

# INTEGRATED M. Sc. BIOCHEMISTRY

## SEMESTER –I

COURSE CODE	COURSE TITLE	CREDITS (L-T-P)
GPT 301	MORAL AND VALUE EDUCATION	2(2-0-0)
COMP 302	COMPUTER APPLICATION	2(1-0-1)
MAS 303	BASIC MATHEMATICS-I	3(3-0-0)
PHY 309	BASIC PHYSICS	3(3-0-0)
CHEM311	INORGANIC CHEMISTRY	3(2-0-1)
CHEM312	PHYSICAL CHEMISTRY	3(2-0-1)
CHEM313	ORGANIC CHEMISTRY	3(2-0-1)
<b>TOTAL CREDITS: 19</b>		

## SEMESTER –II

COURSE CODE	COURSE TITLE	CREDITS (L-T-P)
MCE 301	CELL BIOLOGY	3(2-0-1)
MAS 304	BASIC MATHEMATICS-II	3(3-0-0)
PHY 308	BIOPHYSICS	3(3-0-0)
MAS 331	FUNDAMENTAL STATISTICS	3(2-0-1)
MBFT 349	INTRODUCTORY MICROBIOLOGY	3(2-0-1)
BIOL 403	LIFE SCIENCE-I (BOTANY)	3(2-0-1)
BIOL 404	LIFE SCIENCE-II (ZOOLOGY)	3(2-0-1)
<b>TOTAL CREDITS: 21</b>		

## SEMESTER –III

COURSE CODE	COURSE TITLE	CREDITS (L-T-P)
MCE 302	MOLECULAR BIOLOGY	3(3-0-0)
MCE 303	INTRODUCTORY BIOTECHNOLOGY	3(3-0-0)
LNG 304	PROFESSIONAL COMMUNICATION & TECHNICAL WRITING	3(3-0-0)
CHEM 330	ANALYTICAL CHEMISTRY	3(2-0-1)
BCBT 401	BIOCHEMISTRY- I	3(2-0-1)
SES 415	ENVIRONMENTAL STUDIES – I	2(2-0-0)
BCBT 406	BASIC TECHNIQUES IN BIOCHEMISTRY AND INSTRUMENTATION	3(2-0-1)
<b>TOTAL CREDITS: 20</b>		

#### SEMESTER –IV

COURSE CODE	COURSE TITLE	CREDITS (L-T-P)
MCE 401	MOLECULAR GENETICS	3(2-0-1)
TE 401	FUNDAMENTALS OF TISSUE CULTURE	3(2-0-1)
BCBT 402	BASIC PROTEOMICS	2(2-0-0)
BCBT 403	BIOCHEMISTRY-II	3(2-0-1)
BCBT 408	CHEMICAL THERMODYNAMICS	3(3-0-0)
SES 416	ENVIRONMENTAL STUDIES-II	2(2-0-0)
CBBI 501	APPLICATIONS OF BIOINFORMATICS	2(1-0-1)
<b>TOTAL CREDITS: 18</b>		

#### SEMESTER –V

COURSE CODE	COURSE TITLE	CREDITS (L-T-P)
BCBT 404	ENZYMOLGY AND ENZYME TECHNOLOGY	3(2-0-1)
BCBT 405	BASIC IMMUNOLOGY	3(2-0-1)
MCE 402	INTRODUCTION TO PLANT BIOTECHNOLOGY	3(2-0-1)
MCE 404	INTRODUCTION TO ANIMAL BIOTECHNOLOGY	3(2-0-1)
BIOL 545	ANIMAL PHYSIOLOGY	3(2-0-1)
BIOL 546	PLANT PHYSIOLOGY	3(2-0-1)
MCE 501	BIOSAFTY, BIOETHICS& IPR ISSUES	3(3-0-0)
<b>TOTAL CREDITS: 21</b>		

#### SEMESTER –VI

COURSE CODE	COURSE TITLE	CREDITS (L-T-P)
BCBT 501	BIOCHEMICAL ENGINEERING	3(2-0-1)
BCBT 502	INDUSTRIAL BIOTECHNOLOGY	3(2-0-1)
BCBT 506	ANIMAL BIOCHEMISTRY	3(2-0-1)
MBFT 601	FERMENTATION TECHNOLOGY	3(2-0-1)
BCBT 603	MEDICAL AND MOLECULAR DIAGNOSTICS	2(1-0-1)
BCBT 604	PHARMACEUTICAL BIOCHEMISTRY	2(2-0-0)
BCBT 580	SEMINAR-I	1(0-0-1)
<b>TOTAL CREDITS: 17</b>		

#### SEMESTER –VII

COURSE CODE	COURSE TITLE	CREDITS (L-T-P)
BCBT 508	APPLIED BIOCHEMISTRY	3(2-0-1)
BCBT 601	BIOPROCESS & DOWNSTREAM PROCESSING	3(2-0-1)
BCBT 605	IMMUNOTOXIN & DRUG DESIGNING	3(3-0-0)
BCBT 607	BIOTRANSFORMATION & BIOCONVERSION	3(2-0-1)
CHEM710	QUANTITATIVE ANALYTICAL METHODS	3(2-0-1)
MCE 701	MOLECULAR CELL BIOLOGY	3(2-0-1)
BCBT 680	SEMINAR – II	1(0-0-1)
BCBT 702	INTERMEDIARY METABOLISM-I	3(2-0-1)
<b>TOTAL CREDITS: 22</b>		

### SEMESTER –VIII

COURSE CODE	COURSE TITLE	CREDITS (L-T-P)
BCBT 705	INTERMEDIARY METABOLISM-II	3(2-0-1)
BCBT 706	TECHNIQUES IN BIOCHEMISTRY AND INSTRUMENTATION	3(2-0-1)
BCBT 811	PHYSIOLOGICAL BIOCHEMISTRY	3(2-0-1)
BCBT 813	ENZYME TECHNOLOGY	3(2-0-1)
COMP 805	COMPUTER PROGRAMMING	3(2-0-1)
MAS 711	STATISTICS-I	3(2-0-1)
CBBI 801	BIOINFORMATICS	3(2-0-1)

**TOTAL CREDITS: 21**

### SEMESTER –IX

COURSE CODE	COURSE TITLE	CREDITS (L-T-P)
BCBT 801	IMMUNOLOGY & MEDICAL BIOCHEMISTRY	3(2-0-1)
BCBT 803	PLANT BIOCHEMISTRY	3(2-0-1)
BCBT 805	NUTRITIONAL BIOCHEMISTRY	3(2-0-1)
BCBT 812	CLINICAL BIOCHEMISTRY	3(2-0-1)
TE 801	PLANT TISSUE CULTURE TECHNOLOGY	3(2-0-1)
MAS 715	STATISTICS –II	3(2-0-1)
BCBT 780	SEMINAR – III	1(0-0-1)

**TOTAL CREDITS: 19**

### SEMESTER –X

COURSE CODE	COURSE TITLE	CREDITS (L-T-P)
BCBT 899	DISSERTATION	15(0-0-30)

**TOTAL CREDITS: 15**

**CREDITS GRAND TOTAL: 193**

# INTEGRATED M. Sc. BIOCHEMISTRY

## SEMESTER- I

**PHY 309**

**Basic Physics**

**3 (3-0-0)**

### **Unit 1: Optics**

Interference: Coherent sources, conditions of interference, Fresnel's bi-prism experiment, interference in thin films, wedge shaped film, Newton's ring.

Diffraction: Single slit and double slit diffraction, diffraction grating, Raleigh's criterion of limit resolution, resolving power of telescope and microscope.

Polarization: Polarization of light, Brewster's law, Malus law, phenomenon of double refraction, geometry of calcite crystal, optic axis, principal section, ordinary and extraordinary rays, construction and working of Nicol prism. Plane, circularly and elliptically polarized light. Their production and analysis. Retardation Plates, optical activity, specific rotation, polarimeters.

### **Unit 2: X-rays**

Origin of X-rays, continuous and characteristic X-ray spectra, Mosley's law, absorption of X-rays, Diffraction of X-rays, Bragg's law, Bragg's spectrometer, practical applications of X-ray, X-ray Machine.

### **Unit 3: Laser**

Spontaneous and stimulated emission of radiation, Einstein's Coefficients. Components of laser. Type of laser and their working and application. Classes of laser equipments.

### **Unit 4: Electromagnetic Theory.**

Gauss's Law, Poisson and Laplace equation, Maxwell's equations, Basic concepts of Electromagnetic waves and its solution in free space. Para, dia, ferro, antiferro and ferri magnetic materials. Hysteresis and magnetic circuits.

### **Reference books:**

1. Fundamentals of Optics  
Jetkins & White.
2. Perspectives of Modern Physics  
Beiser
3. Electrodynamics  
David Griffith.
4. Laser – Theory & Applications  
Thyagranjan / Ghatak
5. Fundamentals Of Physics  
Resnick & Halliday.
6. Engineering Physics  
Uma Mukherjee.

**MAS 303**

**Basic Mathematics I**

**3 (3-0-0)**

**Algebra:** Theory of quadratic and cubic equations. partial-fractions, Binomial-Theorem (for +ve index). Elementary concepts of Permutations and Combinations. Exponential and logarithmic series. Evaluation of Determinants using their properties. Solution of homogenous and non homogenous simultaneous linear equations. Matrices: Types, addition, subtraction, multiplication, adjoint and inverse. Evaluation of rank.

**Trigonometry:** Trigonometrical- ratios, sum and difference relations of two angles, relation between product and sum or difference of two angles, multiple and sub multiple angle relations, Trigonometrical-identities, relations between sides and angles of a triangle, properties of triangle, Height and distance.

Complex number: De- Moivre's Theorem and its simple applications.

**Coordinate-Geometry:** Points on a plane; distance between two points, Ratio formula; angle of a triangle; equation of a straight line. Standard equations of conics and their identification.

**CHEM 311**

**Inorganic Chemistry**

**3(2-0-1)**

**Nature of Covalent bond & shape of molecules:** - Valence bond theory, hybridization, VSEPR theory, molecular orbital theory (MOT), LCAO (Linear combination of atomic orbital). Approximation for diatomic homo and heteroatom molecules .

**Nuclear & Radiochemistry:** - Nuclear shell model, Mass defect, packing fraction, Binding energy, Natural radioactive disintegration , Concept of Half Life, Group displacement Law, Artificial radioactivity, Induced radioactivity, Nuclear fusion and Nuclear fission reaction.

**Coordination Chemistry:** - Ligands, coordination number complex ion, IUPAC rules for coordination compounds, Nomenclature, Werner's theory of coordination, Pauling theory, Crystal field theory.

**Organometallic Compounds:** - Classification, Nature of carbon metal bond, preparation, properties.

**Biochemical Significance of Inorganic metals system:** - Introduction, Na, K, Cl, Fe, Zn, Co and their significance in plant and animal kingdom.

**Inorganic Polymers:** - Classification of inorganic polymers, preparation, Silicones.

**A general idea of Boranes, Metal Carbides, Metal Carbonyls, Metal Nitrosyls.**

**Practicals:-**

Semi micro Analysis of inorganic salts and Mixtures.

**CHEM 312**

**Physical Chemistry**

**3(2-0-1)**

**Ionic equilibria:** concepts of acids and bases, their related strength, buffer solution and its pH, hydrolysis of salts, acids -base indicators ostwalds and quinonoids theory, solubility product

**Chemical kinetics:** order and molecularity, differential rate laws and integrated rate laws equations for zero, 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> order reactions (derivations included) significance of rate constant and its evaluation, time for definite fractional change of reaction, determination of order, Effect of temperature on the rate of reactions. Complex reactions (consecutive, side, parallel, chain reactions), collision theory, linderman theory, enzyme kinetics

**Electro chemistry:** reversible and irreversible cells, EMF of a cell and free energy, nernst equation, equilibrium constant, standard electrode potential, types of reversible electrodes, Electrochemical series, Over voltage, Fuel cells, applications of EMF measurements, determination of solubility product, pH, dissociation constant of acids, hydrolysis constant, solubility of soluble salts, potentiometric titrations.

**Practicals :**

1. Determination of rate constant and order of reaction for hydrolysis of ester by an acid.
2. To study the kinetics of dissociation of Magnesium in dilute HCl.
3. To determine the order of saponification of ethyl acetate with NaOH.
4. Determination of density of liquid by density bottle.
5. To find surface tension of the given liquid.
6. To find the relation and absolute viscosity of given liquid.
7. Determination of carbonates, bicarbonates and total alkalinity in water.

**CHEM 313**

**Organic Chemistry**

**3(2-0-1)**

**Unit 1: Carbohydrates:-** Introduction, Classification, Monosaccharide Stereochemistry, Fischer Projection, Structure of D-glucose, cyclic structure of D-glucose, Haworth projection, properties. Oligosaccharides structure of sucrose, Polysaccharides:- Structure of starch, Cellulose and glycogen.

**Unit 2: Amino Acids:-** Classification, Essential and Non essential Amino Acids, Optical activity, synthesis. Properties, Zwitter ion and Isoelectric Point.

**Unit 3: Proteins:-** Classification, Primary, Secondary and Tertiary structure. Properties, Colloidal nature, Denaturation, Test for proteins.

**Unit 4: Fats & Oil:-** Composition of fats, Introduction, Nomenclature of fats, Physical and Chemical properties of fats, Rancidity, Analysis of fats chemical constants, Specification Number, Iodine Number, Acid value, Reichert Miessl value, Polenski value.

**Unit 5: Alkaloids:-** Introduction, Classification, Determination of molecular structure of Alkaloids, Properties, Nicotine, Coniine.

**Unit 6: Terpenoids:-** Introduction, Classification, Structural feature of Terpens or Isoprene Rule, Myrcene, Citral.

**Unit 7: Nucleic Acids:-** Chemistry of Nucleic acids, Structure and composition of purine and pyrimidines, Nucleosides, Nucleotides, general composition of DNA & RNA.

#### **Practicals:-**

1. Identification of sugars and organic acids.
2. Test for proteins and amino acids.
3. Test for fats, fatty acids, acidity and Saponification.
4. Identification of Phenol, Acids, Carbonyl compounds, Hydrocarbons.

#### **GPT 301**

#### **Moral and Value Education**

**3(3-0-0)**

My country and my people, the many Indians, being and becoming Indian, nationalism and internationalism

Some life issues – love, sex and marriage, men and money – value of time, meaning of work, human communication, human suffering, addition, ecology, women issues

Understanding ones neighbor, neighborhood groups: their structure and their functions patterns of social interactions of group dynamics. Preparation for a career, choice of vocation, motivation of study and research, and the present educational system: curriculum and syllabus, teaching methods, examination and work experience

Definition of value education, moral and ethics, laws and morale based on Ten Commandments and two great commandments

Discovery of self, self – awareness, growth of intellect – mans spiritual life emotions, will respect the rights of life, liberty, property, truth reputation

Sin, origin of sin, manifestation of sin, the result of sin, the remedy of sin, sin as an act, sin as a state, sin as a nature.

#### **COMP 302**

#### **Computer Application**

**2(1-0-1)**

**Introduction to windows:** Start menu and accessories, windows explorer, my computer. Introduction to networking of computers.

**Internet-**internet, TCP/IP, IP address, Basic C and C++,Oracle.

Information networks: Internet, world wide web, web browsers, HTTP, HTML and URLS, EMB.

## SEMESTER –II

**MAS 304**

**Basic Mathematics II**

**3 (3-0-0)**

**Differential calculus:** Functions, limit, continuity and differentiability, differential coefficients of standard functions (algebraic, trigonometric, exponential, logarithmic etc.), rules for differentiation of composite, inverse, implicit and parametric functions. Higher order derivatives. Tangent and normal, Maxima and Minima.

**Integral Calculus:** Definite integration of standard functions, integration by substitution, parts, partial fraction. Integration of rational, irrational trigonometric function etc. Definite integrals and properties. Its application in evaluating area and volume.

**Vector Algebra:** Definition and identification of vectors and scalars, Linear operations in vectors, linear combination of vectors, linear independence and dependence. Dot and vector products. Triple Product.

**MCE 301**

**Cell Biology**

**3 (2-0-1)**

**Unit 1. An introduction to cell biology:** History of cell biology. Development of cell theory. Modern cell biology.

**Unit 2. Diversity of cell size and shape:** Structure of prokaryotic cells (bacteria, fungi, virus, cyanobacteria, mycoplasma etc.). General organization of eukaryotic cells, cell shape, cell size, cell volume and cell number.

**Unit 3. Organization of cell:** Cell wall, plasma membrane, their structural organization and functions. Membrane bound cell organelles - nucleus, endoplasmic reticulum, golgi apparatus, mitochondria, chloroplast, lysosomes, peroxisomes and vacuoles. Non-membrane bound cell organelle- ribosome. Cytoskeleton-microtubules, intermediate filaments and microfilaments.

**Unit 4. Cell growth and division:** Cell cycle, kinds of cell division, amitosis, mitosis, meiosis, comparison between mitosis and meiosis, crossing over, significance of cell division.

### Practicals

1. Microscopy- simple and compound microscope
2. Preparation of stains
3. Grams staining
4. Study of cell division - different stages of mitosis
5. Differential staining of blood cells
6. Hanging drop method for motility of bacteria

**MAS 331**

**Fundamental Statistics**

**3 (2-0-1)**

Definition & applications of Statistics, Testing of Hypothesis: Concept of Hypothesis, Degrees of freedom, Level of significance Measures of central – tendency, Measures of dispersion, standard error of mean. Coefficient of variation Probability: Definition & applications, numerical- problems.

Simple-correlation between two variables (definition, properties & numericals).

Regression- Lines : Definition & uses, Method of least square, Concept of regression- coefficient.

- Books:**
1. Probability & Statistics for Engineers : R.A.Johnson.
  2. Probability & Statistics for Engineers: A.J.Haten
  3. Fundamental of Mathematical Statistic : Gun Gupta & Das Gupta.
  4. Fundamental of Mathematical Statistics: Gupta & Kopoor.

**MBFT 349**

**Introductory Microbiology**

**3(2-0-1)**

Definition, Scope and History of Microbiology

Cellular organization of prokaryotic and eukaryotic cells  
Difference between prokaryotic and eukaryotic cells  
General characteristics and nature of Bacteria, Mycoplasma, Rickettsiae, Chlamydiae, Actinomycetes, Protozoa, Fungi, Algae & Viruses

### Practical

1. Familiarity with equipment to be used in Microbiology Laboratory.
2. Cleaning, washing and sterilization of glass wares
3. Observation of permanent slides to study the structural characteristics of common bacteria , fungi, algae & protozoa

## PHY 308

## Biophysics

3(3-0-0)

**Unit 1 : PHYSICAL TECHNIQUES:** Diffusion, Sedimentation, Osmosis, Viscosity, their definition , factors Influencing them and their application in biology.

**Unit 2: SPECTROSCOPIC TECHNIQUES:** Explanation of Absorption Spectroscopy, Fluorescence, Phosphoresce. An introduction to NMR, ESR, IR, Visible/ UV, X-rays & Raman Spectroscopy & their application in Biomedical field.

**Unit 3: RADIATION BIOPHYSICS:** Ionizing Radiation, Interaction of Radiation with matter, Dosimetry & Application of Radio isotopes. Biological effect & radiation effects on living system.

**Unit 4: THERMODYNAMICS:** Thermodynamic System, Equilibrium, laws & their applications. Different type of processes, Thermodynamic variables & Entropy. Thermodynamic potentials & Relations Maxwell's, Equations, Fundamental equation of heat flow.

### Reference books:

1. A Text book of Bio Physics (*R.N. Roy*)
2. Essential of Bio Physics (*P. Narayanan*)
3. Heat & Thermodynamics (*Brij Lal & Subrahamanyam*)
4. Heat & Thermodynamics & Statistical Physics ( *SatyaPrakash*)
5. Basic Thermodynamics ( *E. Guha*)
6. Modern Physics (*Richtmyer*)

## BIOL 403

## Life Sciences I (Botany)

2 (1-0-1)

**Unit 1:** Study of plants and its parts (Root, Stem, Leaf, Inflorescence, Flower and Fruit) Study of different kinds of seeds and their germination

**Unit 2:** Classification of angiosperm with particular reference of Bentham and Hooker system of classification, its merits and demerits. Distinguishing characters of the following families and their economic importance: Leguminaceae, Liliaceae Solanaceae Poaceae

**Unit 3:** Study of structure and function of various tissues

**Unit 4:** Plant and environment: Atmosphere, Water, Light, Temperature, Soil and Biota. Ecosystem Structure, Abiotic and Biotic components, Food chain, Green house effect

**Unit 5:** Economic botany (Specific names and precise plant parts used) of important plant used as cereals, pulses, vegetables, medicines and timber.

### Practical

1. Study of primary structure of root, stem and leaves
2. Study of stomata
3. Description and identification of important families (a) Leguminaceae (b) Liliaceae (c) Solanaceae (d) Poaceae
4. Study of economically important plants (cereals, pulses, vegetables, medicinal plants)

## 5. Demonstration of Osmosis, Transpiration, Photosynthesis, Respiration

**BIOL 404**

**Life Sciences II (Zoology)**

**2(1-0-1)**

**Unit 1:** General principles of classification of animal kingdom with special reference to orders of agricultural importance

**Unit 2:** Life history and control of important animals parasitic on man and animals

**Unit 3:** Economic importance of following animals (a) Indian Snail (b) Slugs (c) Crabs (d) Mammals (e) Birds (f) Earthworm

**Unit 4:** Life history and brief rearing methods of some useful insects (a) Honeybee (b) Lac insects (c) Silk worm

**Unit 5:** Identification of poisonous and nonpoisonous snakes of India. Symptoms of snakebite and antidotes

**Unit 6:** Crustacea and Mollusca

**Unit 7:** Local fishes of economic importance, planning and implementation of fish farming

### **Practical**

1. Study of the life cycle of the honeybee, silkworm and lac insect by preparation slides and charts
2. Study of the general anatomy of an economically important insect by the procedure of dissection
3. Study of microscopic preparation (Permanent mounts) under the microscope
4. Study of morphology (external form and structure) of some of the preserved animals in the laboratory.

## SEMESTER –III

**CHEM 330**

**Analytical Chemistry**

**3 (2-0-1)**

**Unit 1: General Principles of Analytical Chemistry:** Volumetric Analysis. Solutions, Preparation of primary and secondary standard solutions. Neutralization (Acid Base) titration, Iodometry, Iodimetry, Permagnetometry Volumetric Determination of calcium. Gravimetric Analysis: Principles and methodology, Estimation of calcium.

**Unit 2: Colorimetry:** Principle, Lambert's and Beer's Law. Absorption Law (Derivation required). Methodology and applications.

**Unit 3: Thermometric analysis:** Thermogravimetric Analysis- types, Instrumentation, methodology and applications.

**Unit 4: Potentiometric titrations:** Electrode system; Ion selective Electrodes; Ion selective Membrane electrode; Advantages of Potentiometric titrations: Applications of Potentiometric titrations.

**Unit 5: Polarimetry & Flourimetry:** Instrumentation, methodology and applications.

**Unit 6: Spectrophotometry:** Principle, instrumentation, methodology and applications.

**Unit 7: Spectroscopic Techniques:** Introduction of UV, IR & Mass Spectroscopy.

### **Practicals:**

- 1) Preparation of primary and secondary standard solutions.
- 2) Standardization of secondary standard solution.
- 3) Preparation and standardization of an acid solution.
- 4) Preparation and standardization of solution of  $\text{KMnO}_4$
- 5) Volumetric determination of Fe by  $\text{KMnO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$  solution.
- 6) Determination of Calcium Volumetrically.
- 7) Gravimetric Determination of sulphate or calcium.
- 8) Verification of Beer's Law.

**BCBT 401**

**Biochemistry- I**

**3(2-0-1)**

**Unit 1: Chemical structure of proteins** and their properties, cellular membrane and transport phenomenon.

**Unit 2: Intermediary metabolism-** concept of anabolism and catabolism, metabolism of carbohydrates, lipids and amino acids and their interrelationship.

**Unit 3:** Biological oxidation, electron transport system, oxidative phosphorylation, free energy changes in biochemical reactions, energy changes in biochemical reactions, energy rich compounds.

**Unit 4:** Metabolism of nucleic acids and proteins.

**Unit 5:** Hormones: regulation of metabolism by various hormones.

### **Practicals :**

1. Specific group tests for carbohydrates
2. Specific group tests for amino acids.
3. Specific tests for lipids.
4. Determination of mil protein, fat and lactose.
5. Determination of acidity in sample.

**SES 415**

**Environmental Studies I**

**2(1-0-1)**

**Unit 1:** The Multidisciplinary Nature of Environmental Studies

Definition, Scope and importance: Need for public awareness

**Unit 2: Ecosystem**

Concept of an ecosystem, Structure and function of an ecosystem, Procedures, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction types, characteristics 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)

### **Unit 3: Social Issue and the Environment**

Form Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain harvesting, watershed management, Resettlement and rehabilitation of people its problems and concerns. Case studies, Environmental ethics: Issues and possible solutions. Wasteland reclamation: Consumerism and waste products: Environment ethics, issues and possible solutions, 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).

## **MCE 303**

### **Introductory Biotechnology**

**3(3-0-0)**

**Unit 1. Introduction:** Historical development of biotechnology. Basic concepts of biotechnology. Definition and descriptions of some important terminology in biotechnology.

**Unit 2. Branches of biotechnology:** Study of various branches of Biotechnology including Plant, Animal, Medical, Industrial, Environmental, Marine Biotechnology, Bioinformatics, etc.

**Unit 3. Biotechnology in India:** Biotechnology and developing world- concerns and consequences. Role of biotechnology in Indian industry. Impact on agricultural sector.

**Unit 4. Biotechnology and other disciplines:** Biotechnology- an interdisciplinary pursuit, a three component central core, product safety. New trends in biotechnology.

**Unit 5. Applications and scope of biotechnology:** Practice of biotechnology in medicine, industry, agriculture, live stock improvement and environment. Future perspectives.

## **MCE 302**

### **Molecular Biology**

**3(2-0-1)**

**Unit 1: Introduction:** Development of molecular biology. Historical perspectives. Concepts in molecular biology.

**Unit 2: Structure and properties of nucleic acids:** Structure of nucleotides, DNA double helix, helical conformations and DNA topology. Types of DNA and RNA- A, B, Z forms of DNA, mRNA, tRNA, rRNA, hnRNA, snRNA. Physical and chemical properties of DNA.

**Unit 3: DNA protein interaction:** Molecular aspects of protein-nucleic acid binding. DNA binding motifs in proteins- Helix- turn - helix, Zinc finger motifs, Leucine zipper, HMG box, etc.

**Unit 4: Gene organization:** Gene structure and architecture, gene clusters, split genes, overlapping genes, pseudogenes, operon, open reading frames, transposons, oncogenes. Range of genome size. C value and gene numbers. Reassociation kinetics, Repetitive DNA - msatellite DNA.

## **BCBT 406**

### **Basic Techniques in Biochemistry & Instrumentation**

**3(2-0-1)**

**Unit 1:** Electrophoresis: Principle and applications, paper and gel electrophoresis (agarose and PAGE), Isoelectric focusing.

**Unit 2:** Centrifugal techniques: Principle and types, Differential centrifugation, Ultracentrifugation.

**Unit 3:** Restriction analysis of DNA: Competent cell preparation and transformation of DNA. DNA footprinting, DNA finger printing, Polymerase chain reaction (PCR).

**Unit 4:** Radioisotopic and other techniques: Detection and measurement of isotopes (GM and scintillation Counters).

**Unit 5:** Molecular Biology Techniques: Isolation & purification of DNA, RNA and Plasmid DNA. Isolation of m-RNA from mammalian cells, Sequencing of protein and nucleic acids, Chemical synthesis of nucleotides.

**Unit 6:** Chromatography: Ion exchange chromatography, affinity chromatography, HPLC, Column chromatography

**Practical:**

1. Preparation of gels (agarose, PAGE) for electrophoresis.
2. Separation of different proteins by electrophoresis.
3. Protein estimation by Folin-Lowry methods.
4. Protein estimation by Biuret methods.
5. Identification of amino acids by paper chromatography.
6. Separation of amino acids, ions etc by column chromatography.

**LNG 304**

**Professional Communication and Technical Writing**

**3(3-0-0)**

**Language:**

1. Concerned (Subject, Verb Agreement)
2. Antecedents (Noun, Pronoun Agreement)
3. Modifiers (Adjectives, Adverbs, Participle)
4. Prepositions (Usage)
5. Inflection (Noun, Verb)
6. Determiners (General, Specific)
7. Word enrichment (Antonyms, Synonyms, Homonyms, Acronyms, Orthography)
8. Voice

**Communications:**

1. Kinds
2. Different Speeches (Welcome Speech, Voice of thanks)

**Technical Writing:**

1. Importance
2. Objectives
3. Audience
4. Methods
5. Essentials (Documentation, Visuals, Sentences, Punctuation)
6. Process
7. Curriculum Vitae
8. Interview
9. Letter (Components, Format, 5 Kinds)
10. Memos (Administrative, Business)
11. Report (Format, Style, Periodical and Miscellaneous Reports)

**Speech:**

1. Stress
2. Intonation
3. Accent
4. Rhythm

## SEMESTER –IV

**BCBT 403**

**Biochemistry – II**

**3 (2-0-1)**

**Unit 1:** Protein Chemistry: Structure of proteins, methods for determining the 3D structure of a protein – X-ray diffraction, NMR, Mass spectrometry, protein homology among species, protein denaturation and folding, assisted folding, edman degradation, glycoprotein, lipoproteins, proteoglycans, phosphor proteins, chromoprotein, bacterial and viral protein (HIV, HBV, toxins, etc.)

**Unit 2:** Biomembranes: Molecular constituents of membranes, movement of molecules through membranes, energetics of membrane transport system, biosignalling, voltage gated ion channels, transporters and group translocation with examples.

**Unit 3:** Sensory systems: Olfaction, taste, vision, hearing and touch with their biochemical mechanisms.

**Unit 4:** Physiochemical properties of nucleic acids: Hydrogen bonding, bond length, tautomerism and its significance in nitrogen bases, DNA denomination, and factor responsible for hypochromicity. Renaturation of DNA, annealing, wallace's rule, hybridization, ionization, enzymatic of nucleic acids, effect of acids and alkalis on nucleic acids, DNA super coiling and nucleic acid mutations.

### **Practicals:**

1. Fractionation of egg proteins.
2. Detection of alpha – amylase activity in saliva.
3. Determination of sugar/glucose I urine (Benedict's Trirometric method).
4. Identification of blood constitution.
5. Extraction of total nucleic acid from plant tissues.
6. Extraction of RNA from yeast.
7. Assay of protein by Biuret's method.

**SES 416**

**Environmental Studies-II**

**2(2-0-1)**

### **Unit 1: 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 of problems, water logging salinity, case studies.
- e) **Energy resources:** Growing energy needs, renewable and non-renewable energy source, use of alternate energy sources, case studies.
- f) **Land resources:** Land as a resource, and degradation, man induced landslides, soil erosion and desertification.

### **Unit 2: Biodiversity and its Conservation**

**Introduction-**Definition, genetic species and ecosystem diversity, Biographical classification of India, Value of biodiversity, consumptive use, productive use social ethical, aesthetic and option values, Biodiversity at global national and local levels, India as a mega-diversity nation: Hot-spots.

**TE 401**

**Fundamentals of Tissue Culture**

**2(1-0-1)**

**Unit 1: Plant Tissue Culture:** A historical view, organization of tissue culture laboratory, aseptic techniques, media formulation, clonal propagation vs tissue culture, totipotency, growth differentiation and morphogenesis in tissue culture, various types of aseptic cultures and culture techniques.

**Unit 2: Animal Tissue Culture:** Basic techniques, organ culture, media formulation for animal cell, initiation of cell culture, evolution & maintenance of cell lines, Suspension culture & Immobilized culture.

**Unit 3: Application of tissue culture techniques:** Somoclonal and gametoclonal variation, protoplast fusion and somatic hybridization, cybridization, haploid and monoploid production, secondary transformation, production of metabolites, artificial seeds, preservation of genetic resources, cryopreservation, application of tissue culture for plant improvement.

#### **Practicals:**

1. Laboratory equipments used in Plant Tissue culture
2. Plant Growth Hormones
3. Media preparation
4. Preperation and Sterilization of explants
5. Callus induction
6. Meristem culture

#### **BCBT 402**

#### **Basic Proteomics**

**2(2-0-0)**

**Unit 1:** introduction, birth of large scale biology, the genome transcriptome and proteome, functional genomics at the DNA and RNA levels, transcriptomics, large-scale mutagenesis, RNA interference, the need for proteomics, the scope of proteomics, sequence and structural proteomics, Expression proteomics, interaction proteomics, functional proteomics , the challenges of proteomics.

**Unit 2:** strategies of protein separation, protein separation in proteomics-general principles, principles of two dimensional gel electrophoresis, general principles of protein separation by electrophoresis, separation according to charge but not mass-iso-electric focusing, separation according to mass but not charge-SDS-PAGE, two dimensional gel electrophoresis proteomics, principles of liquid chromatography in proteomics.

**Unit 3:** protein expression mapping, protein expression mapping in mammalian systems, microbial system and plat system, quantitative protein expression mapping by metabolic labeling of proteins with radioactive amino acids metabolic labeling of proteins with stable isotopes, in vitro labeling of proteins using isotopes –coded affinity tags.

**Unit 4:** current status of and future of proteomics in health and care, plant biochemistry and animal biochemistry.

#### **MCE 401**

#### **Basics of Molecular Genetics**

**3 (2-0-1)**

**Unit 1. Introduction:** Basic concepts in molecular genetics. Prokaryotic and Eukaryotic genome. Concept of gene and central dogma.

**Unit 2. Transcription:** Mechanism of transcription in prokaryotes and eukaryotes. Transcription of protein coding genes- mRNA. Post transcriptional modifications - 5\_capping, poly A tailing and mRNA splicing in eukaryotes.

**Unit 3. Translation:** Introduction to protein synthesis. The nature of genetic code. Mechanism of translation in prokaryotes and eukaryotes. Post translational modification of proteins.

**Unit 4. Regulation of gene expression:** Gene regulation in prokaryotes - *lac* and *trp* operons as model systems. Gene regulation in eukaryotes – Transcriptional level control, RNA processing level control, translational level control, post translational level control.

**Unit 5. Gene mutation:** Mutagenesis. Causes of mutation – spontaneous and induced. Types of mutagens - physical and chemical. Classification of mutations. Molecular basis of gene mutation.

#### **Practicals**

1. Structural elucidation of nucleotides and nucleic acids.
2. Study of DNA and RNA models
3. Extraction of proteins from plant tissues

#### 4. Estimation of proteins by Lowry and Bradford methods

**BCBT 408**

**Chemical Thermodynamics**

**3(3-0-0)**

**Unit 1: Introduction To Thermodynamics Terms** (System, surrounding, boundaries etc.) open and closed loop systems, isolated systems, thermodynamic variables, extensive and intensive properties.

**Unit 2: Thermodynamic process-** lost thermal, adiabatic process, isobaric, isochoric, cyclic and irreversible processes.

**Unit 3: Laws of thermodynamics-** thermal equilibrium, zero law, first law, second law of thermodynamics, energy concept, law of conservation of energy, concept of enthalpy, entropy.

**Unit 4: Reactive systems,** degree of reaction, reaction equilibrium, laws of mass action, Gibbs functional change heat of reaction, fugacity + reactivity, construction, enthalpy of formation, laws for reaction systems. Air cycle, Otto cycle, work done in cycles, thermal efficiency.

**Unit 5: Refrigeration-** Introduction to principles of vapors compression cycle.

**CBBI 501**

**Applications of Bioinformatics**

**2 (1-0-1)**

**Unit 1:** Bioinformatics and Internet: Internet Basics, FTP, www, connecting to Internet, Electronic mail, internet resources.

**Unit 2:** The NCBI data model: Introduction, Seq-id, Sequence, collection of sequence, annotation of sequence, describing sequence.

**Unit 3:** GenBank Sequence Database: Introduction to structure, Primary and secondary database,

**Unit 4:** Sequence Alignment And Database Searching : FASTA , BLAST ,

**Unit 5:** Multiple Sequence Alignment

**Unit 6:** Phylogenetic Analysis: Fundamental of Phylogenetic model, Tree interpretation, Tree building and tree evaluation, Phylogenetic software.

**Unit 7;** Introduction to Structure , PDB , MMDB , Structure file format , visualizing structure information , Structure viewers , structure similarity searching , Advanced structure modeling.

**Unit 8:** Comparative Genome Analysis: Introduction, application, genome analysis and annotation.

#### **Practicals:**

1. Understanding Linux Operating System and Commands.
2. Introduction to NCBI.
3. Using Entrez to search Literature Databases.
4. Retrieving DNA sequence from GenBank and analyzing various formats of the data stored.
5. Retrieving Protein sequence from GenPept (NCBI) and Expasy.
6. Analyzing Protein Sequences.
7. Analyzing DNA sequence.
8. Sequence alignment using BLAST (Basic Local Alignment Search Tool).
9. Sequence alignment using FASTA.
10. Multiple sequence alignment using ClustalW.

## SEMESTER –V

**BCBT 404**

### **Enzymology and Enzyme Technology**

**3(2-0-1)**

**Unit 1:** Introduction of enzymes: General properties and significance, classification and nomenclature. Terms and definition in enzymology: enzyme activity, specific activity, turnover number, active site, isoenzyme, marker enzyme Multienzyme complex, extracellular enzymes, extremozymes, abzymes, ribozymes, induced enzyme etc

**Unit 2:** Factor affecting enzyme activity: pH, Temperature, substrate concentration etc. Isolation, purification and localization of enzyme, techniques involved in enzyme assays.

**Unit 3:** Enzyme kinetics: steady rate kinetics, Derivation of Michaelis-Menten equation using steady state/equilibrium kinetics, plots of Lineweaver- Bruke etc. mechanism of substrate and multi-substrate enzyme catalyzed reaction.

**Unit 4:** Regulation of enzyme activity: Covalent modification, enzyme inhibition and kinetics. Allosteric enzyme: feed back inhibition, allosteric model concerted and sequential, co-operativity.

**Unit 5:** Mechanism of enzyme action and concept of active site: Vis-a-vis lysozyme, chymotrypsin, alcohol dehydrogenase, glycerldehyde 3 phosphate dehydrogenase, proteases.

**Unit 6:**Enzyme Technology: Commercial production of enzymes, preference of extracted enzymes over whole organism, immobilization of enzymes, example of enzyme engineering, application of enzyme(therapeutic uses, analytical uses, manipulated uses etc.), uses of enzyme in solutions, enzyme reactors, biphasic system, Bi and poly functional enzymes, solvent engineering.

#### **Practical:**

1. Determination of protein
2. Determination of salivary amylase
3. Activity of effect of salt on salivary amylase
4. Detection of effect of pH on enzyme activity
5. Determination of Acid/Alkaline phosphatase
6. Determination of enzyme kinetics
7. Separation of protein by PAGE
8. Identification of extra cellular enzymes like protease, oxidase, urease, catalase and lipase

**BCBT 405**

### **Basic Immunology**

**3(2-0-1)**

**Unit 1: Basic terminology:** Infection, pathogen, antigen, antibody, bacterial and viral antigens, haptens, adjuvants, immunogens interferons, epitopes, paratopes, lymphokines

**Specific and non-specific immune response:** cellular basis of immunity, humoral and cell mediated immunity, biochemistry of immunoglobulins (structure, types, property and function),

**cells of immune system:** cells involved in adaptive immune response i.e. B and T cells, cells involved in innate immune response- macrophages, dendritic cells, phagocytes, mast cells granulocytes, etc.

**Unit 2: Organs of immune system:** primary lymphoid and secondary lymphoid organs, their structure and function. Major Histo Compatibility complex (MHC class I and class II), their structure and function. Chemistry of antigen-antibody interactions, precipitation and agglutination.

**Unit 3:** Structure of T-cell receptors and their comparison with analogous antibody molecule. Natural Killer cell, Their structure and function. Superantigens and Antibody dependent cell mediated cytotoxicity (ADCC).

**Unit 4: Immunodeficiency diseases:** Primary B and T cell deficiency diseases, Autoimmunity, Hypersensitivity. Principles of RIA, ELISA and immunoelectrophoresis (Rocket immunoelectrophoresis), use of monoclonal antibodies in immunodiagnosis and immunotherapy.

#### **Practical:**

1. To prepare blood smear.
2. Separation of serum and plasma from blood.

3. Qualitative tests of important constituents of plasma and serum.
4. Separation of plasma proteins (i.e. Fibrinogen, globulin, and albumin).
5. Determination of E.S.R. of any blood sample.
6. Preparation of antigen from blood.
7. Determination of the blood group.
8. Determination of the haematocrit value of the blood sample.
9. Use of widal kit for rapid quantitative slide test.
10. Determination of density of blood.
11. Determination of bleeding and clotting time of blood.
12. Preparation of haematin crystals.

**MCE 402**

**Introduction to Plant Biotechnology**

**3 (2-0-1)**

**Unit 1. Introduction to plant biotechnology:** Definition. History and development of plant biotechnology. Modern trends in plant biotechnology.

**Unit 2. Gene transfer in plants using *Agrobacterium*:** Ti plasmids, transfer of T-DNA, construction of binary and co-integrate vector systems. *Agrobacterium* mediated leaf disc transformation.

**Unit 3. Direct gene transfer in plants:** Physical (Particle gun delivery, electroporation, microinjection, macroinjection, electroinjection, fiber mediated DNA delivery, Laser induced DNA uptake, Sonication) and Chemical methods of gene transfer (Poly ethylene glycol, Poly vinyl alcohol, Calcium phosphate)

**Unit 4. Applications of plant biotechnology:** Improving agronomic traits – genetic manipulation of plants for salt resistance, herbicide resistance, fungi and virus resistance, insect and other pest resistance. Modification of production traits - delayed fruit ripening, improving seed storage proteins.

**Practicals**

1. Safety aspects and precautions to be taken in Biotechnology Laboratory
2. Preparation of reagents, stock solutions and buffers for plant DNA isolation.
3. Study of Lab wares used for isolation of DNA
4. Isolation of genomic DNA from plant tissues by CTAB method.
5. Purification of crude DNA samples.

**MCE 404**

**Introduction to Animal Biotechnology**

**3(2-0-1)**

**Unit 1. Introduction to animal biotechnology:** Definition, history, importance and scope of animal biotechnology. Applications of animal biotechnology.

**Unit 2. Gene manipulation of animals:** Animal viral genome, animal cloning vectors. Gene transfer methods in eukaryotic systems - retroviral vector method, DNA microinjection method, engineered embryonic stem cell method. Selection of clones by using different methods.

**Unit 3. Transgenic animals:** Production of transgenic mice, rabbits, fish, sheep, goat, cattle, pig, etc.

**Unit 4. Application of animal biotechnology:** Transgenic animals as bioreactors- recombinant proteins produced by animal bioreactors. Transgenic animals as models of human diseases. Xenotransplantation. Embryo transfer technologies in cattle and its application.

**Practicals**

1. Handling of laboratory animals - mice, rabbits etc.
2. Isolation and purification of DNA from blood samples
3. Isolation and enumeration of bacterial population from meat samples
4. Development of Cell Lines from Egg Embryo
5. Screening of UV mutation in *E. coli*

**BIOL 545****Animal Physiology****3 (2-0-1)**

**Unit 1:** Physiological process in animals with special reference to man. Functional anatomy of the digestive & respiratory systems. Physiology of digestion, gland in the alimentary canal & their secretions. Physiology of respiration, mechanism of breathing.

**Unit 2:** Physiology of blood circulation The blood, plasma & tissue fluid, blood corpuscles, hemoglobin, Blood groups & clotting of blood.

**Unit 3:** Physiology of Nervous System. Link between environment & central nervous systems. Nerve Impulse & reflex action.

**Unit 4:** Endocrine system of various glands & their secretions.

**Practical**

1. Study of frog/human blood film.
2. Haemolysis: effect of isotonic, hypotonic & hypertonic solution on
3. Erythrocyte.
4. Preparation of haemin crystals.
5. Study of blood group.
6. Study of secretions of pituitary, thyroid, adrenal, pancreas, testes & ovary
7. From prepared slides.

**BIOL 546****Plant Physiology****3 (2-0-1)**

**Unit 1:** Water relation-Movement of water across membranes Ascent of sap, Transpiration, Translocation of organic substances

**Unit 2:** Study of macro & microelements nutrition. Mechanism of photosynthesis, factors regulating photosynthesis. Carbon fixation in C<sub>3</sub>, C<sub>4</sub> plants. CAM, structure & function of chloroplast.

**Unit 3:** Mechanism of respiration, respiratory substrates & ETC (electron transport chain). ATP synthesis & utilization, structure of mitochondria as the power house of cell.

**Unit 4:** Nitrogen metabolism & assimilation. Vernalisation & Photoperiodism. Elementary knowledge of stress physiology.

**Practical**

1. Demonstration of osmosis
2. Demonstration of osmotic potential of a cell
3. Stomatal studies
4. Measurement of rate of transpiration
5. Nutrients deficiency symptoms in plants
6. Measurement of rate of photosynthesis in an aquatic plant
7. To demonstrate that light and CO<sub>2</sub> are essential for photosynthesis
8. To demonstrate that O<sub>2</sub> is consuming during respiration
9. To demonstrate that CO<sub>2</sub> is liberated during respiration
10. Seed viability test
11. Test for starch and sugar

**MCE 501****Bio-safety and Bioethics and IPR in Biotechnology****3(3-0-0)**

**Unit 1.** The legal and socioeconomic impact of biotechnology, public education of the process of biotechnology involved in generating new forms of life for informed decision making, biosafety regulation and national and international guidelines, r-DNA guidelines, experimental protocol approvals, levels of containment, regulatory bodies in biotechnology, biosafety committee.

**Unit 2.** Ethical issues, moral values on experimental animals, ethical implications of biotechnological products and techniques.

**Unit 3.** Intellectual property rights, WTO, TRIPS, International conventions, patents and copy rights, patent claims, methods of applications of patents.

**Unit 4.** Legal implications, biodiversity and farmers right. Beneficial application and development of research focus to the need of the poor, identification of directions for yield effect in agriculture, aquaculture etc.

## SEMESTER –VI

**BCBT 506**

**Animal Biochemistry**

**3(2-0-1)**

**Unit:1** Biochemistry of Blood and Body fluids-Biochemical composition of blood groups, path way of blood clotting, physiological function of blood, buffering action of blood, kinds other body fluids and their chemistry.

**Unit: 2** Biochemistry of Body tissue-Connective tissue, collagen, elastin muscle protein, muscle construction,

**Unit: 3** Biochemistry of Fat in adipose tissue , steroids-structure and biochemical function cholesterol-Structure and biochemical synthesis, plasma lipids, transport of lipids, lipo-protein, chylomicrons, VLDL, HDL, LDL, and Lp(a), free fatty acids, non- esterified fatty acids.

**Unit: 4** Anti-oxidant-Generation of free radicals, damage produced by reactive-oxygen species (ROS), free-radicals, and scavenging enzyme system.

**Unit: 5** Animal Hormones-Origin, site of action, biochemical mechanism of hormone action, feed-back mechanism of hormonal secretion.

**Practical:**

1. Identification of blood constituents.
2. Action of salivary amylase.
3. Action of digestive enzymes on proteins.
4. Determination of constituents of milk protein, fat, lactose.
5. Determination of sugar in urine and blood.
6. Determination of cholesterol in blood and biological sample.

**BCBT 501**

**Biochemical Engineering**

**3(2-0-2)**

**Unit 1: BIOCHEMICAL ENGINEERING:** Bioreactors definition, classification of chemical reactors, residence time, bioreactors design and their functions, types of bioreactors. Application of bioreactors in bio-fertilizer production, alcohol production, antibiotic production, plant cell culture, animal cell culture, waste management.

**Unit 2:** Control of bioprocess parameters in bioreactors, temperature, pressure, oxygen supply, agitation, nutritional, on/off control, PID control, control of heating of bioreactors, flow measurement control, chemical and electrical methods of foam control, off-line control parameters (measurement of properties analysis of cell population and composition), use of computer technology in bioprocess control system.

**Unit 3: Engineering principles:** transport phenomenon in bioprocess, mass transfer principles, mass transfer coefficient in gasses and liquids, heat transfer principles, coefficient of heat transfer, applied enzyme catalysis, biomass production in cell cultures.

**Unit 4; Upstream and downstream processing:** media formulation, sterilization of equipments, gas compressor types and principles of compression, air filtration, solid and liquid handling. Industrially fermented broth (filtration and ultra-filtration), centrifugation, solvent extraction, chromatographic separation, liquid extraction of biopolymers and antibiotics ion exchange recovery of antibiotics and proteins.

**Practical:**

1. To estimate dimensionless mixing time in a batch reactor.
2. To study the pH control system of bioreactor.
3. To understand the functioning of bioreactor and to carry out its blank sterilization.
4. To study the operation of a bioreactor.
5. To study the dissolved oxygen in bioreactor.

**BCBT 502****Industrial Biotechnology****3(2-0-1)**

**Unit 1:** Application of biotechnology in pharmaceutical, food & beverages, leather, paper, textile, detergent and chemical industries.

**Unit 2:** Biotechnology industry and medicine: Antibiotics, therapeutic application, Developing recombinant proteins for medical and therapeutic use, drug designing, new drug targets and vaccine development- Insulin, anti-haemophilic factor, human serum albumin, engineered enzymes.

**Unit 3:** Food and beverage industry: Xylanase, emulsifiers, high intensity sweetener, edible mushrooms, foods from microbes, role of biotechnology to improve food quality and food production.

**Unit 4:** Fermentation, cultures of microorganisms, solid or semisolid cultures, batch culture, continuous culture, fed-batch culture. Metabolic pathways in microorganisms, glycolysis or EMP pathways, entner-doudoroff pathways, the pentose phosphate pathways.

**Practical:**

1. Estimation of casein protein in milk.
2. Qualitative determination of different constituents of baking powder.
3. Estimation of glucose by anthron method.
4. Determination of vitamin-C in sample.
5. Estimation of lipid.
6. Determination of colour and pigments.
7. Methylene blue reduction test of milk.

**BCBT 604****Pharmaceutical Biochemistry****2(2-0-0)**

**Unit 1:** Introduction: Definition, Pharmaceutical molecule, drug, receptor, units, branches of pharmaceutical science: extraction & purification of pharmaceutical molecule; solution –properties

**Unit 2:** Bio pharmaceutical principles: concept of absorption, distribution & elimination of drugs in bio pharmaceuticals. Drug design:-concept of design , principles, drug factors therapeutic consideration Pharma kinetics

**Unit 3:** Production processes of pharmaceutical products: antibiotics, definitions, Blactam antibiotics, and tetracycline. Amino glycosides, quinines, aromatic, recombinant technology for pharma products: insulin, somatotropin, somatostatin, interferon.

**Unit 4:** pharmaceutical products: preservation & packing, factor of hygienic manufacturer Microbiological contamination control, preservation factor, oil/water partition, effect of container, preservation of combination.

**Unit 5:** pharmaceutical plant design, manufacturing facilities, material of fabrication, material used in fabrications, corosin concept.

**MBMT 601****Fermentation Technology****3(2-0-1)**

**Unit 1:** Fermentation equipment and its use: (i) Basic functions of a fermenter, body construction, aeration, agitation, theories of aeration, oxygen transfer kinetic, baffles. Design of fermentation vessels viz. Airlift Fermenter, tower fermenter, continuous fermenter, fed batch fermenter, waldhof type fermenter.

**Unit 2:** Growth and product formation: concept of primary and secondary metabolites, and their control, kinetics of growth and product formation (growth rate, yield coefficient, efficiency).

**Unit 3:** Development of microbial processes: (i) Screening (ii) Strain improvement (iii) Scale up in fermentations (iv) Inoculum preparations (v) Stock culture maintenance (vi) Contamination problems in fermentation industry

**Unit 4:** Control of metabolic pathways-Environmental control and genetic control of metabolic pathways

**Unit 5:** Fermentation media-Types of fermentation media, sources of carbon, nitrogen, trace elements, growth factors, precursors, buffers, antifoam agents, sterilization of media, screening for fermentation media

**Unit 6:** Computer applications in fermentation technology-General applications and specific applications

**Unit 7:** Process validation and quality assurance Current Good Manufacturing Practices (CGMP), and Current Good Laboratory Practices (CGLP)

### Practical

1. To study about fermentors
2. To isolate yeast cells from fruit juice and rice flour
3. Demonstration of fermentation by using Yeast
4. Demonstration of wine production
5. To produce citric acid by solid state fermentation
6. Production of lipase by submerged fermentation

### BCBT 603

### Medical and Molecular Diagnostics

2(1-0-1)

**Unit 1: Introduction:** Definitions, Diagnosis, Pathogens, abnormality, disorder, infection, virulence, sampling, diagnostic cycle, clinical lab structure- maintenance, sample processing, principles of specimen interpretation, ethical issues.

**Unit 2: Cytological disorders:** techniques and diagnosis- Cancer, pathology of cancer, diagnostic features. Different types of tumors and their diagnosis. **Molecular diseases:** Sickle cell anemia, thalassemia, erythrocytosis, leber's hereditary.

**Unit 3: Infectious disease and their diagnosis:** Bacterial: salmonella, mycobacterium, Viral: hepatitis virus, HIV (Human immunodeficiency virus). **Immune disease:** Autoimmune diseases and hypersensitivity reactions type I and IV and their diagnosis.

**Unit 4: Metabolic Diseases:** Carbohydrate and lipid metabolism- Diabetes mellitus, porphyrias, and gout atherosclerosis. **Protein metabolism:** phenyl ketonouria, maple syrup, cystinosis.

**Unit 5: Diagnostic techniques:** Microscopic techniques, biopsy techniques, flowcytometry, biosensors, and their application.

### Practicals:

1. Estimation of blood glucose.
2. Estimation of blood urea.
3. Estimation of cholesterol in blood.
4. Estimation of iron in blood.
5. Estimation of creatinine.
6. Estimation of bilirubin.
7. Detection of plasmodium pathogen.
8. Detection of salmonella typhae.

## SEMESTER –VII

**BCBT 508**

**Applied Biochemistry**

**3 (2-0-1)**

**Unit 1:** Applied enzymology: use of enzymes in industry, reverse phase enzymes, enzymes in organic synthesis, Biosensors: types, applications. Microbial synthesis of commercial products- small biological molecules, antibiotics and biopolymers, protein pharmaceuticals, large scale production of proteins from recombinant microorganisms.

**Unit 2:** Microbial fermentation: Production of ethanol, organic acids, vitamins and antibiotics. Use of immobilized cells, solid state fermentation, use of bacteria as biopesticides, biofertilizers, and plant growth promoters. Techniques of animal cell cultures and application.

**Unit 3:** Developmental biology: general principles and concept of development, determination and differentiation, communication and signals in development, cell-cell interaction. The eukaryotic cell cycle- stages, regulation.

**Unit 4:** Growth and development: Stages of cell division- growth and development process, developmental genetics in drosophila.

**Unit 5:** Advanced techniques: protein expression system, RAPD's, Antisense oligonucleotides, gene arrays.

### **Practicals:**

1. Fractionation of cellular components and identification by marker enzymes.
2. Preparation of mitotic cell division stages from onion root tip.
3. Extraction of DNA from blood sample.
4. Preparation of polychromosomes.
5. Estimation of DNA by DNP method.
6. Evaluation of catalase activity from plant tissues.
7. Extraction of RNA by AGPC method.

**BCBT 601**

**Bioprocess & Downstream Processing**

**3(2-0-1)**

Microbial biomass, single cell proteins and its nutritional values, bakers yeast brewers yeast, food and fodder yeast, carbohydrates – whey molasses starch cellulose / wood waste, sulfite liquor, SCP production technology bacterial protein ICI process yeast protein actionomyceatous protein, mycoproteins, algal proteins (spirulina cultivations) Production of antibiotics vitamins definition , classification of antibiotics and biochemistry , penicillin , streptomycin, tetracycline's , geriosofulvin , cephalosporin , ampicillin , piocyanase , vitamins-A, Riboflavin , cephalosporin, valinomycin, carotenoids

Solvents, biopolymers and microbial insecticides solvents, ethylalcohol, glycerol, acetone, butanol, 2, 3 butandiol, Biopolymers – expolysaccharides, alaganides xanthan , dextran, curdlan polyhydroxybutrate Computer control of fermentation process of computer, hardware and software application in fermentation technology, fermentation economics, fermentation biofertilizer production, fuel alcohol production, biogas production technology, silage production, aspartame

### **Practicals**

1. Determination of growth curve.
2. Effect of temp. on microbial growth.
3. Effect of pH on microbial growth.
4. Effect of osmotic pressure on microbial growth.

**BCBT 607**

**Biotransformation and Bioconversion**

**3 (2-0-1)**

**Unit 1:** Introduction to biotransformation, characteristics of biotransformation reaction.

**Unit 2:** Biotransformation techniques, biotransformation by growing cells, biotransformation by stationery cells, biotransformation by spores, biotransformation with immobilized cells, Biotransformation by purified enzymes.

**Unit 3:** Biotransformation of various L-amino acids, biotransformation of L-lysine, biotransformation of L-glutamic acid, biotransformation of L-aspartic acids, Biotransformation of vitamins like L-ascorbic acid, alpha tocopherol, biotin, Biotransformation of steroids, Biotransformation of antibiotics ,i.e. penicillin.

**Unit 4:** Pretreatment processes of Raw starchy materials, acid treatment, Milling operations ,dry and wet milling operations, Conversion of lignocellulose material to sugars . Lignocellulosic biotechnology-issues of bioconversion and enzyme production.

**Practical:**

1. Demonstration of urease, production, i.e. urea hydrolysis
2. Degradation of sulphur containing amino acid
3. Demonstration of carbohydrate metabolism
4. Indole production by bacterial sample
5. Production of Ammonia from organic compounds
6. Bioconversion of ammonia to nitrate i.e. nitrification.

**CHEM 710**

**Quantitative Analytical Methods**

**3(2-0-1)**

1. Introduction to Quantitative Analytical Methods.
2. Errors, Precision & Accuracy in Analytical Methods.
3. Classical methods in Analysis – Gravimetric, Volumetric – Neutralization titrations, complexometry & Iodometry.
4. Electrochemical Methods – Redox Titration, Potentiometry, Thermogravimetry, Coulometry, Voltametry.
5. Colorimetry, Spectrophotometry.
6. Chromatography – Adsorption, Partition, Gel filtration, Ion exchange.

**MCE 701**

**Molecular Cell Biology**

**3 (2-0-1)**

**Unit 1. Macromolecules:** Biochemical and molecular aspects of living cells, Carbohydrates, Proteins and Nucleic acids. Cell fractionation procedure.

**Unit 2. Cell organelles:** Molecular organization of cell organelles (structure and function), cell wall, plasma membrane (various models), endoplasmic reticulum, mitochondria, chloroplast, nucleus, etc.

**Unit 3. Cytoskeleton and Extra Cellular Matrix:** Microtubules, intermediate filaments and micro filaments. ECM- definition, significance and biomolecules involved in ECM.

**Unit 4. Cell growth and division:** Cell cycle, mitosis, meiosis, DNA replication, apoptosis, cancer.

**Unit 5. Cell signaling and cell- cell interactions:** signal transduction, endocrine, paracrine and autocrine signalling, surface receptor mediated transduction, chemistry and function of signaling molecules.

**Practicals**

1. Mitosis of Onion Root Tips
2. Tissue Types in Dicot Stem
3. Tissue Types in Monocot Stem
4. Tissue Types in Dicot Root
5. Tissue Types in Monocot Root
6. Gram Staining of Bacteria

**BCBT- 702**

**Intermediary Metabolism- I**

**3(2-0-1)**

**Unit 1: Bioenergetics:** Energy & its- transformation in living systems ; Thermodynamic principles; concept of free energy changes in biochemical reactions, Electro-chemical gradient, energy rich compounds. Introduction to metabolism: methods to study metabolism.

**Unit 2: Carbohydrate metabolism:** Introduction to digestion and absorption of carbohydrates.

Catabolism of carbohydrates: Glycogenolysis, glycolysis, fermentation. TCA, ETS, Energy aspects, HMPS. Anabolism: Biosynthesis of structural polysaccharide. Eg.- peptidoglycon, chitin. Anabolic role of TCA cycle (anapleurotic reactions), gluconeogenesis, glycogenesis, glyoxalate cycle, regulation of carbohydrate metabolism.

**Unit 3: Lipid metabolism:** Introduction to digestion and absorption, oxidation and biosynthesis of fatty acids. Phospholipids: energy aspects, importance and regulation. Biosynthesis of biologically important lipids: biosynthesis of sterols, glycolipids, prostaglandins, prostacyclins, thromboxins. Energy aspects, regulation and importance.

**Unit 4: Oxidative phosphorylation,** introduction to electron transport, chain structure localization. Components, oxidative phosphorylation, ATP formation.

#### **Practicals:**

1. Determination of lactic acid from milk.
2. Estimation of total carbohydrates from potato by anthron method.
3. Extraction of glycogen from liver.
4. Extraction of starch from potato.
5. Determination of citric acid from citrus fruits.
6. Determination of lactose from milk.
7. Determination of fat in milk.
8. Determination of acid value/peroxidation/ saponification no. of fats.
9. Separation of carbohydrate lipid by TLC.

**BCBT-605**

**Immunotoxin & Drug Designing**

**3(3-0-0)**

**Unit 1:** History of drug discovery & Molecular biology for drug:-early and recent history of drug discovery, enzymes/receptor as drug target. molecular biology for drug discovery(recombinant proteins and monoclonal antibodies as drug). Molecular basis of disease processes. Target identification and validation.

**Unit 2:** Organic synthesis for drug discovery:-target oriented organic synthesis and retro synthetic analysis. diversity oriented organic synthesis and evolving synthetic analysis, solid phase synthesis for drug discovery (parallel is split pool strategy) combinatorial chemistry and high through put screening(HTS).

**Unit 3:** Combinatorial chemistry for drug discovery:-combinatorial biocatalysis for drug discovery, synthesis of Bergen in derivatives. Drug discovery in cancer research/new target based drugs in clinical trials.

**Unit 4:** Introduction of pharmacogenomics:-microbial genomics for new antibiotics, immunotoxin drug(eg ricin, a plant toxin).drug designing for blocking enzyme activity through blocking hormones receptor through inhibition of nucleic acid synthesis against heterogenous target.

## 1. Algorithms &amp; Flow Charts

## 2. 'C' Programming

- (i) Preliminaries
- (ii) Constants & Variables
- (iii) Arithmetic Expressions
- (iv) Input-Output Statements
- (v) Control Statements
- (vi) Looping Statements
- (vii) Subscripted Variables
- (viii) Elementary Format Specifications
- (ix) Logical Statements & Decision Tables
- (x) Functions & Subroutines

## 3. Computer Oriented Numerical Methods

- (a) Solution of Non Linear Equation
  - (i) Bisection Method
  - (ii) Newton Method
- (b) Numerical Integration
  - (i) Trapezoidal Method
  - (ii) Simpson's 1/3 & 3/8 rule
- (c) Curve Fitting
  - (i) Construction of forward, backward difference table
  - (ii) Interpolation

## 4. Application of statistical packages

**Reference Books:**

Let Us C by Yashwant Kanetkar BPB publications

Computer Oriented Numerical Methods by R. S. Salaria, Khanna Book Publishing Co.

**Practical List:**

1. To find the largest among three numbers
2. To check whether a given string is a palindrome or not.
3. To find factorial of a given number by iteration.
4. To find whether the given integer is a prime number.
5. To find sum of n terms of series:
  - a.  $n - n*2/2! + n*3/3! - n*4/4! + \dots$
6. To find sum and average of n integers using a linear array.
7. To read n numbers from the keyboard and display these numbers in the reverse order their entry.
8. To search a given number within a linear array.
9. To generate the fibonacci series.
10. To find factorial of a given number using a function.
11. To deduce error involved in polynomial equation.
12. To Find out the root of the Algebraic and Transcendental equations using Bisection, Regula-falsi, Newton Raphson and Iterative Methods. Also give the rate of convergence of roots in tabular form for each of these methods.
13. To implement Newton's Forward and Backward Interpolation formula.
14. To implement Gauss Forward and Backward, Bessel's, Sterling's and Evertt's Interpolation formula
15. To implement Newton's Divided Difference and Lang ranges Interpolation formula.
16. To implement Numerical Differentiations.

17. To implement Numerical Integration using Trapezoidal, Simpson 1/3 and Simpson 3/8 rule.  
18. To implement Least Square Method for curve fitting.

**MAS 711****Statistics I****3 (2-0-1)**

Standard – deviation, Coefficient of variation, standard error of mean.

Theory of Probability : equally likely, mutually exclusive events , definitions of probability, addition & multiplication theorems of probability & problems based on them.

Normal & Binomial Distributions.

Simple correlation & regression, Multiple- regression, Multiple & Partial- Correlation.

Testing of Hypothesis : Concept of Hypothesis, Degrees of freedom, Level of significance. Type I & Type II errors.  $X^2$  , t, Z & F – tests. (definition, applications & problems based on these tests).

**BCBT 706****Techniques in Biochemistry and Instrumentation****3(2-0-1)**

**Unit 1:** Chromatography: Adsorption, partition, exclusion, ion exchange, affinity, H.P.L.C., G.L.C., column.

**Unit 2:** Biosensors: Types and uses.

**Unit 3:** Centrifugation Techniques: Differential, zonal and density gradient, ultra, types of centrifuges and applications.

**Unit 4:** Electrophoresis: Principles and applications, paper, gel, S.D.S., P.A.G.E., P.F.G.E., Isoelectric phosphor.

**Unit 5:** Molecular Biology Techniques: Isolation and purification of DNA, RNA, plasmid DNA, sequencing of proteins and nucleic acids, chemical synthesis of nucleotides, competent cell preparation and transformation, DNA foot printing, DNA fingerprinting, PCR.

**Unit 6:** Immunological Techniques: RIA, ELISA, flow cytometry.

**Unit 7:** Radio isotopic and tracer techniques: Detection and measurement of isotopes (GM and scintillation counters), autoradiography.

**Practicals:**

1. Determination of pH using indicators.
2. The separation of amino acids by paper electrophoresis.
3. The validity of Beer's law for the colorimetric estimation of creatinin.
4. Total chlorophyll estimation from the plant sample.
5. Protein estimation- A. Biuret method, B. Lowry's method.
6. Estimation of nucleic acid by electrophoresis.

**BCBT-813****Enzyme Technology****3(2-0-1)**

**Unit 1:** Introduction of enzymes:General properties and significance, classification and nomenclature.Terms and definition in enzymology, co-factors, coenzymes, active site concept, isoenzymes, allosteric enzymes, marker enzymes, multienzyme complex, ribozyme, abzyme, synzyme, extremozyme, therapeutic enzymes and immobilized enzymes etc.

**Unit 2:** Enzyme kinetics:steady rate kinetics, Derivation of Michaelis-menten equation using steady state/equilibrium kinetics, plots of lineweaver- Bruke, Hanes, Eadie- Hofster etc. Mechanism of bisubstrate and multisubstrate enzyme catalyzed reaction, Enzyme inhibitors, mechanism of enzyme action-lysozyme, chymotrypsin, alcohol DH.

**Unit 3:** Regulation of enzyme activity: Covalent modification, allosteric model concerted and sequential, cooperativity. Feedback inhibition.

**Unit 4: Enzyme Technology:** Commercial production of enzymes, immobilization of enzymes, example of enzyme engineering, application of enzyme (therapeutic uses, analytical uses, manipulated uses etc.), uses of enzyme reactors.

**Unit 5:** Isolation, purification and localization of enzymes. Various methods to estimate the enzyme activity.

**Practical:**

1. Effect of temperature, pH, substrate concentration and enzyme concentration and enzyme concentration on enzyme activity.
2. Action of salivary amylase on starch.
3. Determination of acid phosphatase activity in sample.
4. Determination of alkaline phosphatase activity in sample.
5. Determination of SGOT in serum.
6. Determination of SGPT in serum.
7. Determination of urease in plant sample.
8. Assay of protein by lowry method.
9. Assay of catalase in vegetables.
10. Hydrolysis of egg protein by pepsin.

**BCBT-811**

**Physiological Biochemistry**

**3 (2-0-1)**

**Unit 1: Membrane Physiology:** Concept of membrane potential, Initiation and propagation of action potential, Role of  $\text{Na}^+$  and  $\text{K}^+$  in action potential, Special characteristics of signal transmission, Impulse transmission from nerve endings to skeletal muscle fibres (neuromuscular junction), Acetylcholine secretion at nerve terminals. Drugs that enhance and block transmission at neuro-muscular junction. Myasthenia gravis and its significance.

**Unit 2: Homeostasis:** Intra cellular fluid (E.C.F.) and Intracellular fluid balance, origin of nutrients in the E.C.F., Removal of metabolic end products. Regulation of body functions. Examples of control mechanisms and characteristics of control system.

**Unit 3: Gastro intestinal physiology:** General principles of gastrointestinal motility, Neural control of gastro intestinal function (enteric nervous system). Types of neurotransmitters secreted and their hormonal control, Movements in G.I.T. and blood flow (splanchnic circulation), Nervous control of G.I. blood flow.

**Unit 4: Aviation, Space and Deep- Sea Diving Physiology:** Effects of low  $\text{O}_2$  pressure on the body, effects of breathing pure  $\text{O}_2$  at different altitudes. Hypoxia, Acclimatization to low  $\text{PO}_2$  and human beings during at high altitudes, Chronic/ acute mountain sickness, reduced work capacity at high altitudes and positive effects of acclimatization, high altitude pulmonary edema.

**Unit 5: Sports Physiology:** Muscles in exercise, muscle metabolic systems in exercise, phospho- creatin- creatin system, nutrients used during muscle activity, effect of athletic training and drugs on muscle and muscle performance, Respiration in exercise, body heat in exercise, body fluid and salts in exercise.

**Practicals:**

1. Determination of Biomolecules (protein, lipid and carbohydrates) in different animal tissues.
2. Determination of permeability of membranes.
3. Determination of blood glucose level during exercise .
4. Determination of electrolytes during exercise.
5. Measurement of  $\text{O}_2$  uptake by pipette manometer.
6. Determination of bile salts and bile acids.

**Unit 1:** Introduction to Bioinformatics, philosophical, directional and application oriented background of bioinformatics.

**Unit 2:** HGP – influence area in Bioinformatics, Application in different industries, and its Indian scenario, as a business, problem and future aspects.

**Unit 3:** Information network – Internet, web Browser and address (NCBI, EBI etc).

**Unit 4:** Databases – information resources for Proteins and Genomics.

**Unit 5:** SRS, Algorithms, Alignment.

**Unit 6:** Phylogenetic Analysis: Fundamental of Phylogenetic model, Tree interpretation – Paralogues and orthologues, Tree building and tree evaluation, Phylogenetic software.

**Unit 7:** Comparative Genome Analysis: Introduction, application, genome analysis and annotation.

**Unit 8:** Molecular structure Prediction and visualization (X-ray crystallography/NMR/Bioinformatics).

**Unit 9:** Micro array data analysis.

**Unit 10:** Different analysis packages and other Miscellaneous Tools etc.

### BCBT- 705

### Intermediary Metabolism- II

3(2-0-1)

**Unit 1: Amino acid catabolism:** introduction to digestion and absorption, amino acid degradation pathways and their mode of degradation- Transamination, oxidative deamination, deamination and importance. Urea cycle, formation of excretory products, linking to TCA cycle and regulation.

**Unit 2: Amino acid biosynthesis:** overview, biosynthesis of essential amino acid tryptophan, tyrosine, valine, lysine. Biosynthesis of non-essential amino acids: glycine, serine, cystine, threonine, phenylalanine, histidine, proline, arginine.

**Unit 3: Purine & Pyrimidine nucleotide metabolism:** introduction, de novo and salvage pathways of purine and pyrimidine nucleotide biosynthesis. Catabolism of purine and pyrimidine nucleotides. Biosynthesis of nucleotide coenzymes.

**Unit 4: Membranes- Transport phenomenon:** biomembranes, diffusion- passive and facilitated and active transport processes. Mechanism of ATP synthase and its regulation, malate aspartate shuttle.

#### Practicals:

1. Parametric analysis of section of protein-dye.
2. Determination of protein from milk.
3. Fractionation of egg proteins.
4. Quantification of serum proteins by honey method.
5. Estimation of protein from leaf tissue.
6. Isolation of DNA from plant /bacterial sample.
7. Quantification of DNA.
8. Isolation of RNA from bacterial/ plant tissue.

## SEMESTER –IX

**BCBT 803**

**Plant Biochemistry**

**3(2-0-1)**

**Unit 1: Photosynthesis:** significance of photosynthesis, ultra structure of chloroplast, photosynthetic pigments. Light absorption phenomenon, Photosynthesis in C<sub>3</sub> and electron transport, photophosphorylation: photo respiration, CAM.

**Unit 2:** Bacterial Photosynthesis, photochemistry and electron transport and CO<sub>2</sub> fixation.

**Unit 3: Nitrogen metabolism:** Metabolism of N-compounds in plants, biological nitrogen cycle, nitrogenase structure and function, nitrate reduction, nitrification, denitrification, symbiotic and non symbiotic nitrogen fixation, Nif- genes- organization, function and regulation, Assimilation of fixed nitrogen by plants.

**Unit 4: Plant Hormones:** Definition of phyto hormones, Auxins, biochemistry and mode of action of Auxins, Gibberellin, Cytokinins and other natural growth hormones in plants (ethylene, abscissic acid).

**Unit 5: Plant disease and defense mechanism:** Biochemistry of bacterial and viral and fungal diseases, Micro and Macro nutrients deficiency in plants. (Biochemical role of inorganic ions in plants).

**Unit 6: secondary metabolism in plants:** Phenolic metabolism shikimate, and phenyl propanoid pathways, flavonoids, lignins, and anthocyanins. Isoprenoid metabolism, terpenoids and carotenoids, phosphor, cyanogenic glycosides and non protein amino acids.

### **Practicals:**

1. Analysis of plants and plant product for various constituents.
2. Extraction and identification of sugars from plants, fruits and vegetables.
3. Extraction and determination of amino acid and protein.
4. Determination of lipids, phospholipids, cholesterol in food, fruits and vegetables.
5. Determination of various plants nutrients.

**BCBT- 801**

**Immunology & Medical Biochemistry**

**3(2-0-1)**

**Unit I:** Fundamental Immunology: Basic terminology: Antigen, antibody, lymphokines, cytokines, hapten, adjuvants, immunogen, pathogen, epitopes, paratopes, etc. specific and nonspecific immune response, humoral and cell mediated immunity. Cells of adaptive immune response- B & T cell. Cells of innate immune response- macrophages, phagocytes, mast cells, dendritic cells, granulocytes, agranulocytes. Organ of immune system- 1.primary lymphoid organs 2.secondary lymphoid organs

Defens phosphor - 1.inflammation

2. phagocytes

**Unit 2:** Generation of antibody diversity, clonal selection hypothesis definition idiotopes, idiotypes, allotypes, structure and function of M.H.C(both class 1&class 2), chemistry of antigen –antibody interaction, precipitation &agglutination.

**Unit 3:** structure and function of natural killer cells, superantigens, cells-mediated cytotoxicity(A.D.C.C), the complement system (both classical &alternative path ways).experimental assessment of A.D.C.C i.e. by C.M.L, M.L.R and graft vs. host reaction .

**Unit 4:** Primary B&T-cells immunodeficiencies, auto immunity hypersensitivity, structure of t-cells receptor and comparison with antibody molecule.

**Unit 5:** Techniques of immunology, immunoelectrophoresis (one dimensional and two dimensional), ELISA, RIA, Immunofluorecence, western immuno blotting, biochemistry of cancer & AIDS.

### **Practical:**

1. Preparation of blood smears

2. Separation of serum & plasma
3. Qualitative test for assessment of different constituent of plasma/seven
4. Separation of plasma proteins (i.e fibrinogen, globulin and albumin)
5. Determination of E.S.R of the given blood sample
6. Preparation of antigens from blood
7. Determination of the blood group
8. Determination of the haematocrit value of any blood sample
9. Use the widal kit for rapid quantitative slide test.

**BCBT 805**

**Nutritional Biochemistry**

**3(2-0-1)**

**Unit 1. Nutritional aspects of carbohydrates-** Biochemical functions the relative importance of different carbohydrates in diet, utilization of absorbed carbohydrates in the body, regulation of blood glucose level of blood dietary fibre and their biochemical effect in human nutrition.

**Unit 2. Nutritional aspects lipids-** Fats in the body and food, biochemical function of fats, role of in diet, effect of trans fatty acids, blood lipids, transport and storage of lipids, role of liver in lipid metabolism, omega fatty acids.

**Unit 3. Nutritional aspects proteins-** Nutritional significance of amino acids , specific function of some important amino acids, complementary value of proteins, methods of proteins (BV, NB, PER, NPR)

**Unit 4. Role of vitamins minerals in health and disorders** biochemical function of water detoxification.

**Unit 5. Biochemical features** some diet related disorders like protera-calorie malnutrition diabetes , cardiovascular disease goitre anemia etc.

**Practical:**

1. Determination of moisture in food sample
2. Determination of total ash in the food sample
3. Quantitative analysis in ash for mineral constituent eg calcium, phosphorus etc.
4. Determination of crude fat in the given food sample
5. Determination of total carbohydrate by anthrone method
6. Determination of protein by lowery method in the food sample
7. Determination of ascorbic acid in food sample
8. Identification of phenols carotenoids etc in blood samples

**BCBT 812**

**Clinical Biochemistry**

**3(2-0-1)**

**Unit 1: In born error metabolism** of protein, Amino acid, nucleic acid. Occurrence, pattern of inheritance disorders of amino acids metabolism- phenyl ketouria, Maple syrup, urine disease, cystinosis, etc.

**Disorders of carbohydrates** and lipid metabolism. Porphyrrias and Gout.

**Unit 2: Molecular disease** – sickle cell anemia and thalassemias, adenosine deaminase deficiency, systemic lupus erythematosus.

**Liver and kidney tests-** their significance.

**Unit 3: Endocrine disorders-** pancreatic, diabetes, mellitus, mellituria, hypoglycemia, glucose tolerance test, thyroid hypo and hyper parathyroidism, parathyroid- abnormalities of parathyroid functions.

**Unit 4: Blood related disorders:** Abnormal hemoglobin and hemoglobinopathies, anemias, polycythemia, erythremia, eosinophilia, schistosomiasis, leucopenia, leukemias, hemophilia, thrombocytopenia, thromboembolic conditions.

**Practicals:**

1. Analysis of blood for clotting and prothrombin time, haemoglobin, and derivative,

blood sugar by chemical and enzymatic method.

2. Analysis of serum- for creatinin and creatin, uric acid bilirubin, chlorides, Ca, lipid profiles- HDL cholesterol and LDL cholesterol, total protein- albumin and globulin, GOT, GPT, acid and alkaline phosphatase, creatin kinase.

3. Analysis of plasma for fibrinogen.

4. Determination of ABO, Rh blood group.

**TE- 801**

**Plant Tissue Culture Technology**

**3 (2-0-1)**

**Unit 1: Introduction to plant tissue culture:** Historical developments and landmarks in Plant Tissue Culture. Organization of tissue culture laboratory, aseptic techniques, media formulation, clonal propagation vs tissue culture, Totipotency: growth, differentiation and morphogenesis in tissue culture.

**Unit 2: Micropropagation:** Concept, various stages, organogenesis and somatic embryogenesis. Meristem culture: Meristem culture for mass and clonal propagation, production of pathogen free plants, application in forestry.

**Unit 3: Somatic hybridization:** Isolation, purification and culture of protoplasts, protoplast fusion and somatic hybridization, identification and characterization of somatic hybrids / cybrids, its applications.

**Unit 4: Secondary metabolites:** Production of secondary metabolites by plant cell culture, hairy root culture, and biotransformation.

**Unit 5: Cell Lines:** Cell line selection for resistance to herbicide, stress, insect and diseases

**Unit 6: Haploid culture:** Tissue culture methods for haploid production & its applications

**Practicals:**

1. Media preparation
2. Explant selection, sterilization & inoculation
3. Callus & cell suspension culture: Induction and growth parameters
4. Androgenesis: Anther & Pollen culture
5. Plant regeneration from embryo, meristem & callus culture
6. Synthetic seed preparation

**MAS 715**

**Statistics- II**

**3 (2-0-1)**

Analysis of variance technique: Definition & assumptions, One way classification, two way classification with more than one observation per cell.

Designs of experiments: Principles of Experimental- Design, Randomized Block Design (R.B.D), Latin Square Designs (L.S.D)., Missing Plot Technique in R.B.D & L.S.D. Critical-difference (C.D) Split plot design.

Factorial – Experiments:  $2^2$ ,  $2^3$ ,  $3^2$ , &  $3^3$ , factorial-designs. (Yates method of Analysis),

$2 \times 3$  &  $2 \times 4$  factorials.

Duncan's Multiple Range Test. Newman's Kuel's Test

Sampling techniques: Simple Random Sampling, Stratified Random Sampling & Systematic Sampling.