

UTTARAKHAND  
TECHNICAL UNIVERSITY  
DEHRADUN

SYLLABUS

BACHELOR OF SCIENCE  
IN  
BIOTECHNOLOGY

## **COURSE STRUCTURE & ORDINANCES FOR B.Sc. BIOTECHNOLOGY**

Course duration : SIX semester (three years)

1. Objectives and Rules: Six semesters (three years) BSc. Programme is formulated for developing competent Biotechnologist who are confident enough to take up various jobs. The course is based on interdisciplinary nature of Biochemistry, Chemistry, Quantitative Biology, Genetics, Microbiology and Biophysics. The programme obliges students to read original publications and envisages significant inputs in laboratory work, communication skill, creativity, planning, execution and critical evaluation of the scientific data.
- 2 Eligibility for admission: 10+2 with biology are eligible for admission to the course.  
Marks requirement : Minimum 45% of aggregate (General Category),  
Minimum 40% of aggregate (SC, ST Category) or  
as per University / Government norms.
- 3 There shall be five theory papers (Paper I, II, III, IV & V), two lab. Courses (Paper I & II) & internal assessment in B.Sc. First semester.
- 4 There shall be five theory papers (Paper VI, VII, VIII, IX, & X), two lab. Courses (Paper III & IV) & internal assessment in B.Sc. Second semester.
- 5 There shall be five theory papers (Paper XI, XII, XIII, XIV & XV), two lab. Courses (Paper V & VI) & internal assessment in B.Sc. Third semester.
- 6 There shall be five theory papers (Paper XVI, XVII, XVIII, XIX & XX), two lab. Courses (Paper VII & VIII) & internal assessment in B.Sc. Fourth semester.
- 7 There shall be five theory papers (Paper XXI, XXII, XXIII & XXIV, XXV), two lab. Courses (Paper IX & X) & internal assessment in B.Sc. Fifth semester.
- 8 There shall be five theory papers (Paper XXVI, XXVII, XXVIII, XXIX & XXX), two lab. Courses (Paper XI & XII) and a seminar & internal assessment in B.Sc. Sixth semester.
- 9 The minimum passing marks shall be 50% in aggregate and 40% in each individual paper of theory, practical, seminar & internal assessment and dissertation / project work.
- 10.

- 10 The division shall be determined on the basis of aggregate marks of all the papers ( theory, practical, seminar, internal assessment and dissertation / project work) of both previous and final year prescribed for the degree.
- 11 Conduct of examination and award of division will be as per following :-
  - a) First division 60% and above
  - b) Second division 48% and above but less than 60%
  - c) Third division 40% and above but less than 48%
12. The details of papers and scheme of examination is given on following pages.

## **CERTIFICATE**

This is to certify that the Dissertation entitled “.....”. Submitted by  
.....

Enrollment no. .... University roll no.....in partial fulfillment of the degree of Master of Science in Biotechnology (Name of the Institute) of Uttarakhand Technical University, Dehradun, Uttarakhand is a bonafide and original research work carried out by her/him under my / our supervision and guidance during the academic year ..... No part of this dissertation has been submitted to any other university for any other degree or diploma.

UTTARAKHAND TECHNICAL UNIVERSITY

STUDY AND EVALUATION SCHEME

B.Sc. BIOTECHNOLOGY Ist YEAR

SEMESTER-I

S.No.	Course Code	Subject Name	Period (Hours)		Sessional Exam	ESE	Subject Total
			L	P			
1.	BBT-111	BOTANY-I	3	0	20	80	100
2.	BBT-112	ZOOLOGY-I	3	0	20	80	100
3.	BBT-113	CHEMISTRY-I	3	0	20	80	100
4.	BBT-114	BIOCHEMISTRY-I	3	0	20	80	100
5.	BBT-115	CELL BIOLOGY	3	0	20	80	100
6.	BBT-116	PROFESSIONAL SKILLS					
PRACTICALS			DAY TO DAY EVALUATION				
1.	BBT-151	PRACTICAL-I (PAPER 1 & 2)	0	6	20	80	100
2.	BBT-152	PRACTICAL-II (PAPER 3,4 & 5)	0	6	20	80	100

UTTARAKHAND TECHNICAL UNIVERSITY

STUDY AND EVALUATION SCHEME

B.Sc. BIOTECHNOLOGY Ist YEAR

SEMESTER-II

S.No.	Course Code	Subject Name	Period (Hours)		Sessional Exam	ESE	Subject Total
			L	P			
1.	BBT-121	BOTANY-II	3	0	20	80	100
2.	BBT-122	ZOOLOGY-II	3	0	20	80	100
3.	BBT-123	CHEMISTRY-II	3	0	20	80	100
4.	BBT-124	MICROBIOLOGY	3	0	20	80	100
5.	BBT-125	BIOCHEMICAL & BIOPHYSICAL TECHNIQUES	3	0	20	80	100
PRACTICALS			DAY TO DAY EVALUATION				
1.	BBT-153	PRACTICAL-I (PAPER 1 & 2)	0	6	20	80	100
2.	BBT-154	PRACTICAL-II (PAPER 3,4 & 5)	0	6	20	80	100

UTTARAKHAND TECHNICAL UNIVERSITY

STUDY AND EVALUATION SCHEME

B.Sc. BIOTECHNOLOGY IInd YEAR

SEMESTER-I

S.No.	Course Code	Subject Name	Period (Hours)		Sessional Exam	ESE	Subject Total
			L	P			
1.	BBT-211	BIOCHEMISTRY-II	3	0	20	80	100
2.	BBT-212	BIOPHYSICAL CHEMISTRY	3	0	20	80	100
3.	BBT-213	MOLECULAR BIOLOGY	3	0	20	80	100
4.	BBT-214	MATHS, BIostatISTICS & COMPUTERS	3	0	20	80	100
5.	BBT-215	BIODIVERSITY & CONSERVATION BIOLOGY	3	0	20	80	100
6.		ENVIRONMENTAL SCIENCES					
PRACTICALS			DAY TO DAY EVALUATION				
1.	BBT-251	PRACTICAL-I (PAPER 1 & 2)	0	6	20	80	100
2.	BBT-252	PRACTICAL-II (PAPER 3,4 & 5)	0	6	20	80	100

UTTARAKHAND TECHNICAL UNIVERSITY

STUDY AND EVALUATION SCHEME

B.Sc. BIOTECHNOLOGY IInd YEAR

SEMESTER-II

S.No.	Course Code	Subject Name	Period (Hours)		Sessional Exam	ESE	Subject Total
			L	P			
1.	BBT-221	IMMUNOBIOLOGY	3	0	20	80	100
2.	BBT-222	ANIMAL BIOTECHNOLOGY & DEVELOPMENTAL BIOLOGY	3	0	20	80	100
3.	BBT-223	GENETICS & MOLECULAR GENETICS	3	0	20	80	100
4.	BBT-224	RDT & GENOMICS	3	0	20	80	100
5.	BBT-225	ENZYMOMOLOGY & PROTEIN ENGINEERING	3	0	20	80	100
PRACTICALS			DAY TO DAY EVALUATION				
1.	BBT-253	PRACTICAL-I (PAPER 1 & 2)	0	6	20	80	100
2.	BBT-254	PRACTICAL-II (PAPER 3,4 & 5)	0	6	20	80	100

UTTARAKHAND TECHNICAL UNIVERSITY

STUDY AND EVALUATION SCHEME

B.Sc. BIOTECHNOLOGY IIIrd YEAR

SEMESTER-I

S.No.	Course Code	Subject Name	Period (Hours)		Sessional Exam	ESE	Subject Total
			L	P			
1.	BBT-311	ANIMAL PHYSIOLOGY & TOXICOLOGY	3	0	20	80	100
2.	BBT-312	PLANT BREEDING & ECONOMIC BOTANY	3	0	20	80	100
3.	BBT-313	MICROBIAL GENETICS	3	0	20	80	100
4.	BBT-314	PLANT PHYSIOLOGY	3	0	20	80	100
5.	BBT-315	PLANT BIOTECHNOLOGY	3	0	20	80	100
PRACTICALS			DAY TO DAY EVALUATION				
1.	BBT-351	PRACTICAL-I (PAPER 1 & 2)	0	6	20	80	100
2.	BBT-352	PRACTICAL-II (PAPER 3,4 & 5)	0	6	20	80	100

UTTARAKHAND TECHNICAL UNIVERSITY

STUDY AND EVALUATION SCHEME

B.Sc. BIOTECHNOLOGY IIIrd YEAR

SEMESTER-II

S.No.	Course Code	Subject Name	Period (Hours)		Sessional Exam	ESE	Subject Total
			L	P			
1.	BBT-321	ENVIRONMENTAL CHEMISTRY	3	0	20	80	100
2.	BBT-322	BIOPROCESS ENGINEERING	3	0	20	80	100
3.	BBT-323	ENVIRONMENTAL BIOTECHNOLOGY	3	0	20	80	100
4.	BBT-324	FOOD & BEVERAGE BIOTECHNOLOGY	3	0	20	80	100
5.	BBT-325	PROTEOMICS & GENOMICS	3	0	20	80	100
PRACTICALS			DAY TO DAY EVALUATION				
1.	BBT-353	PRACTICAL-I (PAPER 2 &3)	0	6	20	80	100
2.	BBT-354	PRACTICAL-II (PAPER 4 & 5)	0	6	20	80	100

## **B.Sc BIOTECHNOLOGY I Year Semester I**

**Course Code : BBT 111**

### **BOTANY-I (Fungi, Plant Pathology, Algae & Bryophytes)**

#### **Unit-I**

Salient features & Classification of fungi by Alexopoulos. Habit, Habitat, structure and methods of reproduction in different classes of fungi. General account of Lichens.

#### **Unit-II**

General symptoms of plant diseases. General principal of infection and resistance. General methods of chemical and biological control of the plant diseases. The symptoms morphology of the causal organism, disease cycle and control measures of the following diseases: White rust of Crucifers, Late Blight of potato, Loose smut of wheat and Red rot of Sugarcane.

#### **Unit-III**

General Characteristics & Classification of Algae. Organization of thallus in Algae. Mode of reproduction in different genera of Algae viz: Chlamydomonas, Vaucheria, Ectocarpus & Polysiphonia.

General account of Cyanobacteria & Bacillariophyceae

Ecology of Algae: A brief idea of fresh water, marine, terrestrial algae, phytoplanktons, epiphytic, parasitic & symbiotic algae. Economic importance of Algae.

#### **Unit -V**

Basic characteristics & Classification of Bryophytes

Comparative account of the gross morphology anatomy, vegetative and Sexual reproduction, spore dispersal based on Riccia & Marchantia. General account of Anthoceros and Mosses. Economic importance of Bryophytes.

## **B.Sc BIOTECHNOLOGY I Year Semester I**

**Course Code : BBT 112**

### **ZOOLOGY I**

#### **UNIT I**

Introduction to Non-chordata; General characters, outline classification up to classes, **Protozoa**: Salient Features, Study of *Amoeba* and *Paramecium* in relation to structure, nutrition and reproduction (Life history).



**Porifera:** Salient features Study of *Leucosolenia* with reference to structure & reproduction (Life History), Canal System in sponges  
**Coelentrata:** Salient features, study of *Obelia* with reference to structure & reproduction (Life History). Polymorphism.

## UNIT II

**Helminthes:** Salient Features, Study of *Fasciola* and *Taenia* with reference to structure, reproduction ( Life Cycle) and their Parasitic adaptations

**Annelida:** Salient Features, Types and significance of Coelom, Metamerism & its significance, Study of *Hirudinaria* with reference to structure and reproduction, parasitic adaptations of *Hirudinaria*. Trochophore larva and its significance.

**Arthropoda:** Salient Features, Study of *Palaemon* with reference to structure and reproduction

## UNIT III

**Mollusca:** Salient Features, Study of *Pila* with reference to structure and reproduction (Life history), Torsion in Gastropoda, Pearl formation.

**Echinodermata:** Salient Features, Study of *Asterias* with reference to structure, Water vascular system, mode of feeding and reproduction.

## Unit IV

Concept of Evolution; Evidence in favour of evolution: Comparative anatomy, Comparative embryology, Palaentology, Biochemistry & Genetics

Theories of organic evolution; Lamarckism, Darwinism and Modern Synthetic theory

Palaentology: Fossils and Fossilization

Significance of fossil record

## UNIT V

**Taxonomy:** Definition and Scope, Zoological Nomenclature: Binomial and Trinomial, ICZN; Components of classification: Linnaean hierarchy

**Introduction of Medical Zoology:** Parasitic Protozoa and human diseases

Helminthes and Human Diseases

Arthropods and vector of human diseases (Mosquitoes, Flies), Mode of transmission of Pathogens by vectors: Prevention and Cure

## B.Sc BIOTECHNOLOGY I Year Semester I

**Course Code : BBT 113**

**Subject: CHEMISTRY-I**

### Unit -I

#### Atomic Structure

**(0.5)**

Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of  $\Psi$  and  $\Psi^2$ . Quantum numbers, radial and

angular wave functions and probability distribution curves, shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles. Hund's multiplicity rule. Electronic configurations of the elements, effective nuclear charge.

## **Unit-II**

### **Periodic Properties**

**(0.5)**

Atomic and ionic radii, ionization energy, electron affinity and electronegativity definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behaviour.

## **Unit-III**

### **Chemical Bonding**

**(1.0)**

Covalent Bond- Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to  $\text{NH}_3$ ,  $\text{H}_3\text{O}^+$ ,  $\text{SF}_4$ ,  $\text{ClF}_3$ ,  $\text{ICl}_2$  and  $\text{H}_2\text{O}$ . MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules.

Ionic Solids- Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule. lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarizability of ions. Fajan's rule. Metallic bond-free electron theory.

Weak Interactions- hydrogen bonding, van der Waals force.

## **Unit-IV**

### **Thermodynamics**

**(0.75)**

First law of thermodynamics, statement, definition of internal energy and enthalpy. Heat capacity- heat capacities at constant volume and pressure and their relationship. Calculation of  $w$ ,  $q$ ,  $dU$  &  $dH$  for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

Second Law of Thermodynamics. Carnot cycle and its efficiency. Concept of entropy: Entropy as a state function. Entropy as function of  $V$  &  $T$ , entropy as a function of  $P$  &  $T$ . Gibbs ( $G$ ) & Helmholtz function ( $A$ ).  $A$  &  $G$  as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change.

## **Unit-V**

### **Chemical Kinetics**

**(0.75)**

Rate of reaction, factors influencing the rate of a reaction-concentration, temperature, pressure, solvent, light, catalyst. Concentration dependence of rates, mathematical characteristics of simple chemical reaction-zero order, first order, second order, pseudo order, half life and mean life. Determination of the order of reaction-differential method, method of integration, method of half life period and isolation method, concept of activation energy.

# **B.Sc BIOTECHNOLOGY I Year Semester I**

**Course Code : BBT 114**

**Subject: BIOCHEMISTRY-I**

## **Unit I**

Introduction to biochemistry and its scope. Types and strength of solutions, acid base and salts, pH, solutions and their importance, redox potentials, bonding in Biomolecules.

## **Unit II**

Carbohydrates: classification, structure, chemistry, properties and function.

## **Unit III**

Proteins: Types of amino acids, structure, properties and functions. Bonding in proteins. Primary, secondary and tertiary structure of proteins and Ramachandran plot.

## **Unit IV**

Lipids: classification, nomenclature, properties and function. Nucleic acids, nucleosides, nucleotides, structure of DNA and its chemical bonding.

## **Unit V**

Enzymes: Classification, structure, kinetics and mechanism of action. Coenzymes, isoenzymes and ribozymes. Vitamins: types and their biological significance.

## **B.Sc BIOTECHNOLOGY I Year Semester I**

**Course Code : BBT 115**

### **CELL BIOLOGY**

#### **UNIT I**

Introduction to Cell theory, Comparison of a generalized Prokaryotic & Eukaryotic cell  
Elementary idea of cell fractionation, Usage of radioisotopes and antibodies in cell biology. Light and Phase contrast microscopy Brief introduction to application of Chromatography and Electrophoresis. Elementary knowledge of the structure and function of plasma membrane.

#### **UNIT: II**

Ultrastructure Chemical composition, Functions of various Cytoplasmic Organelles;  
Endoplasmic reticulum, Golgi Complex, Lysosome, Peroxisome, Nucleus and Nucleolus  
Ribosome, Mitochondria, Chloroplast, Introduction to Cytoskeleton  
Basic feature of cell cycle : Mitosis, Meiosis  
Elementary idea of cell transformation and cancer

#### **UNIT: III**

Chromosome structure, Euchromatin, Heterochromatin, Histone and Non-histone proteins, Nucleosome Histones Polytene and Lampbrush Chromosomes Fine Structure of Gene , Interaction of Genes

#### **UNIT: IV**

Mendel's Law, Exceptions to Mendel's law, Sex- linked inheritance, Genetic disorders  
Nature and Properties of Genetic code Linkage & Crossing over, Sex determination

#### **UNIT: V**

Pedigrees and their applications, Population and evolution genetics  
Eugenics and Euphenics, Cancer genetics

## **B.Sc BIOTECHNOLOGY I Year Semester II**

**Course Code : BBT 121**

### **BOTANY-II (Pteridophytes, Gymnosperm and Angiosperms)**

#### **Unit-I**

General characters and classification of Pteridophytes., A comparative study *Rhynia*, *Selaginella*, *Equisetum* and *Adiantum* on basis of following features: Morphology and

anatomy of the vegetative plant body and spore production organs, sexual reproduction, male and female gametophytes and fertilization.

### **Unit-II**

Outlines of Classification and distinguishing features of Gymnosperms.

Comparative account of the structure, life history and evolutionary trends based on the following examples- *Cycas*, *Pinus* and *Gnetum*. Economic importance of Gymnosperms.

### **Unit-III**

Angiosperm taxonomy- fundamental components. Comparison and evolution of the systems of classification as proposed by Linnaeus, Bentham and Hooker and Hutchinson. Nomenclature: International Code of Botanical Nomenclature (ICBN), history, scientific naming of plants, priority, types, validity, nomina conservanda. Collection and preservation techniques of specimens for herbarium and museum. Botanical gardens and Herbaria: A brief idea of Botanical Survey of India (BSI).

### **Unit-IV**

Taxonomy, important distinguishing characters, classification and economic importance of the following families: Dicotyledonae: Polypetalae: Ranunculaceae, Papaveraceae, Caryophyllaceae, Malvaceae, Meliaceae, Rutaceae, Fabaceae, Rosaceae, Cucurbitaceae, Apiaceae.

### **Unit-V**

Gamopetalae: Solanaceae, Convolvulaceae, Apocynaceae, Asclepiadaceae, Acanthaceae and Lamiaceae Monochlamydae: Euphorbiaceae, Moraceae and Polygonaceae. Monocotyledonae: orchidaceae, Liliaceae and Poaceae.

## **B.Sc BIOTECHNOLOGY I Year Semester II**

### **Course Code : BBT 122**

### **ZOOLOGY II**

#### **UNIT I**

General characters and outline classification of Chordates.

**Hemichordata:** Classification; General organization and affinities

**Urochordata:** Classification; General organization and affinities

**Cephalochordata:** Classification; General organization and affinities

**Cyclostoma:** Classification; External features of Petromyzon and Myxine

## UNIT II

**Pisces:** Origin; general characters; and affinities. External features, digestive, Blood vascular system of *Scoliodon*

**Teleosts:** Scales and fins of fishes, Aquatic and aerial respiratory organs, Air bladder in fishes. Fish migration

Dipnoi; distribution, general characters and affinities.

## UNIT III

**Amphibia:** Origin, general characteristics, Parental care; Neoteny and Paedogenesis

**Reptilia:** Origin; Terrestrial adaptation, general organization, distribution and affinities. General characters of Rhynchocephalia and Ophidia. Poisonous Non-poisonous snakes

## UNIT IV

**Aves:** Origin and General Characters, External features, Digestive and Respiratory system of *Columba*

Feathers in birds; flightless birds & their distribution; Aerial mode of adaptation

Migration in birds

**Mammalia:** Origin; General organization, distribution and affinities of Prototheria, Metatheria, and Eutheria

Aerial and aquatic adaptations in mammals; definitions in mammals

## UNIT V

Approaches to the study of animal behaviour; ecological, physiological, quantitative, evolutionary patterns of behaviour, Individual types, Social types, Instinct versus learning behaviour, Imprinting

Introduction to internal control of behaviour; Neural & hormonal control of behaviour. Communication in animals: visual, acoustic, & chemical. Biological rhythms: Circadian, Circannual rhythms; biological clock

Language of bees

## B.Sc BIOTECHNOLOGY I Year Semester II

**Course Code : BBT 123**

**Subject: CHEMISTRY-II**

Unit-I

**Structure and Reactivity :** Atomic orbital's, hybridization, orbital representation of methane, ethane, ethene, ethyne and benzene; polarity of bonds - inductive, resonance and steric effects and their influence on acidity and basicity of organic compounds. Hyper conjugation, aromaticity and Hydrogen bonding.

**Organic reaction mechanisms:** Heterolytic and homolytic cleavage, nucleophiles, electrophiles and free-radicals; substitution, addition and elimination reactions; Reaction intermediates, carbocations, carboanions, free radical, nitrens, carbenes and arynes, energy profile diagrams-transition states (general considerations).

Unit-II

**Stereoisomerism:** Structural, stereo, geometrical and optical isomerism, chirality, Configuration nomenclature, D L, R S, E Z , threo and erythro nomenclature. Sequence rule, configuration, and conformation.

**Unit-III**

**Carbohydrates:** Classification and nomenclature. Monosaccharide's, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharide's. Erythro and threo diastereomers. Conversion of glucose to mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D (+) glucose. Mechanism of mutarotation. General study of disaccharides (structure determination is not required). General introduction of structure of ribose and deoxyribose.

**Unit-IV**

**Amino Acids, Peptides, Proteins and Nucleic Acids:** Classification, structure and stereochemistry of amino acids. Acids-base behaviour, isoelectric point and electrophoresis. Preparation and reaction of alpha amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis solid-phase peptide synthesis. Structure of peptides and proteins. Levels of protein structure. Protein denaturation/renaturation. Nucleic acids introduction. Constitutions of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

Unit-V

**Instrumental methods of analysis:** Basis principal, instrumentation, theories, experimental procedure, technique and applications of UV, IR, NMR, XRD, TGA/DTA.

## **B.Sc BIOTECHNOLOGY I Year Semester II**

**Course Code : BBT 124**

### **MICROBIOLOGY**

#### **UNIT I**

Microbial world: Classification and general account of microorganisms: Bacterial, Fungi, Algae, Protozoa, Viruses, Yeast and Mycoplasma.

#### **UNIT II**

Introduction to Bacteriology: Fine Structure of Bacteria; Laboratory Identification and staining techniques.

Introduction to Virology: classification, general structure, lysogenic and lytic cycle of Bacteriophage (T-2)

### **UNIT-III**

Media for microbial culture: selective and differential media, enriched media. Pure culture technique.

Action mechanism of Antibiotics.

### **UNIT-IV**

Microbial growth: Synchronous & Diauxic, Factors affecting Microbial Growth. Measurement of microbial growth (cell number & cell count).

Modes of Nutrition: Photoautotrophs, photoorganotrophs, chemolithotrophs, chemoorganotrophs.

### **UNIT V**

Microbial metabolism: Overview of Energy production and utilization, N<sub>2</sub> fixation.

General microbiology of water, air, soil & sewage.

## **B.Sc BIOTECHNOLOGY I Year Semester II**

**Course Code : BBT 125**

### **BIOCHEMICAL & BIOPHYSICAL TECHNIQUES**

#### **Unit I**

Basic knowledge of the principles and applications of Microscopy

Light, phase contrast, fluorescence, Confocal Microscopy, Scanning and Transmission Electron microscopy, (SEM, TEM).

Biosensors: Introduction and principles. First, second & third generation instruments, cell based biosensors, enzyme immunosensors

Spectroscopic methods: principle and applications of UV-visible, IR, NMR, ESR and X-ray spectroscopy.

#### **Unit II**

Analytical separation methods: Principles and techniques:

Chromatography: Adsorption chromatography, Partition chromatography, Gas chromatography, liquid chromatography, Paper chromatography, thin layer chromatography, Gel filtration chromatography, ion exchange chromatography, affinity chromatography, HPLC.

#### **Unit III**

Centrifugation-basic principles, common centrifuges used in the laboratory (clinical, high speed centrifuges). Types of rotors (fixed angle, swing bucket)



Ultra centrifugation: Sedimentation rate: zonal centrifugation, equilibrium density gradient, centrifugation sedimentation constants.

#### **Unit IV**

Electrophoresis-General principle, application and types: Paper electrophoresis, moving boundary method, Gel electrophoresis (Native, Denaturing & reducing), Disc Gel electrophoresis, Isoelectrofocussing (IEF).

Isotachophoresis, Molecular weight estimation.

#### **Unit-V**

Application of radioisotopes in biology. Properties in units of radioactivity.

Radioactive isotopes and half life. Measurement of radioactivity: (Basic knowledge) GM Counter, gamma counter, liquid scintillation counter, Tracer techniques (basic knowledge): Autoradiography, radioimmunoassay, pitfalls of immunoassays, radioreceptor assay., Safety rules in handling of radioisotopes and hazardous chemicals

### **B.Sc BIOTECHNOLOGY II Year Semester I**

**Course Code : BBT 211**

#### **BIOCHEMISTRY-II**

##### **Unit -I**

Principle of bioenergetics: concept of entropy and free energy changes in biological reactions, redox reactions. Role of high energy phosphates, structural basis of free energy change of ATP hydrolysis.

##### **Unit II**

Carbohydrate metabolism: Glycolysis, Kreb's cycle, oxidative phosphorylation and pentose phosphate pathway, Gluconeogenesis, glycogenesis, and glycogenolysis.

##### **Unit III**

Lipid metabolism: Transport of fatty acid, oxidation of fatty acids ( $\alpha$ ,  $\beta$ ,  $\omega$ ) Oxidation of unsaturated and odd chain fatty acids, Cholesterol metabolism and its regulation, Regulation of fatty acid metabolism. Ketone bodies.

##### **Unit IV**

Brief introduction of amino acids biosynthesis, amino acid breakdown and urea cycle.

##### **Unit V**

Brief introduction of purine and pyrimidine nucleotides biosynthesis and breakdown.

## **B.Sc BIOTECHNOLOGY II Year Semester I**

**Course Code : BBT 212**

### **BIOPHYSICAL CHEMISTRY**

#### **Unit -I**

**Interactions in biological systems:** Intra and inter molecular forces, electrostatic interactions and hydrogen bonding interactions. Vander waals and hydrophobic interactions. Disulphides bridges. Role of water and weak interactions.

#### **Unit -II**

**Structure of proteins:** Conformational properties of polypeptides. Primary and secondary structures of alpha helix, beta sheet structures etc. Tertiary and quaternary structures. Structural features of membrane proteins. Conjugated and metal binding proteins. Secondary and tertiary structure prediction of protein conformation.

#### **Unit -III**

**Multiple Equilibrium:** Titration of proteins to evaluate net and total charge. Scatchard and hill plots. Folding unfolding equilibrium and denaturation of proteins. Effect of temperature and solvent condition on the thermodynamics of protein folding-unfolding equilibrium. Kinetics of protein folding.

#### **Unit -IV**

**Techniques for the study of macro molecular structure:** Ultrafugation, Sedimentation velocity and equilibrium determination of molecular weights. Viscosity. Microcalorimeter. Circular dichroism spectroscopy, UV, Visible and Fluorescence spectroscopy, X-ray diffraction, Nuclear magnetic resonance (NMR)

## **.B.Sc BIOTECHNOLOGY II Year Semester I**

**Course Code: BBT 213**

### **Molecular Biology**

#### **Unit I**

Chemical and physical properties of nucleic acid: nitrogenous bases, sugars, nucleosides and nucleotides. Structure and types of RNA and DNA. The Watson Crick model. DNA as genetic material.

#### **Unit II**

Different forms of DNA. Topological properties of DNA. DNA renaturation kinetics. The cytoplasmic inheritance. The molecular structure of chromosome in eukaryotes: structure of chromatin and higher order packaging in chromosome. Centromere and telomere, giant chromosome, polytene and lampbrush chromosome.

### **Unit III**

Information flow from genes to protein (central dogma of molecular biology)  
Concept of genetic code. Mechanism of replication in prokaryotes and eukaryotes.  
Repair of DNA damage in prokaryotes and eukaryotes Homologous recombination

### **Unit IV**

Structure and different forms of RNA. Gene transcription and control. Mechanism of transcription in prokaryotes and eukaryotes. Gene transcription in mitochondria. Reverse transcription.

### **Unit V**

Post transcriptional processing of RNA: (Capping, polyadenylation, splicing, RNA editing). Protein targeting. Mechanism of translation in prokaryotes and eukaryotes  
Translational control mechanisms Programmed destruction of proteins Transposable elements. Retrovirus and cancer.

## **B.Sc BIOTECHNOLOGY II Year Semester I**

**Course Code : BBT 214**

### **Biomaths, Biostatistics and Computer Application**

#### **Unit -I**

Introduction : relationship of life science with Mathematics, Linear Function concept  
Periodic Function : Introduction, Coordinate System, Elementary Trigonometry & Trigonometric relations, Trigonometric Polynomials. Differential & Integration Concept.

#### **Unit -II**

Mathematical study of single & interacting species behaviour. Growth Rate concept & Exponential Growth, Logistic Model, Mathematical Technique- Trajectories & Equilibria. Logarithm: Conversion and Plotting of Graph.

#### **Unit - III**

Importance of biostatistics in biomedical research. Mean, Mode & median, Range, Variance, Standard deviation Standard error. Graphs: Bargraphs, Histogram, polygons, Scatter, Pie , line. Concepts of co-efficient of variation. Skewness & curtosis. Correlation, Regression (scatter diagram, regression co-efficient regression lines ).

#### **Unit -IV**

Elementary idea of probability and its application. Random variables and their distribution (elementary idea). Binomial, Poisson & Normal distribution. The t tests, f test Chi-square tests.

**Unit -V**

Introduction to computers : Mini, micro, main frame and super computers . components of computer system(CPU, I/O units).

Data storage device, Memory concepts. Software and types of software.

Introductory concepts of computer language. Elementary idea of disk operating system (DOS). Elementary ideas of application of common packages, WINDOWS(3.1, 95, 98).

Computer application in biology and information communication (database , e-mail and local networks).

Applications of common packages, Microsoft word, Microsoft excel, Microsoft Powerpoint.

**B.Sc BIOTECHNOLOGY II Year Semester I**  
**Course Code : BBT 215**  
**Biodiversity and Conservation Biology**

**Unit I**

Biodiversity: Definition and Types, Animal diversity of Garhwal Himalaya, Plant diversity of Garhwal Himalaya, Microbial diversity of Garhwal Himalaya

**Unit II**

Loss of biodiversity, Types of Extinction, Threat to biodiversity

**Unit III**

Biodiversity at global, national and local level. Conservation and management of biodiversity  
Impact of green revolution

**Unit IV**

Conservation biology: Definition and scope, Concept of Protected Areas  
Ex-situ and In-situ Conservation India's wildlife: Habitat and distribution, Conservation status and efforts, Principal Zoogeographic Realms of the world characteristics & fauna of oriental region  
Barriers and means of dispersal, Zoogeography of India  
Endangered and endemic species of India

**Unit V**

Conservation of various ecosystem, Understanding biogeochemical cycles, Concept of habitat and niche, Effect and management of deforestation, Environmental laws and Acts in India

## **B.Sc BIOTECHNOLOGY II Year Semester II**

**Course Code : BBT 221**

### **Immunobiology**

#### **Unit I**

Introduction to Immune system, Innate and Acquired immunity  
Cells and organs of immune system, Structure of TCR and BCR  
Antibody structure and Function, Immunogenicity, Haptens and Epitopes

Antigens and Antigenicity

#### **Unit II**

Cytokines, MHC structure and interaction with peptides, Antigen processing and presentation, Complement system

#### **Unit III**

Activation of immune response, Cell mediated cytotoxicity, mechanism of T cell and NK cell mediated lysis, Antibody dependent cell mediated cytotoxicity

#### **Unit IV**

Brief introduction to Hypersensitivity, Tissue transplantation and graft rejection  
Diseases of immune system and Immunodeficiencies

#### **Unit V**

Introduction to Hybridoma technology, Ag- Ab precipitin and agglutination reactions,  
Western blotting, ELISA, RIA, Immunofluorescence

## **B.Sc BIOTECHNOLOGY II Year Semester II**

**Course Code : BBT 222**

### **Animal Biotechnology and Developmental Biology**

#### **Unit I**

Structure and organization of animal cell, Equipment and materials for animal cell culture technology, Animal cell culture medium: Balanced salt solutions, simple and complex media, role of CO<sub>2</sub> and other supplements, Serum and serum free media, Basic techniques of in vitro mammalian cell culture, Methods of tissue disaggregation (Mechanical and enzymatic)

#### **Unit II**

Primary culture and established cell lines, Maintenance of cultured cells, Viability, cytotoxicity, Parameters for measuring growth, Cell synchronization, Cell separation

### **Unit III**

Stem cells: Embryonic stem cells and adult stem cell cultures, Characterization, maintenance and differentiation of stem cells , Cell cloning, Transgenic Technology of animals

### **Unit IV**

Gametogenesis: Spermatogenesis and Oogenesis

Morphology of mature spermatozoon

Fertilization: Steps, mechanism and molecular events

Types of eggs and cleavage, Role of yolk during cleavage Fate map

### **Unit V**

Pictorial account of gastrulation in sea urchin, frog, chick and mammals

Extra-embryonic foetal membrane (chick)

Induction: nature and mechanism

Totipotency, Teratogenesis

Development of chick embryo up to 72 hours

Differentiation and organogenesis of vertebrate eye

# **B.Sc BIOTECHNOLOGY II Year Semester I**

## **Course Code : BBT 2**

### **GENETICS**

#### **Unit -I**

Mendelian laws of inheritance  
Lethality and interaction of Genes.  
Multiple Alleles and isoalleles.

#### **Unit -II**

Linkage and crossing- over: Mapping of gene interference; coincidence in pro- and eukaryotes  
Sex determination in plants and animals: Sex-linkage; non-disjunction as a proof of chromosomal theory of inheritance.  
Basic microbial genetics: Conjugation, transformation, transduction and their use in genetic mapping.

#### **Unit -III**

Concept of Gene: Classical and modern gene concepts; pseudoallelism, position effect; intergenic crossing over and complementation (Cistron, recon and muton), Benzer's work on rII locus in T<sub>4</sub> Phage .

#### **Unit -IV**

Mutation- spontaneous and induced; chemical and physical mutagens; induced mutation in plants, animals and microbes for economic benefit of man. Structural and numerical aberrations involving chromosomes; Evolution of wheat, cotton and rice; heredity defects Klinefelter, Turner, Cri-du-chat and Down syndromes.

#### **Unit -V**

Extrachromosomal inheritance: Cytoplasmic inheritance; Mitochondrial and Chloroplast genetic systems. Population Genetics: Hardy-Weinberg equilibrium, gene and genotypic frequencies



## **B.Sc BIOTECHNOLOGY II Year Semester II**

**Course Code : BBT 224**

### **Recombinant DNA Technology and Genomics**

#### **UNIT-I**

Introduction to DNA technology and application.

Cloning vector (characteristics applications) Plasmids, Phages, Cosmids  
YACs, BACs and HACs

Preparation of cloning vectors, suitable markers

Isolation of nucleic acids (Plasmid, RNA & DNA)

Nucleic acid modifying enzymes

Restriction endonuclease

#### **UNIT-II**

Basic steps of gene cloning

Cloning Strategies

Screening strategies of recombinants

Synthesis of cDNA

Construction of cDNA and genomic libraries

Blotting techniques (Methodologies and applications) southern, northern and western blotting

Probe labeling and hybridization

#### **UNIT-III**

DNA sequencing: chemical and enzymatic methods

PCR

Transposon tagging

Site directed mutagenesis

Genomic analysis: Exon-intron trapping, R-loop analysis, S-1 mapping, RFLP, RAPD, AFLP

Chromosome walking, Ribonuclease protection assay, Gel retardation assay, DNA foot printing,

DNA finger printing, DNA profiling

Antisense and ribozyme technology

Expression of cloned gene in heterologous system: Prokaryotes and Eukaryotes

Potential hazards of recombinant DNA technology

#### **UNIT-IV**

Transgenic technology: Types, approaches and application (Plant & animals)

Gene Therapy: Principles, strategies and ethics of human gene therapy

Gene therapy for inherited disorders and neoplastic disorders

#### **UNIT-V**

Introduction to genome and genome analysis: (Prokaryotes and Eukaryotes)

Human Genome Project: Strategy and implications, genomics in relation to proteomics.

# **B.Sc BIOTECHNOLOGY II Year Semester II**

**Course Code : BBT 225**

## **Enzymology & Protein engineering**

### **Unit I**

Historical perspectives

Isolation, crystallization and purification of enzymes, test of homogeneity of enzyme preparation, methods of enzyme analysis.

Enzyme classification (rationale, overview and specific examples) zymogens and their activation (Proteases and prothrombin)

Enzyme substrate complex: concept of ES complex, binding sites, active site, specificity, kinetics of enzyme activity, Michaelis-Menten equation and its derivation, Different plots for the determination of  $K_m$  and  $V_{max}$  and their physiological significance, factors affecting initial rates, E, S, temp & pH. Collision and transition state theories, Significance of activation energy and free energy.

### **Unit II**

Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition, determination of  $K_i$ , suicide inhibitor

Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. Techniques for studying mechanism of action, chemical modification of active site groups, specific examples: chymotrypsin, lysozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase

Enzyme regulation: Product inhibition, feedback control, covalent modification

### **Unit III**

Allosteric enzymes with special reference to aspartate transcarbamoylase and phosphofructokinase. Qualitative description of concerted and sequential models.

Negative co-operativity and half site reactivity. Enzyme-Enzyme interaction, Protein ligand binding, measurements analysis of binding isotherm, cooperativity, Hill and Scatchard plots, kinetics of allosteric enzymes.

#### **Unit IV**

Isoenzymes- multiple forms of enzyme with special references to lactate dehydrogenase. Multienzyme complex, Multifunctional enzyme-FA synthases.

Enzyme Technology: Methods for large scale production of enzymes

Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors, application of immobilized and soluble enzyme in health and industry. Application to fundamental studies of biochemistry. Artificial enzyme, enzyme electrode.

#### **Unit V**

Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering-selected examples. Delivery system for protein pharmaceuticals structure function relationship in enzymes, structural motifs and enzyme evolution.

Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes. Protein folding *in vivo* & *in vitro*.

### **B.Sc BIOTECHNOLOGY III Year Semester II**

**Course Code : BBT311**

**Animal Physiology and Toxicology**

## **Unit I**

**Respiration:** Types of respiration (cutaneous, branchial, tracheal and pulmonary)

Respiratory pigments (Haemoglobin, and myoglobin)

Dissociation of oxyhaemoglobin

Factors affecting oxyhaemoglobin dissociation (carbon dioxide, pH, and temperature)

Chloride shift

**Nutrition:** Food constituents

Digestion and absorption of Carbohydrates, Lipids and Proteins

## **Unit II**

**Circulation:** Composition of blood and function of blood corpuscles

Haemopoiesis

Blood coagulation

Blood groups

Heart - Types and physiology

**Excretion:** Excretion of nitrogenous wastes (Ammonotelic, Uricotelic, Ureotelic and Guanotelic animals)

Structure of nephron

Physiology of urine formation

## **Unit III**

**Nervous System:** Types of neurons

Initiation and conduction of nerve impulse (Resting and action potential)

Synapse and chemical transmission

**Muscles:** Types of muscles

Ultra structure of skeletal muscles

Muscle proteins

Chemistry of muscle contraction

Mechanism of muscle contraction

Elementary knowledge of muscle twitch, tetanus and fatigue

## **Unit IV**

**Concept of Toxicology:** Definition, goal and scope of study

Major source of toxicants: Sewage, Industrial and Agricultural

Classification of toxicants: Domestic, Industrial and Carcinogenic

Pesticides: Insecticides, Fungicides, Herbicides

Measurement of toxicity: LC50 or LD50, determination of safe concentration

Acute vs chronic toxicity

## **Unit V**

Dose-Response curve - Response of test organism (fish, and rat) to various doses of DDT and Detergents

Bioaccumulation and biomagnifications of hydrocarbons, pesticides and heavy metals in animals

Absorption of toxic substances from animal body

Excretion of toxic substances from animal body

## **B.Sc BIOTECHNOLOGY III Year Semester I**

**Course Code : BBT312**

### **PLANT BREEDING & ECONOMIC BOTANY**

#### Unit-I

Importance of plants to mankind.

Origin of cultivated plants, monophyletic and polyphyletic origin;

Centre of origin of some important crop plants.

#### Unit-II

Origin, history, botanical features and cultivation of cereals-

wheat, paddy, maize and bajra. Legumes- an introduction to the

economically important legumes. Oil-castor oil, linseed oil, mustard oil and mint

oil.

#### Unit-III

General account of fruits (apple, banana, citrus, litchi and Mango) and

vegetable (root, stem, leaf and fruit vegetable) plants.

Fibres (coir, cotton, flax, hemp) and medicinal

(Aconitum, Atropa, Cinchona, Ephedra and Rauwolfia) plants.

Common timber yielding plants (Chir, deodar, sal, shisham and teak) of

western Himalayas.

#### Unit-IV

Plant Breeding: Aims and objectives, basic techniques of plant breeding.

Crop improvement method- Plant introduction, selection, acclimatization and

hybridization. Vegetative propagation and grafting.

Mutational breeding and breeding for disease resistance.

#### Unit-V

Improved seed- production, multiplication and distribution.

Maintenance and seed testing.

National Seeds Corporation and seed testing Laboratories.

# **B.Sc BIOTECHNOLOGY III Year Semester I**

**Course Code : BBT 313**

## **MICROBIAL GENETICS**

### **UNIT I**

Modes of genetic recombination in Bacteria: Conjugation- distinct sexes in *E.coli*, F-factor, conjugal transfer process, interrupted mating and time of entry mapping, high frequency recombination (hfr) strains.

### **UNIT-II**

Transformation- competence, DNA uptake by competent cells.

Mechanism of transformation. Gene mapping by transformation.

Transduction- types of transduction, mechanism of generalized transduction, abortive transduction, formation of specialized transduction particles, transfection.

### **UNIT III**

Mutation and mutagenesis: phenotypes and genotypes, auxotrophic mutants, conditional and lethal mutants.

Spontaneous Mutation- the random nature of mutations, evidences for spontaneous mutations, mutation rate, the origin of spontaneous mutations. Induced Mutation- chemical mutagens, alkylating agents (EMS and nitrosoguanidine), intercalating agents (acridine orange) and physical agents.

### **UNIT-IV**

Plasmids and Transposable elements: Types of plasmids, detection of plasmids, F-Plasmids in *E.coli*, conjugative and non conjugative plasmids. Control of plasmid copy number, plasmid amplification incompatibility, plasmid DNA, replication, curing of plasmids.

Transposable Sequences- insertion sequences (IS), composite transposons (Tn10, Tn5), Phage Mu as transposon, conjugative transposons.

### **UNIT V**

Genetics of Bacteriophages: Lytic and Lysogenic cycle, expression of phage genes in regulation of lytic and lysogenic circuit. Maintenance of lysogen by autogenous circuit, repressor structure and repressor synthesis.

## **B.Sc BIOTECHNOLOGY II Year Semester I**

### **Course Code : BBT 314 PLANT PHYSIOLOGY**

#### **Unit I**

Cell physiology, diffusion, permeability, plasmolysis, imbibition, water potential, diffusion pressure deficit and osmotic potential.

Types of soil water, water holding capacity, water requirement, wilting coefficient.

Active and passive absorption and anatomical features of xylem, Ascent of sap, path of water transport.

#### **Unit II**

Loss of water from plants, transpiration, factor affecting transpiration, guttation, anatomy of the leaf with special reference to loss of water.

Structure of stomata, mechanism of stomata opening and closing.

#### **Unit III**

Mechanism of absorption of mineral salts.

Translocation of solutes, mechanism of translocation, Anatomical features of the phloem with reference to translocation.

Elementary knowledge of the macro and micro nutrients, symptoms of nutrient deficiency, techniques of water and sand culture.

#### **Unit IV**

Nitrogen cycle and nitrogen fixation, importance of nitrate reductase and its regulation, ammonium assimilation.

Photosynthesis, historical background and importance of process, role of primary pigments, concept of two photosystem, Z-schemes, photophosphorylation. Calvin cycle, Photorespiration, C<sub>4</sub> plants, CAM plants Factors affecting photosynthesis, Chemosynthesis.

#### **Unit V**

Respiration, glycolysis, Krebs' cycle, Electron transport mechanism. ATP-the biological energy currency Oxidative phosphorylation, Pentose phosphate pathway.

Plant growth regulators, auxin, Gibberellin, cytokinin, Abscisic acid and ethylene.

Seed germination and dormancy, elementary plant movement.

Physiology of flowering, photoperiodism and vernalization.

# **B.Sc BIOTECHNOLOGY III Year Semester I**

**Course Code : BBT 315**

## **Plant Biotechnology**

### **Unit-I**

History of Biotechnology, Conventional methods for crop improvement- Pedegree, Heterosis and Mutation breeding. Tissue culture in crop improvement Micropropagation for virus-free plants, Somaclonal variation, Somatic hybridization. Artificial seed production, Haploids in plant breeding.

### **Unit-II**

Basic concepts and genetic engineering for increasing crop productivity by manipulation of Photosynthesis, Nitrogen fixation , Nutrient uptake efficiency, biotic stress tolerance- Insects, fungi, bacteria, viruses, weeds, Abiotic stress- drought, flooding, salt and temperature and for quality improvement- Protein, lipids, carbohydrates, vitamins & mineral nutrients

### **Unit-III**

Plants as bioreactor or Molecular farming- value added crops, edible vaccines, industrial enzymes, antibodies, medicines. Cell cultures for secondary metabolite production; Concept of Molecular breeding; Constructing molecular maps; Physical maps of chromosomes; The concept of map-based cloning and their use in transgenic; Markerassisted selection of qualitative and quantitative traits

### **Unit-IV**

*In silico* discovery of genes, gene synteny, High throughput approach in molecular Marker technology. Plant genomes and comparative genomics  
Diversity; Historical and geographical causes for diversity; Genetic and Molecular diversity; Species and population biodiversity; Biodiversity and its centres of origins of plants; Biodiversity hot spots in India; Collection and conservation of biodiversity; Morphological and molecular characterization of biodiversity.

### **Unit-V**

Intellectual property rights (IPR) in relation to biotechnology, sovereignty rights, CBD, bioethics and patenting, General agreement on trade and tariffs, Indian sui-generis system for plant variety and farmer's rights protection act. **Biosafety**, Biosafety for human health and environment, Social and ethical issues, Biosafety in relation to transgenic research of applications.



## **B.Sc BIOTECHNOLOGY III Year Semester II**

**Course Code : BBT 321**

### **ENVIRONMENTAL CHEMISTRY**

#### **UNIT-I**

**Introduction to Environmental Chemistry** : Concept and scope of environmental chemistry, Environmental terminology and nomenclatures, Environmental segments, The natural cycles of environment (Hydrological, Oxygen, Nitrogen, Phosphorous and Sulphur cycles).

#### **UNIT-II**

**Atmosphere** : Regions of the atmosphere, Reactions in atmospheric chemistry, Earth's radiation balance, Particles, ion and radicals in the atmosphere, stratospheric chemistry: The chemistry of ozone layer, The role of chemicals in ozone destruction, The greenhouse effect and Global warming, El-Nino phenomenon.

#### **UNIT-III**

**Hydrosphere** : Complexation in natural water and waste-water, Micro-organism in aquatic chemical reactions, Eutrophication, Re-cycle of waste-water in process industry, Treatment of sewage and reuse of water in industry and agriculture, Microbiologically mediated redox reactions and Nitrogen transformation by bacteria.

#### **UNIT-IV**

**Lithosphere** : The terrestrial environment, Soil formations, Soil properties (physical/chemical), inorganic and organic components in soil, acid-base and ionexchange reactions in soil, micro and macro nutrients, nitrogen pathways and NPK in soil, waste and pollutants in soil, waste classification and disposal.

#### **UNIT-V**

**Chemical Toxicology** : Toxic chemicals in the environments, Impact of toxic chemicals on enzymes, Biochemical effects of arsenic, cadmium, lead, mercury, carbon monoxide, nitrogen oxides, sulphur oxides, ozone, PAN, cyanide, pesticides, insecticides and carcinogens.

## B.Sc BIOTECHNOLOGY III Year Semester II

Course Code : BBT 322

### Bioprocess Engineering & Technology

#### Theory

1. Introduction to bioprocess engineering
2. Bioreactors
3. Isolation, preservation and maintenance of industrial microorganisms
4. Kinetic of microbial growth and death
5. Media for industrial fermentation
6. Air and media sterilization
7. Types of fermentation processes: Analysis of batch, fed-batch and continuous bioreactions, biotransformation, Stability of microbial reactors, analysis of microbial populations, specialized bioreactors (pulsed, fluidized, photobioreactors etc.)
8. Measurement and control of bioprocess parameters
9. Downstream processing: Introduction, removal of microbial cells and solid mat foam separation, precipitation, filtration, centrifugation, cell disruptions, liquid-liquid extraction, chromatography, membrane process, drying and crystallization, effluent treatment: DOC and COD treatments and disposal of effluents.
10. Enzyme and whole cell immobilization and their industrial applications
11. Industrial production of chemicals. Alcohol (ethanol), acids (citric, acetic & gluconic), solvents (glycerol, acetone, butanol), antibiotics (penicillin, streptomycin, tetracycline), aminoacids (lysine, glutamic acid), single cell protein.
12. Use of microbes in mineral beneficiation and oil recovery
13. Introduction to food technology
  - Elementary idea of canning and packing
  - Sterilization and pasteurization of food products
  - Technology of typical food/food products (bread, cheese, idli.)

## **B.Sc BIOTECHNOLOGY III Year Semester II**

**Course Code : BBT 323**

**Environmental Biotechnology**

### **Unit I**

Environment: Basic Concept,  
Limiting factors and Homeostasis,  
Abiotic factor and biotic factor,  
Edaphic factors

### **Unit II**

Environmental pollution: Air pollution its source and control measures, Soil  
pollution its source and control measures,  
Noise pollution its source and control measures  
Radioactive pollution its source and control measures

### **Unit III**

Water pollution and its control  
Need for water management  
Measurement of water pollution  
Waste water treatment - physical, chemical and biological treatment processes

### **Unit IV**

Environmental ethics: Issues and possible solution  
Climate change, Global warming  
Acid rain, Ozone layer depletion, nuclear accidents and holocaust

### **Unit V**

Treatment schemes for waste waters of dairy, distillery, tannery and sugar industries  
Solid waste: Sources and management (composting, Vermiculture, and methane  
production  
Environment and human health: Edible vaccines, therapeutic proteins

## **B.Sc BIOTECHNOLOGY III Year Semester II**

**Course Code : BBT 324**

### **Food & Beverage Biotechnology**

#### **Unit I**

Food and Microorganism: Microorganism in food & beverage industry, contamination of food, general principles underlying spoilage and chemical changes

#### **Unit II**

Contamination and spoilage of different kinds of food and beverages: Cereals & cereals product, sugar and sugar products, vegetable and fruits, meat, fish, poultry and eggs, sea food, milk and milk products, canned foods, alcohol & alcoholic beverages, fruit juices & soft drinks etc.

#### **Unit III**

Biotechnology of food, feed and beverages, cultures and fermentation, fermentation of food products. Beverage production: alcohol and alcoholic beverages, fruit juices, soft drinks, feed production, SCP, fats, amino acid, food additives.

#### **Unit IV**

Food beverages & Diseases: Food borne illness due to bacterial food poisoning, infection and intoxication (non bacterial). Biotechnology of food borne disease outbreaks, disease investigation, materials and equipments, laboratory testing, field analysis, interpretation of data and preventive measures

#### **Unit V**

Food hygiene: food sanitation, bacteriology of water and food products, food manufacturing practice. Hazard analysis critical points (HACCP). Food control: International agencies, federal agency and law of state agencies, processing industry and microbial criteria of food.

Principles of food preservation: general principles of asepsis technology, preservation by high temperatures, drying, food additives and radiation.

## **B.Sc BIOTECHNOLOGY III Year Semester II**

**Course Code : BBT 325**

**Genomics and proteomics.**

### **UNIT-I**

Genome evolution and phylogenetics. Origin of Genomes Acquisition of new Genes.

### **UNIT-II**

DNA sequencing- chemical and enzymatic methods. The Origin of Introns, Restriction mapping

### **UNIT-III**

DNA & RNA fingerprinting. The Human Genome.

### **UNIT-IV**

Basic principles of protein structure. Modelling of three-dimensional structure of a protein from amino acid sequence. Modeling mutants

### **UNIT-V**

Evaluating protein structures, Designing Proteins. Analysis of Nucleic acid/protein sequence and structure data, genome and proteome data using Web-based tools.