

BT-201N	CELL BIOLOGY (B.Tech. Biotechnology Semester III)					
Lecture	Tutorial	Practical	Theory	Sessional	Total	Time
3	1	-	75	25	100	3 Hrs.
Purpose	To familiarize the students with the basics of Cell Biology.					
Course Outcomes						
CO1	Students will learn basic principles of cell biology especially the structure and functions of Biological Membranes.					
CO2	Students will come to know about various cellular organelles and their integrated functioning. Will be able to learn basic knowledge of concepts that leads to development of life and different processes related to these developments.					
CO3	This unit will enable the students to learn the concept of inhibition and activation of biological phenomenon by simple methods.					
CO4	Students will be able to use simple methods of engineering and mathematics like using graphs and osmotic diffusion and many more like that to solve scientific biological aspects. They will be able to gain knowledge of different factors affecting the normal functioning of muscular and nervous system.					

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 signaling, 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 Books:

1. Cell Biology: Organelle structure and function, Sadava, D E.(2004) Panima pub., New Delhi.

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 and Molecular Biology, 8th ed. Robertis, EDP De and Robertis, EMF De (2002) Lippincot Williams and Wilkins Pvt. Ltd.,(International Student Edition) Philadelphia.
4. Molecular Cell Biology 4th ed. Lodish, Harvey and .Baltimore, D(2000) W.H. freeman & Co. New York

Note: 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 atleast one from each uni

BT-203N	MICROBIOLOGY (B.Tech. Biotechnology Semester III)					
Lecture	Tutorial	Practical	Theory	Sessional	Total	Time
3	1	-	75	25	100	3 Hrs.
Purpose	To familiarize the students with the basic of Microbiology					
Course Outcomes						
CO1	Student to learn the history and classification of microbiology					
CO2	To learn microbial nutrition and various microbiological techniques					
CO3	Able to understand microbial growth and Genetics					
CO4	Student will able to know about various microbial diseases and fermentation products					

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: Morphology and cell structure of major groups of microorganisms e.g. bacteria, fungi, algae, protozoa and viruses.
4. Cultivation and microbial nutrition of Microorganism: Methods of isolation, purification and preservation. Pure culture technique and sterilization methods. Requirement for C, N, S and growth factors. Nutritional categories of microorganisms.

UNIT - III

5. 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.
6. Microbial Genetics: Transposable elements, Bacterial plasmids. Bacterial recombination: transformation, transduction and conjugation. Formation of endospores and mechanism of sporulation.

UNIT - IV

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

Text Book:

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.

References Books:

3. Modern Food Microbiology. Jay, J.M. (1996) CBS Publishers and Distributors, New Delhi.
4. Food Microbiology 2nd ed, Adam, M. R. and Moss (2003) Panima Pub, New Delhi.

Note: 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 atleast one from each unit.

BT-205N	BIOCHEMISTRY (B.Tech. Biotechnology Semester III)					
Lecture	Tutorial	Practical	Theory	Sessional	Total	Time
3	1	-	75	25	100	3 Hrs.
Purpose	To introduce the students with basics of Biochemistry					
Course Outcomes						
COI	The students will be able to understand the structure and functions of carbohydrates and proteins					
COII	The students will be able to learn structure and functions of lipid and nucleic acids along with basic concepts of enzymes					
COIII	The students will be able to write major pathways of carbohydrates and lipid metabolism					
CO IV	To make the students understand synthesis and degradation of pyrimidine nucleotides					

UNIT – I

1. **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

2. **Carbohydrates-Structure and functions:** Structures and properties of monosaccharides, oligosaccharides and polysaccharides. Ring structure and mutarotation. Homo- and hetero-polysaccharides. Mucopolysaccharides

UNIT – II

3. **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.

4. **Nucleic Acids-Structure and functions:** Structure and properties of purine and pyrimidine bases. Nucleosides and nucleotides. Biologically important nucleotides.

5. **Enzymes:** Nomenclature and classification of Enzymes. Activation energy and rate of reaction. Basic concept of holoenzymes, apoenzymes, cofactors, coenzymes, prosthetic groups, metalloenzymes, Definitions of enzyme activity, specific activity and enzyme specificity. Enzyme inhibition and concept of allostery. Michaelis-Menten equation.

UNIT-III

6. **Integration of metabolism** – Basic concepts and importance of metabolism

7. **Carbohydrate Metabolism:** Glycolysis and TCA cycle. 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.

8. **Lipid Metabolism:** Beta -oxidation of saturated fatty acids, oxidation of unsaturated and odd carbon fatty acids. Ketogenesis and its importance. 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 acid metabolism- transamination, oxidative and non-oxidative deamination and decarboxylation. General pathways of amino acid degradation. Urea cycle and its regulations.

10. **Nucleic Acid Metabolism:** Catabolism, *de novo*-biosynthesis and salvage pathway .

Formation of deoxyribonucleotides. Importance of nucleotides

11. **Mitochondrial oxidative phosphorylation:** Mitochondrial electron transport chain. Hypotheses of mitochondrial oxidative phosphorylation. Inhibitors and uncouplers of oxidative phosphorylation.

Text Books

1 Biochemistry, 4th edition, by L. Stryer (1995). W.H. Freeman & Co. NY

2 Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox (2000) Maxmillan/ Worth publishers

References Books:

1. Biochemistry, 4th edition, by G. Zubay (1998). Wm.C. Brown Publishers.

2. 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.

3. Biochemistry, 2nd edition, by R.H. Garrett and C.M. Grisham (1999) . Saunders college Publishing, NY.Sons, NY.

4. Fundamentals of Biochemistry by Donald Voet and Judith G Voet (1999) , John Wiley & Sons, NY

5. 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.

Note: 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 atleast one from each unit.

BT-207N	GENETICS (B.Tech. Biotechnology Semester III)					
Lecture	Tutorial	Practical	Theory	Sessional	Total	Time
3	1	-	75	25	100	3 Hrs.
Purpose	To familiarize the students with theoretical and practical aspects of Genetics					
Course Outcomes						
CO1	Students will be able to implicate simple mathematical calculations like ratios, probability, and sum and product rules to biological phenomenon. They can identify the complex phenomenon and can formulate the already existing to develop solutions for different biological aspects.					
CO2	Covers the harmful and beneficial factors included in the mutations concept which in turn have hazardous impact on environment.					
CO3	This unit will enable the students to apply simple mathematical calculations to natural biological phenomenon as in gene mapping and they will be able to develop new software's which can solve these phenomenon					
CO4	Students will be able to use derivation and integration phenomenon along with mathematical calculation to solve inheritance pattern in general which can be applied to solve scientific biological aspects.					

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 Books:

1. Basic Genetics. (2000) Miglani, G.S., Narosa Publishing House, New Delhi.
2. Fundamentals of Genetics. Singh, B.D., Kalyani Publishers, New Delhi.

References 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.

Note: 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 atleast one from each unit.

HS-201N	FUNDAMENTALS OF MANAGEMENT (B Tech All Branches Semester III/IV)					
Lecture	Tutorial	Practical	Theory	Sessional	Total	Time
3	-	-	75	25	100	3 Hrs.
Purpose	To make the students conversant with the basics concepts in management thereby leading to nurturing their managerial skills					
Course Outcomes						
CO1	An overview about management as a discipline and its evolution					
CO2	Understand the concept and importance of planning and organizing in an organization					
CO3	Enabling the students to know about the importance of hiring and guiding the workforce by understanding the concept of leadership and communication in detail					
CO4	To understand the concept and techniques of controlling and new trends in management					

UNIT-1

- 1. Introduction to Management:** Meaning, Definition, nature, importance & Functions, Management as Art, Science & Profession- Management as social System, Concepts of management-Administration
- 2. Evolution of Management Thought:** Development of Management Thought- Scientific management, Administrative Theory of Management, Bureaucratic Organization, Behavioral approach (Neo Classical Theory): Human Relations Movement; Behavioral Science approach; Modern approach to management – Systems approach and contingency approach.

UNIT-II

- 3. Planning:** nature, purpose and functions, types of plans, planning process, Strategies and Policies: Concept of Corporate Strategy, formulation of strategy, Types of strategies, Management by objectives (MBO), SWOT analysis, Types of policies, principles of formulation of policies
- 4. Organizing:** nature, importance, process, organization structure: Line and Staff organization, Delegation of Authority and responsibility, Centralization and Decentralization, Decision Making Process , Decision Making Models, Departmentalization: Concept and Types (Project and Matrix), formal & informal organizations

UNIT-III

- 5. Staffing:** concept, process, features; manpower planning; Job Analysis: concept and process; Recruitment and selection: concept, process, sources of recruitment; performance appraisal, training and development
- 6. Directing:** Communication- nature, process, formal and informal, barriers to Effective Communication, Theories of motivation-Maslow, Herzberg, McGregor ; Leadership – concept and theories, Managerial Grid, Situational Leadership. Transactional and Transformational Leadership.

UNIT-IV

- 7. Controlling:** concept, process, types, barriers to controlling, controlling Techniques: budgetary control, Return on investment, Management information system-MIS , TQM-Total Quality Management, Network Analysis- PERT and CPM.

8. Recent Trends in Management: -

Social Responsibility of Management–Management of Crisis, Total Quality Management, Stress Management, .. Concept of Corporate Social Responsibility (CSR) and business ethics.

Functional aspects of business: Conceptual framework of functional areas of management- Finance; Marketing and Human Resources

Text books

1. Management Concepts - Robbins, S.P; Pearson Education India
2. Principles of Management - Koontz & O'Donnel; (McGraw Hill)

Recommended books

1. *Business Organization and Management* – Basu ; Tata McGraw Hill
2. *Management and OB--* Mullins; Pearson Education
3. *Essentials of Management* – Koontz, Tata McGraw-Hill
4. *Management Theory and Practice* – Gupta, C.B; Sultan Chand and Sons, new Delhi
5. Prasad, Lallan and S.S. Gulshan. *Management Principles and Practices*. S. Chand & Co. Ltd., New Delhi.
6. Chhabra, T.N. *Principles and Practice of Management*. DhanpatRai& Co., Delhi.
7. *Organizational behavior* – Robins Stephen P; PHI.

Note: 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 atleast one from each unit.

BT-209N	CELL BIOLOGY & GENETICS LAB (B.Tech. Biotechnology Semester III)					
Lecture	Tutorial	Practical	Practical/Viva-voce	Sessional	Total	Time
-	-	3	60	40	100	3 Hrs.
Purpose	To learn working of instruments and their principles to study of biological phenomenon.					
Course Outcomes						
CO1	Students will be able to operate compound microscope.					
CO2	Preparation of temporary and permanent slides will be known by students.					
CO3	Students will come to know about the procedure of isolation of different organelles of the cell by means of techniques of Centrifugation on the basis of density gradient.					
CO4	Students will learn Techniques of DNA extraction and its analysis of Quantity and Quality.					

LABORATORY EXPERIMENTS

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

BT-211N	MICROBIOLOGY LAB (B.Tech. Biotechnology Semester III)					
Lecture	Tutorial	Practical	Practical/Viva-voce	Sessional	Total	Time
-	-	3	60	40	100	3 Hrs.
Purpose	To learn working of instruments and their principles to study of biological phenomenon.					
Course Outcomes						
CO1	Students will be able to operate microscopes and staining methods					
CO2	Learning of Culture Media Preparation for Microbial Growth					
CO3	Students will learn Pure Culture Techniques for maintenance and preservation of microbes.					
CO4	Students will learn various aspects of Biochemical Tests used in Microbial Taxonomy					

LABORATORY EXPERIMENTS

- 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.

TextReferences 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.

BT-213N	BIOCHEMISTRY LAB (B.Tech. Biotechnology Semester III)					
Lecture	Tutorial	Practical	Practical/Viva-voce	Sessional	Total	Time
-	-	3	60	40	100	3 Hrs.
Purpose	To learn working of instruments and their principles to study of biological phenomenon.					
Course Outcomes						
CO1	Students will be able to learn qualitative and quantitative estimation of biomolecules					
CO2	Learning of various Enzyme Assays					
CO3	Students will learn effect of environmental factors on enzyme activity					
CO4	Students will learn biochemical tests used in Clinical Biochemistry					

LABORATORY EXPERIMENTS

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).

Text/ 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.

MPC-202N	ENERGY STUDIES (B Tech All Branches Semester III/IV)					
Lecture	Tutorial	Practical	Theory	Sessional	Total	Time
3	-	-	75	25	100	3 Hrs.
Purpose	To make the students conversant with the basics concepts and conversion of various form of Energy					
Course Outcomes						
CO1	An overview about Energy , Energy Management, Audit and tariffs					
CO2	Understand the Layout and working of Conventional Power Plants					
CO3	Understand the Layout and working of Non Conventional Power Plants					
CO4	To understand the role of Energy in Economic development and Energy Scenario in India					

UNIT-I

Introduction: Types of energy, Conversion of various forms of energy, Conventional and Non-conventional sources, Need for Non-Conventional Energy based power generation.

Energy Management: General Principles of Energy Management, Energy Management Strategy.

Energy Audit: Need, Types, Methodology and Approach.

UNIT-II

Conventional Energy sources: Selection of site, working of Thermal, Hydro, Nuclear and Diesel power plants and their schematic diagrams & their comparative advantages- disadvantages.

UNIT-III

Non Conventional Energy sources: Basic principle, site selection of Solar energy power plant, photovoltaic technologies, PV Systems and their components, Wind energy power plant , Bio energy plants , Geothermal energy plants and tidal energy plants. MHD

UNIT-IV

Energy Scenario: Lay out of power system, Role of Energy in Economic development, energy demand, availability and consumption, Commercial and Non-commercial energy, Indian energy scenario, long term energy scenario, energy pricing, energy sector reforms in India, energy strategy for the future.

References:

1. Energy Studies-Wiley Dream tech India.
2. Non-conventional energy resources- Shobhnath Singh, Pearson.
3. Soni, Gupta, Bhatnagar: Electrical Power Systems – Dhanpat Rai & Sons
4. NEDCAP: Non Conventional Energy Guide Lines
5. G.D. Roy : Non conventional energy sources
6. B H Khan : Non Conventional energy resources - McGraw Hill
7. Meinel A B and Meinel M P, Addison: Applied Solar Energy- Wesley Publications
8. George Sutton: Direct Energy Conversion - McGraw

Note: 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 atleast one from each unit.

BT-202N	MOLECULAR BIOLOGY (B.Tech. Biotechnology Semester IV)					
Lecture	Tutorial	Practical	Theory	Sessional	Total	Time
3	1	-	75	25	100	3 Hrs.
Purpose	To make the students conversant with the basics concepts and conversion of various form of Energy					
Course Outcomes						
CO1	Introduction to Basic structure of DNA RNA , about their hereditary role Periodicity of DNA					
CO2	To impart basic concept of DNA replication process and regulation					
CO3	Basic knowledge of Transcription of DNA in Prokaryotes and Eukaryotes Control of transcription					
CO4	Knowledge of Translation in Prokaryotes and Eukaryotes Splicing					

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 :** 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.

Text/Reference Books :

1. Genes XI Lewin, Benjamin(2013)OUP, Oxford.
2. Genomes, 2nd ed, Brown, T. A.(2002) John Wiley and sons ,Oxford

3. Molecular biology of cell 4th ed 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 & Bartlett 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

Note: 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.

BT-204N	IMMUNOLOGY (B.Tech. Biotechnology Semester IV)					
Lecture	Tutorial	Practical	Theory	Sessional	Total	Time
3	1	-	75	25	100	3 Hrs.
Purpose	To learn the role of various components of Immune System and their response against various diseases					
Course Outcomes						
CO1	Basic concepts of cells and organs related to immune system. Basic Concepts related to Antigen and Antibody					
CO2	To learn the formation, maturation and functions of B cells & T cells					
CO3	To learn the concepts of various Immunological techniques and understanding various Effector Responses of body against an infection					
CO4	To understand the immunological reasons behind various Diseases					

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.

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

UNIT –III

6. Immunological techniques: Immunoprecipitin reactions, agglutination reactions, complement tests, ELISA, RIA, Immunofluorescence.

7. 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 Book:

1. Kuby's Immunology, 5th ed. Goldsby, R A. Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.

Reference Books

1. Essential Immunology, 10th ed Roitt, Ivon; Delves, Peter (2001) Blackwell Scientific Publications Oxford.
2. Fundamentals of Immunology: Paul W.E. (Eds.) Raven Press, New York.
3. Immunology by Prescott.

Note: 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 atleast one from each unit.

BT-206N	BIOANALYTICAL TECHNIQUES (B.Tech. Biotechnology Semester IV)					
Lecture	Tutorial	Practical	Theory	Sessional	Total	Time
3	1	-	75	25	100	3 Hrs.
Purpose	To learn the role of various components of Immune System and their response against various diseases					
Course Outcomes						
CO1	Basic concepts of Various kinds of Microscopy and Centrifugation Techniques					
CO2	To learn the theoretical and practical aspects of Electrophoresis and Chromatography Techniques					
CO3	To learn the concepts of different kinds of Spectroscopy and Colourimetry					
CO4	To understand the concept of radioisotope techniques and their applications in research					

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) McGraw 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.

Note: 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 atleast one from each unit.

BT-208N	INDUSTRIAL MICROBIOLOGY AND ENZYME TECHNOLOGY (B.Tech. Biotechnology Semester IV)					
Lecture	Tutorial	Practical	Theory	Sessional	Total	Time
3	1	-	75	25	100	3 Hrs.
Purpose	To learn the role of various principles of Industrial Microbiology					
Course Outcomes						
CO1	Basic concepts of Industrial Microbiology and Fermentation Technology					
CO2	To learn the theoretical aspects of Process Technology for the production of various products					
CO3	To learn the concepts of vaccines, biopesticides, biofuels and biofertilizers					
CO4	To understand the concept of enzyme technology and its applications in Biotechnology					

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, Devine and Collego
- 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

1. A Textbook of Basic and Applied Microbiology. Aneja, K. R., Jain, P. and Aneja, R. (2008). New Age International Publishers, New Delhi

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.

Note: 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 atleast one from each unit.

BT-210N	ORGANIC CHEMISTRY (B.Tech. Biotechnology Semester IV)					
Lecture	Tutorial	Practical	Theory	Sessional	Total	Time
3	1	-	75	25	100	3 Hrs.
Purpose	To learn the role of various principles of Industrial Microbiology					
Course Outcomes						
CO1	Basic concepts of Industrial Microbiology and Fermentation Technology					
CO2	To learn the theoretical aspects of Process Technology for the production of various products					
CO3	To learn the concepts of vaccines, biopesticides, biofuels and biofertilizers					
CO4	To understand the concept of enzyme technology and its applications in Biotechnology					

UNIT-I

IUPAC Nomenclature: Systematic IUPAC nomenclature of alkenes, alkynes, cycloalkanes, aromatics, bicyclic and polyfunctional organic compounds. Bond line notation **Types of Organic Reactions:** Substitution, Addition, Elimination reactions. WangerMeerwin rearrangement reaction. **Hyperconjugation:** concept and consequences, **Mole concept**

UNIT-II

Bonding: Hydrogen bonding- Nature, type, stability and its importance in organic compounds. $p\pi$ - $d\pi$ bonding. **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. **Important processes and their application:** alkylation, acylation, halogenations, dehydration, condensation and cyclisation.

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, Epoxy resins, 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., concept of solvent extraction and crystallization

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 & Reagents, 37th ed. Aggarwal (2003) Goel Publishing House, Meerut. 7. Organic Analytical Chemistry. Jagmohan (2003) Narosa pub. New Delhi.

Note: 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.

BT-212N	MOLECULAR BIOLOGY LAB (B.Tech. Biotechnology Semester IV)					
Lecture	Tutorial	Practical	Practical/Viva-voce	Sessional	Total	Time
-	-	3	60	40	100	3 Hrs.
Purpose	To learn working of instruments and their principles to study of biological phenomenon.					
Course Outcomes						
CO1	Students will be able to learn Isolation of DNA from Prokaryotic and Eukaryotic Cells					
CO2	Learning of Gel Electrophoresis for separation of DNA, RNA and Proteins					
CO3	Students will learn the technique of PCR Amplification of Nucleic Acids					
CO4	Students will learn Restriction Mapping of Plasmid DNA					

LABORATORY EXPERIMENTS

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 wt. 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:

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

BT-214N	IMMUNOLOGY LAB (B.Tech. Biotechnology Semester III)					
Lecture	Tutorial	Practical	Practical/Viva-voce	Sessional	Total	Time
-	-	3	60	40	100	3 Hrs.
Purpose	To learn working of instruments and their principles to study of biological phenomenon.					
Course Outcomes						
CO1	Students will be able to learn Routine Techniques in handling laboratory animals					
CO2	Learning of techniques for purification of immunoglobulins					
CO3	Students will learn the technique of Immunoprecipitation and Agglutination					
CO4	Students will learn the principles of ELISA					

LABORATORY EXPERIMENTS

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.

BT-216N	BIOANALYTICAL TECHNIQUES LAB (B. Tech. Biotechnology Semester IV)					
Lecture	Tutorial	Practical	Practical/Viva-voce	Sessional	Total	Time
-	-	3	60	40	100	3 Hrs.
Purpose	To learn the Bioanalytical Techniques used in the field of Biotechnology					
Course Outcomes						
CO1	Students will learn Separation of Biomolecules by Chromatography					
CO2	Learning of techniques for partial purification of enzymes					
CO3	Students will learn molecular weight determination of Proteins					
CO4	Students will learn the technique of cell fractionation					

LABORATORY EXPERIMENTS

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.

BT-218N	INDUSTRIAL MICROBIOLOGY LAB (B.Tech. Biotechnology Semester IV)					
Lecture	Tutorial	Practical	Practical/Viva-voce	Sessional	Total	Time
-	-	3	60	40	100	3 Hrs.
Purpose	To learn the Practical Aspects of Industrial Microbiology					
Course Outcomes						
CO1	Learning of Sterilization Techniques used in Microbiology Lab					
CO2	Learning of Identification of industrially important microorganisms					
CO3	Students will learn production of antibiotics and enzymes from microbes					
CO4	Students will learn determination of microbial cell growth					

LABORATORY EXPERIMENTS

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.
11. Production of organic acids (Citric and lactic) by microorganisms.
12. Production of industrially important enzymes (protease, amylase) by microorganisms.

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.

MPC-201N	ENVIRONMENTAL STUDIES ((B.Tech. All Branches Semester –III/IV)					
Lecture	Tutorial	Practical	Theory	Sessional	Total	Time
3	-	-	75	25	100	3 Hrs.
Purpose	To learn the role of various principles of Industrial Microbiology					
Course Outcomes						
CO1	Basic concepts of Industrial Microbiology and Fermentation Technology					
CO2	To learn the theoretical aspects of Process Technology for the production of various products					
CO3	To learn the concepts of vaccines, biopesticides, biofuels and biofertilizers					
CO4	To understand the concept of enzyme technology and its applications in Biotechnology					

UNIT 1

The multidisciplinary nature of environmental studies. Definition, Scope and Importance. Need for public awareness. Natural Resources: Renewable and Non-Renewable Resources: Natural resources and associated problems.

- (a) Forest Resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- (b) Water Resources- Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
- (c) Mineral Resources- Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- (d) Food Resources- World Food Problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- (e) Energy Resources- Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
- (f) Land Resources- Land as a resource, land, degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyle.

UNIT II

Ecosystem-Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological Succession. Food Chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem-

- a. Forest Ecosystem
- b. Grassland Ecosystem
- c. Desert Ecosystem
- d. Aquatic Ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Field Work. Visit to a local area to document Environment assets-river/forest/grassland/hill/mountain. Visit to a local polluted site- Urban /Rural Industrial/Agricultural. Study of common plants, insects and birds. Study of simple ecosystems-pond, river, hill, slopes etc. (Field work equal to 5 lecture hours).

UNIT III

Biodiversity and its conservation. Introduction, Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity of global, National and local levels. India as a mega-diversity nation Hot spots of Biodiversity. Threats to biodiversity: Habitat loss, poaching of wild life, man-wildlife conflicts. Endangered and endemic species of India. Conservation of Biodiversity- In situ and Ex-Situ conservation of biodiversity.

Environmental Pollution Definition. Cause, effects and control measures of- (a) Air Pollution (b) Water Pollution (c) Soil Pollution (d) Marine Pollution (e) Noise Pollution (f) Thermal Pollution (g) Nuclear Hazards
Solid waste management- cause, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides

UNIT IV

Social Issues and the Environment. From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people: Its problems and concerns. Case Studies. Environmental ethics-issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland Reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public Awareness. Human population and the Environment. Population growth, variation among nations. Population explosion-Family Welfare Programme. Environment and human health. Human rights. Value Education. HIV/AIDS, Women and Child Welfare. Role of Information Technology in Environment and Human Health. Case Studies.

Text Books

1. Environmental Studies- Deswal and Deswal. Dhanpat Rai & Co.
2. Environmental Science & Engineering Anandan, P. and Kumaravelan, R. 2009. Scitech Publications (India) Pvt. Ltd., India
3. Environmental Studies. Daniels Ranjit R. J. and Krishnaswamy. 2013. Wiley India.
4. Environmental Science- Botkin and Keller. 2012. Wiley, India

Note- Paper will be set as per UGC norms.