

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

### UNIT- I

- 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.
- From Genes to Genomes :** exons and introns, repetitive and non-repetitive DNA, C-value paradox.
- DNA Replication :** Origin of DNA replication. Bacterial and eukaryotic replicons. DNA polymerases. Mechanism and regulation of DNA replication in prokaryotes and eukaryotes.

### UNIT - II

- Transcription:** Various RNA species and their properties- tRNA as an adapter and turnover of mRNA.
  - Transcription in Prokaryotes:** RNA polymerases. Mechanism of transcription- initiation, elongation and termination. Role of sigma factor in transcription.
  - 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.
  - The Operon:** Positive and negative control of transcription, repressor-inducer complex, catabolite repression and attenuation.
  - Regulation of Transcription:** DNA binding domains- zinc finger motif, helix loop helix, leucine zippers and homeodomains. Demethylation and gene regulation.

### UNIT -III

- Genetic Code:** Evidence for triplet code. Properties of genetic code, Wobble hypothesis. Mitochondrial genetic code. Suppressor tRNAs.
- 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.
- Protein folding :** Role of molecular chaperones.

### UNIT -IV

- 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 :

- Genes XI Lewin, Benjamin(2013)OUP, Oxford.
- 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.**

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

### 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  $\alpha$ ,  $\beta$  and  $\gamma$ -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.
<b>Purpose</b>	<b>To learn the role of various principles of Industrial Microbiology</b>					
<b>Course Outcomes</b>						
<b>CO1</b>	<b>Basic concepts of Industrial Microbiology and Fermentation Technology</b>					
<b>CO2</b>	<b>To learn the theoretical aspects of Process Technology for the production of various products</b>					
<b>CO3</b>	<b>To learn the concepts of vaccines, biopesticides, biofuels and biofertilizers</b>					
<b>CO4</b>	<b>To understand the concept of enzyme technology and its applications in Biotechnology</b>					

#### 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.  $\pi$ - $\delta$  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  $\text{LiAlH}_4$ ,  $\text{NaBH}_4$ ,  $\text{Pt/Ni/H}_2$ , Metal/ $\text{NH}_3$  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.**

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

### 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.

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

### 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.

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

### 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.
<b>Purpose</b>	<b>To learn the Practical Aspects of Industrial Microbiology</b>					
<b>Course Outcomes</b>						
<b>CO1</b>	<b>Learning of Sterilization Techniques used in Microbiology Lab</b>					
<b>CO2</b>	<b>Learning of Identification of industrially important microorganisms</b>					
<b>CO3</b>	<b>Students will learn production of antibiotics and enzymes from microbes</b>					
<b>CO4</b>	<b>Students will learn determination of microbial cell growth</b>					

### 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.
<b>Purpose</b>	<b>To learn the role of various principles of Industrial Microbiology</b>					
<b>Course Outcomes</b>						
<b>CO1</b>	<b>Basic concepts of Industrial Microbiology and Fermentation Technology</b>					
<b>CO2</b>	<b>To learn the theoretical aspects of Process Technology for the production of various products</b>					
<b>CO3</b>	<b>To learn the concepts of vaccines, biopesticides, biofuels and biofertilizers</b>					
<b>CO4</b>	<b>To understand the concept of enzyme technology and its applications in Biotechnology</b>					

### 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.**