

**Mother Teresa Women's University, Kodaikanal**  
**ALLOCATION OF PAPERS AND CREDITS (SEMESTER-WISE) FOR B.Sc.,**  
**BIOCHEMISTRY PROGRAMMES AS PER THE TANSICHE RULES 2018-19**  
**ONWARDS**

**B.Sc. Biochemistry Course Structure under Choice Based Credit System (CBCS)**

P. No.	Paper Code	Course Title	Hours	Credits	Continuous Internal Assessment (CIS)	End Semester Exam (ESE)	Total
<b>Semester I</b>							
1.	ULTA11	Part-I- Tamil	5	3	25	75	100
2.	ULEN11	Part-II-English	5	3	25	75	100
3.	UBCT11	Core I (Theory)-Biomolecules	6	4	25	75	100
4.	UBCT12	Core II (Theory)- Nutritional Biochemistry	6	4	25	75	100
5.	UBCA11	Allied Theory I – Chemistry I	5	4	25	75	100
6.	UVAE11	Value Education	3	3	25	75	100
<b>Total</b>			<b>30</b>	<b>21</b>			<b>600</b>
<b>Semester II</b>							
7.	ULTA22	Part I-Tamil	5	3	25	75	100
8.	ULEN22	Part II-English	5	3	25	75	100
9.	UBCT21	Core III (Theory)- Enzyme & Enzyme Technology	6	4	25	75	100
10.	UBCP21	Core Practical I- Lab in Biomolecules	6	4	25	75	100
11.	UBCA21	<i>Allied Practical I - Chemistry Practical</i>	5	4	25	75	100
12.	UEVS21	Environmental Studies	3	2	25	75	100
<b>Total</b>			<b>30</b>	<b>20</b>			<b>600</b>
<b>Semester III</b>							
13.	ULTA33	Part I-Tamil	5	3	25	75	100
14.	ULEN33	Part II- English	5	3	25	75	100
15.	UBCT31	Core IV (Theory)-Intermediary Metabolism	6	4	25	75	100
16.	UBCA32	Allied II - Statistics for Biology	5	4	25	75	100
17.	UBCE31	Elective I –	5	3	25	75	100

		Bioinstrumentation/Human physiology					
18.	UBCN31	Non Major Elective Course I- Biofertiliser	2	2	25	75	10
19.	UBCS31	SBE- Tools & Techniques in Biochemistry (Lab)	2	2	25	75	100
<b>Total</b>				<b>21</b>			<b>700</b>
<b>Semester IV</b>							
20.	ULTA44	Part I-Tamil	4	3	25	75	100
21.	ULEN44	Part II-English	4	3	25	75	100
22.	UBCT41	Core V (Theory)- Immunology	5	4	25	75	100
23.	UBCP42	Core Practical II- Lab in Immunology & Microbiology	5	4	25	75	100
24.	UBCA42	Allied Theory- Physics for Biology	4	4	25	75	100
25.	UBCE42	Elective II - General Microbiology/Bioprocess technology	4	3	25	75	100
26.	UBCN42	Non Major Elective course II- Mush room cultivation	2	2	25	75	100
27.	UBCS42	Skill Based Studies II – Protein purification Techniques (Lab)	2	2	25	75	100
<b>Total</b>			<b>30</b>	<b>25</b>			<b>800</b>
<b>Semester V</b>							
28.	UBCT51	Core VI(Theory) - Clinical Biochemistry	5	4	25	75	100
29.	UBCT52	Core VII (Theory) - Molecular Biology	5	4	25	75	100
30.	UBCT54	Core VIII (Theory) - Plant Biochemistry	5	4	25	75	100
31.	UBCT55	Core IX (Theory) – Pharmacology	5	4	25	75	100
32.	UBCT55	Core X (Theory) - Genetics	5	4	25	75	100
33.	UBCE56	Elective III – General Biology/Developmental Biology	3	3	25	75	100
34.	UBCE53	Skill Based Studies III – Clinical Biochemistry (Lab)	2	2	25	75	100
<b>Total</b>			<b>30</b>	<b>25</b>			<b>700</b>

		Semester VI					
35.	UBCT61	Core XI (Theory) - Hormones & Neurochemistry	4	4	25	75	100
36.	UBCT62	Core XII (Theory) - r DNA technology	4	4	25	75	100
37.	UBCT63	Core XIII (Theory) - Genetics & Genetic Engineering	5	4	25	75	100
38.	UBCP63	Core Practical III – Lab in Genetics & Molecular Biology	5	4	25	75	100
39.	UBCP64	Core Practical IV - Lab in Biochemical Techniques	5	4	25	75	100
40.	UBCE64	Elective IV – Bioinformatics/ Biosafety & IPR	4	3	25	75	100
41.	UBCS64	Skill Based Studies IV – Bioinformatics(Lab)	2	2	25	75	100
42.	UEAS61	Extension Activity	1	3	25	75	100
<b>Total</b>			<b>30</b>	<b>28</b>			<b>800</b>
<b>Grand Total</b>				<b>140</b>			<b>4200</b>

**SEMESTER - I**  
**CORE I (THEORY) - BIOMOLECULES**

**UBCT11**

**6 hrs/4credits**

**Objectives:**

- To understand the basic fundamentals of biochemistry.
- To learn about the general properties of carbohydrates, proteins and lipids its role in the living beings.
- To understand the major role of nucleic acids in life processes.
- Student can understand the chemistry of biomolecules and its significance

**UNIT I**

Cellular and chemical foundations of life, Historical background of the origin and development of Biochemistry. Carbohydrates - basic structure of monosaccharides, its isomers, epimers and enantiomers – Structure & biological importance of disaccharides, Trisaccharides. Polysaccharides – structural & storage polysaccharides, homo & hetero polysaccharides with examples - other polysaccharides.

**UNIT II**

Amino acids and Proteins - classification amino acids, physical properties of amino acids - Solubility, electrochemical properties, fundamental role of proteins in life - Composition of proteins - General properties of proteins - Rudimentary treatment of structure, classification of the proteins on the basis of their Biological functions- Criteria for the purity of Proteins.

**UNIT III**

Lipids – Fatty acids - Classification, Hydroxy and keto derivatives and cyclic fatty acids - physical properties of fatty Acids - solubility, boiling point, absorption, spectro chemical properties of fatty acids - Salts, detergents and wetting agents, esters - reactions of unsaturated fatty acids - hydrogenation, halogenations and oxidation.

Fats - Fatty acids esters of glycerol - Chemical structures. Physical and chemical properties of fats – Waxes, phospholipids, non-phosphorylated lipids and steroids.

**UNIT IV**

Nucleic Acids- fundamental role of nucleic acids in life processes- DNA & its types, RNA – types, functions. Structure of bases, nucleosides and nucleotides - bond linking the various bases.

**UNIT V**

Vitamins – Discovery and physico- chemical properties of vitamins, fat-soluble vitamins, vitamin A, D, E and K - Water soluble vitamins, vitamin B complex, vitamin C – Brief mention of source and physiological role.

**REFERENCE**

1. E.S.West Todd, W.R Mason H.S.Van Bruggan J.J. 1967, Textbook of Biochemistry: Fourth edition, The Macmillian Company, New York.

2. Lehninger, A.L .Biochemistry. 2012, Sixth edition, Kalyani publishers. India.
3. Lubert Stryer 2012, Biochemistry, Seventh edition, W.H. Freeman and Company, New York.
4. E.E.Conn and Stumpf, 1987. Outlines of Biochemistry, Fifth edition, WILEY EASTERN LIMITED.

## **CORE II (THEORY) - NUTRITIONAL BIOCHEMISTRY**

**UBCT12**

**6hrs/4 credits**

### **Objectives:**

- To know the value and nutritional components of food.
- To understand the sources of nutrients such as carbohydrates, proteins, fibres and fats for good health.
- To get aware about the disorders caused due to deficiency of protein, vitamin deficiency and minerals
- Enlighten the student about the healthy food- balanced diet, food production and food storage applications and can able to identify the food adulterations.

### **UNIT I**

Introduction of nutrition - Function of foods and its relation to nutritional and clinical health, essential nutrients, analysis of food composition, food groups, ICMR five-food group, food pyramids.

### **UNIT II**

Carbohydrates: types, functions, food sources. Fibre. Fat - types, functions, food sources, essential fatty acids, and cholesterol. Proteins - types, Function, food source, complete and incomplete protein. Nitrogen balance, quality of food proteins and requirements, protein deficiency disorders.

### **UNIT III**

Vitamins: Definition, Classification, Sources, distribution, function, abnormalities, minimum requirements and optimum allowances.

Mineral Nutrition: Essential-micro and macro mineral nutrients, distribution, sources, function and abnormalities.

### **UNIT IV**

Energy: Basal metabolism, measurement of BMR,RDA,BMI, factors affecting BMR, regulation of body temperature, energy needs, and total energy requirement estimation of energy requirements and energy value of foods, obesity.

Balanced diet formulation- Assessment of nutritional status. Nutrition at various stages of growth and development, diets of infants, children, adolescents, pregnant women, lactating mothers and old age.

## UNIT V

Nutritional Challenges of the future: Food production and food storages, future foods, new protein foods, new fat foods and changing food habits Food adulterations.

## REFERENCE

1. Dr.M.Swaminathan 2005 Principles of Nutrition Determination dietetics-, Anmol publication
2. Corine Robinson, 1967.Normal and Therapeutic Nutrition, seventh edition
3. B.Srilakshmi 2003, Food science, Third edition, New age international.
4. Bernard L. Oser Hawk's.1965. Physiological chemistry. 14th Ed. McGraw-Hill Book Co.

## ALLIED THEORY I- CHEMISTRY-I ORGANIC, INORGANIC & PHYSICAL CHEMISTRY

UBCA11

5hrs/4credits

### Objectives:

- To study the chemical kinetics, enzyme kinetics and the rate of reactions.
- To understand the principles and application of electrochemistry and analytical chemistry.
- To know the principles and methods of corrosion, electroplating process and the properties of carbohydrates
- The students can learn the kinetics, bonding theory, atomic orbital and MO theory.

## UNIT I

Bonding:

- 1) VB theory – Postulates of VB theory – Applications to the formation of simple molecules like  $H_2$  and  $O_2$ . Overlap of atomic orbitals S-S, S-P and P-P overlap –principles of hybridization.
- 2) MO theory – Formation of MO's – bonding and antibonding and non bonding MO's – MO diagram for hydrogen, helium,  $F_2$ .

## UNIT II

Chemical kinetics: Rate of reaction – rate law and rate constant – order and molecularity of reactions – derivation of first order rate constant – half-life period –examples of second order and third order reaction – enzyme kinetics.

## UNIT III

Electrochemistry:

A. Arrhenius theory of electrolytes – weak electrolytes – Oswald's dilution of law and its application – ionic product of water and its applications – solubility product and its determination. pH – definition –simple calculation of pH from molarity of acids and bases –

common ion effect and its application in analytical chemistry – buffer solution – definition – theory of buffer action – application.

B. Acid – base indicators – working range of indicators – choice of indicators – commercial cells – primary and secondary cells – Weston – cadmium cell lead storage cell.

#### **UNIT IV**

Corrosion Principle and methods – corrosion and passivity rusting of iron preventive methods from rusting – Electroplating

#### **UNIT V**

Carbohydrates – definition and classification:

a) Monosaccharide – preparation properties and uses of glucose and fructose. Configuration of glucose and fructose. Haworth's structure.

b) Disaccharides: Sucrose – manufacture, properties and uses of sucrose – structure. Only (No elucidation) Distinction between glucose fructose and sucrose.

c) Polysaccharides: Starch and cellulose (A general study)

### **VALUE EDUCATION**

#### **UVAE11**

**3hrs/3 credits**

#### **UNIT I**

Values – definition – value crisis – need for practicing positive values for good life – values erosion – its impact on individual, societal – cultural level – way out.

#### **UNIT II**

Family, material, human values – good health – individual and intellectual freedom – human progress – production and distribution – prosperity and peace – Aesthetic values – sense of beauty – moral ethical value – conscience – integrity – fairness.

#### **UNIT III**

Societal values – cooperative living – healthy behaviors – justice – social responsibility – free from bribery and corruption – good citizen – good society – pursuit of excellence – Psychological values - self-esteem and acceptance – emotional intelligence – spiritual values – devotion and self-fulfillment

#### **UNIT IV**

Bioethics – definition – goals and objectives – love of life – animal use and ethics – medical ethics – negligence and wrong judgments – issues genomes on organ transplantation – donors – drugs – mortality – social ethics – child labour and bonded labor

#### **UNIT V**

Women – and development – sex versus gender – women's rights – factors affecting development – violence against women – right to privacy – abortion and reproductive rights – social stigma – women empowerment – social, economic and political – government program and policies.

**SEMESTER - II**  
**CORE III (Theory) - ENZYME AND ENZYME TECHNOLOGY**

**UBCT21**

**6hrs/4credits**

**Objectives:**

- To study the enzyme reaction and enzyme kinetics through Michaelis-Menten equation and LB plot.
- To learn the methods of enzyme assay and the regulation mechanism of enzyme activity.
- To understand and know the mode of enzyme action and the industrial applications of enzymes.
- The students can gain the knowledge about the significance and industrial application of enzymes.

**UNIT I**

Introduction, Function, nomenclature, classification, isolation, purification and characterization of enzymes. Enzyme specificity and its reactions.

**UNIT II**

Enzyme substrate complexes – Michaelis – Menten kinetics: Determination of  $K_m$  and  $V_{max}$  – Line Weaver Burk plot – Factors influencing enzyme reaction and enzyme inhibition – competitive inhibition, non - competitive inhibition, un competitive inhibition, Inhibitors and its types.

**UNIT III**

Enzyme assay – methods and applications, regulation of enzyme activity- allosteric regulation, covalent modification, zymogens and feedback regulation.

**UNIT IV**

Mechanism of enzyme action: acid base catalysis – Ribonuclease, covalent catalysis - chymotrypsin, metal ion catalysis – carboxy peptidase A, activation energy, role of coenzymes in enzyme reaction. eg: NADH,FADH and CoASH.

**UNIT V**

A brief account of enzyme applications – Immobilized enzymes and diagnostic enzymes (Liver enzymes (SGOT,SGPT),LDH,CK, Phosphatase) – enzymes as drugs in digestive disorders, applications of enzymes in Industries.

**REFERENCE**

1. Nicholas Price, 1982. Fundamentals of Enzymology 3<sup>rd</sup> edition.
2. Malcolm Dixon and Edwin C. Web, 1964. Enzymes - Academic press.
3. Allan Fersht, 1977.Enzyme Structure and Mechanism.
4. Trevor Palmer, 4<sup>th</sup> edition, 1995. Understanding enzymes. Ellis-Horwood Limited.
5. Dixon and Webb, 1964. Enzymes Edwin Clifford *Webb*. Edition, 2. Publisher, Academic Press.



6. Chapline & Bucke. 1990. Enzyme Technology Christopher *Bucke* (Cambridge University Press)
7. Alan Welshman, 1933. Hand book of enzyme biotechnology, 2<sup>nd</sup> edition,

### **CORE PRACTICAL I - LAB IN BIOMOLECULES**

**UBCP21**

**6hrs/4credits**

#### **Obectives:**

- To learn the preparation mode of biological chemicals from bio-based materials.
  - To acquire the knowledge about to operate pH meter and preparation of buffer.
  - To understand the instrumentation of colorimeter and verification through Beer Lamberts law.
  - Student can acquire the skills for the qualitative and quantitative analysis of bio-organic compounds
1. Qualitative analysis of Bio-organic Compounds
    - i. Carbohydrates
    - ii. Amino acids
    - iii. Proteins
    - iv. Lipids and cholesterol
    - v. Nucleic acids
  2. Biochemical Preparation
    - i. Starch (potato)
    - ii. Lactose (milk)
    - iii. Casein (milk)
    - iv. Caffeine (coffee seeds)
  3. pH meter- preparation of Buffer.
  4. Verification of Beer Lamberts law using colorimeter.
    - i. Determination of the extinction co-efficient of given colored compound.
    - ii. Determination of the concentration of given colored compound using a standard graph.

#### **REFERENCE**

1. S.Sadasivam and A.Manickam, 2007. Biochemical methods -
2. Dr. Plummer, 2010. Biochemical methods.
3. David T. Plummer, 1988 an introduction to practical bio-chemistry.
4. Pattabiraman, 1994. Laboratory manual in bio-chemistry.
5. J.Jayaraman, 1966. Practical bio-chemistry.

## ALLIED PRACTICAL I - ORGANIC & VOLUMETRIC ANALYSIS

UBCA21

5 hrs/4credits

### Objectives:

- To enlighten the volumetric analytical methods.
- The students can learn organic analytical methods practically and to improve the laboratory skills.

### UNIT I

Organic analysis:

Analysis of the following function group – Acids, phenols, aldehydes, ketones, esters, amines, amides, anilides, glucose and fructose. No preparation of solid derivatives.

### UNIT II

Volumetric Analysis

#### I. Acidimetry and alkalimetry

- a) Titration between a strong acid against NaOH
- b) Titration between a strong acid against  $\text{Na}_2\text{CO}_3$ .
- c) Titration between sodium hydroxide against oxalic acid.

#### II. Permanganometry

- a) Titration between  $\text{KMnO}_4$  against oxalic acid.
- b) Titration between  $\text{KMnO}_4$  against ferrous sulfate
- c) Titration between  $\text{KMnO}_4$  against Mohr's salt (ferrous ammonium sulfate)

#### III Iodometry

- a) Titration between sodium thiosulfate and potassium dichromate
- b) Titration between sodium thiosulfate and copper sulfate

Estimation: Only one question has to be set either from Unit I or Unit II (Random choice)

## ENVIRONMENTAL STUDIES

UEVS21

3 hrs/2 credits

### UNIT – I

The multidisciplinary nature of environmental studies  
Definition, Scope and importance.  
Need for public awareness

### UNIT – II

Natural resources:

Renewable and non – renewable resources

Natural resources and associated problems

- a) Forest resources: Use and over – exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams – benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non – renewable energy sources, use of alternate energy sources, case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable of resources for sustainable lifestyles.

### **UNIT – III**

- Concept of an ecosystem
- Structure and function of an ecosystem
- Producers, consumers and decomposers.
- Energy flow in the ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystem:
  - Forest ecosystem
  - Grassland ecosystem
  - Desert ecosystem
  - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

### **UNIT – IV**

#### **Biodiversity and its conservation**

- Introduction – definition: generic, species and ecosystem diversity.
- Biogeographical 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 of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wild life, man – wildlife conflicts.
- Endangered and endemic species of India.
- Conservation of biodiversity: In – situ and Ex-situ conservation of biodiversity.

### **UNIT – V**

#### **Environmental Pollution**

- Causes, effects and control measures of:
  - Air pollution
  - Water pollution
  - Soil pollution

- Marine pollution
- Noise pollution
- Thermal pollution
- Nuclear hazards
- Solid waste Management: causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Disaster management: floods, earthquakes, cyclone and landslides.

## **UNIT – VI**

### Social issues and the Environment

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation. Rainwater harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and control of Pollution) Act.
- Wildlife Protection Act.
- Forest Conservation Act.
- Issues involved in enforcement of environmental legislation.
- Public awareness.

## **UNIT - VII**

### Human population and the Environment

- Population growth, variation among nations.
- Population explosion – family Welfare Programme.
- Environment and human health
- Human Rights
- Value Education
- HIV / AIDS.
- Women and child welfare
- Role of Information Technology in Environment and human health.
- Case studies.

## **UNIT - VIII**

### Field work

- Visit to a local area to document environment assets – river / forest/ grassland/ hill/ mountain.

- Visit to a local polluted site – Urban/ Rural/ Industrial/ Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems – pond, river, hill slopes, etc.

## REFERENCE

1. Agarwal, K.C 2001 Environmental Biology, Nidi Publ Ltd, Bikaner
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt Ltd. (R)
3. Brunner R.C 1989, Hazardous Waste Incineration, McGraw Hill Inc 480p
4. Clark R.S Marine Pollution, Claderson Press, Oxford (TB)
5. Cunningham, W.P Cooper, T.H Gorhani, E & Hepworth, M.T 2001, Environmental Encyclopedia, Jaico Publ House, Mumbai 1196p.
6. De A.K Environmental Chemistry, Wiley Eastern Ltd.,
7. Down to Earth, Centre for Science and Environment (R)
8. Gleick, H.P 1993 Water in crisis, Pacific Institute for Studies in Dev., Environmental & Security. Stockholm Env. Institute. Oxford Univ Press 473p.
9. Hawkins R.E Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R).
10. Heywood, VH & Watson R.T 1995 Global Biodiversity Assessment. Cambridge Univ Press 1140p.
11. Jadhav, H 7 Bhosale, V.M 1995 Environmental Protection and Laws. Himalaya Pub House, Delhi 248p.
12. McKinney M.L & Schoch R.M 1996 Environmental Science systems & Solutions, Web enhanced edition 639p.
13. Mhaskar A.K Matter Hazardous, Techno Science publications (TB)
14. Miller T.G Jr Environmental Science, Wadsworth Publishing Co (TB).
15. Odum, E.P 1971 Fundamentals of Ecology, W.B Saunders Co USA, 574p.
16. Rao MN & Datta A.K 1987. Waste Water treatment. Oxford & IBH Publ Co Pvt Ltd. 345p.
17. Sharma B.K 2001 Environmental Chemistry Goel Publ House, Meerut.
18. Survey of the Environment, The Hindu (M)
19. Townseed C. Harper J and Michael Begon, Essentials of Ecology, Blackwell Science (TB).
20. Trivedi R.K Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol I and II, Enciro Media (R).
21. Trivedi R.K and P.K Goel, introduction to air pollution, Techno Science Publications (TB).
22. Wagner K.D 1998 Environmental Management W.B Saunders Co Philadelphia, USA 499p.(M) Magazine, (TB) Textbook, (R) Reference.

## SEMESTER - III

### CORE IV (THEORY) - INTERMEDIARY METABOLISM

UBCT31

6 hrs/4 credits

#### Objectives:

- To learn the metabolic pathways involved in the physiological processes
- To understand the concept of bioenergetics, carbohydrate and amino acid metabolism
- To study the lipid and nucleotide metabolism
- Student acquire the knowledge about the bioenergetics and intermediate metabolism of biomolecules

#### UNIT I

Metabolism – definition, importance in physiological processes, Division of metabolism. Bioenergetics: high energy and low energy phosphates, Oxidative phosphorylation.

#### UNIT II

Carbohydrate metabolism: glycolysis, TCA cycle, ETC, HMP Shunt, glycogenolysis, glycogenesis, gluconeogenesis.

#### UNIT III

Amino acid metabolism: A brief account of amino acid metabolism of glycine, cysteine, proline, homoserine, phenylalanine, (other amino acids excluded), urea cycle, a brief account on protein biosynthesis.

#### UNIT IV

Lipid metabolism: Oxidation of fatty acids, energetics of oxidation, ketone body metabolism, glycerol metabolism. Biosynthesis of fatty acids, biosynthesis of triglycerides, phospholipids, cholesterol metabolism.

#### UNIT V

Nucleotide metabolism: Purine and pyrimidine bases, De novo synthesis and Salvage pathway, catabolism of nucleic acids.

#### REFERENCE

1. Robert K, Murray, Harper's Biochemistry, 2001 25th Edition, Peter A, Meyes Victor W. Rodwell.
2. Albert L. Lehinger, 2015 Principles of Biochemistry.
3. Bender, David, (1985). Amino Acid Metabolism. A. Willey
4. Devlin, 2010 Biochemistry.
5. Voet and Voet, 2011. Biochemistry.
6. Murray, K. Robert, *et al.*, - Harper's Biochemistry. 25th edition.
7. Voet and Voet - Biochemistry. 4th edition. 2011. John Wiley and Sons.
8. Mathews, Freeland and Miesfeld 1972. - Biochemistry – a short course. Wiley & sons, 4<sup>th</sup> edition
9. Garrett and Grisham – 2006. Biochemistry. 4<sup>th</sup> edition, Saunders College Publishers

## **. ALLIED - II (THEORY) - STATISTICS FOR BIOLOGY**

**UBCA32**

**5 hrs/4 credits**

### **Objectives:**

- To understand the basics and purpose of statistics in organization and representation of collected data.
- To learn the measure of central tendency and probability calculations.
- The students can able to understand the correlation, regression and test of statistical significance to confirm the significance level
- After this course student can able to use appropriate statistical tool for the validation, interpretation of biological data and present clearly

### **UNIT I**

Statistics: Definition, collection and organization of data, representation of data, sampling and sampling design, tabulation, diagrammatic and graphical representation.

### **UNIT II**

Measures of central tendency: Mean, median, mode, measures of dispersion: range, mean deviation, standard deviation, and variance (problems and explanation).

### **UNIT III**

Probability, Binomial, Poisson and normal distribution.

Measures of symmetry: Skewness, kurtosis and moments - a brief explanation (Problems not necessary).

### **UNIT IV**

Correlation and regression: Explanation, types of correlation - positive and negative correlation, methods of studying correlation, Karl Pearson's co-efficient of correlation (simple problems related to correlation and regression).

### **UNIT V**

Tests of statistical significance: F test, t test, Chi square test, Analysis Of Variance.

### **REFERENCE**

1. Gupta SP. 1997. Statistical Methods.
2. Bhaskar Rai T. 2001. Methods of Biostatistics.
3. Bliss C.I.K. 1967. Statistics in Biology. Vol I. McGraw Hill, New York.
4. Campbell R.C. 1974. Statistics for Biologists, Cambridge University Press.

## MAJOR ELECTIVES - ELECTIVE I (THEORY)-

UBCE31

5hrs/3credits

### Option-1: BIOINSTRUMENTATION

#### Objectives:

- To gain the knowledge about the components, types and application of microscopes, centrifugation techniques and electrophoresis
- To understand about the principles and function of spectrometry in biological field.
- To learn the chromatographic techniques and its types for the separation of biological compounds.
- Student can understand the basic principle and application of all bioinstrumentation for the biological samples analysis.

#### UNIT I

Microscopy – parts and their function, resolving power, aperture – simple, compound, light and dark field, electron and phase contrast ,SEM,TEM microscopes – their applications.

#### UNIT II

Colorimeter: parts and their functions - Beer Lambert's Law. Spectroscopy – pH meter.

#### UNIT III

Chromatography techniques – Principles and types – paper, TLC, Column, HPLC and GC.

#### UNIT IV

Centrifugation techniques – principle, centrifuges and their uses, separation and analytical methods. Ultracentrifugation - applications

#### UNIT V

Electrophoretic techniques – principle, electrophoresis of proteins and nucleic acids. Capillary electrophoresis.

#### REFERENCE

1. Practical Biochemistry – Fifth edition Keith Wilson and John Wilson.
2. Analytical Biochemistry & Separation Techniques – Palanivelu.P
3. Fundamental Laboratory & Approach for Biochemistry & Biotechnology – Alexander.J Ninfa



## **ELECTIVE I (THEORY)**

**UBCE31**

**5 hrs/3 credits**

### **Option-2: HUMAN PHYSIOLOGY**

#### **Objectives:**

- To understand the composition and function of blood, ABO blood grouping and the students also can learn to about the properties of cardiac muscles, cardiac problems and how to measure the blood pressure.
- To study the anatomy of human body and the function of organs in the growth and development of human.
- To learn about the structure and function of respiratory system and endocrine system of human body.
- Student can learn all body organ structure and its function.

#### **UNIT I**

Composition and Functions of blood; White Blood Cells – Types and function; Red Blood Cells – Structure and functions; Haemoglobin –Structure and functions, Blood coagulation, Blood group – ABO, Rh. Structure of heart and blood vessels; Properties of cardiac muscle; cardiac cycle; origin and conduction of heart beat; measurement of arterial blood pressure. cardiac arrest.

#### **UNIT II**

General Anatomy; Digestion in the mouth, stomach and intestines. Movements of the intestine; Role of Liver and Pancreas – Structure and Functions.

#### **UNIT III**

Structure of Respiratory organs; Sub – divisions of lung air; Chemistry of Respiration. Physiology of the Urinary System- Structure of kidney and nephron; Formation of urine, Skin – Structure and functions, Regulations of body temperature

#### **UNIT IV**

Endocrine System – Structure and functions of thyroid, pituitary, parathyroid, adrenals, islets of langerhans of pancreas b) Reproductive System – anatomy of the male and female reproductive organs; menstrual cycle; mammary glands; Fertilization; Development of Embryo; Pregnancy and parturition

#### **UNIT V**

General classification of nervous system ; Structure of nerve cell and Spinal cord; Basic Knowledge of different parts of the brain – anatomy and functions of cerebrum, cerebellum and medulla oblongata. Structure and function of eye and ear; taste, smell and cutaneous sensations.

#### **REFERENCES**

1. Chatterjee C.C (2004), Human Physiology, Volume I, Medical Allied Agency, Kolkata
2. Chatterjee C.C (2004), Human Physiology, Volume II, Medical Allied Agency, Kolkata

3. Sembulingam, K. (2000) Essentials of Medical Physiology, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.
4. Best and Taylor, (1992) The Physiological Basis for Medical Practice, Saunders Company.
5. Chaudhri, K. (1993) Concise Medical Physiology, New Central Book Agency (Parental) Ltd., Calcutta.

### **NON MAJOR ELECTIVES –I (THEORY) – BIOFERTILIZER**

**UBCN31**

**2hrs/2credits**

**Objectives:**

- To know the production of biofertilizer using algal and fungal strains which are alternative for the chemical fertilizer.
- To learn the preparation methods of manures and biopesticides using plant based sources and green manuring to increase the soil fertility.
- To learn the application and production of organic compost and vermicompost through eco-friendly route.
- The students can get aware about the importance and need of eco-friendly biofertilizer for improving crop yield also can become entrepreneur.

**UNIT I**

Introduction: History, importance and present status of different types of fertilizers and their application to crop plants. Need of ecofriendly fertilizers. Effect of chemical fertilizers on environment. Energy consuming pattern for chemical fertilizers.

**UNIT II**

Algal and fungal (mycorrhizae) biofertilizers Bacterial biofertilizers Rhizobial, free living N<sub>2</sub> fixers and phosphate solublizing bacteria, their significance and practice. Nitrogen fixing mechanisms.

**UNIT III**

Manures: A general account of manures such as leaf moulds, composts form Yard Manure and a study of the following oilseed cakes: castor and neem as Biopesticide. Green Manuring Role of serbania serban for improving soil fertility.

**UNIT IV**

Application of biofertilizers and manures: A combination of biofertilizer and manure application.organic farming-compost and vermi compost.

**UNIT - V**

Mass production of Cyanobacterial Biofertilizers -- Nostoc, Anabaena Azolla. Blue green algae. Bacterial Biofertilizers -Azotobacter, Azospirillum ,Rhizobium ,Pseudomonas

## REFERENCE

- 1.N.S. Subbao Rao-soil microorganisms and plant growth.
- 2.N.S. Subbao Rao-Biofertilizer
- 3.Ronald M. Atlas& Richard bartha, Microbial Ecology,Fundamentals & application
4. Alexander1977.Introduction to soil microorganism and plant growth.

## SKILL BASED STUDIES I- TOOLS & TECHNIQUES IN BIOCHEMISTRY

UBCS31

2hrs/2 credits

### Objectives:

- To know the laboratory safety practices such as do's and don'ts inside the lab, handling of glass wares and toxic chemicals.
- To know the preparation and storage methods of chemical solutions.
- To learn the working methods of pH meter, centrifuge and spectrophotometer.
- Students can obtain the basic instrument handling skills and various solution preparation for biomolecules analysis

1. Safety practices in the laboratory.
2. Preparation and storage of solutions. Separation of blood sample
3. Working of a pH meter, centrifuges
4. Preparation of buffer
5. Spectroscopy- UV-visible and fluorescence spectroscopy.
  - a. Determination of concentration of a protein
  - b. Principle and instrumentation of Calorimeter
6. Introduction and importance of virtual labs in biochemistry

## REFERENCE

1. Physical Biochemistry: Principles and Applications (2010) 2<sup>nd</sup> ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.
2. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2<sup>nd</sup> ed., Freifelder, D., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 /ISBN:0-71671444-2.
3. An Introduction to Practical Biochemistry (1998) 3<sup>rd</sup> ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.

**SEMESTER - IV**  
**CORE V (THEORY) - IMMUNOLOGY**

**UBCT41**

**5hrs/4 credits**

**Objectives:**

- To study the basics of immunology and function of immune system against infections.
- To learn the properties and functions of antigens and antibody types.
- To acquire knowledge about hypersensitivity caused by immunological action and autoimmune disorders.
- Students can understand the immunodeficiency disorders, vaccine production and the fundamentals of oncology.

**UNIT I**

Development of immunology – Immunity – types –Organs of immune system – Hematopoiesis – Cells of immune system – blood grouping ABO and Rh systems – Blood transfusion.

**UNIT II**

Antigens – properties – types – Haptens and adjuvants – antibodies – structure – classes and biological functions.

**UNIT III**

Antigen antibody reaction – Host response – humoral and cell mediated immunity – complement - pathways of complement activation, MHC.

**UNIT IV**

Hypersensitivity – immune tolerance – transplantation immunity – auto immune diseases.

**UNIT V**

Immunodeficiency – Immunology of infectious diseases –microbial infection bacterial, protozoan, viral infection – toxoid. Vaccines – type – vaccine development – Oncology.

**REFERENCE**

1. I.M. Roitt, 1988. Essential immunology; Blackwell Scientific Publications, Oxford.
2. R.M Coleman. 1992. Fundamentals of Immunology. W.C Brown Publ.
3. Janis Kuby. 1992. Immunology. W.H Freeman and Coy, N.Y.
4. Illustrated dictionary of Immunology, Cruse.
5. Cellular and Molecular Immunology, Abbas.

## **CORE PRACTICAL II - LAB IN IMMUNOLOGY AND MICROBIOLOGY**

**UBCP42**

**5hrs/4 credits**

### **Objectives:**

- To learn the blood grouping and method to estimate haemoglobin level in blood.
- To train the students to know the diagnostic methods in laboratory level.
- To know the isolation and identification of microbes from various samples.
- Students can equip the skills of immunotechniques and microbial techniques

- 1) Blood grouping
- 2) Estimation of Hemoglobin
- 3) Precipitation method
  - i. Immunodiffusion
  - ii. Immunoelectrophoresis(OD)
- 4) WIDAL test
- 5) ELISA
- 6) VDRL test
- 7) CRP test
- 8) RA test
- 9) ASO test
- 10) Aseptic Techniques – Sterilization
- 11) Serial Dilution, Pour Plate and Spread Plate & streak plate method
- 12) Staining – Simple and Gram's Staining
- 13) Antibiotic sensitivity test (Disc diffusion method)

### **REFERENCE**

1. Hudson and Hay Practical Immunology.
2. Cappuccino, G. James and Natalie Sherman, 1999. Gram stain, Microbiology A Lab. Manual.
3. Atlas, M. Ronald, 1995, Alfred E. Brown and Lawrence C. Parks, Gram stain, Experimental Microbiology.
4. Handbook of Microbiological Media – Hi Media

## **ALLIED – III (THEORY) - PHYSICS FOR BIOLOGY**

**UBCA42**

**5hrs/4 credits**

### **Objectives:**

- To obtain knowledge about the principles and types of spectroscopy and its application in the analysis of biological macromolecules.
- To study the types of radioisotopes, techniques used for the measurement of radioactivity and its use in biological studies.
- To learn the role of isotopes in biological field, autoradiography techniques.

- The students can acquire skills on spectroscopy and can get awareness about hazardous effect of radioactive substances and to know how to handle the radioisotopes.

### **UNIT I**

Spectroscopy - Absorption spectroscopy – principle, instrumentation and applications of atomic absorption, UV visible spectroscopy, Infrared spectroscopy, Nuclear Magnetic Resonance Spectroscopy, NOSY, COSY and ROSY techniques. Electron Spin resonance.

### **UNIT II**

Emission spectroscopy – introduction, principle, method and application of Flame photometry. Fluorimetry – principle, instrumentation and application. Mass spectroscopy – principle, instrumentation and application. Light scattering Raman Spectroscopy; principles, method, application with reference to biological macromolecules such as proteins and nucleic acids.

### **UNIT III**

Principles of thermodynamics and their applications. Introduction, thermodynamics system, thermodynamic state functions, first and second laws of thermodynamics, concept of free energy, standard free energy, determination of  $\Delta G$  for a reaction, relation between equilibrium constant and standard free energy change, biological standard state and standard free energy change in coupled reactions.

### **UNIT IV**

Types of radioisotopes used in biology, units of radioactivity measurements, techniques used to measure radioactivity (gas ionization and liquid scintillation counting), nuclear emulsions used in biological studies (pre-mounted liquid and stripping).

### **UNIT V**

Isotopes commonly used in biochemical studies –  $^{32}\text{P}$ ,  $^{35}\text{S}$ ,  $^{14}\text{C}$  and  $^3\text{H}$ . Autoradiography, Biological hazards of radiation and safety measures in handling radioisotopes – Biological applications.

### **REFERENCE**

1. Physical Biochemistry – VanHolde K.E., Prentice Hall Inc.
2. Biophysical Chemistry – Upathayah
3. Practical Biochemistry – Principles and Techniques – Keith Wilson & John Walker.
4. Practical Biochemistry – D. Friefelder, WH Freeman & Co USA.

## **ELECTIVE II (THEORY)**

**UBCE42**

**4 hrs/3 credits**

### **Option-1 GENERAL MICROBIOLOGY**

#### **Objectives:**

- To understand the basics of microbiology, classification and general characteristics of microbes.
- To study the structural organization and morphological features of microorganisms.
- To know the growth, reproduction and metabolism of bacteria.
- After this course student can get thorough knowledge of microbial classification, metabolism, microbial production of medicine, fuel, food products and diseases caused by microbes.

#### **UNIT I**

History of microbiology, Microscope (light & electron), natural distribution of microorganism, general classification of microorganisms (bacteria, yeast) and their characteristics.

#### **UNIT II**

Organization and structure of Microorganisms: Prokaryotic organization, cytoplasm membranes and their function, mesosomes, cell wall – gram positive and gram negative reactions, capsule and slime layers, flagella and cilia, bacterial chromosome, plasmids, ribosomes, reserved food and endospore.

#### **UNIT III**

Bacterial nutrition: Growth and reproduction, autotrophic and heterotrophic nutrition, bacterial photosynthesis, chemolithotrophy, bacterial metabolism, fermentation, homo fermentative and hetero conjugation, transformation, transduction, speculation, kinetics of bacterial growth, normal growth curve.

#### **UNIT IV**

Food Microbiology: Food spoilage, food poisoning, food borne infections and disease causing microorganisms.

#### **UNIT V**

Industrial Microbiology: Use of microbes in industries, ethanol production, organic acid (penicillin and streptomycin) production. Microorganisms and milk: Sources of microorganisms, fermentation of milk and characteristic, Transmission of disease through milk, determining the wholesomeness of mild, frozen dairy products.

#### **REFERENCE**

1. Y.Stainer L. Wheelis, 2005.General Microbiology.
2. David genenwood, 2012. Medical Microbiology.
3. Gerand J.Tortora, 2015. Microbiology An introduction.
4. Cordic Nims, Hazel M.Dockrell, Medical Microbiology.

## **ELECTIVE II (THEORY)**

**UBCE42**

**4 hrs/3 credits**

### **Option-2: BIOPROCESS TECHNOLOGY**

#### **Objectives:**

- To acquire the knowledge about bioreactors design, used for fermentation process and the recovery of end products.
- To know the production of valuable chemicals such as alcohol, antibiotics and protein from microbial fermentation.
- To study the food preservation methods and application of enzymes in biosensor and application of commercial product production using enzymes.
- The students can obtain knowledge regarding the bioreactors, microbial production and recovery of useful products.

#### **UNIT –I**

Introduction to industrial microorganisms: Isolation, Preservation and Maintenance of Industrial Microorganisms. Kinetics of microbial growth and death. Media for industrial fermentation. Air and Media Sterilization.

#### **UNIT- II**

Types of fermentation processes: Analysis of batch, Fed-batch and continuous bioreactors; components of bioreactor- Measurement and control of bioprocess parameters.

#### **UNIT –III**

Downstream Processing: Introduction, Removal of microbial cells and solid matter, foam removal, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction chromatography, Membrane process, Drying and Crystallization. Effluent treatment: BOD and C.O.D. Treatment and disposal of effluents.

#### **UNIT- IV**

Industrial Production of Chemicals: Alcohol (Ethanol), Acids (Citric), Antibiotics (Penicillin), Amino acids (lysine), Single Cell Protein (algae/fungi).

#### **UNIT- V**

Introduction to Food Technology: Food Preservation – methods. Enzyme technology-biosensor, immobilization of enzymes. Commercial production of enzymes-techniques and applications.

#### **REFERENCES**

1. Stanbury, P.F. and Whitaker, A.,(Eds). 1984. Principles of Fermentation Technology. Pergamon Press, Oxford.
2. Arnold L Demain and Julian E.Davies. 1999. Manual of Industrial Microbiology and Biotechnology, III edition .ASM press, Washington DC.



3. Frazier, W.C. and Dennis, C. Westhoff. 1995. Food Microbiology, Tata McGraw Hill Publishing Company, New Delhi.
4. Casida, L.E. 2003. Industrial Microbiology. New Age International (P) Ltd., New Delhi.
5. Michael Shuler and Fikret Kargi. 2002. Bioprocess Engineering: Basic Concepts, 2<sup>nd</sup> Edition, Prentice Hall, Englewood Cliffs, NJ.
6. Pauline M. Doran. 1995. Bioprocess engineering principles, 1 Edition, Academic Press
7. Bailey, J.E. and D.F Ollis. 1986. Biochemical Engineering Fundamentals, 2nd ed. McGraw-Hill Chemical Engineering Series, Berkshire, U.K.
8. Aiba. S., Humphrey, A.E. and Millis N.F. 1973. Biochemical Engineering. University of Tokyo Press, Tokyo
9. Aktinson B. 1974. Biochemical Reactors. Pion Ltd., London
10. Jackson, A.T . 1991. Process Engineering in Biotechnology. Prentice Hall, Englewood Cliffs, NJ, USA. 26.
11. Enfors, S. O and Haggstrom, L.H. 1998. Bioprocess Technology – Fundamentals and Application.

### **NON MAJOR ELECTIVE – II - MUSHROOM CULTIVATION**

**UBCN42**

**2 hrs/2 credits**

**Objectives:**

- To gain the knowledge about mushroom types and its nutritional properties.
- The students can obtain knowledge about morphological, life cycle of mushroom and methods for cultivation of mushroom.

Student can become mushroom entrepreneur

1. Mushroom and its nutritional value
2. Morphology of mushroom
3. Life cycle of mushroom
4. Spawn preparation
5. Cultivation of mushroom
6. Mushroom diseases and control measures.

**REFERENCE**

1. T.N. Kaul. Introduction to Mushroom Science (Systematics), Oxford and IBM Publishing Co. Ltd.
2. Nita Bahl. Handbook on Mushroom Science (Third edition).
3. K.R Aneja. Experiment in Microbiology, Plant Pathology Tissue Culture and Mushroom Cultivation, New Age International Ltd.
4. Experiment in Microbiology, Plant Pathology and Biotechnology, New Age International (P) Ltd.

## **SKILL BASED STUDIES – II - PROTEIN PURIFICATION TECHNIQUES**

**UBCS42**

**2 hrs/ 2 credits**

### **Objectives:**

- To know the techniques for the purification of proteins.
  - To learn the chromatography techniques and protein characterization methods.
1. Purification and characterization of a protein from a complex mixture
    - Preparation of the sample.
    - Ion-exchange chromatography.
    - Gel filtration chromatography.
    - Affinity chromatography.
    - Electrophoresis.
  2. Principle of High Performance Liquid Chromatography (HPLC)

### **REFERENCE**

1. Physical Biochemistry: Principles and Applications (2010) 2<sup>nd</sup> ed., Sheehan, D., Wiley Blackwell (West Sussex)
2. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2<sup>nd</sup> ed., Freifelder, D., W.H. Freeman and Company (New York).
3. An Introduction to Practical Biochemistry (1998) 3<sup>rd</sup> ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi).

## **SEMESTER - V**

### **CORE VI (THEORY) - CLINICAL BIOCHEMISTRY**

**UBCT 51**

**5 hrs/4 credits**

### **Objectives:**

- The students can understand about scope of clinical biochemistry to detect disorders.
- To study the disorders caused due to the error in carbohydrate, lipid, protein metabolism and regulation of blood glucose level.
- To learn the tissue function tests, biochemical tests and renal disorders.
- Student can get the theoretical knowledge of clinical test.

### **UNIT I**

Introduction, scope and development of clinical biochemistry. Disorders of carbohydrate metabolism: Regulation of blood glucose, digestion and absorption, normal blood glucose level, hypo and hyper glycemia, diabetes GTT, glucosuria GTT, and galactosemia, GTT. Inborn errors of carbohydrate metabolism.

### **UNIT II**

Disorders of lipid metabolism: Digestion and absorption of lipid, hypo and hyper lipoproteinemias, disorders of triglycerides, phospholipids and cholesterol metabolism, inborn errors of lipid metabolism.

### **UNIT III**

Disorders of amino acid and protein metabolism: Digestion and absorption, urea cycle, disorders of urea, uric acid, creatinine and ammonia. Hypo urecemia, hyper urecemia and porphyria, inborn errors of amino acid metabolism.

### **UNIT IV**

Disorders of nucleic acid metabolism: Purine and pyrimidine metabolism. Gout, orotic aciduria and xanthinuria.

### **UNIT V**

Tissue function tests: Biochemical tests of liver, kidney and pancreas, significance of tissue function tests. Renal and liver transport: Renal Glycosuria, cystenuria, Fanconi syndrome, Crigglar- Najjar disease, Gilbert's disease, Dubin – Johnson disease.

### **REFERENCE**

1. Hawk's, 1965. Physiological Chemistry.
2. Harold Varley, 1960. Practical Clinical Biochemistry –Fourth edition.
3. Tietz, Edward R. Ashwood, David E. Bruns, 2012. Clinical Biochemistry.
4. Burtis A. Carl and Edward R. Ashwood, Tietz 1994, text book of clinical chemistry W.B. Saunders company, 2<sup>nd</sup> edition.
5. Philip D. Mayne, 1994. Clinical Chemistry in diagnosis and treatment. ELBS Publication, 6<sup>th</sup> edition.
6. Montgomery, Conway, Spector, Biochemistry 1990– A case oriented approach. The C.V. Mosby Company, 5<sup>th</sup> edition.

## **CORE VII (THEORY) - MOLECULAR BIOLOGY**

**UBCT 52**

**5 hrs/4 credits**

### **Objectives:**

- To study about the genetic material, mutation, and DNA repair mechanism.
- To understand the mechanism and types of DNA replication in prokaryote and eukaryote.
- To obtain the knowledge of bacterial genetic exchange, genetic maps and linkage.
- The students can understand the genetic material, regulation of gene expression

### **UNIT I**

Nucleic acid as genetic material, Experimental evidence, mutation – types, introns, exons, probes, complementation of gene function. Genetic code: codon, Wobble hypothesis.

### **UNIT II**

Replication: types and mechanism of replication, difference between prokaryotic and eukaryotic replication, DNA polymerases. Transcription: mechanism, RNA polymerase. Translation

### **UNIT III**

Genetic exchange in bacteria: transformation, transduction, and conjugation. genetic maps, linkages, HFr strain.

#### **UNIT IV**

Regulation of Gene expression: Organization of operon, positive and negative operon, lac and ara operon. Chemical mutagen: NTG, HNO<sub>2</sub>, physical mutagen: UV and biological mutagen.

#### **UNIT V**

Extra chromosomal inheritance: Plasmids, types; Transposons: structure and functions; DNA damage and repair mechanism.

#### **REFERENCE**

1. Lewin, Gene VIII 2004. Oxford University Press.
2. Arthur Kornberg, 1992. DNA replication.
3. Lodish, Berk, Zippursky, 2012. Molecular Cell Biology (W.H Freeman).
4. Freifelder, Molecular Biology 1982. Narosa Publishing Co.,
5. Weaver, F., Robert, Hedrick, W. Philip, Genetics, 1997, W.C. Brown Publishers 4th ed.
6. David Freifelder, 2002, Jones and Bartlett publishers, Molecular Biology, Reprint, , Narosa Publishing House.
7. Gardner, Simmons, 1994, 8<sup>th</sup> edition, Principles of Genetics

### **CORE VIII (THEORY) - PLANT BIOCHEMISTRY**

**UBCT54**

**5 hrs/4 credits**

#### **Objectives:**

- To understand the photosynthesis process occurs in plants.
- To enlighten the students about plant nutrition, nitrogen fixation, the function of mineral, sulphur and nitrate metabolism in the plants.
- To understand the plant physiology
- The deep knowledge can use for the production of new crop variety and transgenic plants

#### **UNIT I**

Photosynthesis: Photosynthesis apparatus and photosynthesis pigments, light and dark reactions of photosynthesis, C<sub>3</sub> C<sub>4</sub> and CAM plants, factors affecting photosynthesis, photorespiration.

#### **UNIT II**

Plant growth regulators: Normal growth hormones, Auxins, GA, Cytokinins, Ethylene and ABA, synthetic growth hormones.

#### **UNIT III**

Plant nutrition: Essential mineral nutrients, absorption, translocation and function, effects to toxicity and deficiency, N<sub>2</sub>, cycle N<sub>2</sub> fixation, symbiotic and asymbiotic N<sub>2</sub> fixation: nitrogenase, nitrate assimilation, sulphur metabolism, sulphur as a mineral nutrient, sulphate assimilation.

#### **UNIT IV**

Physiology and reproduction: Brief account on physiology of germination, dormancy, photoperiodism, vernalization.

#### **UNIT V**

Plant tissue culture (an elementary treatment), Disease resistance in plants, plant chemicals and their significance, storage carbohydrates, proteins and fats, secondary metabolites, their physiological, biochemical and pharmacological properties. Terpenes, terpenoids and alkaloids (structural elucidation not necessary).

#### **REFERENCE**

1. Bonner and Varner, 1972. Plants Biochemistry, Third edition, Academic press.
2. Hopkins, 2008. Plant physiology.
3. John. W. Anderson and John Brardall, Molecular activities of plant cell – An Introduction to Plant Biochemistry. Black well Scientific Publications, 1994.
4. Lea and Lea wood, Plant Biochemistry and Molecular Biology, John Wiley and sons, 1997.
5. Devlin N. Robert and Francis H. 1971. Witham Plant Physiology –, CBS Publications.
6. Hans Walter Heldt, 1997, Plant Biochemistry and Molecular Biology –.Oxford University Press, New York,
7. William G. Hopkins, John Wiley and sons, 2004. Introduction to Plant Physiology.
8. C.K. John 1997, Rajani, S. Nadyanda AF. Mascarenhas, Niscom, Tissue culture of economic plants, New Delhi.

#### **CORE IX (THEORY) - PHARMACOLOGY**

**UBCT55**

**5 hrs/4 credits**

#### **Objectives:**

- To understand the drug receptors, principles and phases of drug metabolism and pharmacological activity.
- To study the principles and methods of chemotherapy for cancer and mode of anticancer drugs.
- To get knowledge about the adverse effect of drugs and metabolism of Xenobiotics.
- The students can acquire profound knowledge regarding the drug metabolism

#### **UNIT I**

Definition, classification of drugs, routes of drug administration, absorption of drugs, factors influencing absorption of drugs. Drug distribution: role of kidney in drug interaction with biomolecules, binding of drugs to plasma proteins.

#### **UNIT II**

Drug receptors: drug receptor interaction, involvement of binding forces in drug receptor interaction, drug action not mediated by receptors.

### **UNIT III**

Drug metabolism: effects of drug metabolism, principles of phase I & II reactions, microsomal metabolism of drugs, role of cytochrome p450, enzyme induction and pharmacological activity.

### **UNIT IV**

Chemotherapy: Principles of cancer chemotherapy, target sites for cancer chemotherapeutic agents. Mode of action of anticancer drugs: antibiotics, antimetabolites, alkylating agents, hormones and other agents. Mode of action of sulphonamides, antiviral substances, antimalarials and cancer chemotherapy.

### **UNIT V**

Unusual, adverse response to drugs, drug tolerance and intolerance, drug induced diseases, commonly abused drugs and their biological effects.

Metabolism of xenobiotics and their biomedical importance.

### **REFERENCE**

1. The pharmacology, 1991. Volumes I and II – Goodman, Gilman
2. Rang, Dale, 2012. Basic and clinical pharmacology 7th edition – Katzung, Printice Hall,
3. Satoskar *et al.*, 2012. Pharmacology and pharmacotherapeutics, Popular Prakashar, Mumbai
4. Foye, Waverks, 2012. Principles of medicinal chemistry, Pvt. Ltd. New Delhi
5. Burger's medicinal chemistry and drug discovery. 2012. Principles and practice – Wolf, John Wiley
6. Davies, 1988. Molecular basis of inherited diseases, Read, IRL Press.
7. Glick, Pasternak, 2002. Molecular biotechnology 2nd edition, Panima Publishers,

## **CORE X (THEORY) - GENETICS**

**UBCT 55**

**5 hrs/4 credits**

### **Objectives:**

- To get deep knowledge about the concepts of genetics, principles and mechanism of Mendelian inheritance, genes, chromosome and Mendel's law.
- To study the gene interaction, structure of chromosome, chromosomal abberation gene organization.
- To study about the chromatin, metabolic pathways, mRNA molecules and nuclear transcription.
- Student can able to get the thorough knowledge in genetics which can be used for advanced research

### **UNIT I**

Introduction to genetics, Mendelian analysis of inheritance, genes, chromosomes, alleles, homozygous, heterozygous and mechanism of Mendelian inheritance, Mendel's laws. Linkage:

definition, simple measurement and salient features. Salient features of autosomal dominant, recessive, extra nuclear inheritance.

## **UNIT II**

Gene and gene interaction, Sex determination and sex linkage in diploids, linkage and crossing over, gene mapping. Chromosomal theory of inheritance, maternal inheritance.

## **UNIT III**

Chromosomal variation in number, changes in chromosomal structure, chromosomal aberrations, transposable elements in prokaryotes and eukaryotes.

## **UNIT IV**

Structure of chromosome, organization of gene, cistron, recon, structure of eukaryotic gene, experimental evidence for DNA as the genetic material, cytoplasm genetic system: mitochondria and chloroplast DNA.

## **UNIT V**

Heterochromatin, euchromatin, chromatin remodeling, regulation of galactose metabolism in yeast, regulation by phosphorylation of nuclear transcription factors, regulatory RNAs, riboswitches, RNA interference, synthesis and function of mRNA molecules, phosphorylation of nuclear transcription factors.

## **REFERENCE**

1. Genetics Daniel L. Hartl, Maryellen Ruvolo , 2011. Analysis of gene and genomes, sixth edition
2. Benjamin H. Pierce, 2012.Genetics – Fourth Edition.
3. Primrose *et al.*, 1960. Principles of gene manipulation, 6<sup>th</sup> Edition.
4. Brown, John wisely. 1999, Genomes.
5. Lodish *et al.*, 2012. Molecular Biology.

## **ELECTIVE III (THEORY)**

**UBCE56**

**3 hrs/3 credits**

### **Option-1: GENERAL BIOLOGY**

#### **Objectives:**

- The students learn about the classification of plants and general characteristics of plants, fungi and algae.
- To acquire more knowledge about the general characters of bryophytes, gymnosperms and angiosperms with examples.
- To understand the organ structure and function.
- Student can get basic knowledge about plant and animal biology

## **UNIT I**

Basis of Classification – Bentham and Artificial, Natural Classification of plants, Morphology, Structure and reproduction in plants, Algae- General characters – Sargassum as an example – Economic importance of Seaweeds. Fungi – General characters – Yeasts as an example.

## **UNIT II**

Bryophytes – General characters – Funaria as an example- alternation of generation. Pteridophytes – General characters – Selaginella. Gymnosperm – General characters – Pinus – Economic uses of gymnosperms. Angiosperms – Monocot flower – Allium cepa. Dicot flower – Tribulus terrestris.

## **UNIT III**

Organization, movement and secretions of gastrointestinal tract, Respiration – respiratory organs in mammals – morphology –respiratory pigments. Blood and circulation – composition of blood – General organization of circulatory systems.

## **UNIT IV**

Excretion – excretory organs – general organization in man – muscular system – ultra structure of voluntary muscle.

## **UNIT V**

Nervous system – CNS – Autonomic nervous system – Endocrine glands in man

## **REFERENCE**

1. A.C.Dutta, Botany for degree students
2. G.M.Smith, Cryptogamic Botany, Volume I & II
3. W.T.Taylor and R.J.Wehe – General Biology
4. Narayanaswamy – Outlines of Botany
5. General Biology – Cambridge Press

## **ELECTIVE III (THEORY)**

**UBCE56**

**3 hrs/3 credits**

### **Option-2: DEVELOPMENTAL BIOLOGY**

#### **Objectives:**

- To study about gametogenesis, origin of sperm and egg, cleavages.
- To learn about gastrulation, metabolism and molecular changes and gene activities during gastrulation.
- To study about the organogenesis and regeneration.
- Student can get deep knowledge in embryo formation and development.

## **UNIT – I**

Gametogenesis: Definition-primordial germ cells-origin-spermatogenesis-physiological ripening of sperm-oogenesis-previtellogenesis-vitellogenesis.



## **UNIT – II**

The egg: Size-shape-egg membranes, tertiary membranes, organization of the egg yolk, pigments, egg cortex, polarity, origin of polarity, types of eggs. Cleavage-Definition, morula, blastula, types of blastula, molecular changes, planes of cleavages, types of cleavage, factors affecting cleavage, cleavage laws, adhesion of blastomeres during cleavage, nuclei of cleaving cells, cytoplasm of cleaving cells.

## **UNIT – III**

Gastrulation: Definition, exogastrulation, metabolism and molecular changes during gastrulation, gene activities during gastrulation. Morphogenic movements- Definition, types epiboly, emboly mechanism of morphogenic movements.

## **UNIT – IV**

Organogenesis: Definition, tabulation, neurogenesis, spermatogenesis, growth and differentiation derivatives of ectoderm and mesoderm.

## **UNIT – V**

Regeneration: Definition – Types, Human Reproduction puberty, Menstrual cycle. Menopause, Pregnancy and related problems parturition and lactation.

## **REFERENCE**

1. Verma.S and Agarwal V.K. 2000. Chordate Embryology S.Chand & Co. New Delhi.
2. Berrill.N.J., 1986 Developmental Biology Mc.Graw Hill, New Delhi.
3. Patten, B.M., (1958) Foundations of Embryology Mc.Graw Hill, New Delhi.
4. Saunders.J.W (1982) Developmental Biology – Pattern and Principles, Macmillan New York.
5. Principles of Embryology – Waddington.
6. Embryology by Brath.

## **SKILL BASED STUDIES III - CLINICAL BIOCHEMISTRY (LAB)**

**UBCE53**

**2 hrs/2 credits**

### **Objectives:**

- The students can acquire the clinical laboratory skills
- To know the techniques to estimate glucose, triglycerides and bilirubin in blood and urine.

The students can get practice basic clinical test

1. Organization of clinical laboratory
2. Collection of blood and storage.
3. Separation and storage of serum
4. Total Blood Cell Count (RBC, WBC)
5. Estimation of glucose blood / urine.
6. Estimation of triglycerides in blood / urine

7. Estimation of bilirubin (direct and indirect).
8. Quantitative determination of serum creatinine and urea/ urine
9. Qualitative experiments of urine

## **REFERENCE**

1. Practical Manual of Biochemistry – S.P.Singh
2. Biochemical Analysis – Dr.Palanivelu
3. Medical Laboratory Technology, Vol II Kanai, L.Mukherje

## **SEMESTER VI CORE XI (THEORY) - HORMONES AND NEUROCHEMISTRY**

**UBCT 61**

**4 hrs/4 credits**

### **Objectives:**

- To get the deep knowledge about the classification, biosynthesis and degradation mechanism of hormones.
- To learn about the biosynthesis and mode of action of thyroid hormone, pancreatic and adrenal hormones.
- To gain the profound knowledge about the structure and function of brain, neurotransmitters with examples.
- Student can get thorough knowledge in hormone chemistry and neurochemistry

### **UNIT I**

Hormones: Definition, classification, biosynthesis and degradation. Mechanism of hormone action, class I and II hormone receptors, steroids. Feedback regulation of hormones.

### **UNIT II**

Hypothalamus and pituitary hormones: Hypothalamic releasing factors vasopressin, oxytocin. Biosynthesis, secretion, transport, regulation and biological effects of growth hormones, FSH, LH, TSH, ACTH and prolactin.

### **UNIT III**

Thyroid hormones: biosynthesis, secretion, transport, regulation and biological actions. Hypo and hyperthyroidism, antithyroid agent's role of parathyroid hormones, calcitriol, calcium and phosphorous homeostasis. Hypo and hyperparathyroidism.

### **UNIT IV**

Pancreatic hormones: Islets of Langerhans, cell types. Insulin and glucagon: biosynthesis, mechanism of action and biological effects. Hormonal action of somatostatin and pancreatic polypeptide.

Adrenal hormones: biosynthesis, secretion, transport, mechanism of action and excretion of glucocorticoids, mineralocorticoids, adrenal medullary hormones - epinephrine and nor epinephrine, steroid hormones - androgens and estrogens.

### **UNIT V**

Structure and function of the brain, central nervous system, peripheral and autonomic nervous system. Cells of nervous system: Neurons, Glial cells, Oligodendrocytes and Schwann cells. Neurotransmitters - Synthesis, storage, release, uptake, degradation and action of neurotransmitters. Acetyl choline, GABA, serotonin, dopamine, glutamate, aspartate, nitrous oxide. Mechanism of action of anesthetics, analgesics, hallucinogens, depressants, stimulants and toxins on the nervous system. Addiction and drug abuse.

## **CORE XII (THEORY) – rDNA TECHNOLOGY**

**UBCT62**

**4 hrs/4 credits**

### **Objectives:**

- To study the construction of prokaryotic and eukaryotic cloning vectors.
- To know the techniques for the production of rDNA, mode of recombination and synthetic primer synthesis and gene transfer methods.
- To develop the knowledge regarding the genomic library, PCR and the applications of genetic engineering in biotechnology.
- The students can acquire knowledge about recombinant DNA technology and the manipulating methods which can be used for transgenic plant production.

### **UNIT I**

Introduction to recombinant DNA technology:

Overview of recombinant DNA technology. Restriction and modification systems, restriction, endonucleases and other enzymes used in manipulating DNA molecules, separation of DNA by gel electrophoresis. Extraction and purification of plasmid and bacteriophage DNA.

### **UNIT II**

Cloning vectors for prokaryotes and eukaryotes:

Plasmids and bacteriophages as vectors for gene cloning. Cloning vectors based on *E. coli* plasmids, pBR322, pUC8, pGEM3Z. Cloning vectors based on M13 and  $\lambda$  bacteriophage. Vectors for yeast, higher plants and animals.

### **UNIT III**

Production of r DNA:

Ligation of DNA molecules. DNA ligase, sticky ends, blunt ends, linkers and adapters. Synthetic oligonucleotides, synthesis and use. Uptake of DNA by cells, preparation of competent cells. Selection for transformed cells.

### **UNIT IV**

Selection of recombinants:

Identification for recombinants - insertional inactivation, blue-white selection. Introduction of phage DNA into bacterial cells. Identification of recombinant phages. Introduction of DNA into animal cells, electroporation.

### **UNIT V**

Methods for clone identification:

The problem of selection, direct selection, marker rescue. Gene libraries, identification of a clone from gene library, colony and plaque hybridization probing, methods based on detection of the translation product of the cloned gene. PCR, DNA sequencing. Applications of genetic engineering in Biotechnology

### **CORE XIII (THEORY)- GENETICS & GENETIC ENGINEERING**

**UBCT63**

**5 hrs/4 credits**

#### **Objectives:**

- To study the basic concept of genetic engineering, different types of vectors ,expression of transfer gene
- To understand about cloning vectors and the construction of genomic library and cDNA libraries.
- To learn the key concepts of PCR and sequencing methods.
- Student can learn the application of rDNA technology in agriculture field or high yield and to produce therapeutic agents and can know the effect of biohazards, biosafety levels and handling and disposal of hazardous materials.

#### **UNIT I**

Outline process of genetic engineering and recombinant DNA technology, Isolation of genes, exonuclease & endonuclease, Concept of restriction and modification – Restriction endonucleases, DNA modifying enzymes, Ligases.

#### **UNIT II**

Different Kinds of Vectors - Plasmids, Phage vectors, Cosmids, Phagemids, Virus vectors, Shuttle vectors and expression vectors- YAC, BAC- *S. cerevisiae* system as a model.

#### **UNIT III**

Host-vector system - Cloning vectors for *E. coli.*, Cloning vectors for Eukaryotes- Cloning strategies, construction of genomic libraries and cDNA Libraries.

#### **UNIT IV**

DNA amplification using polymerase chain reaction (PCR): key concepts, Analysis of amplified products. Sequencing (chemical degradation; chain termination and automated sequence.

#### **UNIT V**

Applications of recombinant DNA technology in agriculture – Ti plasmids and their uses in pharmaceuticals, Insulin, Aminoacids, protein engineering and drug design – transgenic plants, animals and microbes – biohazards and biosafety.

#### **REFERENCES**

1. Cell and molecular biology, 3rd edition, Philip Sheeler, Donal E Bianchi, John Wiley
2. Molecular biology of cell, Alberts et al
3. Molecular cell biology, Lodish, Baltimore, Scientific American books, 1994

4. Molecular and cell biology, Stephen L Wolfe, Wordsworth Publishing company 1993
5. Cell biology. Sadava

**CORE III (PRACTICAL) - LAB IN GENETICS & MOLECULAR BIOLOGY**

**UBCP63**

**5 hrs/4 credits**

**Objectives:**

- To develop the laboratory skills and to learn the techniques to isolate plasmid DNA and amplification of DNA by PCR.
  - To learn the transformation techniques.
  - To learn the handling and knowledge to perform blotting, electrophoresis and ELISA methods.
  - Student can learn all genetic and molecular techniques for biological research
1. Isolation of plasmid DNA from *E. coli* cells.
  2. Amplification of a DNA fragment by PCR.
  3. Transformation of *E. coli* cells with plasmid DNA.
  4. Blotting Techniques – Western, Southern
  5. Agarose gel electrophoresis
  6. SDS – PAGE
  7. ELISA

**CORE IV (PRACTICAL) - LAB IN BIOCHEMICAL TECHNIQUES**

**UBCP64**

**5 hrs/4 credits**

**Objectives:**

- To know the methodology to quantify carbohydrate, sugar, protein and amino acid in the biological samples.
  - To learn the techniques for the estimation of DNA and RNA isolated from biological sample.
  - To know the mode to determine the acid number, iodine number and saponification number.
  - Student can able to do the qualitative and quantitative analysis of biomolecules.
1. Estimation of carbohydrate by Anthrone method
  2. Estimation of reducing sugar by DNSA Method.
  3. Estimation of total protein concentration by
    - a. Biuret method b) Lowry's method.
  4. Determination of total amino acid by Ninhydrin method
  5. Estimation of DNA by diphenyl amine methods.
  6. Estimation of RNA by orcinol method.
  7. Estimation of Iodine Number
  8. Determination of Acid Number

9. Determination of Saponification Number

**REFERENCE**

1. Dr. Plummer, 2010. Biochemical methods.
2. David T. Plummer, 1988 an introduction to practical bio-chemistry.
3. Pattabiraman, 1994. Laboratory manual in bio-chemistry.
4. J.Jayaraman, 1966. Practical bio-chemistry

**ELECTIVE IV (THEORY)**

**UBCE64**

**4 hrs/3 credits**

**Option 1: BIOINFORMATICS**

**Objectives:**

- To gain the knowledge about the history and development of different types of computers.
- To learn the basic concepts of bioinformatics and its application in various field.
- To understand the sequencing methods, database searching tools and Phylogenetic construction tools.
- To obtain knowledge to take and submission process of protein and nucleotide sequence form the databases.
- Student can learn the bioinformatics tool for the application of biological research .

**UNIT I**

History, development and types of computers, general awareness of computer systems, hardware and software (CPU and other peripheral devices, computer arithmetic, computer logic, programming languages – machine language, assembly language, higher level languages), Email, World Wide Web and Surfing.

**UNIT II**

Introduction to bioinformatics, classification of biological databases, biological data formats, application of bioinformatics in various fields. Introduction to single letter code of amino acids, symbols used in nucleotides, data retrieval – Entrez and SRS..

**UNIT III**

Sequence analysis: need and importance, pairwise alignment, dynamic programming, Global (Needleman – Wunsch) and Local (Smith Waterman) Alignment concepts, Database searching tools – Entrez, BLAST, FASTA, multiple alignment– Clustal, construction of phylogenetic trees.

**UNIT IV**

Use of nucleic acid and protein data banks – NCBI, EMBL, DDBJ, SWISSPORT. 3D structural analysis of biomolecules, molecular visualization tools – RasMol.

**UNIT V**

Evolutionary analysis; Distance, Clustering methods – Rooted and Unrooted tree representation, Bootstrapping strategies, Neural Networks.

## **REFERENCE**

1. Bioinformatics – Principles and potential of a new multidisciplinary tool, TIBITE, 1996.
2. A. Fielding. 1985, computing for biologists. Benjamin/Cuming Publ.Co.
3. G.Von Heine, Sequence Analysis in molecular Biology
4. Devereux and Gtribskov, Sequence analysis – A pioneer.
5. Attwood T and Parry, D. 2002, Introduction of Bioinformatics –Pearson Education Asia.

## **ELECTIVE IV (THEORY)**

**UBCE64**

**4 hrs/3 credits**

### **Option 2: BIOSAFETY AND IPR**

#### **Objectives:**

- To understand the key concept and historical background of biosafety and to know the importance of biosafety levels, biosafety guidelines and regulations and the function of institutional biosafety committee.
- To study the application of GMOs in various field and methods to release GMO's in the environment.
- To acquire the knowledge about IPR, patenting, trademark, copyrights and geographical indications.
- Student can acquire the knowledge regarding biosafety rules and patenting protocols

#### **UNIT - I**

Biosafety: Introduction; biosafety issues in biotechnology-historical background; Introduction to Biological Safety Cabinets; Biosafety Levels.

#### **UNIT - II**

Biosafety Guidelines: Biosafety guidelines and regulations (National and International) – operation of biosafety. Guidelines and regulations of Government of India; Roles of Institutional Biosafety Committee.

#### **UNIT - III**

Definition of GMOs & LMOs; RCGM, GEAC etc. GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication.

#### **UNIT - IV**

Types of Intellectual Property: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications. Importance of IPR – patentable and non patentables – patenting life – legal protection of biotechnological inventions – world intellectual property rights organization (WIPO).

#### **UNIT -V**

Patent Filing Procedures: National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/nondisclosure; Financial assistance for patenting.

## **REFERENCES**

1. Martin. M.W. and Schinzinger R. 2003. Ethics in engineering, III Edition, Tata McGraw- Hill, New Delhi.
2. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
3. Kankanala, K . C. 2007. Genetic Patent Law & Strategy, 1st Edition. Manupatra Information Solution Pvt. Ltd.,Noida, India.
4. Jose B. Cibelli, Robert P. Lanza, Keith H. S. Campbell, Michael D.West. 2002. Principles of Cloning, Academic Press, SanDiego, Gurdon.

## **SKILL BASED STUDIES IV- BIOINFORMATICS (LAB)**

**UBCS64**

**2 hrs/2 credits**

### **Objectives:**

- To gain the practical knowledge to retrieve protein and gene sequences from databases.
- To know the methods to predict the structure of a compound through molecular visualization software.
- To know the methods to sequence similarity searching tools such as FASTA and BLAST.
- The students can learn the phylogentic tree construction for finding the relationship between the species.

1. Sequence retrieval of Protein from NCBI
2. Sequence retrieval of gene from NCBI
3. Structure download of protein from PDB
4. Structure download of gene from PDB
5. Molecular viewer by visualization software
6. Database searching by – Fasta
7. Database searching by – BLAST
8. Phylogenetic tree construction
9. Multiple sequence alignment using ClustalW

## **REFERENCE**

1. Bioinformatics: Sequence and Genome Analysis (2001), 1<sup>st</sup> ed., Mount, D.W. Cold Spring Harbor Laborator Press (New York), ISBN: 0-87969-608-7.
2. Bioinformatics and Functional Genomics (2003), 1<sup>st</sup> ed., Pevsner, J., John Wiley & Sons, Inc. (New Jersey), ISBN: 0-47121004-8.