microorganisms in food, food spoilage.

UNIT-2. Fermented Foods-Fermentation processes for manufacture of fermented food and food products-alcohlic beverages and other products,fermented milk products,pickles.

UNIT-3. Protein foods and nutraceuticals:SCP,mushroom,food yeasts,algal proteins nutraceuticals from plant parts (flavonoids,caraotenoids,phytosterol) and their applications, curative foods and transgenic plant foods.Bioprotection and biopresevation.

UNIT-4. Enzymes in food: Mechanisms of enzyme functions and reactions in process techniques-starch and sugar convertion process,banking by amylases,deogenation and desugaring by glucose oxidase,cheese making by proteases.beer mashing and chill proofing.

UNIT-5. Process waste:Bioconvertion of whey,molasses,starch substrates and other food wasters to useful products.

Reference

1. Modern Food Micro-Biology by James M. Jay, (2000), 6th edition, An Aspen Publication, Maryland, USA.
2. Food Microbiology: Fundamentals and frontiers by M.P. Doyle, L.R. Beuchat and Thoma J. Montville, (2001), 2nd edition, ASM press, USA.
3. Food Science and Food Biotechnology by G.F.G. Lopez & G.V.B. Canovas (2003), CRC Press, Florida, USA.
4. Process Biotechnology Fundamentals by S.N. Mukhopadhyay (2001). Viva Books Private Limited
5. Bioprocess Technology- fundamentals and applications, S O Enfors & L Hagstrom (1992), RIT, Stockholm.

PLANT BIOTECHNOLOGY

Paper code-06BBT104
SIXTH SEMESTER

UNIT-1.General introduction,history,scope,concept of cellular differentiation,totipotency. Classical vs modern approach,

Production of disease free plants explant, shoot tip culture, shoot tip grafting, viricidtel compounds

UNIT-2. Micropropagation Basic technique, Automation in the area scope as an commercial venture.

Tissue Culture as some of Genetic Variability Somaclonal and gametoclonal variation, Selection, Sources and causes of variation, Application in crop improvement.

UNIT-3. Protoplast Related Techniques Protoplast, Isolation, Culture and fusion, Selection of hybrid cells, regenration of hybrid plants, somatic hybridization and cybridization, Applications in crop improvement.

Plant as Biofactories Concept, Production of Chemicals, Pigments, Perfume, Flavors, Insecticides, anticancer agents and other important compounds.

UNIT-4.Transformation Techniques Physical methods, *Agrobacterium*, Mediated transformation

Transgenics Basic concept and essential steps of the process, Some examples of transgenic plants, Use of suitable promoters, Gene silencing and measures to overcome it, Commercial aspects of the technology.

UNIT-5. Nitrogen Fixation Basic concepts, nif genes and their regulation, potential scope in crop improvement

Transformation of organelles: Methods and success, advantages of organller transformation.

Molecular Markers Concept, SNPs, RAPD, RFLP, ISSR, STMS, role in crop improvement and genome mapping.

Reference

1. Plant Tissue Culture: Applications and Limitations. S.S. Bhojwani (1990), Elsevier, Amsterdam.
2. Micropropagation: P.C. Debergh and R.H. Zimmerman (1990), Kluwer Academic Publ. Dordrecht.
3. Transgenic plants – Lindsey and Jones
4. Plants, genes & crop improvement, Crispeels – ASPB, 2002
5. Agricultural Biotechnology – A. Altman.

BIOSENSORS

Paper code-06BBT105:

SIXTH SEMESTER

UNIT-1:Introduction to Biosensors: Concepts and applications.

UNIT-2:Biosensors for personal diabetes management.
Microfabricated Sensors and the Commercial Development of the I- stat Point-of-Care system.

UNIT-3:Noninvasive Biosensors in Clinical Analysis.
Surface Plasmon Resonance.

UINT-4:Biosensors based on Evanescent Waves.

UNIT-5:Applications of Biosensor-based instruments to the bioprocess industry.
Application of Biosensors to environmental samples.
Introduction to Biochips and their application in modern sciences.

Reference

1. Commercial Biosensor: Grahm Ramsay, John Wiley & Son, INC. (1998)

PROFESSIONAL COMMUNICATION SKILLS

Paper code-06BBT106:
SIXTH SEMESTER

UNIT1. Communication:Definition, Barriers in communications,implication of Communication,Purpose of communication. Elements:Preparation,structure and personnal interaction

UNIT-2. Oral Communication;Skill and Techniques of Speaking preparation of Speaking,Defelopment of speaking skills, barriers to speaking, speaking structure,bridging points,time limitation/Length of speech, Use of Humor.

UNIT-3. Visual Communication:Nature ans scope of visual aids, Bolds, slides,overhead projector,cutouts. Technical letter writing:Purpose of writing,space/layour,economy of words,use of verb/passive voice,typeface (italics,bold,underline) and use of Verb/passive voice, typeface (italics, bold, underline) and use of intentation.

UNIT-4. Report writing :Preparation, report structure (purpose of report, scope,shape presentation of report,introduction or report,bridging of report,style of report,and index of report.

UNIT-5. Public communication:meetings,planning and discussion,opening procedure,timing degree of formality,behavior,repetitive,interviews (complexity of situation, preparation of thinking, preparation of setting, opening of the interview,style of interview)
Note :Group discussion may be introduced to enhance oral communication and debates,speeches;addresses may be introduced for Public.

Reference

1. Business Communication by Prof.R.N.Jha and Pooja Mehra
2. Business Communication by Chaturvedi And Chaturvedi
3. Essentials of Communication by Rajendra Pal and J.S.Korhalli
4.

LABORATORY WORK

Genome Analysis –Lab

- Use of micropipettes and loading DNA gels.
- Isolation of DNA.
- Isolation of bacterial DNA.
- Quantitative estimation of DNA.
- Qualitative estimation of DNA.
- SDS-PAGE

Fermentation Technology and Downstream Processing

- Identification of industrially important microorganisms.
- Staining techniques for identification of industrial microorganisms
- Study factors affecting microbial growth.
- Methods of culture
- Investigating growth requirements
- Phases of cell growth in batch cultures,
- Simple unstructured kinetic models for microbial growth

Food Biotechnology –Lab

- Isolation of microorganisms responsible for food spoilage
- Preparation of culture media
- Biochemical testing for identification of industrial microorganisms
- Culturing of industrially important microorganisms
- Detection of microbial toxins in foodstuffs
- Testing of water supplies
- Testing of different foods
- Study of microorganisms used in food preparations.

Plant Biotechnology-Lab

- Preparation of culture media (a) broth type of media (b) Agar,
- Mechanism of drug resistance
- In vitro germination of seeds.
- Artificial seed production.
- Meristem culture.
- Micropropagation.

SEVENTH SEMESTER

ENVIRONMENTAL BIOTECHNOLOGY

Paper code-07BBT101
SEVENTH SEMESTER

UNIT-I:Role of Biotechnology in Environment Protection :
Environmental Biotechnology, Current Status of Biotechnology in Environment Protection, Future .Microbiology and Biochemistry of Waste Water Treatment :Biological Treatment,Impact of Pollutatnts on Biotreatment, Cell Physiology and Important Microorganisms, Plasmid Borne Metabolic Activities, Bioaugmentation, Packaged Microorganisms, Use of Genetically Engineered Organisms.

UNIT-II:Bioreactors for Waste Water Treatment :
Biological Processes for Industrial Effluent Treatment, Aerobic Biological Treatment, Anaerobic Biological Treatment,Periodic Biological Reactors, Membrane Bioreactors,Use of Immobilized Enzymes and Microbial Cells .

UNIT-III:Removal of Specific Pollutants :
Sources of Heavy Metal Pollution, Microbial Systems for Heavy Metal Accumulation, Biosorption, Bioleaching.Bioremediation :What is Bioremediation? Case Histories, Constraints and Priorities of Bioremediation, Bioaugmentation for Bioremediation, Bioreactors for Remediation Processes, Types of Bioremediation, Applications - Examples, Biotechnology and Oil Spills .

UNIT-IV:Biotechnology for Hazardous Waste Management :
Xenobiotic Compounds, Recalcitrance, Hazardous Wastes, Biodegradation of Xenobiotics, Biological Detoxification, Biotechnology Applications to Hazardous Waste Management, Examples of Biotechnological Applications to Hazardous Waste Management.

UNIT-V:Biotechnology for Waste Treatment of Food and Allied Industries :

Biological Treatment Methods, SCP and Biomass from Waste, Distillery Industry.Novel Methods for Pollution Control :Vermitechnology, Waste Water Treatment Using Aquatic Plants, Root Zone Treatment. Aiming for Biodegradable and Ecofriendly Products .

Reference

1. Environmental Biotechnology by Alan Scragg (1999); Longman.
2. An Introduction to Environmental Biotechnology by Milton Wainwright (1999): Kluwer Academic Press.
3.Biotechnology by B.D.Singh
4.Fundamentals of Biotechnology by R.C.Dubey

DATA BASE MANAGEMENT SYSTEM

Paper code-07BBT102
SEVENTH SEMESTER

UNIT – I:Basic Concepts and Conceptual Database Design Database administrator & Database Users, Characteristics of the Database, Database Systems, Concepts and Architecture, Data Models, Schemes & Instances, DBMS Architecture & Data Independence, Database Languages & Interfaces, Overview of Hierarchical, Network & Relational Data Base Management Systems, Data Modelling Using The Entity-Relationship Model – Entities, Attributes and Relationships, Cardinality of Relationships, Strong and Weak Entity Sets, Generalization, Specialization, and Aggregation, Translating your ER Model into Relational Model

UNIT – II:Relational Model, Languages & Systems: Relational Data Model & Relational Algebra, Relational Model Concepts, Relational Model Constraints, Relational Algebra, SQL – A Relational Database Language, Data Definition in SQL, View and Queries in SQL, Specifying Constraints and Indexes in SQL, Practicing SQL commands using ORACLE

UNIT – III:Relational Data Base Design and Oracle Architecture: Functional Dependencies & Normalization for Relational Databases, Functional Dependencies, Normal Forms Based on Primary Keys, (1NF, 2NF, 3NF & BCNF), Lossless Join and Dependency Preserving Decomposition, Oracle 8 Architecture, Database Storage, Oracle Software Structures, Shared Database Access Mechanism, Database Protection.

UNIT – IV:Transaction Management: Transaction Concept and State, Implementation of Atomicity
and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Concurrency Control Techniques, Lock-Based Protocols, Timestamp-based Protocols, Validation – based Protocols, Multiple Granularity, Multiversion Schemes,

UNIT-V:Deadlock : Deadlock Handling, Recovery System, Failure Classification, Storage Structure, Recovery and Atomicity, Log-based Recovery, Shadow Paging, Recovery with Concurrent Transactions, Buffer Management, Failure with Loss of Nonvolatile Storage, Advanced Recovery Techniques, Remote Backup Systems. Indexing, Hashing and Query Processing: Query Processing, Overview, Measures of Query Cost, Selection Operation, Sorting, Join Operation, Other Operations, Evaluation of Expressions, Concepts of Object

Oriented
Database Management Systems, Distributed Data Base Management Systems.

Reference

Raghu Rama Krishnan:Database Management systems,2nd ed:Tata Mc-Graw Hill
Elmasri-Fundamentals of Data Base systems pearson Educations.
Silverschatz Korth and sudarshan-Database systems Concepts,4th ed. Tata Mc-Graw Hill
Gordan c-Everest-Database Management Objectives Systems Functions and Administration Tata Mc-Graw Hill
Seema Kedar- Database Management systems.Technical Education Pune

BIOINFORMATICS

Paper code-07BBT103
SEVENTH SEMESTER

Unit I:- The Internet and Biologist: Internet basics, FTP, Gopher, World wide web, Introduction to Primary & Secondary databse, Format vs content, computer vs humans, GenBank Flat File dissection, GCG, ACDEB. Structure Databases: Introduction to structures, PDB, MMDB, Structure file formats, Visualizing structural information, Database structure viewers, Introduction to the NCBI database, SeqIDS, Bioseq: Sequences, Bioseqsets, Collections of sequences, Seq. Annot: Annotating the sequence, Seqdiscr: Describing the sequence.

Unit II:- Information Retrieval from Biological Databases & submission of DNA Sequences to the Databses: Retrieving database entries,
Integrated information retrieval: The entrez system, sequence databases beyond NCBI, Medical Databases; Where to submit nucleotide sequences, How to submit on the world wide web, How to submit with sequin.

Unit III:- Sequence Alignment and Database Searching: Introduction, Evolutionary basis of sequence alignment, Optimal alignment methods, Substitution scores & gap penalties, Statistical significance of alignments, Database similarity searching, FASTA, BLAST, Low complexity regions, Repetitive elements

Unit IV:- Multiple Sequence Alignment & Genome Mapping: Progressive alignment methods, Motifs and patterns, Hocks, MOST, Probe, Presentation methods, Abscript; Different types of maps: physical, genetical, etc. Synteny, Human
genome project, Application of genome mapping, Chromosome maps.

Unit V:- Predictive Methods Using Nucleotide & protein Sequences: Framework, marking repetitive DNA, Database search, Codon bias detection, Detecting function sites in the DM, Protein identity based on composition,
Physical properties based on sequences, secondary structure and folding
Classes.

Reference:

1. Bioinformatics: A practical guide to the analysis of genes and proteins A.D. Baxevanis and B.F.F. Ouellette (Eds). 2002 John Wiley and Sons.

2. Bioinformatics: Sequence and Genome Analysis by D.W. Mount, 2001, Cold Spring Harbor

PROTEIN ENGINEERING

Paper code-07BBT104:
SEVENTH SEMESTER

UNIT-1:Protein Structure: Introduction, Overview of protein structure, Higher level structure, Protein post-translational modification, Protein stability and folding.
Protein Sources: Introduction, Microorganisms as sources of proteins, Proteins from plants, Animal tissue as a protein source, Direct chemical synthesis, Conclusion.

UNIT-2:Protein Purification and Characterization: Introduction, Initial recovery of proteins Removal of whole cells and cell ebrisConcentration and primary purification, Column chromatography, Protein inactivation and stabilization, Protein characterization.
Large-Scale Protein Purification: Some general principles, Therapeutic protein production: some special issues, Range and medical significance of impurities potentially present in protein-based therapeutic products, Labelling and packing of finished products.

UNIT-3:Therapeutic Proteins: Introduction, Blood products, Haemophilia A and B, Anticoagulants, Thrombolytic agents, Additional blood-related products, Vaccine technology, Vaccines for AIDS.
Therapeutic Antibodies and Enzymes: Introduction, Antibodies for in vivo application, Therapeutic enzymes.

UNIT-4:Hormones and Growth Factors used Therapeutically: Introduction, Insulin, Glucagon, Gonadotrophins, Growth hormone, Erythropoietin, Other growth factors, Thyrotrophin, Corticotrophin, Prolactin, Peptide Regulatory Factors.
Interferons, Interleukins and Additional Regulatory Factors: Regulatory factors; cytokines versus hormones, Interferons, Interleukins, Tumour necrosis factors, Colonystimulating factors, Cytokine toxicity.

UNIT-5:Proteins Used for Analytical Purposes: Introduction, Enzymes as diagnostic/analytical reagents, Biosensors, Antibodies as analytical reagents.
Non-catalytic Industrial Proteins: Introduction, Functional properties of proteins, Milk and milk proteins, Animal and microbial proteins, Sweet and taste modifying proteins.

Reference

1. Proteins: Biochemistry and Biotechnology by Gary Walsh. (2002): John Wiley & Sons Ltd.
2. Fundamentals of Protein Biotechnology: Edited by Stanley Stein (1990): Marcel Dekker, Inc.
3. Introduction to Proteins Structure by Branden and Tooze (1998): Garland Publishing Group.
4. Biochemistry by Lehninger. McMillan publishers

MARKETING MANAGEMENT

Paper code-07BBT105:
SEVENTH SEMESTER

Unit I:-Marketing Concepts - Approaches to Marketing - Study Approaches and

Functional Approaches - Marketing Process - Functions of Marketing

Unit II:-. Marketing Planning - Nature, Process and Contents of Marketing Plan - The changing marketing environment - Analyzing needs and trends in Macro Environment, Economic Environment, Technical Environment, Political Environment and Sociocultural Environment

Unit III:-Sales Forecasting - Methods - Market Research - Scope, Obstacles in acceptance.Consumer Behaviour - Factors influencing buyer behaviour - Buyer decision process - Consumer Psychology - Industrial Buyer behaviour Vs. Domestic Buyer behaviour - Customer satisfactions Vs. Customer delight - Consumer value and satisfaction

Unit IV:-Dealing with competition - Identification and Analysis of Competitors Market segmentation - Bases for market segmentation of consumer goods, industrial goods and services - Market Targeting and positioning strategies .

Unit V:- Market Evaluation and Controls - Types, process, obstacles to marketing control - Marketing Audit - Marketing Ethics.

Reference

1. Principles of Marketing:kotler Philip
2. Fundamentals of Marketing :Stanton W.J.
3. 3.Marketing A Managerial Approach :Gandhi J.C
4. 4.Marketing Management by V.S.Ramaswami and S namakumari

STEM CELLS IN HEALTH CARE

Paper code-07BBT106:
SEVENTH SEMESTER

Units 1. Introduction: Stem Cell Biology, Fate Mapping of Stem Cells. Stem Cell Pattern: Differentiated Parental DNA Chain Causes Stem Cell Pattern of Celltype Switching in *Schizosaccharomyces pombe*

Units 2. On Equivalence Groups and the Notch/LIN-12 Communication System, Cell Cycle Control, Checkpoints, and Stem Cell Biology, Senescence of Dividing Somatic Cells

Units 3. The Drosophila Ovary: An In Vivo Stem Cell System. Male Germ-line Stem Cells

Units 4. Primordial Germ Cells as Stem Cells, Embryonic Stem Cells, Embryonal Carcinoma Cells as Embryonic Stem Cells, Trophoblast Stem Cells. Hematopoietic Stem Cells: Repopulating Patterns of Primitive Hematopoietic Stem Cells, Molecular Diversification and Developmental Interrelationships, Hematopoietic Stem Cells: Lymphopoiesis and the Problem of Commitment Versus Plasticity, Hemangioblast

Units 5. Mesenchymal Stem Cells of Human Adult Bone Marrow. Stem Cells and Neurogenesis. Epidermal Stem Cells: Liver Stem Cells, Pancreatic Stem Cells, Stem Cells in the Epithelium of the Small Intestine and Colon

Reference

1. Developmental Biology, 6th Edition, Scott F. Gilbert
2. Hematology, William J. Williams, Ernest Beutler, Allan JU. Erslev, Marshall A. Lichtman
3. Molecular Biology of the Cell, 3rd Edition, Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, James D. Watson
4. Stem Cell Biology by Marshak, 2001, Cold Spring Harbar Symposium Pulblication.

LABORATORY WORK

Environmental Biotechnology - Lab

- Detection of pH, colour, turbidity and odour
- Estimation of suspended solid, temperature and conductivity
- Measurement of BOD. COD, DO
- Carry out anaerobic treatment of a sample waste water
- Estimation of total nitrogen, total phosphate

Database Management System

- Implement select query.
- Implement select query with 'where' clause.
- Implement select query with aggregate function like sum, average, maximum etc.
- Implement create table query.
- Implement select query with join operation.
- Create a data base of college.

Bioinformatics Lab

- Sequencing polypeptide chain
- Sequencing DNA chain
- BLASTA
- FASTA

Protein Engineering -lab

- Kinetics of enzyme catalyzed reactions
- Techniques of enzyme immobilization
- Determinations of the specific activity of enzymes from yeast source
- Determination of the specific activity of enzymes from bacterial source

EIGHTH SEMESTER

INDUSTRIAL BIOTECHNOLOGY

Paper code=08BBT101:
EIGHTH SEMESTER

UNIT-1:Introduction, Objectives and Scope; Characteristic and comparison of bioprocessing with chemical processing.
Substrates for bioconversion processes and design of media

UNIT-2:Isolation, preservation and improvement of industrial microorganisms, Cell culture techniques and aseptic transfers
Metabolic basis for product formation. Production of secondary metabolites-penicillin, tetracycline etc

UNIT-3:Process technology for the production of cell biomass and some primary metabolites, e.g. ethanol, acetone-butanol, citric acid, dextran and amino acids.
Microbial production of industrial enzymes-glucose isomerase, cellulase & lipases.

UNIT-4:Applications of bioconversion, transformation of steroids and sterols. Transformation of non-steroidal compounds, antibiotics and pesticides.

UNIT-5:Bioenergy-fuel from biomass, production and economics of biofuels. . Metal recovery and microbial desulfurization of coal.

Reference :

1. Biotechnology: A Text Book of Industrial Microbiology: T.D. Brock, Smaeur Associates, 1990.
2. Industrial Microbiology: L.E. Casida, Willey Eastern Ltd., 1989.
3. Biotechnology, Economic & Social Aspects: E.J. Dasilva, C Rutledge & A Sasson, Cambridge Univ. Press, Cambridge.
4. Biotechnology - a handbook of industrial microbiology: W. Crueger and A. Crueger.
5. Microbial Biotechnology: Channarayaappa, University press, Hyderabd, 2003

INTELLECTUAL PROPERTY RIGHTS IN BOTECHNOLOGY

Paper code-08BBT102:
EIGHTH SEMESTER

Units 1. WTO: As an international agency controlling trade among nations. WTO with refernce to biotechnological affairs, TRIPs. General Introduction: Patent claims, the legal decision – making process, ownership of tangible and intellectual property.

Units 2. Basic Requirements of Patentability Patentable subject matter, novelty and the public domain, non obviousness. Special issues in Biotechnology Patents Disclosure requirements, Collaborative research, Competitive research, plant

Units 3. Plant biotechnology Indian patents and Foreign patents, Plant variety protection act, The strategy of protecting plants.

Units 4. Patent Litigation Substatritive aspects of patent litigation, Procedural aspects of patent litigation, different Doctrines. Recent Developments in Patent System and Patentability of biotechnological inventions.

Units 5 IPR issues in Indian Context Role of patent in pharmaceutical industry, computer related innovations. Case studies Rice, Haldi, neem, etc. and challenges ahead

Reference:

1. The law and strategy of Biotechnological patents by Sibley. Butterworth publications.
2. Intellecutla property rights – Ganguli – Tat McGrawhill
3. Intellectual property right – Wattal – Oxford Publishing House.

BIOSAFETY & BIOETHICS

Paper code-08BBT103:
EIGHT SEMESTER

UNIT-1:Biotechnology and Society: Introduction to science, technology and society, biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs. private funding, biotechnology in international relations, globalisation and development divide.

UNIT-2:Bioethics: Legality, morality and ethics, the principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc.
Biotechnology and Bioethics: The expanding scope of ethics from biomedical practice to biotechnology, ethical conflicts in biotechnology - interference with nature, fear of unknown, unequal distribution of risks and benefits of biotechnology, bioethics vs. business ethics, ethical dimensions of IPR, technology transfer and other global biotech issues.

UNIT-3:Biosafety concepts and issues: Rational vs. subjective perceptions of risks and benefits, relationship between risk, hazard, exposure and safeguards, biotechnology and biosafety concerns at the level of individuals, institutions, society, region, country and the world.
Biosafety in the laboratory institution: Laboratory associated infections and other hazards, assessment of biological hazards and levels of biosafety, prudent biosafety practices in the laboratory/ institution
Biosafety regulations in the handling of recombinant DNA processes and products in institutions and industries, biosafety assessment procedures in India and abroad

UNIT-4:Biotechnology and food safety: The GM-food debate and biosafety assessment procedures for biotech foods & related products, including transgenic food crops, case studies of relevance.
Ecological safety assessment of recombinant organisms and transgenic crops, case studies of relevance (Eg. Bt cotton).

UNIT-5:Biosafety assessment of biotech pharmaceutical products such as drugs/vaccines etc.
International dimensions in biosafety: Catagena protocol on biosafety, bioterrorism and convention on biological weapons

Reference:

1. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and Safety Assessment (3rd Ed).Academic Press.
2. Fleming, D.A., Hunt, D.L., (2000). Biological safety Principles and practices (3rd Ed). ASM Press, Washington.
3. Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH.
4. Encyclopedia of Bioethics

MOLECULAR AND CELLULAR DIAGNOSTICS

Paper code-08BBT104 :
EIGHTH SEMESTER

Units 1. General Clinical Laboratory Techniques & Procedure: Chemical & Related substrates, volumetric analysis, Balancing & Weighing, Concept of solute & solvent, Units of measurement Specimen Collection & Processing: Specimen collection (Blood, urine, spinal fluid, saliva synovial fluid, Amniotic fluid), Preservation, transportation

Units 2. Selection & Interpretation of Lab. Procedure: Classification of BIAS, Sensitivity and specificity, Receiver Operator Characteristics, Interpretation a test. Quality Management: Fundamentals of total quality management, Element of QAP, External quality assessment and proficiency testing programme.

Units 3 Clinical Enzymology: Principle of diagnostic enzymology, Liver, cardiac and skeletal enzyme, Digestive enzyme, Miscellaneous enzyme. General Function Tests: Liver function test, Cardiac Function Test, Renal Function Test, Thyroid Function test, Reproductive endocrime function test

Units 4. Immunodiagnostics: Introduction, Antigen-Antibody Reactions, Conjugation Techniques, Antibody Production, Enzymes and Signal Amplification Systems, Separation and Solid-Phase Systems, Case studies related to bacterial, viral and parasitic infections. Product Development: Immunoassay Classification and Commercial Technologies, Assay Development, Evaluation, and Validation, Reagent Formulations and Shelf Life Evaluation, Data Analysis, Documentation, Registration, and Diagnostics Start-Ups.

Units 5. DNA based diagnostics: PCR, RFLP, SSCP, Microarrays, FISH, In-situ hybridization, Case studies related to bacterial, viral and parasitic infections. Cell based diagnostics: Antibody markers, CD Markers, FACS, HLA typing, Bioassays. Biosensors: Concepts and applications, Biosensors for personal diabetes management, Noninvasive Biosensors in Clinical Analysis, Introduction to Biochips and their application in modern Sciences, Introduction to Nanotechnology.

Text / Reference Books:

1. Tietz Textbook of Clinical Chemistry, Carl A. Burtis, Edward R. Ashwood, Harcourt Brace & Company Aisa Pvt. Ltd.

2. Commercial Biosensors: Graham Ramsay, John Wiley & Son, INC. (1998).
3. Essentials of Diagnostic Microbiology, Lisa Anne Shimeld.
4. Diagnostic Microbiology, Balley & Scott's.
5. Tietz Text book of Clinical Biochemistry, Burtis & Ashwood.
6. The Science of Laboratory Diagnosis, Crocker Burnett.

LABORATORY WORK

Industrial Biotechnology

- Batch and Fed Batch fermentation
- Antibiotic production
- Carry out batch scale production of single cell protein
- Preparation of medium for fermentation
- Purification of a fermentation product by Chromatography
- Production of alcohol from molasses.
- Production of enzyme (amylase)
- Production of organic acid (citric acid).

Molecular and Cellular Diagnostics

- DNA electrophoresis
- SDS-PAGE
- Estimation of protein
- Estimation of carbohydrate
- Chromatography

Biosafety and Bioethics

- Instumentation
- Centrifugation
- Biosafety measures during lab handling

FIFTH SEMESTER EXAMINATION

SUB. CODE	PAPER	TEACHING PERIOD		
	THEORY	L	T	P
05BBT101	Recombinant DNA Technology	3	1	0
05BBT102	Object Oriented Programming Using C++	3	1	0
05BBT103	Plant Tissue Culture	3	1	0
05BBT104	Animal Biotechnology	3	1	0
05BBT105	Developmental Biology	3	1	0

05BBT106	Analytical Techniques in Biotechnology	**3**	**1**	**0**
LABORATORY				
05BBT201	Rec. DNA Tech. & Appl. Lab	**0**	**0**	**1**
05BBT202	Object Oriented Programming Using C++ Lab	**0**	**0**	**1**
05BBT203	Plant tissue Culture -Lab	**0**	**0**	**1**
05BBT204	Animal tissue Culture -Lab	**0**	**0**	**1**
05BBT301	Discipline &Extra Curricular activities	**0**	**0**	**1**
	Total	**18**	**6**	**5**
	Grand Total	**29**		

SIXTH SEMESTER EXAMINATION

SUB. CODE	PAPER	TEACHING PERIOD		
THEORY		**L**	**T**	**P**
06BBT101	Genome Analysis	**3**	**1**	**0**
06BBT102	Fermentation Technology and Downstream Processing	**3**	**1**	**0**
06BBT103	Food Biotechnology	**3**	**1**	**0**
06BBT104	Professional Communication Skills	**3**	**1**	**0**
06BBT105	Biosensor	**3**	**1**	**0**

06BBT106		**3**	**1**	**0**
LABORATORY				
06BBT201	Genome Analysis –Lab	**0**	**0**	**1**
06BBT202	Food Biotechnology –Lab	**0**	**0**	**1**
06BBT203	–Lab	**0**	**0**	**1**
06BBT204	Fermentation Technology and Downstream Processing	**0**	**0**	**1**
06BBT31	Discipline &Extra Curricular activities	**0**	**0**	**1**
	Total	**18**	**6**	**5**
	Grand Total	**29**		

SEVENTH SEMESTER EXAMINATION

SUB. CODE	PAPER	TEACHING PERIOD		
THEORY		**L**	**T**	**P**
07BBT101	Plant Biotechnology	**3**	**1**	**0**
07BBT102	Database Management System	**3**	**1**	**0**

07BBT103	Bioinformatics	**3**	**1**	**0**
07BBT104	Marketing Management	**3**	**1**	**0**
07BBT105	Protein Engineering	**3**	**1**	**0**
07BBT106	Stem Cells in Health Care	**3**	**1**	**0**
LABORATORY				
07BBT201	Stem Cells in Health Care -Lab	**0**	**0**	**1**
07BBT202	Plant Biotechnology - Lab	**0**	**0**	**1**
07BBT203	Database Management System	**0**	**0**	**1**
07BBT204	Bioinformatics Lab	**0**	**0**	**1**
07BBT301	Discipline &Extra Curricular activities	**0**	**0**	**1**
	Total	**18**	**6**	**5**
	Grand Total	**29**		

EIGHTH SEMESTER EXAMINATION

SUB. CODE	PAPER	TEACHING PERIOD		
THEORY		**L**	**T**	**P**

08BBT101	Industrial Biotechnology			
08BBT102	Intellectual Property Rights in Biotechnology			
08BBT103	Molecular & Cellular Diagnostics			
08BBT104	Biosafety & Bioethics			
Project Work	**Project Work**			
Seminar				
08BBT201	Industrial Biotechnology			
08BBT202	Molecular and Cellular Diagnostics			
08BBT203	Biosafety and Bioethics			
08BBT301	Discipline &Extra Curricular activities			
	Total			
	Grand Total			

FIFTH SEMESTER

05BBT101: RECOMBINANT DNA TECHNOLOGY

UNIT-1:Introduction to gene cloning, tools and enzymes used in gene manipulation:-Restriction enzymes DNA ligases DNA Polymerase Reverse Trascriptase Polynucleotide kinase,End labeling and other process used in rDNA technology.

UNIT-2:Major cloning vehicle and their application-Plasmid vectors, cosmid, Phagemid, phage vector,YAC,BAC,Ti plasmids,expression vector, shuttle vectors binary vectors,

Transposons

UNIT-3:Making of genomic and cDNA libraries, their screening and major application

UNIT-4:Production of transgenic microbes and their application in Biotechnology

UNIT-5:Production of transgenic Animals and their application in Biotechnology
Production of transgenic Plants and their application in Biotechnology.

05BBT102: OBJECT ORIENTED PROGRAMMING USING C++

An overview of object Oriented Programming:Rationale for object programming,procedural vs.objected oriented approach;advantages of OOP; Characteristics of object oriented languages -objects, classes,inheritance, active data,message passing.

UNIT-1: Object Oriented Programming Tools and C++:An overview of C++ programming,simple program construction,functions,statements, inputs/outputs. Variables and manipulators, data types. Library functions.
Functions :function declaration, calling, passing arguments to functions and returning values from functions,reference arguments,overloaded functions, variable and storage classes.

UNIT-2: Objects and Classes :classes and objects, C++ objects and memory. Arrays:definition, multidimensional arrays, passing arrays to functions, arrays of structures.arrays as class members data,arrays of objects,arrays of strings.

UNIT-3: Operator overloading: Overloading unary,binary and arithmetic operators,adding polar coordinates.concatening strings.multiple overloading,pitfalls of operator overloading and conversation.

UNIT-4: Inheritance:derived class and base class, overriding memory functions, class hierarchy,public and private inheritance,multiple inheritance. Pointers:Addresses and pointers,pointer and arrays, pointer and functions use of pointers in strings, linked lists and memory management.

UNIT-5: Files and Streams:Streams,strings and objects I/O, I/O with multiple objects,file operations using pointers. Applications: Object oriented programming in simulation and artificial intelligence,Programming environments.

05BBT103: PLANT TISSUE CULTURE

UNIT-1:History: Important events in the history of plant tissue culture.
Laboratory Requirements and General Techniques: Introduction, requirements, techniques.

UNIT-2:Cellular Totepotency: Introduction, cyto-differentiation, orgemogenic differentiation, loss of morphogenic potential in long-term cultures, practical applications of cellular totipotency
Tissue Culture Media: Introduction, media constituents, media selection, media preparation
Cell and Suspension Culture: Introduction, isolation of single cells, suspension cultures, culture of single cells, plant cell reactors, applications of cell culture.
Proloplast Culture: Proloplast isolation, culture and regeneration.

UNIT-3:Somatic Embryogenesis: Introduction, some examples of formatic embryogenesis, factors affecting somatic embryogenesis, induction and development, maturation
Haploid Production: Introduction, techniques, factor affecting androgenesis, ontogeny of androgenic haploids, plant regeneration from pollen embryos, gynogeresis, haploid production through disport hybridization idiptridization to raise homozygous diploids,applications, limitations.
Triploid Production: Introduction, callusing, histology and cytology of cells, organogenesis, applications of endosperm culture.

UNIT-4:Embryo Culture: Introduction, techniques, culture requirements role of the suspensor in embryo culture, precocious germination, morphogenesis in the culture of seeds with partially differentiated embryos, micronugical experiments, embryo and seed culture of parasitic angiosperms, morphogenic potential of the embryo callus, practial applications.
In-vitro pollination and fertilization: Introduction, terminology, in vitro pollination, in vitro fertilization, applications.
Micropropagation: Introduction, techniques, applications, production of pathogen free plants

UNIT-5:Production of secondary metabolites: Introduction, strategies used to optimize product yield, commercial aspects
Germplasm Storage: Introduction, long-term storages, short or medium term storage

05BBT104: ANIMAL BIOTECHNOLOGY

UNIT-1:Introduction to Animal Tissue Culture: Background, Advantages, Limitations,Application, Culture Environment, Cell Adhesion, Cell Proliferation, Differentiation.
Design, Layout and Equipment: Planning, Construction, Layout, EssentialEquipments, Aseptic Technique, Objectives, Elements, Sterile Handling, Safety, RiskAssessment, General Safety, Fire, Radiation, Biohazards

UNIT-2:Media: Physicochemical Properties, Balanced Salt Solutions, Complete Media, Serum,Serum-Free Media, Disadvantages of Serum, Advantages of Serum-Free media
Primary Culture: Isolation of Tissue, Steps involved in primary cell culture, Cell Lines,Nomenclature, Subculture and Propagation, Immortalization of cell lines, Cell linedesignations, Routine maintenance

UNIT-3:Characterization & Quantitation of Cell Line: Need for characterization, Morphology,Chromosome Analysis, DNA Content, RNA and Protein, Enzyme Activity, AntigenicMarkers, Transformation, Immortalization, Aberrant Growth Control, Tumorigenicity, Cell
counting, DNA content, Protein, Rates of Synthesis, Cell Proliferation, Plating Efficiency,Labeling Index, Generation Time.

UNIT-4;Contamination: Source of contamination, Type of microbial contamination, Monitoring,Eradication of Contamination, Cross-Contamination
Cryopreservation: Need of Cryopreservation, Preservation, Cell banks, Transportingcells
Cytotoxicity: Introduction, In vitro limitations, Nature of assay, Viability assay, Survivalassay, Microtitration assay, Transformation assay

UNIT-5:Transgenic Animals: Methodology, Embryonic Stem Cell method, Microinjectionmethod, Retroviral vector method, Applications of transgenic animals
Gene Therapy: Ex-vivo gene therapy, In vivo gene therapy, Viral gene delivery system,Retrovirus vector system, Adenovirus vector system, Adeno-Associated virus vectorsystem, Herpex simplex virus vector system, Non-viral gene delivery system, Prodrugactivation therapy, Nucleic acid therapeutic agents
In Vitro Fertilization and Embryo Transfer: Composition of IVF media, Steps involvedin IVF, Fertilization by means of micro insemination, PZD, ICSI, SUZI, MESA

05BBT105: DEVELOPMENTAL BIOLOGY

Unit I:Basic concepts- Cell fate and commitment, its mechanism, mosaic and regulative development, maintenance of differentiation, pattern formation and compartments, Apoptosis, Senescence and Ageing
.
Unit II:Morphogenesis- model organism, developmental mutantsnts, Transgenic organism in development, cellular and microsurgical techniques, Genes and their role in development, signal transduction in development cell division cycle,cytoskeleton.cell adhesion and the extra cellular matrix.

Unit III:Unicellular models sporulation in Bacillus subtilis- Mating type switching in yeast aggregation and culmination in dicyostelium discordeum, Sex gametes and fertilizationgerm line speciation, germ cell migration,gametogenesis,gastrulation in invertebrate and vertebrate, cell lineage, Axis specification in vertebrates, fate of ectoderm, measoderm and endoderm.

Unit IV:Cell differentiation mechanism and factors affecting it- Developmental gradients in hydra, axial gradients in Drosophila development, Organogenesis in invertebrates and vertebrates, plant development, plant versus animal development, development of plant embryo, development of seeding, root, shoot, leaf and flower.

05BBT106: ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY

Unit I:Microscopy- Microscopic identification of various microorganisms; phase contrast and confocal microscopy; SEM-TEM microscopy.

Unit II:Electrophoretic Techniques- Basis and principle of Electrophoresis; Electrophoresis of proteins and nucleic acids; 1D & 2D Gels; pulsed field electrophoresis; capillary electrophoresis; western southern and northern blotting; dot and slot, gel documentation.

Unit III:Methods of biochemical analysis- Carbohydrates, lipids, proteins and nucleotides analysis; enzymatic assays of various metabolites; DNA purification and PCR-based analysis; DNA fingerprinting; DNA sequencing.

Unit IV:Immunological Techniques- Antiserum production, immunofluroscence, immuno histocompatibility ELISA; localization of cells in tissues immunoblotting; monoclonal antibodies.

Unit V:Spectroscopy- UV-Visible spectroscopy, infrared-spectroscopy, NMR & Mass spectroscopy; Principle and application.
Chromatography- Partition chromatography, Adsorption chromatography, Affinity chromatography (principle and application in biotechnology).

LABORATORY WORK

- instruments demo
- Preparation of Standard solutions with given molarity
- Preparation of Standard solutions with given molality.
- Preparation of Standard solutions with given normality.
- Calibration of pH meter.
- To measure the pH of different solutions (acid and base)

- Preparation of buffer solutions of different pH
- various Centrifuges.
- Performing experiments to detect the pH of solutions using various pH meters.
- Studying of Lambert's and Beer's law.
- Staining techniques for identification of microorganisms
- Culturing of Microorganisms in broth
- bacterial culture
- Preparation of culture media (a) broth type of media (b) Agar,
- Mechanism of drug resistance
- In vitro germination of seeds.
- Artificial seed production.
- Meristem culture.
- Micropropagation.

SIXTH SEMESTER

06BBT101: GENOME ANALYSIS

UNIT-1. Basic structure of prokaryotic and eukaryotic genome. Human genome project and its application to future of mankind.

UNIT-2.Chromation model, concept of gene, linkage and crossing over, linkage analysis in drosophila and neurospora.

UNIT-3.Pedigree analysis in human.Genetic mapping and its tools,genetic mapping of complex character.

UNIT-4.Multigene families in human genome and repetitive DNA C-Value paradox and complexity of genome

UNIT-5 Physical mapping of genome-chromosome walking,chromosome painting,FISH, GISH,zoo biot. Dot blot, VNTR, RFLP, RAPD, RACE, SNPs, QtLs, EST, CpG island indentification.exon trapping and sequence analysis.

06BBT102: FERMENTATION TECHNOLOGY AND DOWNSTREAM PROCESSING

UNIT-1. An introduction fermentation technology-basic microbial growth kinetics,Isolation,preservation and improvement of industrially important microorganism Sterlization process, media for industrial fermentation,development of inocula for Industrial fermentations.

UNIT-2. Designing of a fermentor,operation and application.Instrumentation and Control, fermentation kinetics, optimization of fermentation process by Quantitative analysis. Aeration and agitation.

UNIT3. Product recovery operations :-filteration, solvent extraction, adsorption-desorption process. Salt precipitation,Recovery of

UNIT-4. Memberane based seperation process :-Reverse osmosis, ultra filtration.Micro filtration,pervaporatio.memberane modules,flux expression,conceteration polarization. membrane characterization methods.

UNIT-5. Downstream processing Recovery and purification of fermentation products,Effluent treatment.

06BBT103: FOOD BIOTECHNOLOGY

UNIT1. Micro-organisms associated with food, factors affecting growth of microorganisms in food, food spoilage.

UNIT-2. Fermented Foods-Fermentation processes for manufacture of fermented food and food products-alcohlic beverages and other products,fermented milk products,pickles.

UNIT-3. Protein foods and nutraceuticals:SCP,mushroom,food yeasts,algal proteins nutraceuticals from plant parts (flavonoids,caraotenoids,phytosterol) and their applications, curative foods and transgenic plant foods.Bioprotection and biopresevation.

UNIT-4. Enzymes in food: Mechanisms of enzyme functions and reactions in process techniques-starch and sugar convertion process,banking by amylases,deogenation and desugaring by glucose oxidase,cheese making by proteases.beer mashing and chill proofing.

UNIT-5. Process waste:Bioconvertion of whey,molasses,starch substrates and other food wasters to useful products.

06BBT104: PROFESSIONAL COMMUNICATION SKILLS

UNIT1. Communication:Definition, Barriers in communications,implication of Communication,Purpose of communication. Elements:Preparation,structure and personnal interaction

UNIT-2. Oral Communication;Skill and Techniques of Speaking preparation of Speaking,Defelopment of speaking skills, barriers to speaking, speaking structure,bridging points,time limitation/Length of speech, Use of Humor.

UNIT-3. Visual Communication:Nature ans scope of visual aids, Bolds, slides,overhead projector,cutouts. Technical letter writing:Purpose of writing,space/layour,economy of words,use of verb/passive voice,typeface (italics,bold,underline) and use of Verb/passive voice, typeface (italics, bold, underline) and use of intentation.

UNIT-4. Report writing :Preparation, report structure (purpose of report, scope,shape presentation of report,introduction or report,bridging of report,style of report,and index of report.

UNIT-5. Public communication:meetings,planning and discussion,opening procedure,timing degree of formality,behavior,repetitive,interviews (complexity of situation, preparation of thinking, preparation of setting, opening of the interview,style of interview)
Note :Group discussion may be introduced to enhance oral communication and debates,speeches;addresses may be introduced for Public.

06BBT105: BIOSENSORS

UNIT-1:Introduction to Biosensors: Concepts and applications.

UNIT-2:Biosensors for personal diabetes management.
Microfabricated Sensors and the Commercial Development of the I- stat Point-of-Care system.

UNIT-3:Noninvasive Biosensors in Clinical Analysis.
Surface Plasmon Resonance.

UINT-4:Biosensors based on Evanescent Waves.

UNIT-5:Applications of Biosensor-based instruments to the bioprocess industry.
Application of Biosensors to environmental samples.
Introduction to Biochips and their application in modern sciences.

LABORATORY WORK

- Isolation of microorganisms responsible for food spoilage
- Preparation of culture media
- culture
- Identification of industrially important microorganisms.
- Staining techniques for identification of industrial microorganisms
- Biochemical testing for identification of industrial microorganisms
- Culturing of industrially important microorganisms
- Detection of microbial toxins in foodstuffs
- Testing of water supplies
- Testing of different foods
- Study of microorganisms used in food preparations.
- Study factors affecting microbial growth.
- Methods of culture
- Investigating growth requirements
- Phases of cell growth in batch cultures,
- Simple unstructured kinetic models for microbial growth,

SEVENTH SEMESTER

07BBT101: PLANT BIOTECHNOLOGY

UNIT-I:Role of Biotechnology in Environment Protection :
Environmental Biotechnology, Current Status of Biotechnology in Environment Protection, Future .Microbiology and Biochemistry of Waste Water Treatment :Biological Treatment,Impact of Pollutatnts on Biotreatment, Cell Physiology and Important Microorganisms, Plasmid Borne Metabolic Activities, Bioaugmentation, Packaged Microorganisms, Use of Genetically Engineered Organisms.

UNIT-II:Bioreactors for Waste Water Treatment :
Biological Processes for Industrial Effluent Treatment, Aerobic Biological Treatment, Anaerobic Biological Treatment,Periodic Biological Reactors, Membrane Bioreactors,Use of Immobilized Enzymes and Microbial Cells .

UNIT-III:Removal of Specific Pollutants :
Sources of Heavy Metal Pollution, Microbial Systems for Heavy Metal Accumulation, Biosorption, Bioleaching.Bioremediation :What is Bioremediation? Case Histories, Constraints and Priorities of Bioremediation, Bioaugmentation for Bioremediation, Bioreactors for Remediation Processes, Types of Bioremediation, Applications - Examples, Biotechnology and Oil Spills .

UNIT-IV:Biotechnology for Hazardous Waste Management :
Xenobiotic Compounds, Recalcitrance, Hazardous Wastes, Biodegradation of Xenobiotics, Biological Detoxification, Biotechnology Applications to Hazardous Waste Management, Examples of Biotechnological Applications to Hazardous Waste Management.

UNIT-V:Biotechnology for Waste Treatment of Food and Allied Industries :
Biological Treatment Methods, SCP and Biomass from Waste, Distillery Industry.Novel Methods for Pollution Control :Vermitechnology, Waste Water Treatment Using Aquatic Plants, Root Zone Treatment. Aiming for Biodegradable and Ecofriendly Products .

07BBT102: DATA BASE MANAGEMENT SYSTEM

UNIT – I:Basic Concepts and Conceptual Database Design Database administrator & Database Users, Characteristics of the Database, Database Systems, Concepts and Architecture, Data Models, Schemes & Instances, DBMS Architecture & Data Independence, Database Languages & Interfaces, Overview of Hierarchical, Network & Relational Data Base Management Systems, Data Modelling Using The Entity-Relationship Model – Entities, Attributes and Relationships, Cardinality of Relationships, Strong and Weak Entity Sets, Generalization, Specialization, and Aggregation, Translating your ER Model into Relational Model

UNIT – II:Relational Model, Languages & Systems: Relational Data Model & Relational Algebra, Relational Model Concepts, Relational Model Constraints, Relational Algebra, SQL – A Relational Database Language, Data Definition in SQL, View and Queries in SQL, Specifying Constraints and Indexes in SQL, Practicing SQL commands using ORACLE

UNIT – III:Relational Data Base Design and Oracle Architecture: Functional Dependencies & Normalization for Relational Databases, Functional Dependencies, Normal Forms Based on Primary Keys, (1NF, 2NF, 3NF & BCNF), Lossless Join and Dependency Preserving Decomposition, Oracle 8 Architecture, Database Storage, Oracle Software Structures, Shared Database Access Mechanism, Database Protection.

UNIT – IV:Transaction Management: Transaction Concept and State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Concurrency Control Techniques, Lock-Based Protocols, Timestamp-based Protocols, Validation – based Protocols, Multiple Granularity, Multiversion Schemes,

UNIT-V:Deadlock : Deadlock Handling, Recovery System, Failure Classification, Storage Structure, Recovery and Atomicity, Log-based Recovery, Shadow Paging, Recovery with Concurrent Transactions, Buffer Management, Failure with Loss of Nonvolatile Storage, Advanced Recovery Techniques, Remote Backup Systems. Indexing, Hashing and Query Processing: Query Processing, Overview, Measures of Query Cost, Selection Operation, Sorting, Join Operation, Other Operations, Evaluation of Expressions, Concepts of Object Oriented
Database Management Systems, Distributed Data Base Management Systems.

07BBT103: BIOINFORMATICS

Unit I:- The Internet and Biologist: Internet basics, FTP, Gopher, World wide web, Introduction to Primary & Secondary databse, Format vs content, computer vs humans, GenBank Flat File dissection, GCG, ACDEB. Structure Databases: Introduction to structures, PDB, MMDB, Structure file formats, Visualizing structural information, Database structure viewers, Introduction to the NCBI database, SeqIDS, Bioseq: Sequences, Bioseqsets, Collections of sequences, Seq. Annot: Annotating the sequence, Seqdiscr: Describing the sequence.

Unit II:- Information Retrieval from Biological Databases & submission of DNA Sequences to the Databses: Retrieving database entries,
Integrated information retrieval: The entrez system, sequence databases beyond NCBI, Medical Databases; Where to submit nucleotide sequences, How to submit on the world wide web, How to submit with sequin.

Unit III:- Sequence Alignment and Database Searching: Introduction, Evolutionary basis of sequence alignment, Optimal alignment methods, Substitution scores & gap penalties, Statistical significance of alignments, Database similarity searching, FASTA, BLAST, Low complexity regions, Repetitive elements

Unit IV:- Multiple Sequence Alignment & Genome Mapping: Progressive alignment methods, Motifs and patterns, Hocks, MOST, Probe, Presentation methods, Abscript; Different types of maps: physical, genetical, etc. Synteny, Human
genome project, Application of genome mapping, Chromosome maps.

Unit V:- Predictive Methods Using Nucleotide & protein Sequences: Framework, marking repetitive DNA, Database search, Codon bias detection, Detecting function sites in the DM, Protein identity based on composition,
Physical properties based on sequences, secondary structure and folding
Classes.

07BBT104: MARKETING MANAGEMENT

Unit I:-Marketing Concepts - Approaches to Marketing - Study Approaches and Functional Approaches - Marketing Process - Functions of Marketing

Unit II:-. Marketing Planning - Nature, Process and Contents of Marketing Plan - The changing marketing environment - Analyzing needs and trends in Macro Environment, Economic Environment, Technical Environment, Political Environment and Sociocultural Environment

Unit III:-Sales Forecasting - Methods - Market Research - Scope, Obstacles in acceptance.Consumer Behaviour - Factors influencing buyer behaviour - Buyer decision process - Consumer Psychology - Industrial Buyer behaviour Vs. Domestic Buyer behaviour - Customer satisfactions Vs. Customer delight - Consumer value and satisfaction

Unit IV:-Dealing with competition - Identification and Analysis of Competitors Market segmentation - Bases for market segmentation of consumer goods, industrial goods and services - Market Targeting and positioning strategies .

Unit V:- Market Evaluation and Controls - Types, process, obstacles to marketing control - Marketing Audit - Marketing Ethics.

07BBT105: PROTEIN ENGINEERING

UNIT-1:Protein Structure: Introduction, Overview of protein structure, Higher level structure, Protein post-translational modification, Protein stability and folding.
Protein Sources: Introduction, Microorganisms as sources of proteins, Proteins from plants, Animal tissue as a protein source, Direct chemical synthesis, Conclusion.

UNIT-2:Protein Purification and Characterization: Introduction, Initial recovery of proteins Removal of whole cells and cell ebrisConcentration and primary purification, Column chromatography, Protein inactivation and stabilization, Protein characterization.
Large-Scale Protein Purification: Some general principles, Therapeutic protein production: some special issues, Range and medical significance of impurities potentially present in protein-based therapeutic products, Labelling and packing of finished products.

UNIT-3:Therapeutic Proteins: Introduction, Blood products, Haemophilia A and B, Anticoagulants, Thrombolytic agents, Additional blood-related products, Vaccine technology, Vaccines for AIDS.
Therapeutic Antibodies and Enzymes: Introduction, Antibodies for in vivo application, Therapeutic enzymes.

UNIT-4:Hormones and Growth Factors used Therapeutically: Introduction, Insulin, Glucagon, Gonadotrophins, Growth hormone, Erythropoietin, Other growth factors, Thyrotrophin, Corticotrophin, Prolactin, Peptide Regulatory Factors.
Interferons, Interleukins and Additional Regulatory Factors: Regulatory factors; cytokines versus hormones, Interferons, Interleukins, Tumour necrosis factors, Colonystimulating factors, Cytokine toxicity.

UNIT-5:Proteins Used for Analytical Purposes: Introduction, Enzymes as diagnostic/analytical reagents, Biosensors, Antibodies as analytical reagents.
Non-catalytic Industrial Proteins: Introduction, Functional properties of proteins, Milk and milk proteins, Animal and microbial proteins, Sweet and taste modifying proteins.

07BBT106: STEM CELLS IN HEALTH CARE

1. Introduction: Stem Cell Biology, Fate Mapping of Stem Cells

2. Stem Cell Pattern: Differentiated Parental DNA Chain Causes Stem Cell Pattern of Celltype Switching in *Schizosaccharomyces pombe*

3. On Equivalence Groups and the Notch/LIN-12 Communication System,

4. Cell Cycle Control, Checkpoints, and Stem Cell Biology, Senescence of Dividing Somatic Cells

5. The Drosophila Ovary: An In Vivo Stem Cell System

6. Male Germ-line Stem Cells
7. Primordial Germ Cells as Stem Cells, Embryonic Stem Cells, Embryonal Carcinoma Cells as Embryonic Stem Cells, Trophoblast Stem Cells

8. Hematopoietic Stem Cells: Repopulating Patterns of Primitive Hematopoietic Stem Cells, Molecular Diversification and Developmental Interrelationships, Hematopoietic Stem Cells: Lymphopoiesis and the Problem of Commitment Versus Plasticity, Hemangioblast

9. Mesenchymal Stem Cells of Human Adult Bone Marrow

10. Stem Cells and Neurogenesis

11. Epidermal Stem Cells: Liver Stem Cells, Pancreatic Stem Cells, Stem Cells in the Epithelium of the Small Intestine and Colon

LABORATORY WORK

- Kinetics of enzyme catalyzed reactions
- Techniques of enzyme immobilization
- Determinations of the specific activity of enzymes from yeast source
- Determination of the specific activity of enzymes from bacterial source
- Detection of pH, colour, turbidity and odour
- Estimation of suspended solid, temperature and conductivity
- Measurement of BOD. COD, DO
- Carry out anaerobic treatment of a sample waste water
- Estimation of total nitrogen, total phosphate

EIGHTH SEMESTER

08BBT101: INDUSTRIAL BIOTECHNOLOGY

UNIT-1:Introduction, Objectives and Scope; Characteristic and comparison of bioprocessing with chemical processing.
Substrates for bioconversion processes and design of media

UNIT-2:Isolation, preservation and improvement of industrial microorganisms, Cell culture techniques and aseptic transfers
Metabolic basis for product formation. Production of secondary metabolites-penicillin, tetracycline etc

UNIT-3:Process technology for the production of cell biomass and some primary metabolites, e.g. ethanol, acetone-butanol, citric acid, dextran and amino acids.
Microbial production of industrial enzymes-glucose isomerase, cellulase & lipases.

UNIT-4:Applications of bioconversion, transformation of steroids and sterols. Transformation of non-steroidal compounds, antibiotics and pesticides.

UNIT-5:Bioenergy-fuel from biomass, production and economics of biofuels. . Metal recovery and microbial desulfurization of coal.

08BBT102: INTELLECTUAL PROPERTY RIGHTS IN BOTECHNOLOGY

1. WTO: As an international agency controlling trade among nations. WTO with refernce to biotechnological affairs, TRIPs.

2. General Introduction: Patent claims, the legal decision – making process, ownership of tangible and intellectual property.

3. Basic Requirements of Patentability Patentable subject matter, novelty and the public domain, non obviousness

4. Special issues in Biotechnology Patents Disclosure requirements, Collaborative research, Competitive research, plant

5. Plant biotechnology Indian patents and Foreign patents, Plant variety protection act, The strategy of protecting plants.

6. Patent Litigation Substatritive aspects of patent litigation, Procedural aspects of patent litigation, different Doctrines

7. Recent Developments in Patent System and Patentability of biotechnological inventions.

8. IPR issues in Indian Context Role of patent in pharmaceutical industry, computer related innovations

9. Case studies Rice, Haldi, neem, etc. and challenges ahead

08BBT103: MOLECULAR AND CELLULAR DIAGNOSTICS

1. General Clinical Laboratory Techniques & Procedure: Chemical & Related substrates, volumetric analysis, Balancing & Weighing, Concept of solute & solvent, Units of measurement

2. Specimen Collection & Processing: Specimen collection (Blood, urine, spinal fluid, saliva synovial fluid, Amniotic fluid), Preservation, transportation

3. Selection & Interpretation of Lab. Procedure: Classification of BIAS, Sensitivity and specificity, Receiver Operator Characteristics, Interpretation a test

4. Quality Management: Fundamentals of total quality management, Element of QAP, External quality assessment and proficiency testing programme.

5. Clinical Enzymology: Principle of diagnostic enzymology, Liver, cardiac and skeletal enzyme, Digestive enzyme, Miscellaneous enzyme

6. General Function Tests: Liver function test, Cardiac Function Test, Renal Function Test, Thyroid Function test, Reproductive endocrime function test
7. Immunodiagnostics: Introduction, Antigen-Antibody Reactions, Conjugation Techniques, Antibody Production, Enzymes and Signal Amplification Systems, Separation and Solid-Phase Systems, Case studies related to bacterial, viral and parasitic infections.

8. Product Development: Immunoassay Classification and Commercial Technologies, Assay Development, Evaluation, and Validation, Reagent Formulations and Shelf Life Evaluation, Data Analysis, Documentation, Registration, and Diagnostics Start-Ups.

9. DNA based diagnostics: PCR, RFLP, SSCP, Microarrays, FISH, In-situ hybridization, Case studies related to bacterial, viral and parasitic infections.

10. Cell based diagnostics: Antibody markers, CD Markers, FACS, HLA typing, Bioassays.

11. Biosensors: Concepts and applications, Biosensors for personal diabetes management, Noninvasive Biosensors in Clinical Analysis, Introduction to Biochips and their application in modern Sciences, Introduction to Nanotechnology.

08BBT104: BIOSAFETY & BIOETHICS

UNIT-1:Biotechnology and Society: Introduction to science, technology and society, biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs. private funding, biotechnology in international relations, globalisation and development divide.

UNIT-2:Bioethics: Legality, morality and ethics, the principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc.
Biotechnology and Bioethics: The expanding scope of ethics from biomedical practice to biotechnology, ethical conflicts in biotechnology - interference with nature, fear of unknown, unequal distribution of risks and benefits of biotechnology, bioethics vs. business ethics, ethical dimensions of IPR, technology transfer and other global biotech issues.

UNIT-3:Biosafety concepts and issues: Rational vs. subjective perceptions of risks and benefits, relationship between risk, hazard, exposure and safeguards, biotechnology and biosafety concerns at the level of individuals, institutions, society, region, country and the world.

Biosafety in the laboratory institution: Laboratory associated infections and other hazards, assessment of biological hazards and levels of biosafety, prudent biosafety practices in the laboratory/ institution
Biosafety regulations in the handling of recombinant DNA processes and products in institutions and industries, biosafety assessment procedures in India and abroad

UNIT-4:Biotechnology and food safety: The GM-food debate and biosafety assessment procedures for biotech foods & related products, including transgenic food crops, case studies of relevance.
Ecological safety assessment of recombinant organisms and transgenic crops, case studies of relevance (Eg. Bt cotton).

UNIT-5:Biosafety assessment of biotech pharmaceutical products such as drugs/vaccines etc.
International dimensions in biosafety: Catagena protocol on biosafety, bioterrorism and convention on biological weapons

LABORATORY WORK

- Batch and Fed Batch fermentation
- Antibiotic production
- Carry out batch scale production of single cell protein
- Preparation of medium for fermentation
- Purification of a fermentation product by Chromatography
- Production of alcohol from molasses.
- Production of enzyme (amylase)
- Production of organic acid (citric acid).