

Scheme of Courses/Examination 2nd YEAR B. Tech. (Bio-Technology)

Bachelor of Technology (Bio-Technology) Scheme of Courses/examination (3rd Semester)											
Sr.No.	Course No.	Subject	Teaching Schedule				Examination Schedule				Duration of Exam.
			L	T	P/D	TOTAL	Th.	Sess.	P/VV	TOTAL	
1	BTT-201E	Cell Biology	3	1	-	4	100	50	-	150	3
2	BTT-203E	Microbiology	3	1	-	4	100	50	-	150	3
3	BTT-205E	Biochemistry	4	1	-	5	100	50	-	150	3
4	BTT-207E	Genetics	3	1	-	4	100	50	-	150	3
5	BTT-209E	Organic Chemistry	3	1	-	4	100	50	-	150	3
6	BTT-211E	Cell Biology and Genetics Lab	-	-	4	4	-	50	50	100	4
7	BTT-213E	Microbiology Lab	-	-	3	3	-	50	50	100	4
8	BTT-215E	Biochemistry Lab	-	-	4	4	-	50	50	100	4
9	BTT-217E	Organic Chemistry Lab	-	-	3	3	-	50	50	100	4
TOTAL			16	5	14	35	500	450	200	1150	
Bachelor of Technology (Bio-Technology) Scheme of Courses/examination (4th Semester)											
Sr.No.	Course No.	Subject	Teaching Schedule				Examination Schedule				Duration of Exam.
			L	T	P/D	TOTAL	Th.	Sess.	P/VV	TOTAL	
1	BTT-202E	Molecular Biology	4	1	-	5	100	50	-	150	3
2	BTT-204E	Immunology	3	1	-	4	100	50	-	150	3
3	BTT-206E	Bio-analytical Techniques	3	1	-	4	100	50	-	150	3
4	BTT-208E	Industrial Microbiology & Enzyme Technology	3	1	-	4	100	50	-	150	3
5	BTT-210E	Thermodynamics of Bio-processes	3	1	-	4	100	50	-	150	3
6	BTT-212E	Molecular Biology Lab	-	-	4	4	-	50	50	100	4
7	BTT-214E	Immunology Lab	-	-	3	3	-	50	50	100	4
8	BTT-216E	Bio-analytical Techniques Lab	-	-	3	3	-	50	50	100	4
9	BTT-218E	Industrial Microbiology Lab	-	-	4	4	-	50	50	100	4
TOTAL			16	5	14	35	500	450	200	1150	

Students will undergo Practical Training of 6 weeks duration after the 4th Semester.

3rd Semester B. Tech. (Bio-Technology)

CELL BIOLOGY

BTT-201E

L **T**
3 **1**

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

Unit I

- 1. Cell:** An introduction, classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation.
- 2. Cell membrane and permeability:** Chemical components of biological membranes, organization and fluidity of membrane components, the membrane as a dynamic entity, cell signalling, cell recognition and membrane transport.

Unit II

- 3. Cytoskeleton and cell motility:** Structure and functions of microtubules, microfilaments, intermediate filaments.
- 4. Structure and Functions of Cellular Organelles:** Endoplasmic reticulum, golgi complex, lysosomes, vacuoles and microbodies, ribosomes, mitochondria, plastids .

Unit III

- 5. Nucleus:** Structure, cell-cycle (interphase and M phases), regulation of cell cycle.
- 6. Extracellular matrix:** Composition, molecules that mediate cell adhesion, membrane receptors for extracellular matrix macromolecules, regulation of receptor expression and function.

Unit IV

- 7. Muscle contraction:** Different muscle types in the body, structural proteins of muscles, energetics and regulation of muscle contraction.
- 8. Neurons and neurotransmission:** Resting potential, action potential, synaptic transmission, neurotransmitters and receptors, the generation of action potential by sensory stimuli and mechanism of nerve-impulses.

Text/ References Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce(*et... al*)(2002) Garland Science Publishing, New York..
2. Cell Biology- Smith and Wood by Chapman and Hall.
3. Cell Biology: Organelle structure and function, Sadava, D E.(2004) Panima pub., New Delhi.
4. Cell and Molecular Biology, 8th ed. Robertis, Edp De and Robertis, Emf De (2002) Lippincot Williams and Wilkins Pvt. Ltd.,(International Student Edition) Philadelphia.
5. Molecular Cell Biology 4th ed. Lodish, Harvey and .Baltimore, D(2000) W.H. freeman & Co. Newyork

3rd Semester B. Tech. (Bio-Technology)
MICROBIOLOGY
BTT-203E

L T
3 1

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT - I

- 1. History and scope of Microbiology:** Development of Microbiology, various branches of microbiology and applications of microbiology.
- 2. Classification of Microorganisms:** Microbial Taxonomy- criteria used including molecular approaches. Microbial phylogeny and current classification of bacteria.

UNIT - II

- 3. Microbial Diversity:** Prokaryotes and Eukaryotes. Morphology and cell structure of major groups of microorganisms e.g. bacteria, fungi, algae, protozoa and viruses.
- 4. Cultivation and Maintenance of Microorganisms :** Methods of isolation, purification and preservation. Pure culture technique and sterilization methods.
- 5. Principles of microbial nutrition:** Requirement for carbon, nitrogen, sulphur and growth factors. Nutritional categories of microorganisms.

UNIT - III

- 6. Microbial Growth and Metabolism:** Growth curve (normal and biphasic) and generation time. Measurement of growth. Synchronous, batch and continuous cultures. Metabolic pathways- catabolic, anabolic and amphibolic. Microbial fermentation and its types.
- 7. Microbial Reproduction:** Sexual and asexual reproduction (taking an example from each group). Bacterial recombination: transformation, transduction and conjugation. Formation of endospores and mechanism of sporulation.

UNIT - IV

- 8. Environmental microbiology:** Normal and contaminating microflora of water, soil and air. Methods to study water, soil and air pollution. Major water, air and soil borne microbial diseases.
- 9. Food Microbiology:** Definition, important fermented foods and beverages (curd, yogurt, cheese, bread, idli, pickles, beer, wine). Factors effecting spoilage of food and food preservation methods. Methods to study food quality.

Text/References Books:

1. Microbiology 5th Edition. Prescott, L.M.; Harley, J.P. and Klein, D.A.(2003) McGraw Hill, USA.
2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. (1993) Tata McGraw Hill, New Delhi.
3. Food Microbiology 2nd ed, Adam, M. R. and Moss (2003) Panima Pub, New Delhi.
4. The Handbook of Water and Wastewater Microbiology Ed. Mara, D. and Horan, N. (2003) Academic Press.
5. Modern Food Microbiology. Jay, J.M. (1996) CBS Publishers and Distributors, New Delhi.
6. Food Microbiology: Fundamentals and Frontiers 2nd Edition. Doyle, M.P. Beuchat; L.R. and Montville, T.J. (2001) ASM Press Washington D.C.

3rd Semester B. Tech. (Bio-Technology)

BIOCHEMISTRY

BTT-205E

L T
4 1

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT - I

- 1. Introduction to Biochemistry : A Historical prospective**
- 2. Amino acids & Proteins** –Structure and properties of amino acids. Essential and non-essential amino acids. Peptide bonds. Types of proteins and their classification. Forces stabilizing protein structure and shape. Different levels of structural organization of proteins.
- 3. Carbohydrates-Structure and functions:** Structures and properties of monosaccharides, oligosaccharides and polysaccharides. Ring structure and mutarotation. Homo- and hetero-polysaccharides. Mucopolysaccharides .

UNIT - II

- 4. Lipids- Structure and functions :** Classification of lipids and their general functions. Essential fatty acids. Hydrolysis of fats, Saponification value, Rancidity of fats, Iodine number and Acid value. Cholesterol- its structure and biological functions.
- 5. Nucleic Acids- Structure and functions:** Structure and properties of purine and pyrimidine basis. Nucleosides and nucleotides. Biologically important nucleotides.
- 6. Enzymes :** Nomenclature and classification of Enzymes. Basic concept of holoenzymes, apoenzymes, cofactors, coenzymes, prosthetic groups, metalloenzymes, monomeric and oligomeric enzymes. Definitions of enzyme activity, specific activity and enzyme specificity. Role of NAD⁺/NADP⁺, FMN/FAD, coenzymes A, thiamine pyrophosphate, pyridoxal phosphate, lipoic acid, biocytin, Vitamin B₁₂ coenzymes and tetrahydrofolate in enzyme catalysis.

UNIT-III

- 7. Carbohydrate Metabolism :** Glycolysis. Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance. Gluconeogenesis pathway. Biosynthesis of lactose, sucrose and starch. Glycogenolysis, glycogenesis and control of glycogen metabolism. Maintenance of blood glucose level. Energetics and regulation of carbohydrate metabolism. Glyoxylate cycle. Photosynthesis (light and dark reactions).
- 8. Lipid Metabolism :** Beta -oxidation of saturated fatty acids, oxidation of unsaturated and odd carbon fatty acids. Alpha and omega oxidation of fatty acids. Formation and utilization of ketone bodies. Degradation of triacylglycerols by lipases. Biosynthesis, elongation and desaturation of saturated fatty acids. Biosynthesis of triacylglycerols, phospholipids and cholesterol.

UNIT - IV

- 9. Amino Acid Metabolism :** General reactions of amino acids metabolism- transamination, oxidative and non-oxidative deamination and decarboxylation. General pathways of amino acids degradation. Urea cycle and its regulations. Nitrogen cycle.
- 10. Nucleic Acid Metabolism :** Catabolism, *de novo*-biosynthesis and regulation of purine and pyrimidine nucleotides. Formation of deoxyribonucleotides.
- 11. Mitochondrial oxidative phosphorylation:** Mitochondrial electron transport chain. Hypotheses of mitochondrial oxidative phosphorylation. Inhibitors and uncouplers of oxidative phosphorylation.
- 12. Integration of metabolisim –** Basic concepts.

Text/ References Books:

1. Biochemistry, 4th edition, by L. Stryer (1995). W.H. Freeman & Co. NY
2. Biochemistry, 4th edition, by G. Zubay (1998). Wm.C. Brown Publishers.
3. Biochemistry, 2nd edition, by Laurence A. Moran, K.G. Scrimgeour, H. R. Horton, R.S. Ochs and J. David Rawn (1994), Neil Patterson Publishers Prentice Hall.
4. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox (2000) Maxmillan/ Worth publishers.
5. Biochemistry, 2nd edition, by R.H. Garrett and C.M. Grisham (1999) . Saunders college Publishing, NY. Sons, NY.
6. Fundamentals of Biochemistry by Donald Voet and Judith G Voet (1999) , John Wiley & Sons, NY
7. Harper's Biochemistry, 25th edition, by R.K. Murray, P.A. Hayes, D.K. Granner, P.A. Mayes and V.W. Rodwell (2000). Prentice Hall International.

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3rd Semester B. Tech (Bio-Technology)

GENETICS

BTT-207E

L T
3 1

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT - I

1. Principles of Heredity and Variation: Mendel and his experiments, monohybrid crosses, incomplete dominance and codominance, dihybrid crosses, multiple alleles(blood group systems), epistasis, lethal genes. Probability in prediction and analysis of genetic data. Pedigree analysis.

2. Genes and Chromosomes: General features of chromosomes, cell division, sexual reproduction. Chromosomal theory of inheritance, sex determination. Sex-linked, sex-limited and sex-influenced inheritance. Variation in chromosome number and structure.

UNIT - II

3. Molecular organization of chromosomes: Genome size and evolutionary complexity, supercoiling of DNA, structure of bacterial chromosome, structure of eukaryotic chromosome.

4. Gene Mutation and DNA Repair: Classification of mutations, spontaneous mutations, induced mutations, application of induced mutations, detection of mutations, site-directed mutagenesis, mechanisms of DNA repair.

UNIT - III

5. Gene Linkage and Chromosome Mapping: Linkage and recombination of genes in a chromosome, crossing over and genetic mapping, gene mapping by 2-point and three point test crosses.

6. Somatic Cell Genetics : Somatic cell hybrids production and gene mapping.

UNIT - IV

7. Population Genetics and Evolution : Allele frequencies and genotype frequencies, random mating and Hardy-Weinberg principle. Inbreeding. Genetics and evolution (Mutation and migration, natural selection, random genetics drift).

8. Quantitative Genetics : Quantitative inheritance, causes of variation.

Text/ Reference Books:

1. Genetics: Analysis of Genes and Genomes.5th edition (2001) Hartl, D.L. and Jones, E.W., Jones and Bartlet Publishers, Boston.
2. Genetics. 5th edition (1998) Russell, P.J., Addison Wesley Longman, Inc., California.
3. Genetics: Analysis and Principles. (1999) Brooker, R.J. McGraw Hill, New York.
4. Basic Genetics. (2000) Miglani, G.S., Narosa Publishing House, New Delhi.

3rd Semester B. Tech (Bio-Technology)

ORGANIC CHEMISTRY

BTT-209E

L T
3 1

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT-I

- Types of Organic Reactions:** Substitution, Addition, Elimination reactions. Wanger-Meerwin rearrangement reaction. Rearrangements of electron deficient nitrogen atom(Hoffmann, Beckmann and Curtius). Hyperconjugation : concept and consequences.
- IUPAC Nomenclature:** Systematic IUPAC nomenclature of alkenes, alkynes, cycloalkanes, aromatics, bicyclic and polyfunctional organic compounds. Bond line notation .

UNIT-II

- Bonding:** Hydrogen bonding- Nature, type, stability and its importance in organic compounds. $p\pi - d\pi$ bonding. Ylids (S & P) and Wittig reaction. Biological methylating reagents. Tautomerism-concept, Ring-chain tautomerism, Ring-chain isomerism, properties and reactions of keto-enol tautomers.
- Stereo Chemistry:** Classification of stereoisomers, diastereoisomers, separation of enantiomers, absolute configuration (R & S), projection formulae, stereochemistry of compounds containing two asymmetric C- atoms, stereochemistry of biphenyls. Geometrical isomerism-concept, E & Z nomenclature.
- Carbonyl Compounds:** Nature and structure of carbonyl group, Relative reactivities of carbonyl compounds, hydration and addition of alcohol to aldehydes and ketones. Addition of ammonia and ammonia derivatives to aldehydes and ketones. Wolf-Kishner reduction and its mechanism, Aldol condensation, Claisen condensation, Reformatsky and Perkin reactions.

UNIT -III

- Acid Derivatives:** Acid catalyzed and base catalyzed hydrolysis of esters and acid amides, ammonolysis and alcoholysis of esters, acid halides and acid anhydrides.
- Polymers:** Classification of polymers. Tacticity and functionality, mechanism of chain growth and step growth polymerization, coordination polymerization. Preparation, properties and uses of epoxy resins, PMMA. Natural rubber and its vulcanization. Elastomers-GR-S, GR-M and GR-I. Biomedical polymers-silicone rubber, polyurethanes & their applications

UNIT-IV

- Reducing Agents:** Their applications in Organic Chemistry with special emphasis on LiAlH_4 , NaBH_4 , Pt/Ni/H_2 , Metal/ NH_3 Solution, Hydroboration and Tri-n-butyl tin hydride.
- Peptide Bond Synthesis :** Protection of N-terminal and C-terminal of amino acids, formation of peptide bond, solid phase peptide synthesis.

10. Epoxides: properties and nucleophilic ring opening of epoxides. Crown ethers and their uses.

Text/Reference Books:

1. Organic Chemistry V1:6th ed. Finar, I L (2003) Pearson Education, Delhi
2. Organic Chemistry V2:5th ed. Finar, I L (2003) Pearson Education, Delhi.
3. Organic Chemistry 6th ed. Morrison, R & Boyd, T. (2003) Pearson Education, Delhi.
4. Organic Chemistry. Paula Yurkanis Bruice ; Pearson Education, Delhi.
5. Principle of Organic Synthesis. Richard Norman and James M Coxon.
6. Organic Chemistry :Reactions and Reagents, 37th ed. O.P. Aggarwal (2003) Goel Publishing House, Meerut.
7. Organic Analytical Chemistry. Jagmohan (2003) Narosa pub. New Delhi.

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**3rd Semester B. Tech. (Bio-Technology)
CELL BIOLOGY & GENETICS LAB
BTT-211E**

L T P
- - 4

Practical/V.V : 50 Marks
Sessional : 50 Marks
Total : 100 Marks
Time : 4 Hrs.

Note : A college must offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available .

1. Microscopy: Structure of Prokaryotic and eukaryotic cell,
Fixation, Microtomy.
Histology of various organ systems (Nervous, digestion, reproductive, respiratory and circulatory system).
Mitochondrial staining and enzyme localization (Histochemistry and immunohistochemistry).
2. Cell division in onion root tip.
3. Cell division in insect gonads/flower bud.
4. Fluorescence labeling of cellular organelles.
5. Isolation of DNA and study of its denaturation spectrophotometrically and viscometrically.

Reference books:

1. Principles and techniques of Practical Biochemistry: K. Wilson and J. Walker (1994), Cambridge University Press, Cambridge.
2. Introductory practical Biochemistry by S.K. Sawhney and Randhir Singh (2000), Narosa Publishing House, New Delhi.
3. An introduction to Practical Biochemistry by David T. Plummer (1988), McGraw- Hill, Book company, UK.

**3rd Semester B. Tech. (Bio-Technology)
MICROBIOLOGY LAB**

BTT-213E

L T P
- - 3

Practical/V.V : 50 Marks
Sessional : 50 Marks
Total : 100 Marks
Time : 4 Hrs.

Note : A college must offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

1. **Microscopy:** Use of microscopes, microscopic examination of microorganisms.
2. **Micrometry:** Microscopic measurement of microorganisms.
3. **Staining methods.**
4. **Preparation of culture media.**
5. **Isolation and enumeration of microorganisms from different sources.**
6. **Pure culture techniques-** Streak plate, pour plate, spread plate.
7. **Measurements of growth and study of effect of various factors on growth of microorganisms-**temperature, pH, salt concentration, U.V and R.H.
8. **Biochemical tests useful in bacterial taxonomy.**
9. **Water Microbiology-** BOD, multiple tube fermentation test.
10. **Milk Microbiology-** SPC, testing the quality of milk.

References Books:

1. Experiments in Microbiology, Plant Pathology and Biotechnology. 4th Edition. Aneja, K.R. (2003) New Age International Publishers, New Delhi.
2. Microbiology- a laboratory manual. 4th edition. Cappuccino J. and Sheeman N. (2000) Addison Wesley, California.
3. Environmental Microbiology – A Laboratory Manual Pepper. I.L.; Gerba, C.P. and Brendecke, J.W.(1995) Academic Press, New York.

3rd Semester B. Tech. (Bio-Technology)
BIOCHEMISTRY LAB
BTT 215E

L T P
- - 4

Practical/V.V : 50 Marks
Sessional : 50 Marks
Total : 100 Marks
Time : 4 Hrs.

Note : A college must offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available..

1. Qualitative tests for amino acids, proteins, Lipids and carbohydrates.
2. Quantitative estimation of proteins, Lipids and carbohydrates.
3. Assay of any commonly occurring enzyme.
4. Effect of pH, temperature, enzyme concentration and protein denaturation on an enzyme activity.
5. Determination of K_m and V_{max} of any commonly occurring enzyme.
6. Biochemical analysis of urine and blood (pH, Uric acid, creatinine, proteins and carbohydrates).

Reference Books:

1. Principles and techniques of Practical Biochemistry: K. Wilson and J. Walker (1994), Cambridge University Press, Cambridge.
2. Introductory practical Biochemistry by S.K. Sawhney and Randhir Singh (2000), Narosa Publishing House, New Delhi.
3. An introduction to Practical Biochemistry by David T. Plummer (1988), McGraw- Hill, Book company, UK.

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3rd semester B. Tech. (Bio-Technology)

ORGANIC CHEMISTRY LAB

BTT-217E

L T P
- - 3

Practical/V.V : 50 Marks
Sessional : 50 Marks
Total : 100 Marks
Time : 4 Hrs.

Note : A college must offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available

1. Derivativizations of poly sugars such as agarose with cyanogen bromide for binding with proteins.
2. Derivatization of polystyrene to generate carboxyl groups.
3. Derivatization of polystyrene to generate amino groups.
4. Derivatization of polystyrene to generate aldehyde groups.
5. Derivatization of polysugars to generate aldehyde group and establish covalent linkage to protein through amino and carboxyl groups.
6. Sialinization of solid phases such as polyester, glass, polystyrene to provide amino groups.
7. Covalent linkage of proteins to solid phase through carbodiimide reaction.
8. Estimation of reactive groups such as amino, aldehyde and carboxyl group on solid-phase/liquid phase.
9. Preparation of aspirin from salicylic acid.
10. Preparation of anthranilic acid from phthalic anhydride.
11. Preparation of p-nitro acetanilide from aniline.
12. Preparation of phenacetin from p-aminophenol.

4th Semester B. Tech. (Bio-Technology)
MOLECULAR BIOLOGY
BTT-202E

L T
4 1

Theory : 100 Marks
 Sessional: 50Marks
 Total : 150 Marks
 Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

Unit –I

1. Genes : DNA/RNA as the genetic material. Double helical structure of DNA. Types of DNA. Super coiling and periodicity of DNA. Linking number of DNA. Nature of multiple alleles, Cis- acting sites and Trans-acting molecules. Euchromatin and heterochromatin. Nucleosomes. Organelle DNA- Mitochondrial and chloroplast DNA.

2. From Genes to Genomes : Gene mapping, exons and introns, repetitive and non –repetitive DNA, C-value paradox.

3. DNA Replication : Origin of DNA replication. Bacterial and eukaryotic replicons. DNA polymerases. Mechanism and regulation of DNA replication in prokaryotes and eukaryotes.

UNIT - II

- 4. Transcription:** Various RNA species and their properties- tRNA as an adapter and turnover of mRNA.
- a) **Transcription in Prokaryotes:** RNA polymerases. Mechanism of transcription- initiation, elongation and termination. Role of sigma factor in transcription.
 - b) **Transcription in Eukaryotes:** RNA Polymerases. Downstream and upstream promoters. Techniques to define promoters- foot printing experiment. Mechanism of transcription. Interaction of upstream factors with basal apparatus. Role of enhancers. Post-transcriptional modifications of various RNA species. Transcription in mitochondria and chloroplast.
 - c) **The Operon:** Positive and negative control of transcription, repressor-inducer complex, catabolite repression and attenuation.
 - d) **Regulation of Transcription:** DNA binding domains- zinc finger motif, helix loop helix, leucine zippers and homeodomains. Demethylation and gene regulation.

UNIT - III

- 5. Genetic Code:** Evidence for triplet code. Properties of genetic code, Wobble hypothesis. Mitochondrial genetic code. Suppressor tRNAs.
- 6. Protein Synthesis :** Structure of prokaryotic and eukaryotic ribosomes and their role in protein synthesis. Mechanism of initiation, elongation and termination of protein synthesis. Regulation of translation in prokaryotes and eukaryotes. Post translational modifications of proteins.
- 7. Protein folding :** Role of molecular chaperones.

UNIT - IV

- 8. Nuclear Splicing :** Lariat formation, Sn RNAs, cis-splicing and trans-splicing reactions. Catalytic RNA- Ribozymes- Ribonuclease P, small RNAs, group I & II introns.
- 9. Transposons:** Transposition by replicative and non replicative mechanisms. Intermediates of transposition. Retroviruses and retroposons.
- 10. Cell Cycle and Growth Regulation :** Different stages of cell cycle. Control of cell cycle by phosphorylation and dephosphorylation mechanisms. Basic concept of Apoptosis.

Text/Reference Books :

1. Genes VII, Lewin, Benjamin(2002)OUP, Oxford.
2. Genomes, 2nd ed, Brown, T. A.(2002) John Wiley and sons ,Oxford
3. Molecular biology of cell 4thed Alberts, Bruce; Watson, J D(2002) Garland Science Publishing, New York.
4. Molecular cell biology 4th ed Lodish, Harvey and. Baltimore, D(2000) W.H. Freeman and Co., New York
5. Cell and Molecular Biology 8th ed, Robertis, EDP De & Robertis, EMF De(2002) lippincott Williams & Wilkins international student edition, Philadelphia.
6. Essentials of Molecular Biology 4th ed, Malacinski, G. M. (2003) Jones & Bartlet Publishers, Boston
7. Cell and Molecular Biology: concepts and experiments 3rd ed Karp, Gerald(2002) John Wiley and sons, New York.
8. The Cell-a molecular approach, 3rd ed Cooper, G M& Hausman, R E(2004) ASM Press, Washington D C

4th Semester B. Tech. (Bio-Technology)
IMMUNOLOGY
BTT-204E

L T
3 1

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT - I

1. **Introduction to immune system:** Innate and acquired immunity, cells and organs of immune system- B-Lymphocytes and T-Lymphocytes, primary and secondary lymphoid organs, humoral and cell mediated immune response.

2. **Immune System:** Antigens. Immunoglobulins- structure and function, antigenic determinants(isotype, allotype, idiotype). Monoclonal antibodies. Hybridoma technology. Antibody engineering.

UNIT - II

3. **Antibody Diversity:** Organization and expression of immunoglobulin genes, generation of antibody diversity; class switching.

4. **Generation of B-Cell and T-Cell Responses :** Major histocompatibility complex. Antigen processing and presentation.

7. **Cell mediated immunity:** T-cell receptor, T-cell maturation, activation and differentiation.

UNIT - III

8. **Immunological techniques :** Immuno-precipitin reactions, agglutination reactions, complement tests, ELISA, RIA, Immunofluorescence.

9. **Immune effector responses :** Cytokines. Complement system.

UNIT - IV

8. **Immune System in Health and Disease :** Hypersensitive reactions. Auto immunity and immune response to infectious diseases. Tumor immunity. Immune response to transplants. Vaccines.

Text / Reference Books:

1. Kuby's Immunology, 5th ed. Goldsby, R A., Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
2. Essential Immunology, 10th ed Roitt, Ivon; Delves, Peter(2001) Blackwell Scientific Publications Oxford.
3. Fundamentals of Immunology: Paul W.E. (Eds.) Raven Press, New York.
4. Immunology by Presscot.

4th Semester B. Tech. (Bio-Technology)
BIO-ANALYTICAL TECHNIQUES
BTT-206E

L **T**
3 **1**

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT- I

- 1. Microscopy:** Light, electron (scanning and transmission), phase contrast, fluorescence microscopy, atomic force microscopy, freeze-fracture techniques, specific staining of organelles or marker enzymes.
- 2. Centrifugation:** Techniques and their applications, differential centrifugation, zonal, density gradient and ultracentrifugation techniques.

UNIT- II

- 3. Electrophoresis:** Paper and gel electrophoresis, immunoelectrophoresis, isoelectric focussing, two-dimensional electrophoresis.
- 4. Chromatography:** Paper, TLC, adsorption, partition, ion-exchange, reverse phase, gel filtration, affinity, gas chromatography, High Pressure Liquid Chromatography (HPLC).

UNIT- III

- 5. Spectrophotometry:** Basic concepts and brief description of applications of UV/visible, IR, NMR, ESR, fluorescence, Raman. Mass spectroscopy (LC-MS, MALDI-TOF, ES-MS) X-ray diffraction (diffraction by fibrous proteins, globular proteins and molecular crystals), CD and ORD.
- 6. Calorimetry:** Differential scanning calorimetry, titration calorimetry.

UNIT- IV

- 7. Radioisotope Techniques:** Nature of radioactivity, properties of α , β and γ -rays, measurement of radioactivity, use of radioisotopes in research, *In vivo* and *in vitro* labelling techniques, double labelling, instruments for monitoring radioactivity, quenching, internal standard, channel ratio, external standard ratio, emulsion counting, radioactive decay, autoradiography, radio-immunoassay.

Text/ References Books:

1. Biological Spectroscopy: Campbell and Durek
2. Physical Biochemistry, 2nd edition, by D Friefelder (1983). W.H. Freeman & Co., U.S.A.
3. Introduction to instrumental analysis: Robert D. Braun (1987) Mc Graw Hill International Editions, Chemistry Series.
4. Analytical Chemistry for technicians : John Kenkel (1994), Lewis Publishers. Boca Raton.
5. Principles and techniques of Practical Biochemistry: K. Wilson and J. Walker (1994), Cambridge University Press, Cambridge.
6. Biophysical Chemistry: Principles and Techniques, 2nd edition by A. Upadhyay, K. Upadhyay and N. Nath. (1998). Himalaya Publishing House, Delhi.
7. Physical Biochemistry, 2nd edition, by K. E. VanHolde (1985), Prentice Hall Inc, New Jersey.

4th Semester B. Tech. (Bio-Technology)
INDUSTRIAL MICROBIOLOGY AND ENZYME TECHNOLOGY
BTT-208E

L T
3 1

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT- I

- 1. Industrial Microbiology:** Introduction, objectives and scope.
- 2. Fermentation Technology:** Principle, range and component of fermentation processes. Types of fermentation. Purification of fermentation products.
- 3. Industrially important microbes:** Sources, isolation, screening, preservation and maintenance of industrially important microorganisms. Improvement of industrially important microorganisms, selection of mutants, use of rDNA technology.

UNIT - II

- 4. Process technology for the Production of various Products:** Primary metabolites (ethanol, acetone, butanol, citric acid, vinegar) Production of alcoholic beverages (wine and beer).
- 5. Microbial production of industrial enzymes:** Cellulase, amylase and protease.
- 6. Production of secondary metabolites:** Antibiotics (*e.g.* penicillin, streptomycin and tetracycline)

UNIT - III

- 7. Vaccines:** Types of vaccines and their production
- 8. Biopesticides:** Characteristics of biopesticides. Important biopesticides- Bt-toxin, Kasugamycin, Beauverin, Dexamethasone and Coligo
- 9. Microbial protein:** Quorn
- 10. Biofuels and biofertilizers:** Basic concepts and important types of biofuels and biofertilizers

UNIT - IV

- 11. Enzymes:** Nomenclature and Classification of enzymes. Mechanism of enzyme action, acid base catalysis, covalent catalysis proximity and orientation effects. Mechanism of action of selected enzymes- chymotrypsin, lysozyme and ribonuclease. Purification of enzymes. Immobilized enzymes. Stability of enzymes- enzyme stabilization by selection and protein engineering. Application of enzymes in industry, analytical purposes and medical therapy.

Text/Reference Books:

1. Industrial Microbiology. Casida Jr., L.E. (1968) New Age International (P)Ltd. New Delhi.
2. Prescott & Dunn's Industrial Microbiology. Ed. E.G. Reed (1987). CBS Publishers, New Delhi.
3. Biotechnology: A Textbook of Industrial Microbiology 2nd Edition. Crueger, W. and Crueger, A. (2000) Panima Publishing Corporation, New Delhi.
4. Enzymes: Biochemistry, Biotechnology, Clinical chemistry. Palmer, T. (2000) Horwood publishing Colphon.
5. Process engineering in biotechnology. Jackson, A.T. (1991) Prentice Hall.
6. Manual of Industrial Microbiology and Biotechnology 2nd Edition. Ed. Arnold L. Demain and Julian E. Davies (1999) ASM Press Washington D C

4th Semester B. Tech. (Bio-Technology)
THERMODYNAMICS OF BIO-PROCESSES
BTT-210E

L T
3 1

Theory : 75 Marks
Sessional : 25 Marks
Total : 100 Marks
Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT- I

1. Concept of Open, Closed, adiabatic and isolated systems with suitable examples. Biological System as open systems. Thermodynamic parameters –internal energy, enthalpy ; their relationship and their significance.
2. First law of thermodynamics. Kirchoff's Equation. Heat capacity at constant pressure and volume and their relationship.
3. Concepts of Free energy and Entropy, Second law of thermodynamics. Entropy changes for reversible and irreversible processes. Entropy of mixing.
4. Third Law of Thermodynamics. Entropy & life processes. Numerical problems on Laws of Thermodynamics.

UNIT-II

1. Basic concept of Equilibrium and steady state conditions, Free energy and its relation with equilibrium constant, Chemical potential, Gibbs-Duhem equation and their application, Standard biochemical state and standard free energy changes. Thermodynamic basis of Biochemical reactions.
2. Phase Equilibrium and phase rule (thermodynamic derivation), Free energy of transfer between phases.
3. Structural transition in biological macromolecules and molecular processes.
4. Binding – independent and non-cooperative binding, Co-operative binding and its biological significance.

UNIT -III

1. Biological application of thermodynamics. Concept of coupled reactions and group transfer potentials. Thermodynamic analysis of some important metabolic pathways.
2. Concept of flux and forces. Non-equilibrium thermodynamics and its biological applications.
3. Coupled flows and Onsager's phenomenological co-efficients and reciprocal relations.
4. Membrane-types and transport across biomembranes.

UNIT- IV

1. Prigogine and Prigogine-Curie law. Thermo analysis of oxidative phosphorylation.
2. Stability of non equilibrium stationary state.
3. Ordering in time and space far from equilibrium.
4. Biological significance of the thermodynamic properties of water.
5. Biochemical oscillations and Biological clocks.

Text/Reference Books :

1. Kinetics and Thermodynamics in Biochemistry : Bray & White.
2. Biophysical chemistry Vol. I : Edsall and Wyman
3. Non Equilibrium Thermodynamics in Biophysics : Katchalasky and Curran; Harvard University Press.
4. Physical Biochemistry : Van Holde
5. Physical basis of biochemistry : Foundations of molecular biophysics, Bergethan, P.R.(2000) NY, Springer.
6. Introduction to the thermodynamics of biological processes : Jou D.& Llebot J.E., Prentice Hall, New Jersey.
7. Biochemical Engineering Fundamentals, 2nd ed., Bailey J.E.; Ollis D.F.(1986) MGH, New York.

4th Semester B. Tech. (Bio-Technology)
MOLECULAR BIOLOGY LAB
BTT-212E

L T P
- - 4

Practical/V.V : 50Marks
Sessional : 50Marks
Total : 100Marks
Time : 4Hrs

Note : A college must offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available .

1. Isolation of genomic DNA from eukaryotic cells.
2. Isolation of RNA from eukaryotic cells.
3. Isolation of proteins from eukaryotic cells.
4. Isolation of genomic DNA from prokaryotic cells.
5. Isolation of plasmid DNA from Prokaryotic cells.
6. Restriction mapping of plasmid DNA: This experiment involves single and double digestion of the plasmid with restriction enzymes.
7. Gel electrophoretic separation of DNA and molecular weight determination.
8. Gel electrophoretic separation of RNA.
9. Gel electrophoretic separation of proteins.
10. Transblot analysis of DNA.
11. Gel Extraction of DNA.
12. PCR amplification of DNA: Visualization by gel electrophoresis.

Reference Book:

Molecular Cloning – A laboratory manual: 3rd Edition Vol. 1-3. Sambrook J and Russell D.W. (2001). Cold Spring Harbor laboratory Press, New York.

4th Semester B. Tech. (Bio-Technology)
IMMUNOLOGY LAB
BTT-214E

L T P
- - 3

Practical/V.V : 50Marks
Sessional : 50Marks
Total : 100Marks
Time : 4Hrs

Note : A college must offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

1. Routine techniques in handling laboratory animals: feeding, cleaning and bleeding procedure for mice and rabbit.
2. Surgical removal of lymphatic organs from mice.
3. Preparation and administration of antigens, following immunization protocols.
4. To bleed rabbits for the generation of antibodies.
5. Purification of immunoglobulins.
6. Isolation and purification of lymphocytes from mouse.
7. Immunoprecipitation techniques
8. Agglutination techniques
9. ELISA

Reference Books:

1. Using Antibodies: A Laboratory Manual. Harlow & Lane(1998) Cold Spring Harbor Lab Press.
2. Immunological Techniques Made Easy. Cochet, et al.(1998)Wiley Publishers,Canada.

www.uniqueinstitutes.org

4th Semester B. Tech. (Bio-Technology)
BIO-ANALYTICAL TECHNIQUES LAB
BTT-216E

L T P
- - 3

Practical/V.V : 50Marks
Sessional : 50Marks
Total : 100Marks
Time : 4Hrs

Note : A college must offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

1. Verification of Beer-Lambert's law.
2. Separation of amino acids/ sugars by paper chromatography.
3. Extraction of lipids from tissues and their separation using TLC.
4. Partial purification of an enzyme by ammonium sulphate fractionation, Ion exchange and gel filtration chromatography of proteins.
5. Determination of molecular weight of an enzyme by gel filtration.
6. Separation of proteins by SDS-PAGE.
7. Cell fractionation

Reference Books:

1. Principles and techniques of Practical Biochemistry: K. Wilson and J. Walker (1994), Cambridge University Press, Cambridge.
2. Introductory practical Biochemistry by S. K. Sawhney and Randhir Singh (2000), Narosa Publishing House, New Delhi.
3. An introduction to Practical Biochemistry by David T. Plummer (1988), McGraw- Hill, Book company, UK.

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**4th Semester B. Tech. (Bio-Technology)
INDUSTRIAL MICROBIOLOGY LAB
BTT-218E**

L T P
- - 4

Practical/V.V : 50Marks

Sessional : 50Marks

Total : 100Marks

Time : 4Hrs

Note : A college must offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

1. Sterilization Techniques (Media, air & water)
2. Construction of various fermenters (bioreactors)
3. Identification of industrially important microorganisms e.g. molds, yeasts and bacteria.
4. Production of various products in the lab. Alcohol, wine, cellulase, protease and bread.
5. Isolation of antibiotic producing microorganisms from the soil.
6. Penicillin production and testing of antimicrobial activity.
7. Isolation of streptomycin-resistant mutants by replica plating method.
8. Isolation of UV induced auxotrophic mutants.
9. Testing of microbial enzyme activity in the lab.
10. Determination of cell growth.

Reference Books:

1. **Experiments in Microbiology, Plant Pathology and Biotechnology.** Aneja, K.R.(2003) 4th Edition. New Age International Publishers, New Delhi.
2. **Fermentations & Biochemical Hand Book: Principles, Process Design and Equipment.** HC Vogel and Noyes(1983).
3. **Microbiology Laboratory Manual.** Cappuccino, J. and Sheeman, N.(2000), 4th Edition, Addison Wesley, California.
4. **Manual of Industrial Microbiology and Biotechnology.** 2nd Edition. Ed. Arnold L. Demain and Julian E. Davies (1999) ASM Press Washington D.C.